D4.6 Model for a standardised procedure for regulatory approval of greening retrofit solutions

Synergetics | Synergies for Green Transformation of Inland and Coastal Shipping

GRANT AGREEMENT NO.	101096809
DURATION OF THE PROJECT	42 months
DELIVERABLE NUMBER	D4.6
DISSEMINATION LEVEL	Public
DELIVERABLE LEADER	CRS
STATUS	FINAL
SUBMISSION DATE	31-12-2025
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Co-Funded by the European Union. Views and opinions expressed are however those of the authors only and do not necessarily reflect those of the European Union or CINEA. Neither the European Union nor the granting authority can be held responsible for them.

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| List of acronyms

ADA	Alternative design and arrangements approval
ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterway
AFIR	Alternative Fuels Infrastructure Regulation
CESNI	European committee for drawing up standards in the field of inland navigation
CESNI/PT	CESNI working group on technical requirements
CCC	IMO Sub-Committee on Carriage of Cargoes and Containers
CCNR	Central Commission for the Navigation of the Rhine
CII	Carbon Intensity Indicator
CO_2 e	CO_2 equivalents
CRS	Croatian Register of Shipping
DMA	Danish Maritime Authority
EC	European Commission
EC	European Community (in the titles of Directives or Regulations)
EEDI	Energy Efficiency Design Index
EEXI	Energy Efficiency Existing Ship Index
EIAPP	Engine International Air Pollution Prevention Certificate
ENI	Unique European Vessel Identification Number
EU	European Union
ES-TRIN	European Standard laying down Technical Requirements for Inland Navigation Vessels
ETS	Emissions trading system
EUROMOT	Association of European manufacturers of internal combustion engines and alternative powertrains
FMEA	Failure mode and effects analysis
FMECA	Failure mode, effects, and criticality analysis
GEME	Group on emissions from non-road mobile machinery engines
GHG	Greenhouse gas
HAZID	Hazard identification
HAZOP	Hazard and Operability
HVO	Hydrotreated vegetable oil
MCA	Maritime and Coastguard Agency (United Kingdom)
MJ	Megajoule
NMA	Norwegian Maritime Authority

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NRMM	Non-Road Mobile Machinery
IBC Code	International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk
IGC Code	International Code for the Construction and Equipment of Ships Carrying Liquified Gases
IGF Code	International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels
IMO	International Maritime Organisation
JRC	Joint Research Centre
LL	International Convention on Load Lines
LNG	Liquid natural gas
LPG	Liquid petroleum gas
MARPOL	International Convention for preventing pollution from ships
MSC	Marine Safety Committee (IMO)
NOx	Nitrogen oxides
OEM	Original engine manufacturer / Original equipment manufacturer
RED III	Renewable Energy Directive (3rd amendment)
RV/G	CCNR working group on vessel inspection regulations (Groupe de travail du règlement de visite)
RVIR	Rhine Vessel Inspection Regulation
SOLAS	International Convention for the Safety of Life at Sea
TEN-T	Trans European Transport Network
tkm	tonne-kilometre
UNECE	United Nations Economic Commission for Europe
WP	Work Package

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Executive Summary

This deliverable of WP4, Task 4.5, outlines the overview of the existing and near future legal framework and it also addresses the regulatory bottlenecks that hinder the accelerated adoption of greening retrofit solutions for inland navigation vessels and coastal navigation ships in European Union (EU) territory. The objective is to provide suggestions for streamlining approval procedures, identify gaps in existing regulations and provide clear guidance for applicants seeking approval for innovative, zero-emission technologies. Considering the international bodies governing the respective legal frameworks (EU/CCNR/CESNI for inland navigation vs. IMO for maritime shipping) the focus is more on the challenges and issues specific to inland navigation vessels, where in particular ES-TRIN is under continuous development and already covers some provisions for alternative fuels.

Key EU and CCNR regulatory frameworks for inland navigation vessels are Directive (EU) 2016/1629, the Rhine Vessel Inspection Regulation (RVIR) and ES-TRIN which govern technical requirements, Directive 2008/68/EC and European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways (ADN Agreement) and Regulation (EU) 2016/1628 (NRMM) which sets emission limits for internal combustion engines, but currently excludes alternative fuels like methanol and hydrogen from its list of reference fuels.

Key regulatory frameworks for coastal ships consist of International Maritime Organisation (IMO) Conventions and Codes which provide safety and environmental standards for ships using alternative fuels. However, prescriptive regulations for methanol and hydrogen are still under development. Coastal ships operating within EU territory are also subject to EU legislative (directives and regulations) while Member States are allowed to impose additional national rules.

Major bottlenecks that have been found for the inland navigation sector include the lack of detailed mandatory regulations for alternative fuels such as methanol and hydrogen, resulting in reliance on interim guidelines and case-by-case approvals. Fragmented regulatory approach across Member States creates legal uncertainty. Very complex approval procedures, which include the applications for derogations and exemptions under directives and regulations, together with the required coordination between multiple authorities, stringent conditions for field testing – such as retention of engine ownership by engine manufacturer within NRMM – are time-consuming and delay innovations. In parallel, availability of alternative fuel bunkering infrastructure and "chicken-and-egg" dilemma on who will make a first move – vessel operator adopting the alternative fuels without reliable supply (and demand from their customers) or infrastructure providers not waiting for sufficient demand – in connection to lack of harmonisation of taxation policies, discourages investments, slows progress and create market distortion with discouraging decarbonisation efforts.

Based on the current situation, recommendations for policy makers are going in the following directions:

- derogation procedures could be simplified by empowering competent authorities/inspection bodies to issue Union inland navigation certificates based on consensual technical assessment (CESNI) to reduce reliance on lengthy European Commission implementing acts,
- align the timelines and conditions for derogations under Directive (EU) 2016/1629 and Regulation (EU) 2016/1628 to minimise administrative delays.
- consistent standards for alternative fuels need to be ensured by fostering a coordinated regulatory approach between Directive (EU) 2016/1629, Regulation (EU) 2016/1628 and ADN Agreement,
- level playing field needs to be created by harmonising national regulations on fuel taxation, emission trading and infrastructure deployment,
- support infrastructure development and break the "chicken-and-egg" dilemma by incentivising the deployment of alternative fuel infrastructure and encouraging Member States to cooperate on strategies for alternative fuel supply and infrastructure,

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- promote knowledge sharing by developing comprehensive guidance documents for applicants based on best practices from existing projects and facilitate early and close interaction between vessel owners, manufacturers and approval authorities to clarify requirements and expedite approvals.

The transition to zero-emission inland and coastal shipping is impeded by regulatory fragmentation, complex approval processes, and infrastructure gaps. Addressing these challenges requires harmonised standards, streamlined procedures, and targeted policy interventions. By fostering collaboration among stakeholders and aligning regulatory frameworks, Europe can accelerate the uptake of greening retrofit solutions and achieve its climate goals.

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1. Introduction

This deliverable addresses the topic "Streamlining of the regulatory procedures for accelerated uptake of greening retrofit solutions which is task 4.5 of the SYNERGETICS project according to the Grant Agreement. The title of deliverable D4.6 is "Model for a standardised procedure for regulatory approval of greening retrofit solutions", and the Croatian Register of Shipping (CRS) leads the execution of this task.

As the regulatory framework influences, yet does not adequately support, the transition process to zero-emissions for the inland waterway transport fleet and coastal ships, the purpose of this report is to identify bottlenecks or missing links in regulations and standards related to vessels and new technologies, in order to effectively support the transition towards zero-emission inland waterway transport fleet and coastal ships in Europe.

To do so, the major bottlenecks in the assessment and acceptance procedures are identified with a view to provide a clear and concise guidance to potential applicants for a targeted preparation of the required documentation which should be submitted to the relevant authority for approval.

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2. Existing and near-future legal framework - overview

2.1 Inland Navigation

Three EU legal instruments form a legally binding framework for the use of alternative fuels and technologies for propulsion, as well as for the transport of new fuels as cargo in inland navigation:

1) Directive laying down technical requirements for inland navigation vessels, Directive (EU) 2016/1629 [1], complemented by Central Commission for the Navigation of the Rhine (CCNR) Rhine Vessel Inspection Regulations (RVIR) [2].
2) Directive on the inland transport of dangerous goods, 2008/68/EC [3] and European Agreement concerning the International Carriage of Dangerous goods by Inland Waterways (ADN).
3) Regulation on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery", Regulation (EU) 2016/1628 (NRMM Regulation) [4].

2.1.1 Technical Requirements (ES-TRIN)

2.1.1.1 Existing legal framework

A craft operating on European Union (EU) waterways or on the Rhine must carry either a Union Inland Navigation Certificate or Rhine Vessel Inspection Certificate. Both certificates confirm the full compliance of the vessel with the technical requirements (in particular the ES-TRIN - European Standard laying down Technical Requirements for Inland Navigation Vessels [5]), in some cases subject to transitional provisions and/or individual derogations. These technical requirements contain provisions on inland navigation vessel construction and equipment as well as special provisions for certain categories of vessels such as passenger or container vessel. Union Inland Navigation Certificates are issued by the competent authorities (inspection bodies) of the Member States in accordance with Directive (EU) 2016/1629, and Rhine Vessel Inspection Certificates are issued by competent authorities (inspection bodies) of one of the Contracting States of the Revised Convention for Navigation on the Rhine of 17 October 1868 (Mannheim Act or Mannheim Convention).

As the safety, environment protection and efficient operation of vessels are of upmost importance to all interested parties in inland navigation sector and shipbuilding, the aim of the technical requirements is to provide a high level of safety and protect the environment and people on board and supporting the sector's energy transition.

For recall, ES-TRIN is not binding per se, the EU, the Central Commission for the Navigation of the Rhine (CCNR) and other international organisations or third countries can apply this Standard by referring to it in their respective legal frameworks. The EU and the CCNR have enacted ES-TRIN 2023/1 in a coordinated way, with effect from 1 January 2024, by means of a reference in their respective legislative frameworks (Directive (EU) 2016/1629 and the Rhine Vessel Inspection Regulations, respectively).

The concrete technical requirements are set out in ES-TRIN, with the current edition being ES-TRIN 2023/1, which entered into force on 1st January 2024. ES-TRIN is updated every two years by the European Committee for drawing up standards in the field of inland navigation (CESNI).

To date, ES-TRIN 2023/1 in general allows only conventional fuels (i.e., fuels having flash point of more than 55°C (ES-TRIN 2023/1, Article 8.01(3), which, in essence, means diesel fuel). However, since the 2017 edition of ES-TRIN general provisions for low flashpoint fuels (ES-TRIN 2023/1, Chapter 30) and a dedicated Annex 8 are also included. So far, Annex 8 provides concrete requirements on the storage of LNG and the use of LNG in propulsion or auxiliary internal combustion engines as well as for propulsion and auxiliary systems using fuel cells as energy converter.

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ES-TRIN 2025/1 (already adopted by CESNI, formally entering into force by 1 January 2026) will extend the scope of Annex 8 to requirements for the storage and use of methanol in propulsion or auxiliary internal combustion engines.

Concerning electric propulsion systems, ES-TRIN covers requirements for accommodation of lithium-ion batteries since the ES-TRIN 2017/1 edition, specific requirements for electric vessel propulsion were first included in Chapter 11 ES-TRIN 2019/1, with a major re-cast of Chapter 11 being introduced with ES-TRIN 2025/1.

In line with the CCNR and EU's objective of largely eliminating greenhouse gas and other inland navigation emissions by 2050, CESNI has initiated modifications of ES-TRIN to allow the use of alternative fuels, such as methanol or hydrogen, in inland vessels. The needs associated to the amendment of ES-TRIN are to[1]:

- ease the acceptance of new technologies by limiting safety or environmental issues,

- provide legal certainty which influences very much the investment in new technologies.

- stimulate a structuration of the market.

One alternative was not to amend the ES-TRIN and to continue to grant recommendations permitting exemptions for innovative vessels in accordance with the CCNR and EU legal frameworks. However, the lack of legal certainty could have discouraged some shipowners from investing in innovative ships and therefore hampered the development of the technologies.

Besides the technical requirements containing provisions on inland navigation vessel construction and equipment, as well as special provisions for certain categories of vessels such as passenger or container vessel, another important regulatory framework to consider is the regulation for the transport of dangerous goods, particularly the European Agreement concerning the International Carriage of Dangerous goods by Inland Waterways (ADN) and the Directive 2008/68/EC.

2.1.1.2 Near future legal framework

The next edition, ES-TRIN 2025/1, will enter into force on 1st January 2026[2], followed by ES-TRIN 2027/1 which will enter into force on 1st January 2028.

As noted in the above explanation, most vessels in inland navigation rely on diesel propulsion. Apart from exhaust emissions requirements for newly installed engines via the NRMM Regulation, the EU currently lacks specific, enforceable standards for emissions reductions pathways in inland navigation, in particular considering GHG emission, although this is becoming an increasingly important policy focus.

The need of requirements for storage of alternative fuels, such as methanol or compressed hydrogen, remains. It will be addressed step-by-step in future editions of ES-TRIN.

In October 2023, the CESNI Committee approved interim guidelines relating to the storage and use of Methanol on board inland vessels for pilot projects. Technical requirements for Methanol are included in the ES-TRIN 2025/1 edition, formally entering into force by 1 January 2026.

[1] https://www.cesni.eu/wp-content/uploads/2018/11/Guide_Tr_craft_en.pdf

[2] Commission Delegated Regulation (EU) 2025/2177 (https://eur-lex.europa.eu/eli/reg_del/2025/2177/oj)

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In October 2024, the CESNI Committee approved the draft requirements for gaseous hydrogen storage as interim guidelines for pilot projects. In September 2025, they were supplemented with requirements for the use in propulsion / auxiliary systems.

In practical terms, this means that the working document could be freely circulated outside CESNI by members and approved organisations, thereby facilitating the use of the draft requirements by developers of innovative vessel projects. It does not prejudge the final content of ES-TRIN 2027/1 but would allow experience to be gained with the draft requirements and where appropriate to adapt the requirements before the adoption of ES-TRIN 2027/1 in 2026.

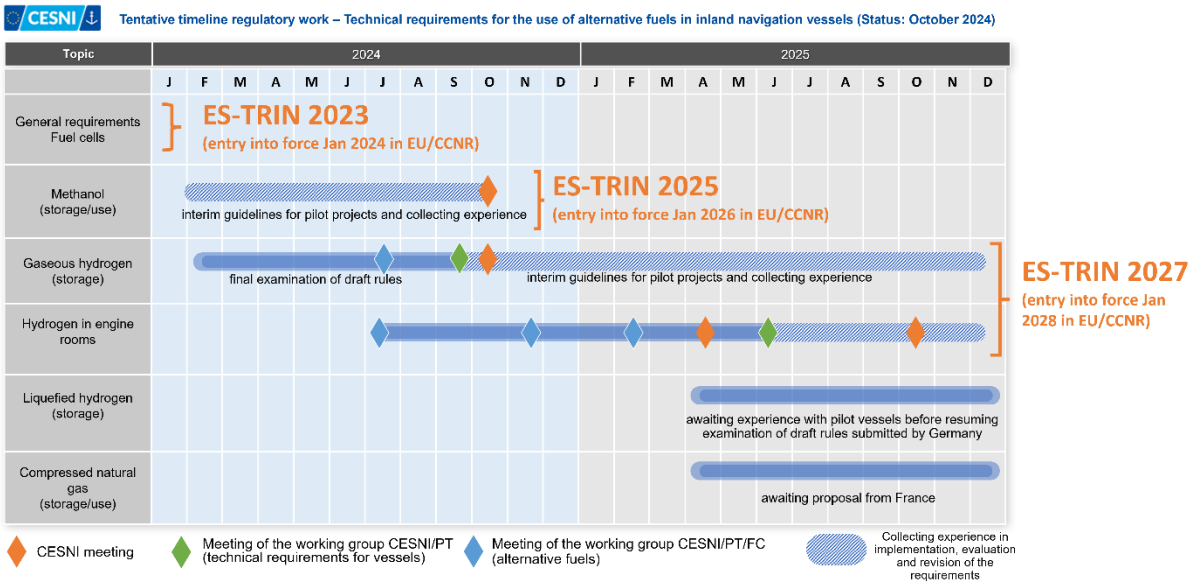

Figure 1 CESNI - Tentative timeline for regulatory work concerning alternative fuels (October 2024 - https://www.cesni.eu/en/technical-requirements/)

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2.1.2 Internal Combustion Engines for inland navigation vessels

2.1.2.1 Existing legal framework

Internal combustion engines for inland navigation applications may only be placed on the market in accordance with the requirements of Regulation (EU) 2016/1628 on requirements relating to gaseous and particulate pollutant emission limits and type-approval for internal combustion engines for non-road mobile machinery. Article 9.01(2) of ES-TRIN 2023/1 requires internal combustion engines intended for installation on inland navigation vessels to be furnished with such type-approval.

In essence, this means that internal combustion engines intended for use in inland navigation may only be placed on the EU market and installed on inland navigation vessels if they are type approved. Requirements for type-approval contain, inter field alia, compliance with emission limits for several gaseous and particulate exhaust gas components and long-term emission performance characteristics using precisely defined reference fuels.

Article 25(2) of Regulation (EU) 2016/1628 currently lists 6 types of reference fuels:

- Diesel[3]
- Petrol
- Petrol/oil mixture (for two stroke spark-ignition engines)
- Natural gas/bio methane
- Liquid petroleum gas (LPG)
- Ethanol

Alternative fuels such as methanol, hydrogen, or ammonia are not yet contained in the list of permitted reference fuels, hence type-approval cannot be granted for engines using these fuels.

Article 34(4) of Regulation (EU) 2016/1628 (in conjunction with Annex XI of Delegated Regulation (EU) 2017/654 [6]) grants authorisation for engines without type approval to be placed on the market temporarily (for up to 24 + 24 months) for field testing purposes. The conditions for this field-testing exemption are quite stringent and require, inter alia, a retention of ownership for the engine in question by the original engine manufacturer (OEM) over the entire field-testing period, which may collide with national requirements of the Member States regarding ownership of an inland navigation vessel and its equipment (cf. e.g. IVR Paper on Emission Legislation[4], May 2025, p. 36 ff; Commission Delegated Regulation (EU) 2017/654 (Annex XI (1))).

Article 35 of Regulation (EU) 2016/1628 provides a framework for exemptions for new technologies or new concepts, addressing in particular technologies or concepts incompatible with one or more requirements of the Regulation, which would clearly apply to engines using fuels not contained in the list of reference fuels in accordance with Article 25(2).

In contrast to Article 34(4) Article 35 foresees issuing of a type-approval certificate for engines falling into its scope. The EU type-approval certificate for new technologies or new concepts shall be granted subject to an implementing act adopted by the European Commission. Pending the Commission's decision on the EU type-approval, approval authorities of the Member States are authorised to issue a provisional EU type-approval which shall be valid only in the territory of that Member State, only in

[3] Or fuels considered to be equivalent to Diesel in the light of the different applicable EU standards, like, e.g. HVO

[4] https://www.ivr-eu.com/wp-content/uploads/2025/05/IVR-NRMM-paper-May-2025.pdf

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respect of the engine type or engine family covered by the exemption sought and for a duration of at least 36 months (cf. Article 35(4)).

Approval authorities of other EU Member States may decide to accept a provisional EU type-approval certificate within their territories (Article 35(5)). These provisions of Regulation (EU) 2016/1628 could therefore in principle be applied to tests as well as pilot installations using engines that run on alternative fuels such as methanol or hydrogen on board inland navigation vessels.

2.1.2.2 Near future legal framework

The addition of alternative reference fuels to the list in Article 25(2) of the NRMM Regulation is a very complex topic. Discussions are ongoing in relevant international working groups such as the Expert Group on Emissions from non-road mobile machinery engine (GEME) or the UNECE working group for non-road mobile machineries (R96).

a Hydrogen

In October 2025 new UNECE documents on hydrogen as reference fuel [7] (monofuel as well as dual-fuel) were presented and discussed in the GEME working group [8]. Discussions on adoption of hydrogen (monofuel and dual-fuel) into the catalogue of reference fuels in the next available amendment of the NRMM Regulation seem to be on a good way.

b Methanol

The outlook for the adoption of methanol into the catalogue of reference fuels seems to be less optimistic, mainly due to a lack of emission limits for formaldehyde and ongoing discussions on the scientific background of such emission limits.

The lack of an accepted benchmark for formaldehyde emission limits is making it also difficult to substantiate and ensure an appropriate level of environmental protection "equivalent" to the level provided by the NRMM Regulation in cases of exemptions for new technologies or new concepts (Article 35).

Further information can be expected in the near future from a Belgian project involving a dual-fuel methanol engine, where the EU's Joint Research Centre (JRC) provides support in the analysis of formaldehyde emissions.

At a workshop in October 2025[5] SYNERGETICS partner ScandiNAOS presented measurement results of formaldehyde and other emissions and argued in favour of regarding formaldehyde as falling into the hydrocarbon (HC) class of emissions, therefore needing no separate regulation. It was further mentioned that formaldehyde emissions also occur at standard diesel engines, which could, if necessary, provide a scientific reference for acceptable emission limits also for methanol engines.

c Exemptions

According to information received from the CESNI/PT working group the Netherlands have submitted a proposal to amend the Commission Delegated Regulation (EU) 2017/654 with respect to the ownership requirement for field testing engines (Art. 34(4) of Regulation (EU) 2016/1628) with a view to better reflect common practices in the shipbuilding sector and to better align with national requirements on ownership of vessels and their equipment.

In October 2025 GEME reacted positively on a proposal for an exemption from the ownership requirement for field testing for inland navigation; a simultaneously submitted proposal for an extension of the field-testing period to 60 instead of 24 months was, however, met with some concerns.

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5 https://www.synergetics-project.eu/wp-content/uploads/2025/12/SYNERGETICS-Newsletter-6_final.pdf

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2.2 Coastal navigation

The following regulations form a legally binding framework for the use of alternative fuels and technologies for propulsion, as well as for the transport of new fuels as cargo in maritime navigation:

1) International Maritime Organisation (IMO):

a) International Convention for the Safety of Life at Sea (SOLAS) [9]
b) International Convention for preventing pollution from ships (MARPOL) [10]
c) International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF Code) [11]
d) International Code for the Construction and Equipment of Ships Carrying Liquified Gases (IGC Code) [12]
e) International Code for the Construction and Equipment of Ships Carrying Dangerous Chemicals in Bulk (IBC Code) [13]

2) European Union (EU) legislative instruments

3) Flag Administration requirements

It is important to note that considerations such as technology readiness levels, sustainability criteria, impact on short term GHG reduction measures like CII/EEXI, and lifecycle GHG analysis of alternative fuels are not covered in this deliverable. Considerations related to the training and employment of crew operating both conventional and alternatively powered ships are also not part of this deliverable.

2.2.1 Technical Requirements

2.2.1.1 Existing legal framework

Maritime legal framework is a multi-layered environment consisting of international regulations, statutory requirements and classification rules. The International Maritime Organisation (IMO) establishes the global (international) regulatory framework through its instruments, which are the foundation of the regulations applicable to ships. These mandatory instruments include:

- International Convention for the Safety of Life at Sea (SOLAS),
- International Convention for Pollution Prevention from Ships (MARPOL),
- International Convention on Load Lines (LL) [14],

and others.

The International Code of Safety for Ships Using Gases or Other Low-Flashpoint Fuels (IGF Code) is a mandatory IMO Code made applicable through SOLAS, which provides specific safety standards for ships using low-flashpoint fuels. In addition to international regulations, ships are subject to the laws of their Flag Administration which is responsible for incorporating IMO conventions into national (domestic) law – referred to as statutory regulations. This ensures compliance with international requirements and enables the Flag Administration to issue valid ship certificates.

Ships flying an EU flag must comply, in addition to the globally binding international rules, with EU legislation (directives and regulations) such as Directive 2009/45/EC (safety rules and standards for passenger ships) [15] and Directive 2013/53/EU (Recreational Craft Directive) [16], as well as the applicable national maritime legislation as mentioned above.

For coastal shipping within EU, Member States may also apply their own rules to ships operating exclusively within their national waters. Thus, coastal shipping in the EU is governed by a combination of international regulations, EU legislation and national law.

In addition to the requirements contained in the above-mentioned rules and regulations, ships must be designed, constructed and maintained in compliance with the structural, mechanical and electrical

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requirements of a Classification Society (some type of ships may not be classed) which is recognised by the Flag Administration in accordance with the provision of SOLAS or with applicable national standards of the Flag Administration which provide an equivalent level of safety. Compliance with the classification rules is followed up by the Classification Society which issue the classification certificate for the ship which is required by most Flag Administrations as a prerequisite for registration.

Concrete technical requirements for ships using alternative fuels and technologies are set out in:

- SOLAS Convention:
    a. Chapter II-1 Construction – Structure, subdivision and stability, machinery and electrical installations, Part F – Alternative design and arrangements, Regulation 55 – Alternative design and arrangements.

       The purpose of this regulation is to provide a methodology for alternative design and arrangements for machinery, electrical installations and low-flashpoint fuel storage and distribution systems. When alternative design or arrangements deviate from the prescriptive requirements, an engineering analysis, evaluation and approval of the design and arrangements shall be carried out in accordance with this regulation --> refer to the Guidelines on alternative design and arrangements for SOLAS chapters II-1 and III – MSC.1/Circ.1212, and the Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments – MSC.1/Circ.1455 [17].

    b. Chapter II-2 Construction – Fire protection, fire detection and fire extinction, Part F – Alternative design and arrangements, Regulation 17 – Alternative design and arrangements.

       The purpose of this regulation is to provide a methodology for alternative design and arrangements for fire safety. Fire safety design and arrangements may deviate from the prescriptive requirements, provided that the design and arrangements meet the fire safety objectives and the functional requirements. When fire safety design or arrangements deviate from the prescriptive requirements of this chapter, engineering analysis, evaluation and approval of the alternative design and arrangements shall be carried out in accordance with this regulation --> refer to the Guidelines on alternative design and arrangements for fire safety – MSC/Circ.1002 [18].

    c. Chapter III Life-saving appliances and arrangements, Part C – Alternative design and arrangements, Regulation 38 – Alternative design and arrangements.

       The purpose of this regulation is to provide a methodology for alternative design and arrangements for life-saving appliances and arrangements. Life-saving appliances and arrangements may deviate from the prescriptive requirements, provided that the alternative design and arrangements meet the intent of the requirements concerned and provide an equivalent level of safety to this chapter. When alternative design or arrangements deviate from the prescriptive requirements of part B, an engineering analysis, evaluation and approval of the design and arrangements shall be carried out in accordance with this regulation --> refer to the Guidelines on alternative design and arrangements for SOLAS chapters II-1 and III – MSC.1/Circ.1212 [19].

    d. Chapter II-1 Construction – Structure, subdivision and stability, machinery and electrical installations, Part G – Ships using low-flashpoint fuels, Regulation 57 --> ships using low-flashpoint fuels shall comply with the requirements of IGF Code.

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- MARPOL Convention:
    a) MARPOL ANNEX VI – prevention of Air Pollution from Ships, Regulation 13 specifies limits for nitrogen oxide (NOx) emissions of combustion engines (known as NOx Technical Code 2008[6]). MARPOL Annex VI is implemented via EU law.

IMO provides an international mandatory regulatory framework through the International Code of Safety for Ships Using Gases or other Low-Flashpoint Fuels (IGF Code). The current version of the IGF Code includes prescriptive regulations only for natural gas as fuel. That means there are currently no detailed and prescriptive IMO regulations to support Flag Administration approval for vessels using other alternative fuels such as hydrogen or methanol.

Regulations for other fuels will be added to the IGF Code as and when the IMO develops them. IMO has provided Interim Guidelines for methanol (Interim Guidelines for the Safety of the Ships Using Methyl/Ethyl Alcohols as Fuel [20]), which was approved in 2021. Recently, IMO Sub-Committee on Carriage of Cargoes and Containers (CCC) at their 11th session finalized interim guidelines for the use of hydrogen as fuel and interim recommendations for the carriage of liquified hydrogen in bulk [21]. The same sub-committee (CCC) has developed interim guidelines for the safety of the ship using fuel cell power.

Given the current status of mandatory regulations, accelerated development process is necessary. However, the earliest opportunity for introducing new mandatory regulations in the IGF Code is 2028.

To that date, IMO provides a general methodology to accommodate the approval of new fuels and technologies through the IMO guidelines to approve alternatives and equivalents (MSC.1/Circ.1455 and 1212). This approval process follows a risk-based approach, where the safety level must be demonstrated to be equivalent to that of a conventional oil-fuelled ship. This approach is commonly referred to as the alternative design and arrangements approval (ADA).

Classification Societies are actively developing Rules for the Classification of ships for new technologies and fuels. Their rule development process is faster than the IMO process, therefore they already published classification rules for methanol and hydrogen, e.g.:

- Lloyd's Register released the Rules and Regulations for the Classification of Ships using Gases or other Low-flashpoint Fuels in July 2025 [22], which cover hydrogen and methanol-fuelled ships,
- Bureau Veritas released the rules for Hydrogen-fuelled ships in April 2025 [23], and rules for methanol and ethanol-fuelled ships in July 2025,
- Croatian Register of Shipping released the rules for ships using gases or other low-flashing fuels in January 2025 [24], which cover methanol-fuelled ships,

Classification societies rules can be applied as basis for Flag Administration approval, or to substantially simplify the alternative design assessment process, provided they are accepted by the Flag Administration.

The IGF Code would not apply to non-conventional size of ships or ships that do not fall within the scope of above-mentioned legal framework, but the provisions of the IGF Code could be applied to such ships on a voluntary basis, based on national legislation. For the application of rules and regulations for such ships, the technical and safety requirements must be agreed with the Flag Administration whose flag the ship is entitled to fly.

[6] imorules.com/NOX2008.html

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2.2.1.2 Near future legal framework

The current legal framework reflects the fact that currently there are no detailed and prescriptive IMO regulations to support Flag Administration approval for ships using hydrogen or methanol. Consequently, IGF Code requirements for these alternative fuels remain non-mandatory or are in the process of being developed because they exist only as interim guidelines until adopted into IGF Code.

At the time of writing this deliverable, interim guidelines for hydrogen were near future legal framework. However, CCC 11 finalized interim guidelines for the safety of ships using hydrogen as fuel. The interim guidelines are limited to liquefied hydrogen concepts, as well as portable compressed and fixed compressed hydrogen concepts, all of which should be fitted on open deck. The revision of the guidelines for methanol as fuel and the revision of the fuel cells guidelines is not discussed due to time constraints. Work on these guidelines will continue in 2026.

CCC 11 updated its existing working plan for the development of new alternative fuels under the IGF Code, with the following items assigned as high priority:

- Revision of the interim guidelines for the safety of ships using methyl/ethyl alcohol as fuel (approval expected 2027)
- Revision of the interim guidelines for the safety of ships using fuel cell power installations (approval expected 2028)
- Development of the interim guidelines for the safety of ships using onboard carbon capture and storage systems (approval expected 2029)

CCC 11 finalized the draft amendments to the IGC Code, concluding on implementation dates for new requirements. The draft amendments are expected to be approved by Marine Safety Committee at their 111th session (MSC 111) in May 2026, aiming for adoption at MSC 112 at the end of 2026 and entry into force on 1 July 2028. In the same session CCC finalized a revision of the interim recommendations for the carriage of liquefied hydrogen in bulk (Resolution MSC.565(108)), adding a new Part D on cargo containment systems.

Some Flag Administrations may issue national guidelines or approvals for hydrogen or methanol fuelled ships before mandatory IMO regulations exist.

2.2.2 Internal combustion engines for maritime navigation ships

The existing legal framework for marine diesel engines is well established and globally harmonised, while the framework for alternative-fuel engines is different, more complex and in many cases under development.

The primary IMO requirement for internal combustion marine engines is Regulation 13 of MARPOL Annex VI, which covers NO_x emissions from diesel engines. It applies to each marine diesel engine with a power output of more than 130 kW installed on ship. Regulation 13 is implemented via the NO_x Technical Code 2008 which sets out procedures for testing, survey and certification of marine diesel engines to ensure they meet the NO_x emission limits under Regulation 13. If the engine is in compliance with NO_x Technical Code 2008, Flag Administration (or Recognised Organisation authorised by it (e.g., a Classification Society) acting on its behalf) issues Engine International Air Pollution Prevention Certificate (EIAPP) for each engine. Some engines are exempted from this Regulation 13, e.g., purely emergency engines or lifeboat engines.

For engines using alternative fuels such as hydrogen or methanol, the IGF Code is the mandatory regulation. However, IGF Code currently provides prescriptive requirements only for natural gas (LNG). Therefore, the designers and manufacturers must rely on IMO interim guidelines and on Flag Administration approval which is often based on risk assessment analysis.

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In addition to statutory requirements, engines have to be in compliance with the rules of the relevant Classification Societies dedicated to engines. Current and future rules or guidelines for internal combustion engines are also related to the points 2.2.1.1 and 2.2.1.2. Class approval is unrelated to statutory requirements for NO_x emission compliance unless the Classification Society is acting on behalf of the Flag Administration for that specific task.

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3. Regulatory framework for alternative fuels

3.1 Alternative fuel infrastructure – Regulation (EU) 2023/1804

Regulation (EU) 2023/1804 [25] is part of the "Fit for 55" package of the European Union and addresses the deployment of alternative fuels infrastructure in the Member States, mainly focusing on the TEN-T core and comprehensive networks.

The specific objectives of the Regulation are[7]:

- To ensure minimum infrastructure to support the required uptake of alternative fuel vehicles across all transport modes and in all EU Member States to meet the EU's climate objectives:
- To ensure full interoperability of the infrastructure; and
- To ensure comprehensive user information and adequate payment options at alternative fuels infrastructure.

The alternative fuels addressed by the Regulation are (Article 2(4)):

- Alternative fuels for zero-emission vehicles, trains, vessels or aircraft:
  - Electricity
  - Hydrogen
  - Ammonia
- Renewable fuels:
  - Biomass fuels, including biomass, and biofuels in accordance with Directive (EU) 2018/2001
  - Synthetic and paraffinic fuels, including ammonia, produced from renewable energy
- Non-renewable alternative fuels and transitional fossil fuels:
  - Natural gas in gaseous form (compressed natural gas (CNG)) and liquefied form (liquefied natural gas (LNG))
  - Liquefied petroleum gas (LPG)
  - Synthetic and paraffinic fuels produced from non-renewable energy.

N.B.: Methanol is to be regarded as "renewable fuel that can be produced from various renewable sources, including biomass" (cf. Annex III of Directive (EU) 2018/2001).

Concerning alternative fuels infrastructure in inland navigation, the Regulation sets out concrete targets only for shore-side electricity supply in inland waterway ports (Article 10) along the TEN-T core and comprehensive networks. Any other aspects of alternative fuels infrastructure in inland navigation are left to the national policy frameworks of the Member States (Article 14). However, Article 14(6) of the Regulation calls on the Member States in particular to "cooperate on establishing strategies on the use of alternative fuels and on the deployment of corresponding infrastructure in waterborne transport".

[7] See https://transport.ec.europa.eu/transport-themes/clean-transport/alternative-fuels-sustainable-mobility-europe/alternative-fuels-infrastructure_en

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3.2 Renewable Energy Directive –Directive (EU) 2023/2413

Another part of the "Fit for 55" package is the Renewable Energy Directive in its latest revision (Directive (EU) 2023/2413 – "RED III" [26]) addressing the promotion of energy from renewable sources.

RED III sets a binding target of increasing the overall share of renewable energy in the energy consumption of the European Union to 42,5 %, with an indicative target of 45 % to be aimed for, for 2030 (Article 3(1)).

For the transport sector in general, RED III foresees a two-way choice of binding targets for the Member States (Article 25(1)) by 2030:

- a share of renewable fuel within the final consumption of energy in the transport sector of at least 29 %, or
- a reduction in greenhouse gas intensity reduction of at least 14,5 % compared to the baseline scenario.

There is, however, no specific target for inland navigation. RED III leaves it to the discretion of the individual Member States how to reach the overall targets and whether to include inland navigation or not.

3.3 Emissions trading system – Directive 2003/87/EC, latest amendment by Regulation (EU) 2024/795

Inland navigation is not in the scope of Annex III of Directive 2003/87/EC as last amended by Regulation (EU) 2024/795.

However, from 2027 on the Member States can decide to unilaterally extend the scope of Annex III to other sectors (opt-in). Any decision of an individual Member State on including other sectors in the scope of their national implementation has to be approved by the European Commission (Article 30, to be adopted by delegated act).

3.4 Taxonomy – Regulation (EU) 2020/852, latest amendment by Delegated Regulation (EU) 2024/3215

The European Union's so-called "Taxonomy" legislation [28] aims at creating a sustainable finance framework to encourage a reorientation of capital flows towards sustainable investment and ensuring market transparency[8].

Inland navigation is primarily addressed in the context of the "Manufacture" and "Transport" chapters of the objective "Substantial contribution to climate change mitigation" and applies the "DNSH" (Do No Significant Harm) approach.

3.4.1 Manufacture

The Regulation defines "technical screening criteria" for economic activities providing "substantial contribution to climate change mitigation" (Annex I, section 3.3 – Manufacture of low carbon technologies for transport). "Economic activity" in that context refers to "manufacture, repair, maintenance, retrofitting, repurposing and upgrade of low carbon […] vessels".

[8] See Commission Staff Working Document SWD(2023) 239 final - https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52023SC0239

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The relevant technical screening criteria for inland navigation vessels are:

- Inland passenger vessels:
  - Vessels having zero direct (tailpipe) CO_2 emissions or
  - until 31 December 2025, hybrid and dual-fuel vessels using at least 50 % of their energy from zero direct (tailpipe) CO_2 emission fuels or plug-in power for their normal operation
- Inland cargo vessels, excluding vessels dedicated for transporting fossil fuels:
  - Vessels having zero direct (tailpipe) CO_2 emissions or
  - until 31 December 2025, vessels having direct (tailpipe) emissions of CO_2 per tonne kilometre (g CO_2 /tkm), calculated (or estimated in case of new vessels) using the Energy Efficiency Operational Indicator (85), 50 % lower than the average reference value for emissions of CO_2 defined for heavy duty vehicles (vehicle subgroup 5-LH) in accordance with Article 11 of Regulation (EU) 2019/1242

The relevant technical screening criteria for maritime ships are:

- sea and coastal freight water transport ships, ships for port operations and auxiliary activities that are not dedicated to transporting fossil fuels, that:
  - Have zero direct tailpipe CO_2 emissions,
  - Until 31 December 2025, are hybrid and dual fuel ship that derive at least 25 % of their energy from zero direct (tailpipe) CO_2 emission fuels or plug-in power for their normal operation at sea and in ports,
  - Until 31 December 2025, and only where it can be proved that the ships are used exclusively for operating coastal and short sea services designed to enable modal shift of freight currently transported by land to sea, the ships that have direct (tailpipe) CO_2 emissions, calculated using the International Maritime Organization (IMO) Energy Efficiency Design Index (EEDI), 50 % lower than the average reference CO_2 emissions value defined for heavy duty vehicles (vehicle subgroup 5-LH) in accordance with Article 11 of Regulation (EU) 2019/1242,
  - Until 31 December 2025, the ships have an attained Energy Efficiency Design Index (EEDI) value 10 % below the EEDI requirements applicable on 1 April 2022 if the ships are able to run on zero direct (tailpipe) CO_2 emission fuels or on fuels from renewable sources.
- Sea and coastal passenger water transport ships, not dedicated to transporting fossil fuels, that:
  - Have zero direct (tailpipe) CO_2 emissions,
  - Until 31 December 2025, hybrid and dual fuel ships derive at least 25 % of their energy from zero direct (tailpipe) CO_2 emission fuels or plug-in power for their normal operation at sea and in ports,
  - Until 31 December 2025, the ships have an attained Energy Efficiency Design Index (EEDI) value 10 % below the EEDI requirements applicable on 1 April 2022 if the ships are able to run on zero direct (tailpipe) CO_2 emission fuels or on fuels from renewable sources.

3.4.2 Transport

Activities addressed are "purchase, financing, leasing, rental and operation of passenger and freight vessels on inland waters, involving vessels that are not suitable for sea transport" (Annex I, sections 6.7 and 6.8). For maritime navigation, activities addressed are purchase, financing, chartering (with or without crew) and operation of ships designed and equipped for transport of freight or for the combined transport of freight and passengers on sea or coastal waters, whether scheduled or not, as well as for

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the ship required for port operations and auxiliary activities, such as tugboats, mooring ships, pilot ships, salvage ships and ice-breakers (Annex I, Sections 6.10 and 6.11).

An activity is compliant with the technical screening criteria for substantial contribution to climate change mitigation if:

- For inland passenger transport
  - Vessels have zero direct (tailpipe) CO_2 emissions, or
  - until 31 December 2025, hybrid and dual fuel vessels derive at least 50 % of their energy from zero direct (tailpipe) CO_2 emission fuels or plug-in power for their normal operation, or
  - where technologically and economically not feasible to comply with zero direct CO_2 emissions, from 1 January 2026 onwards the yearly average greenhouse gas intensity of the energy used on-board by a ship during a reporting period does not exceed the following limits:
    - 76,4 g CO_2 e/MJ from 1 January 2026 until 31 December 2029;
    - 61,1 g CO_2 e/MJ from 1 January 2030 until 31 December 2034;
    - 45,8 g CO_2 e/MJ from 1 January 2035 until 31 December 2039;
    - 30,6 g CO_2 e/MJ from 1 January 2040 until 31 December 2044;
    - 15,3 g CO_2 e/MJ from 1 January 2045 until 31 December 2049;
    - 0 g CO_2 e/MJ from 1 January 2050
- For inland cargo transport, excluding vessels dedicated to the transport of fossil fuels
  - Vessels have zero direct (tailpipe) CO_2 emissions, or
  - where technologically and economically not feasible to comply with zero direct CO_2 emission, until 31 December 2025, the vessels have direct (tailpipe) emissions of CO_2 per tonne kilometre (g CO_2 /tkm), calculated (or estimated in case of new vessels) using the Energy Efficiency Operational Indicator, 50 % lower than the average reference value for emissions of CO_2 defined for heavy duty vehicles (vehicle subgroup 5- LH) in accordance with Article 11 of Regulation (EU) 2019/1242, or
  - where technologically and economically not feasible to comply with zero direct CO_2 emissions, from 1 January 2026 onwards the yearly average greenhouse gas intensity of the energy used on-board by a ship during a reporting period does not exceed the following limits:
    - 76,4 g CO_2 e/MJ from 1 January 2026 until 31 December 2029;
    - 61,1 g CO_2 e/MJ from 1 January 2030 until 31 December 2034;
    - 45,8 g CO_2 e/MJ from 1 January 2035 until 31 December 2039;
    - 30,6 g CO_2 e/MJ from 1 January 2040 until 31 December 2044;
    - 15,3 g CO_2 e/MJ from 1 January 2045 until 31 December 2049;
    - 0 g CO_2 e/MJ from 1 January 2050

Criteria for compliance with the DNSH approach further address climate change adaptation, sustainable use and protection of water and marine resources, transition to a circular economy. In addition, these criteria set out that, specifically with a view to pollution prevention and control, engines in vessels shall comply with emission limits set out in Annex II to Regulation (EU) 2016/1628 (including vessels meeting those limits without type-approved solutions such as through after-treatment).

- For sea and coastal freight water transport, ships for port operations and auxiliary activities
  - The ships have zero direct (tailpipe) CO_2 emissions,
  - Until 31 December 2025, hybrid and dual fuel ships derive at least 25 % of their energy from zero direct (tailpipe) CO_2 emission fuels or plug-in power for their normal operation at sea and in ports,
  - Where technologically and economically not feasible to comply with the zero direct CO_2 emissions, until 31 December 2025, and only where it can be proved that the ships are used exclusively for operating coastal and short sea services designed to enable modal

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shift of freight currently transported by land to sea, the ships have direct (tailpipe) CO_2 emissions, calculated using the International Maritime Organization (IMO) Energy Efficiency Design Index (EEDI), 50 % lower than the average reference CO_2 emissions value defined for heavy duty vehicles (vehicle sub group 5-LH) in accordance with Article 11 of Regulation (EU) 2019/1242,

- Where technologically and economically not feasible to comply with the zero direct CO_2 emissions, until 31 December 2025, the ships have an attained Energy Efficiency Design Index (EEDI) value 10 % below the EEDI requirements applicable on 1 April 2022 if the vessels are able to run on zero direct (tailpipe) CO_2 emission fuels or on fuels from renewable sources.
- Where an economic activity in this category does not fulfil the zero direct CO_2 emissions criteria, the activity is a transitional activity as referred to in Article 10(2) of Regulation (EU) 2020/852, provided it complies with the remaining technical screening criteria set out in this Section.

- For sea coastal passenger water transport
  - The vessels have zero direct (tailpipe) CO_2 emissions,
  - Where technologically and economically not feasible to comply with the zero direct CO_2 emissions, until 31 December 2025, hybrid and dual fuel ships derive at least 25 % of their energy from zero direct (tailpipe) CO_2 emission fuels or plug-in power for their normal operation at sea and in ports,
  - Where technologically and economically not feasible to comply with the zero direct CO_2 emissions, until 31 December 2025, the ships have an attained Energy Efficiency Design Index (EEDI) value 10 % below the EEDI requirements applicable on 1 April 2022, if the ships are able to run on zero direct (tailpipe) emission fuels or on fuels from renewable sources
  - Where an economic activity in this category does not fulfil the zero direct CO_2 emissions criteria, the activity is a transitional activity as referred to in Article 10(2) of Regulation (EU) 2020/852, provided it complies with the remaining technical screening criteria set out in this Section.

Criteria for compliance with the DNSH approach further address climate change adaptation, sustainable use and protection of water and marine resources, transition to a circular economy. In addition, these criteria set out that, specifically with a view of pollution prevention and control, engines in ships shall comply with emission limits set out in Regulation 13 and Regulation 14 of Annex VI of the MARPOL Convention.

Regulations such as Regulation (EU) 2023/1805 (FuelEU Maritime Regulation) or Regulation (EU) 2023/1804 (Alternative Fuels Infrastructure Regulation – AFIR) was not mentioned in this deliverable for coastal ships because they might not be (yet) applicable directly on them.

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4. Major bottlenecks to legally implementing new technologies

4.1 Legal framework of Directive (EU) 2016/1629 and ES-TRIN

Within Directive (EU) 2016/1629 the main instrument for technical solutions deviating from the statutory requirements as set out by ES-TRIN is a derogation in accordance with Article 25.

Article 25 of Directive (EU) 2016/1629 – "in order to encourage innovation and the use of new technologies" – provides for allowing derogations or recognising the equivalence of technical specifications for a specific craft.

Derogations can be authorised for two different levels of technical assessment:

- for an indefinite period of time, provided that an equivalent level of safety *[compared to the requirements set out by ES-TRIN]* is ensured (Article 25(1)(a)), and
- for a limited period of time for trial purposes, provided that an adequate level of safety is ensured (Article 25(1)(b)).

The formal adoption of such derogations shall be executed by implementing acts of the European Commission in accordance with the advisory procedure referred to in Article 33(2). The advisory procedure includes consulting a committee in which every Member State is represented[9]. The decision-making process preceding the adoption of an implementing act furthermore requires an internal consultation of all relevant Commission departments for review and feedback[10].

Pending the adoption of the relevant implementing act, the competent authorities of the Member States may issue provisional Union inland navigation certificates to craft benefitting from a derogation in accordance with Article 25 (Article 9(1)(g)). The duration of validity of provisional Union inland navigation certificates is in this case limited to six months, with an option to extend the validity for additional six months at a time, until the respective implementing act has been adopted (Article 9(3)(c)).

The provisions for adopting derogations under the Rhine Vessel Inspection Regulation take in principle the same approach with regard to the technical assessment (§ 2.20).

4.1.1 Major bottlenecks

Figure 2 Typical pathway of a derogation procedure in accordance with Article 25

While, in general, for new technologies the initial idea, the elaboration of the technical concept, and – within certain limits – the preparation of the technical file will mainly remain in the sphere of the vessel owner and bottlenecks in the process can therefore be directly influenced by, e.g., allocating more

[9] https://commission.europa.eu/law/law-making-process/adopting-eu-law/implementing-and-delegated-acts_en

[10] https://commission.europa.eu/strategy-and-policy/decision-making-process-commission_en

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resources, calling in additional experts etc., the following steps are largely out of reach for those seeking a derogation in terms of addressing and mitigating possible bottlenecks.

It is inherent to "new" concepts and technologies that respective expertise is very limited in general and is in particular not (yet) available at competent authorities and/or inspection bodies tasked with the inspection of inland navigation vessels. It is furthermore quite common that experts for new technologies are not too familiar with specific requirements of inland navigation (vessels), while, naturally, inland navigation experts are usually not familiar with new technologies.

Depending on the extent of initial "common ground" between experts for new technologies and inland navigation experts (vessel operators, shipyards, design offices or authorities), the "frictional losses" until a common understanding of the challenges pertaining to a specific technical solution can be reached, may be considerable.

The main difference and main reason for significant deviations in the duration of processing between the procedures for formal adoption of a derogation with the European Commission (EC) and with the Central Commission for Navigation on the Rhine (CCNR) is that the CCNR has delegated the final decision to its respective technical committee. The EC, in contrast, is bound by the Directive to follow the formal requirements for adopting an implementing act, which, by past experience, leads to considerable delays in comparison to the CCNR procedure (for the three currently finalised cases the time from agreement on CESNI level and the adoption of the respective implementing acts was more than 2,5 years in two (connected) cases and more than 3,5 years in a third case – a fourth case is pending since November 2020 and still not finalised at the moment).

4.2 Legal framework of Regulation (EU) 2016/1628

As pointed out in 0 above the main purpose of the NRMM Regulation is to provide a legal framework for issuing type-approval certificates for engines to be placed on the EU internal market.

However, the Regulation acknowledges that exemptions from the general rule may be necessary and currently offers two main options to address such needs:

- Temporary placing on the market of engines that have not been type-approved, for the purposes of field testing (Article 34(4)) and
- Exemptions for new technologies or new concepts (Article 35).

In accordance with Annex IX (1) of the Commission Delegated Regulation (EU) 2017/654 approval authorities of the Member States may authorise the temporary placing on the market of engines that have not been type-approved for a duration of 24 months. Providing due justification for the extension request, the duration of the field test may be extended for up to 24 additional months.

Article 35 of Regulation (EU) 2016/1628 provides a framework for exemptions for new technologies or new concepts, addressing in particular technologies or concepts incompatible with one or more requirements of the Regulation, which would clearly apply to engines using fuels not contained in the list of reference fuels in accordance with Article 25(2).

EU type-approvals in accordance with Article 35 are subject to authorisation by the European Commission; the authorisation shall be given by means of an implementing act.

Pending the decision on authorisation of the EU type-approval by the European Commission, the approval authority may issue a provisional EU type-approval (Article 35(4)), which shall be valid

- only in the territory of that Member State;
- only in respect of an engine type or engine family covered by the exemption sought; and
- for at least 36 months.

Approval authorities of other Member States may decide to accept provisional EU type-approvals within their respective territory (Article 35(5)).

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4.2.1 Major bottlenecks

The conditions for the field-testing exemption (Article 34(4)) are quite stringent and require, inter alia, a retention of ownership for the engine in question for the original engine manufacturer (OEM) over the entire field testing period, which may collide with national requirements of the Member States regarding ownership of an inland navigation vessel and its equipment (cf. 0 above).

With regard to exemptions for new technologies or new concepts (Article 35) the most important obstacle is the geographical restriction of the validity of the provisional EU type-approval. Taking into account the highly international character of inland navigation the administrative effort for motivating the approval authorities of other Member States covering, e.g., at least the Rhine and Danube corridors to formally accept provisional EU type-approvals could be challenging.

With a view to the adoption of implementing acts, the considerations presented in 4.1.1 above apply likewise.

A further bottleneck is the limited range of reference fuels and the complex and complicated process for extending the list of reference fuels.

4.3 Interaction between Directive (EU) 2016/1629 and Regulation (EU) 2016/1628

Where deviations from statutory technical requirements involve the propulsion systems of inland navigation vessels, it is highly likely that exemptions from both, Directive (EU) 2016/1629, ES-TRIN (Article 9.01(2), type-approval requirement) and Regulation (EU) 2016/1628, will be necessary.

However, the different approaches taken on the scope and purpose of regulation in general and on exemptions in particular by these legal instruments, pose a number of challenges for the users.

- With a view to the general scope and purpose of regulation, Directive (EU) 2016/1629 provides for issuing an individual "Union inland navigation certificate" to each single vessel, while Regulation (EU) 2016/1628 addresses the framework for placing on the market of serially produced engines or even engine families, a central element being the EU type-approval associated not to a single object (like the Union inland navigation certificate) but to all products built in conformity with the type-approved model.
- In line with the principal characteristics of the two legal instruments, the provisions on exemptions differ in their approach:
    - Directive (EU) 2016/1629 addresses the individual vessel, derogations have therefore to be assessed for individual vessels, with the purpose to permit their use on European inland waterways.
    - Regulation (EU) 2016/1628 mainly addresses engine manufacturers (or their authorised representatives in the EU), exemptions are therefore designed with type-approval requirements for (later) placing on the market of the respective products in mind. In particular with regard to field testing, a certain logic behind the requirement that ownership of engines benefitting from field testing exemptions must remain with the engine manufacturer can therefore not be denied.

Applications for derogations in accordance with Directive (EU) 2016/1629 and exemptions in accordance with Regulation (EU) 2016/1628 have to be addressed to different authorities. For a vessel intended to use, e.g., a propulsion system with an internal combustion engine using an alternative fuel at least the following administrative steps have to be taken, and, as far as possible, coordinated:

- The owner of the vessel needs to apply for a derogation in accordance with Article 25 of Directive (EU) 2016/1629 (inspection body)

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- The manufacturer of the engine needs to apply for an exemption in accordance with Article 34(4) or Article 35 of Regulation (EU) 2016/1628 (approval authority)
- Authorisation for placing on the market of a non type-approved engine for field testing or provisional (EU) type-approval must be available, before derogation under Article 25 of Directive (EU) 2016/1629 can be granted

In essence, this results in an administrative procedure with two different applicants, two different authorities and interdependencies between the two procedures.

A further challenge are the different timeframes for derogations and exemptions set out in the two different legal instruments.

While, in a general approach, they align more or less in distinguishing research / development / field testing on the one hand and (permanent) recognition of equivalent safety / equivalent environmental performance on the other hand, the concrete structuring of timeframes, periods of validity and deadlines differs in a way that makes parallel application of both legal instruments rather unwieldy.

The differences are particularly relevant for research / field testing projects, where Directive (EU) 2016/1629 refers to a "limited period" of validity, while Regulation (EU) 2016/1628 specifies a period of 24 months with a single extension option of additional 24 months.

A possible additional administrative obstacle has already been removed by the adoption of Article 9.01(6) with the 2025 edition of ES-TRIN, which waives the requirement of type-approval for engines installed on inland waterway vessels where an authorisation for field testing in accordance with Regulation (EU) 2016/1628 is present (without the need for individual derogations).

The concrete challenges of this set-up are:

- The "limited period" of a derogation for research purposes in accordance with Article 25(1)(b) of Directive (EU) 2016/1629 is set to five years in the only example published on the website of the European Commission[11]. A period of five years is also common practice for derogations granted by the CCNR in accordance with § 2.20 (3) of the RVIR.
- The authorisation for field testing in accordance with Article 34(4) of Regulation (EU) 2016/1628 is a prerequisite for benefitting from the derogation set out in Article 9.01(6) of ES-TRIN 2025. However, the Union inland navigation certificate shall, under this provision, not be valid for longer than the duration of the field test.
    - The Union inland navigation certificate for a vessel in a field-testing programme for an engine applying new technologies or concepts will therefore be valid for less than 24 months, as a part of the 24 months specified by Article 34(4) of Regulation (EU) 2016/1628 will be consumed by processing time for the Union inland navigation certificate.
    - This processing time will probably be relatively short in cases where no (further) derogation from the requirements of ES-TRIN would be necessary and the certificate could be issued by the inspection body directly on availability of the authorisation for field testing.
    - However, in cases where additional derogations from ES-TRIN would be necessary (e.g., relating to the fuel system on board), the processing time in CESNI and the time for adoption of the implementing act by the European Commission could consume a considerable part of the field-testing period.

[11] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32020D0980

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For permanent derogations, i.e., for new/alternative technologies or new/alternative concepts for which "equivalent" safety in relation to the requirements of Directive (EU) 2016/1629 and ES-TRIN and a "level of environmental protection that is at least equivalent to the level provided" by Regulation (EU) 2016/1628 can be established, the timeline is less relevant as both derogations/exemptions, once granted, are valid for the lifetime of the vessel.

The EU-wide derogation under Article 25 of Directive (EU) 2016/1629 applies to all EU inland waterways, though individual navigational restrictions may still apply. In contrast, a provisional EU type-approval issued by a national authority under Article 35(4) of Regulation (EU) 2016/1628 – pending a Commission decision on authorisation – is only valid in the territory of the issuing Member State.

Extension of the territorial validity of a provisional EU type-approval is possible: In accordance with Article 34(5), approval authorities of other Member States can decide to accept a provisional EU type approval within their respective territories. However, for vessels intended to operate internationally (which is often the case), this would require a coordinated effort by all Member States with inland waterways within the intended operating area.

4.4 Interaction between Directive (EU) 2016/1629 and ADN-Agreement

For vessels intended to carry dangerous cargo, in addition to Directive (EU) 2016/1629 (together with ES-TRIN) and Regulation (EU) 2016/1628 the "European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways" (ADN) applies.

Like the ES-TRIN, the ADN in general only permits "internal combustion engines running on fuel having a flashpoint above 55° C". A general exemption from this requirement applies to "internal combustion engines which are part of propulsion and auxiliary systems" as long as these systems meet the requirements of Chapter 30 together with Annex 8, Section II, Chapter 1, and Section III, Chapter 2, of ES-TRIN, i.e., for LNG systems (9.1.0.31, 9.3.1.31, 9.3.2.31 and 9.3.3.31 of the ADN).

For internal combustion engines running on other alternative fuel with a flashpoint ≤ 55° C, in addition to derogations or exemptions in accordance with Directive (EU) 2016/1629 and Regulation (EU) 2016/1628 therefore a derogation in accordance with the ADN, in particular taking into account the compatibility of the fuel and the connected dangers in relation to the dangerous goods to be transported in the vessel, would be necessary.

The approach for derogations in the ADN is quite similar to the approach in Directive (EU) 2016/1629. It foresees an acceptance of equivalence for permanent validity (1.5.3.1 of the ADN) and for a limited period on a trial basis, provided the derogation is assessed to be "sufficiently safe" (1.5.3.2 of the ADN).

The procedure is in principle entirely independent of the procedure in accordance with the Directive (EU) 2016/1629 and is conducted by the Administrative Committee established under the ADN Agreement. In practice, derogations adopted in accordance with Directive (EU) 2016/1629 or with the RVIR or in discussion in the respective working groups are usually taken into account.

An overview of derogations granted under the provisions of the ADN can be found at https://unece.org/equivalences-and-derogations.

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4.5 Uptake of alternative fuels

Apart from technical requirements in general or tailor-made for specific vessels, crucial elements for the uptake of alternative fuels in inland navigation are the available supply infrastructure and the integration of inland navigation into horizontal regulatory issues like emission trading and taxation.

Probably attributable to the low share in the modal split (1,6 % of overall freight transport in the EU in 2023[12]), unfortunately, inland navigation is often either neglected entirely or left to the governance of individual Member States in horizontal regulatory issues.

Taking into account the spread of modal shares in different Member States (from 18,9 % in Romania and 11,7 % in the Netherlands down to 0,1 % in Lithuania and Sweden, data from 2023[13]) it is understandable that the approaches of the individual Member States taken in the governance of inland navigation, where such option is granted by EU-legislation, differ considerably.

However, given the highly international structure of inland navigation, any non-harmonised regulatory approach necessarily leads to fragmentation of markets, bunker tourism, unclear status of, e.g., emission compensation for freight forwarders, and other undesired effects, significantly deteriorating the competitive standing of inland navigation compared to modes of transport with harmonised regulatory approach.[14]

The sufficient and reliable availability of alternative fuels is a crucial factor for the uptake of greening (retrofit) solutions in inland navigation. The lack or unreliability of supply of alternative fuels must therefore be regarded as significant bottleneck.

4.5.1 Fuel Supply Infrastructure

The transition from fossil diesel to alternative fuels poses major challenges for the related infrastructure in inland navigation. While for roughly about hundred years diesel served as the single fuel for inland navigation and a sufficiently dense supply infrastructure is available along all European inland waterways, the range of options of alternative fuels available today, with no clear favourite and no "one-size-fits-all solution" in sight, would make it necessary to not only replace but even to multiply the supply infrastructure accordingly.

Adding to that, the volumetric energy content of all alternative energy carriers is (partly considerably) lower than that of fossil diesel, requiring a significantly denser network of bunkering stations.

A classic "chicken and egg" dilemma is further impairing a quick transition to alternative fuels: vessel operators are not likely to invest in alternative fuels as long as they cannot be sure of the availability of the alternative fuel in their entire area of navigation, while infrastructure providers are not likely to invest without a sufficient consumer base. In addition to that, shippers and logistics chain operators are not (or only very rarely) ready to accept higher freight rates if alternative energy is being used.

Breaking this dilemma will probably not be possible without appropriate intervention by the public sector.

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[12] https://ec.europa.eu/eurostat/databrowser/view/TRAN_HV_MS_FRMOD__custom_7520117/bookmark/table?lang=en&bookmarkId=dcc6fd6f-423c-4ea0-9265-a7c8a9c22977&c=1695209017412

[13] https://ec.europa.eu/eurostat/databrowser/view/TRAN_HV_MS_FRMOD__custom_7520144/bookmark/table?lang=en&bookmarkId=5acf458b-4f84-48ea-8fe7-0fe9bc3a83d1&c=1695209094276

[14] Recent example: the Netherlands decided to apply RED III to inland navigation, while neighbouring Germany decided to refrain from opting in

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As already mentioned in 3.1 above, Regulation (EU) 2023/1804 is rather vague with respect to concrete objectives on alternative fuels infrastructure for inland navigation and leaves it by and large to the national policy frameworks of the Member States, albeit with a call to "cooperate on establishing strategies on the use of alternative fuels and on the deployment of corresponding infrastructure in waterborne transport".

4.5.2 Emission trading

As already mentioned in 3.3 above, inland navigation is not in the scope of Annex III of Directive 2003/87/EC as last amended by Regulation (EU) 2024/795.

Unfortunately, leaving out inland navigation from a harmonised approach concerning emissions trading has a couple of significant drawbacks:

- It can lead to a fragmentation of the market.
- It is likely to incentivise bunkering fossil fuel in Member States where ETS-2 is not applied to inland navigation (bunker tourism).
- It is likely to impair the position of inland navigation in competition with other modes for transport, in particular road transport, which is fully in the scope of ETS-2, as a patchwork of opt-in and non-application leads to a very unclear situation in particular for freight forwarders concerning their obligations for monitoring and documenting GHG emissions in their activities.

4.5.3 Taxation

In particular concerning drop-in fuels like HVO100 a specific obstacle lies in a non-harmonised approach in taxation.

From a purely technical point of view, drop-in fuels can be regarded as "low-hanging fruit" with regard to decarbonisation, as they usually do not require comprehensive adaptations of engines and fuel systems. Furthermore, certain types of drop-in fuels (first and foremost HVO100) are already approved by major engine manufacturers. Many drop-in fuels can be blended with fossil diesel fuel in a wide range of proportions.

However, fossil diesel fuel used in international navigation is often exempted from certain taxes or customs and excise duties, depending on the specific legislation of the Member States. In order to prevent tax evasion, tax-exempted fossil diesel fuel usually must be colour-marked. At the same time, regenerative drop-in fuels are often exempted from taxes in general to promote their use and to reduce the price gap between fossil diesel fuel and regenerative alternatives, and, due to the general exemption, not colour-marked as a distinction between taxed and tax-exempt varieties is not necessary.

Due to the specific requirements for tax-exempt fossil diesel fuel, blending of fossil diesel fuel and regenerative drop-in alternatives is only permitted at the level of the fuel manufacturer. Any blend which might arbitrarily result from bunkering alternately fossil diesel fuel and regenerative alternatives depending on the respective availability can therefore be regarded as an infringement of tax and customs provisions.

A gradual transition – which would be entirely possible and feasible from a technical perspective – is therefore made impossible by purely administrative obstacles. Operators can only switch to regenerative alternatives if they have a reliable source for such drop-in fuels, which is – at least currently – not the case in long-haul transport operations, e.g., along the Danube.

It shall be duly noted that supply of drop-in fuels will be difficult to scale up due to limited availability of sustainable source material and competition between modes of transport. In general, in order to support uptake of alternative energy carriers also beyond drop-in fuels, taxation has to be regarded as an important instrument to support establishing a level playing field.

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4.6 Legal framework for coastal ships

The main instrument for approving technical solutions deviating from binding requirements is provided by IMO general methodology for the approval of new fuels and technologies, as set out in the Guidelines for the Approval of Alternatives and Equivalents (MSC.1/Circ.1455). This approval process is based on risk assessment approach, requiring that the safety level of the alternative design be demonstrated as equivalent to that of a conventional oil-fuelled ship. This methodology is commonly referred to as the Alternative Design Approval (ADA) process, as early mentioned.

4.6.1 Major bottlenecks

It is essential to expedite the development of new fuel technologies, ship designs and safety regulations. The maturity level of alternative fuel technologies and safety regulations has been identified as one of the main bottlenecks to uptake of alternative fuels. The others main bottlenecks are related to demand, cost and fuel availability. This means that there is currently not enough market demand from ships to create or support a large-scale fuel transition. Alternative fuels are more expensive than conventional fuels, there are no mandatory requirements that forcing coastal shipping to switch fuels quickly and the ship owners may not want to pay more for their "green" ship. At the same time, the production costs of alternative fuels are higher than for conventional fuels, and there is no bunkering infrastructure and supply chain for such fuels.

As the risk-based approval process (ADA) is currently required by the IMO regulations for alternative fuel technologies, Flag Administrations provide guidance in order to facilitate this very complex process. Despite the provided guidance, the exact requirements for the approval may vary on case-by-case basis, depending on the Flag Administration's acceptance of available interim guidelines and classification society rules as the basis for their approval, as they are the drivers of the approval process. The number of alternative fuel projects and the ability to translate lessons learned from these projects into rules and their further development will for sure affect the speed of regulatory development, ship design and readiness for safe operation.

Alternative design and arrangement approach usually may require more resources and a more extended timeline than a conventional newbuilding project. This is reflected in the fact that the ADA process may need to go deep into the project details to ensure that all relevant aspects are incorporated into the risk assessment. The safety of early design depends on the quality of risk assessment work and the ability to transfer findings from the risk assessment into the actual design and operation of a ship. Consequently, the quality of the risk assessment work is the key factor in determining the safety level of a project involving alternative fuels, but harmonized way on how to deal with Risk Based Approach Approval is missing.

The approval process for the final design phase is extensive and requires high degree of interaction between the design team and the Flag Administration. The ADA also may extend well into details of final design phase to ensure that all integration details can be accounted for in the risk assessment. This implies that the Flag Administration approval may come much later in the project compared to a conventional newbuild. To manage this risk, early and close interaction with the Flag Administration to clarify the approval scope and process is important.

Many of Flag Administration do not provide national circulars and appropriate forms as for example MCA developed [29]. It is a guidance for ship owner to have information what must be submitted to the MCA when seeking for approval for their alternative fuelled ship.

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5. Guidelines for Applications for Derogations/Exemptions

5.1 Existing guidance documents

In appreciation of the challenges related to derogations and exemptions, CESNI and EUROMOT have published comprehensive guidance documents on derogations and exemptions, explaining options, procedures and necessary documentation.

The "Leaflet on deliberation on derogations and equivalences of technical requirements of the ES-TRIN for specific craft" issued by CESNI and relating to derogations under Article 25 of Directive (EU) 2016/1629 as well as under § 2.20 of the RVIR can be downloaded at https://www.cesni.eu/wp-content/uploads/2019/04/Guide_Sp_craft_en.pdf.

The "EUROMOT Guidance on the Implementation of Article 35 of Regulation (EU) 2016/1628" can be downloaded at https://www.euromot.eu/wp-content/uploads/2024/07/EUROMOT-Guidance-on-the-Implementation-of-Article-35-of-Regulation-EU-2016-1628.pdf.

No specific guidance is currently available for field testing under Article 34(4) of Regulation (EU) 2016/1628.

5.2 Influence of the evolution of technical requirements

As all relevant legal instruments apply a concept of "equivalent", "adequate" or "sufficient" level of safety or environmental performance in comparison to statutory requirements as a benchmark for assessing alternative technical solutions, the evolution of technical requirements has a significant impact on possible alternatives.

In particular where a new technology involves fuel with a flash point equal to or lower than 55° C the demonstration of "equivalent" or "adequate" level of safety in accordance with the provisions of Article 25 of Directive (EU) 2016/1629 on technical requirements for inland waterway vessels will necessarily already comprise a risk assessment in accordance with Article 30.04 of ES-TRIN, even if specific requirements for the fuel in question are not (yet) available.

5.3 Preparation of applications for derogations under Directive (EU) 2016/1629

5.3.1 Project description

A crucial point for every application is a clear project description, supported where applicable by photographs, system drawings, plan drawings and functional descriptions of the respective technical solutions.

For ensuring a quick examination and appraisal of the desired derogation, first by the competent authority/inspection body of the relevant Member State, then by CESNI, it is furthermore absolutely necessary to provide a concise and detailed analysis of all provisions and requirements of ES-TRIN where the project deviates from.

Any inaccuracy in the analysis of deviations, either referring to provisions where actually no relevant deviation is present or leaving out requirements for which deviations would be necessary, will obviously slow down the treatment of the application in the CESNI/PT working group.

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Guidance provided by the CCNR[15] lists the following elements as minimum content of an appropriate project description:

- Project developer, including contact details
- Supplier(s) of the relevant parts
- Owner of the vessel
- Specific provisions for which a derogation is requested
- Reason why a deviation from ES-TRIN is necessary
- If applicable, description of the navigation profile, including the intended navigation area and cargo.

5.3.2 Proof of equivalent safety

The second core element of any application for derogations from ES-TRIN requirements is the proof of equivalent (or adequate) safety.

Proof of equivalent (or adequate) safety can comprise:

- Risk mitigation measures, referring to concrete ES-TRIN requirements
- (Technical) explanations, where possible supported by drawings and diagrams
- Experts' reports
- Certificates issued by recognised Classification Societies
- Complete risk assessments
- Bunkering procedures, procedures for charging or swapping energy storage devices
- Crew training measures

As already mentioned under 5.2 above, for projects using alternative fuels a risk assessment must comply with the requirements of Article 30.04 of the ES-TRIN (especially the type of analysis and the list of risks). The impact of the innovative element on the overall safety of the craft is verified by the risk assessment.

While practical experience gained in other industries can certainly form a good basis for proof of equivalent safety it will probably be necessary to additionally address specific risks for inland navigation, like, for example:

- accumulation of explosive atmospheres in below-deck compartments
- larger quantities of dangerous substances (alternative fuels) on board than, for example, in road transport
- longer bunkering cycles, therefore higher probability of boil-off necessity
- longer access times for external emergency services
- requirements concerning automatic engine shutdown and making steerageway under own power
- structural risks of spills of cryogenic fuels (spontaneous embrittlement of structural components)
- influence on vessel stability of positioning of storage devices
- passing of locks and mooring as part of vessel operation

[15] https://www.ccr-zkr.org/12020200-en.html#05

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5.3.3 Coordination with inspection body and national CESNI delegation

Vessel owners/operators and/or project developers cannot directly apply to CESNI, any application for derogations needs to be submitted to and coordinated with the competent authority/inspection body selected to issue the Union inland navigation vessel certificate and with the respective national delegation to CESNI.

This can be seen as a first level of examination, as it can safely be assumed that no national delegation will present (and defend) an application for derogation where it does not at least see a fair chance of acceptance.

In that phase a draft proposal for the conditions to be stipulated in the envisaged implementing decision of the European Commission will be elaborated.

5.3.4 Submission of project documentation

After a project documentation has been accepted by the respective inspection body and national delegation to CESNI it has to be prepared for submission to CESNI.

While coordination with the inspection body and the national delegation will probably be carried out (at least partly) in an official language of the respective Member State, the project documentation should preferably be provided to CESNI in English.

The schedule of the relevant expert working group, CESNI/PT, typically foresees four meetings per year (meeting schedule see https://www.cesni.eu/en/evenements/). In order to provide delegations with a complete project documentation with sufficient time to study them prior to a CESNI/PT working group meeting it is strongly recommended to submit the dossier to the technical secretariat of CESNI not later than five weeks before the respective CESNI/PT meeting.

5.3.5 Examination of an application for derogation in CESNI/PT

Typically, CESNI/PT aims at deciding on a derogation within 2 or 3 meetings. Based on the feedback received in and closely following the first meeting the "managing" national delegation to CESNI will, together with the vessel owner/operator and the project developer, prepare answers to open questions, elaborate, where requested, additional information and proof of equivalence and, where necessary, informally consult other delegations.

This approach aims at accelerating the adoption of an application for derogation by preparing answers to open questions and addressing concerns expressed by other delegations in the initial meeting well before the following meeting, so that CESNI/PT can then take a well-founded decision on the basis of a mature dossier.

In particular for derogations in accordance with Article 25(1)(b) of Directive (EU) 2016/1629 for trial purposes for a limited period of time (i.e., typically research and development) CESNI/PT will most probably include reporting obligations, covering e.g., regular operational data, irregularities, incidents, accidents, repairs and amendments to the system, exhaust emission records etc.

5.3.6 Agreement reached by the CESNI/PT working group

After the CESNI/PT working group has reached a positive decision on an application for derogation the dossier can be forwarded to the European Commission for formal endorsement (implementing act) by the respective inspection body.

Once the agreement has been reached by the CESNI/PT working group, the respective inspection body is authorised to issue a provisional Union inland navigation vessel certificate in accordance with Article 9(1)(g) of Directive (EU) 2016/1629, pending the adoption of the relevant implementing act. Such provisional Union inland navigation vessel certificate shall be valid for six months and may be extended for

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six months at a time until the respective implementing act has been adopted (Article 9(3)(c) of Directive (EU) 2016/1629).

5.3.7 Adoption of the implementing act

Based on a formal submission of the respective Member State following agreement in CESNI/PT the European Commission is empowered to adopt an implementing act in accordance with Article 25 of Directive (EU) 2016/1629, under the conditions of Article 33(2) of this Directive (advisory procedure).

From past experience, the adoption of the implementing act can take considerable time. In the case of the pusher "Elektra", equipped with hydrogen-operated fuel-cells and high-pressure hydrogen storage the time from agreement on CESNI level (June 2019) until adoption of the respective implementing act (15.03.2023) took close to four years.

5.4 Preparation of applications for derogations under the RVIR

The procedure under the regime of the Rhine Vessel Inspection Regulation is by and large the same, with two notable differences leading to significantly lower processing times and an earlier issuing of a provisional vessel certificate:

- The CCNR has delegated the formal adoption of recommendations in accordance with § 2.20 of the RVIR to its Inspection Regulations Working Group (RV/G – Groupe de travail du règlement de visite)
- In accordance with § 2.05 No. 1 g) of the RVIR the inspection body may issue a provisional Rhine vessel certificate as long as the Central Commission for Navigation on the Rhine has not adopted a recommendation
-

Both measures lead to a significant reduction of the lead time required until a certificate allowing the vessel in question to legally being put into operation is available in comparison to the procedures under Directive (EU) 2016/1629, especially the adoption of implementing act.

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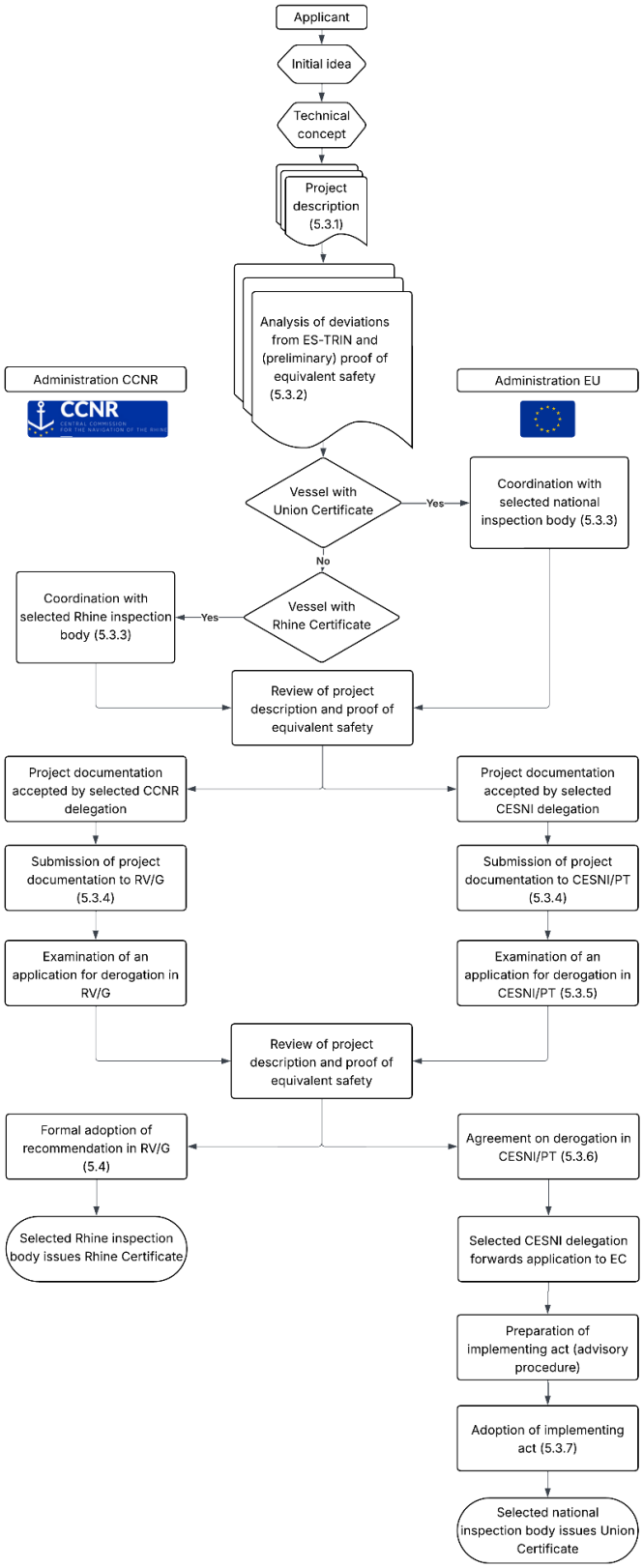

Figure 3 Derogation process for ES-TRIN (Directive (EU) 2016/1629 and IVR)

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5.5 Model for applications for derogations from ES-TRIN requirements

A structured model for the preparation of applications for derogations from ES-TRIN requirements is provided in Annex 1 of this report.

5.6 Guidelines for maritime ships

In order to support the introduction of new technologies and fuels in maritime sector, IMO has developed guidelines for design and operation of ships using alternative fuels. However, since IMO guidelines are only guidelines, Flag Administrations prescribe their own procedures that outline the approval process and their expectations regarding new ship designs and arrangements. Their procedures are generally based on IMO guidelines mentioned in paragraph 2.2.1.1, but the exact requirements for the approval process may vary on a case-base-case basis, depending on the Flag Administration acceptance of available interim guidelines and classification society rules as their approval basis and on factors relating to the design.

Every alternative ship design and arrangement must be submitted to the Flag Administration whose flag the ship owner intends to fly, and Flag Administration will try to facilitate the process. Examples of the description of steps of the approval process can be found on some Flag Administration websites referenced below:

- Approval process of alternative design and arrangements developed by Danish Maritime Authority (DMA) [30]
- Approval of alternative design and arrangements for ships using alternative fuels – developed by Norwegian Administration (NMA) [31]
- Certification process for vessels using innovative technology – developed by UK Maritime and Coastal Agency (MCA) [32]

If the Classification Society (recognised organisations authorised by Flag Administration acting on its behalf) has developed Class rules for the fuels or system components in consideration, these rules might be used as the basis for the alternative design and arrangement, if agreed upon with Flag Administration for the specific project.

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As the procedures for approval process of alternative design and arrangements are already established from

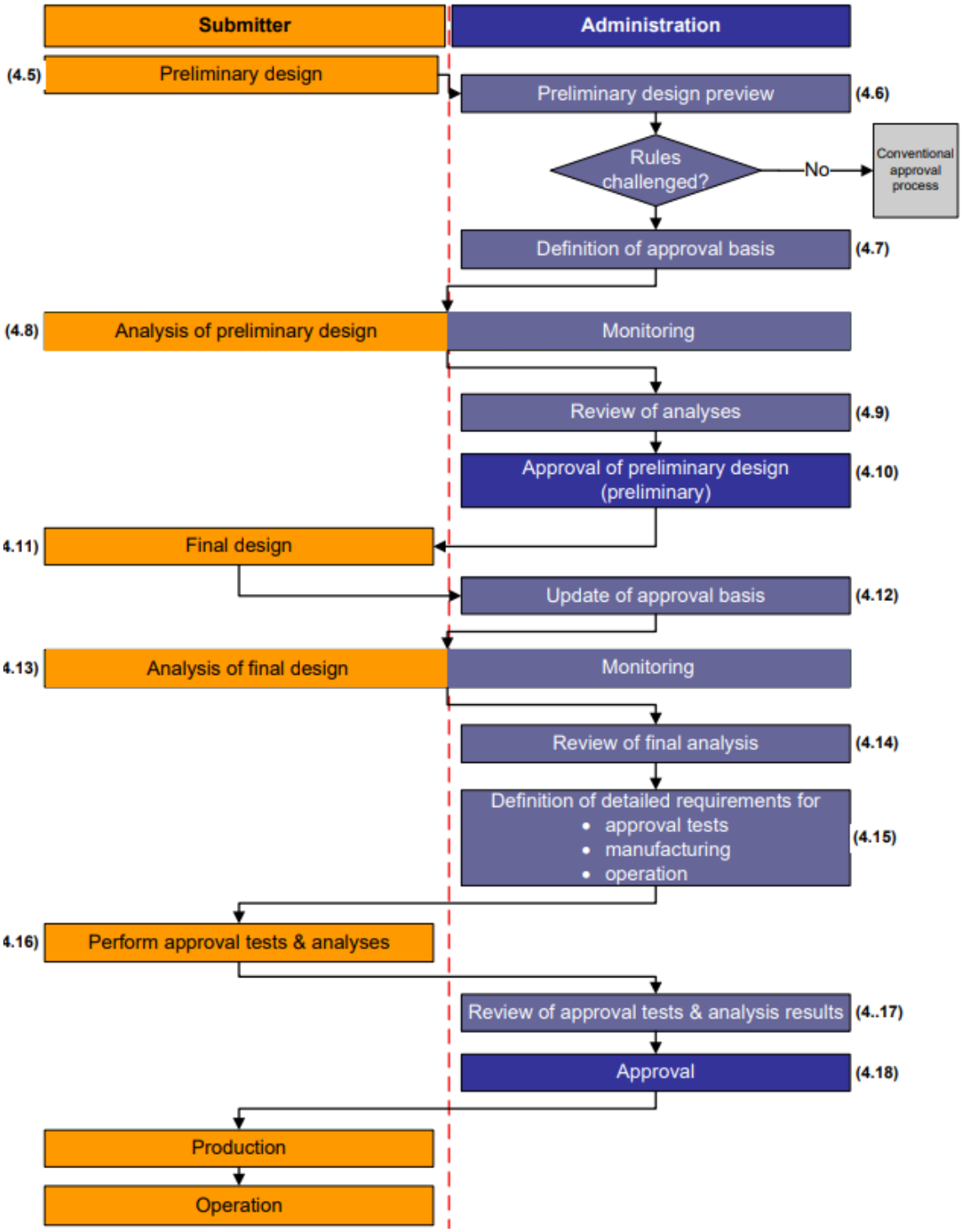

Figure 4 Design and approval process of alternative design and arrangements (MSC.1/Circ.1455)

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The activities at the beginning of alternative design and arrangement process starts with initial meeting between design team and Flag Administration. The design team consist of the ship owner, ship builder and designer, and if necessary, with the Recognised Organisation/Classification Society or any other stakeholder with competences to facilitate the process. Outcome of the initial meeting is the introduction of the project and initial design, followed by discussion about approval process and define the approval basis, initial plan for hazard identification and risk assessment, acceptance criteria and agreement on an outline of the approval process including expected extent of analysis, a tentative time plan and deliverables. Design team needs then further develop the design documentation, plans, reports and drawings. After analysis of the preliminary design the Flag Administration may grant preliminary approval if design appears feasible and critical hazards are adequately addressed. Preliminary approval will often outline requirements for further analysis or conditions that must be met in the final approval phase. It is important to note that receiving approval of preliminary design does not guarantee final approval, as it will depend on the project's ability to meet the conditions of preliminary approval.

Based on preliminary approval, design team is allowed to go ahead with the final design, where detailed drawings, specifications, system integrations and tests are developed and the further risk analysis are performed. The Flag Administration or Recognised Organisation acting on its behalf, review all documents and reports, verifies assumptions and ensures compliance with the established approval basis.

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6. Policy recommendations

In general, it can be observed that the introduction of new technologies in inland navigation is impacted, or even impeded, by

- A lack of resources at approval authorities
- Inefficient or inadequate approval procedures foreseen in Directive (EU) 2016/1629 and Regulation (EU) 2016/1628
- A lack of reference fuels, respectively a slow and cumbersome addition of new reference fuels
- A lack of alignment and reciprocal acknowledgment of different applicable legal instruments
- A lack of harmonisation in particular with respect to accompanying legislation, e.g., on alternative fuel infrastructure, emission trading, and taxation

While a lack of resources at approval authorities certainly has a considerable influence on processing times of applications for derogations from statutory technical requirements for inland navigation vessels as well as internal combustion engines, addressing shortcomings in this area is out of the scope of the present report.

6.1 More efficient approval procedures

For an accelerated adoption of derogations under the regime of Directive (EU) 2016/1629, with a view to possibly matching the overall processing times under the regime of the RVIR, it should be considered whether, instead of the European Commission needing to adopt an implementing act for each individual vessel seeking approval of derogations under Article 25 of Directive (EU) 2016/1629, the respective competent authority / inspection body could be authorised to issue a Union Certificate based on a unanimous technical opinion adopted by CESNI.

In case such rather radical approach should encounter insurmountable legal obstacles, i.e., in particular a complete waiver of an implementing act should not be acceptable for the European Commission, two further options could be explored:

- Reversing the target direction of the implementing act, i.e., a Union Certificate could be issued by the competent authority / inspection body based on a unanimous technical opinion adopted by CESNI provided the European Commission does not object by adopting an implementing act within a reasonable period of time (e.g., 6 months), or
- Clearly specifying in the Directive (EU) 2016/1629 a limited timeframe within which the implementing act must be adopted by the European Commission once the CESNI committee has reached consensus (examples for such approach can be found in rail transport, where for a comparable procedure the respective implementing act must be adopted within 4 months following the submission of a request, or in the TEN-T Regulation (6 months)).

6.2 Facilitated addition of reference fuels

For newly installed internal combustion engines ES-TRIN requires a type-approval in accordance with Regulation (EU) 2016/1628. A prerequisite for issuing such type-approval is testing engines with approved reference fuels. For accelerated uptake of alternative fuels, it would therefore be essential to facilitate and accelerate the addition of new reference fuels to the respective list in Regulation (EU) 2016/1628.

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6.3 Improved alignment and reciprocal acknowledgment of different applicable legal instruments

Directive (EU) 2016/1629 (and ES-TRIN) as well as the NRMM Regulation and the ADN Agreement in principle follow widely comparable approaches for derogation, distinguishing between:

- alternative solutions with a fundamentally equivalent level of safety or environmental performance aiming at permanent recognition of the respective technical solution and
- a permission to derogate from the statutory requirements for a limited duration for trial purposes, obviously mainly intended for research and development.

As the ADN Agreement can be regarded as a separate legal instrument dealing with issues specific to vessels transporting dangerous goods and governed by a different legislator, the following considerations focus on the interaction between Directive (EU) 2016/1629 and the NRMM Regulation – both legal instruments are applicable to all inland waterway vessels equipped with internal combustion engines using alternative fuels and are governed by the European co-legislators.

6.3.1 Interaction between Directive (EU) 2016/1629 and the NRMM Regulation

6.3.1.1 Field testing / research and development – derogations of limited duration

An important first step of alignment between ES-TRIN and NRMM has already been adopted for the 2025 edition of the ES-TRIN, entering into force on 01.01.2026. While the ES-TRIN in principle requires a type-approval for all internal combustion engines falling into the scope of the NRMM Regulation to be installed in inland waterway vessels (cf. Article 9.01(2)), a general derogation has been adopted to permit installation of internal combustion engines under the field-testing regime of the NRMM Regulation (see also 4.3 above).

In recognition of the duration of field-testing exemptions granted in accordance with Article 34(4) of the NRMM Regulation, the ES-TRIN links the duration of validity of the inland navigation vessel certificate to the duration of the field test.

A remaining element that, at the moment, is possibly not sufficiently taken into account is the starting date of the "limited duration" of the respective derogations. A poor coordination of the separate adoption processes can easily lead to a considerable reduction of the available "limited duration" in practice.

Unfortunately, processing times for the adoption of implementing acts for derogations in accordance with Article 25 of Directive (EU) 2016/1629 are in the order of magnitude of the limited duration of field testing foreseen by Article 34(4) of the NRMM Regulation – it is therefore entirely possible that the implementing act is only adopted after the principal duration of the field-testing period, or even the additional extension, has expired.

In that respect, the most favourable scenario for inland navigation would probably be to base the starting date of the field-testing exemption on the date of issue of the respective inland navigation vessel certificate.

6.3.1.2 Permanent acceptance of derogation / exemption

Where a permanent acceptance of a derogation is required, the ES-TRIN, in accordance with Article 9.01(2), requires a type-approval in accordance with the NRMM Regulation. The general derogation for field testing provided by Article 9.01(6) of the ES-TRIN is therefore not applicable for internal combustion engines using alternative fuels.

The necessary type-approval for internal combustion engines using alternative fuels can only be obtained by way of the exemptions for new technologies or new concepts in accordance with Article 35 of the NRMM Regulation.

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Once the final type-approval has been authorised by way of an implementing act adopted by the European Commission, the requirement of Article 9.01(2) of the ES-TRIN is obviously fulfilled, so there is no necessity from the perspective of Directive (EU) 2016/1629 and the ES-TRIN to provide further coordinating or facilitating elements.

However, with a view to an accelerated uptake of greening technologies, there seems to be room for improvement in the coordination of the relevant legal instruments for the interim phase of the provisional EU type approval.

Article 35(4) of the NRMM Regulation, pending the decision on authorisation by the European Commission, provides for the approval authority issuing a provisional EU type-approval. The validity of such provisional EU type approval is restricted to the territory of the issuing Member State. In accordance with Article 35(5), approval authorities of other Member States can decide to accept a provisional EU type approval within their respective territories.

As it might very well prove to be a quite cumbersome effort to obtain acceptance of a provisional EU type approval for all countries an inland waterway vessel might pass during its journeys, a less complex solution would certainly be welcome to cover the interim period pending the authorisation by the European Commission.

The following approaches might be considered further with a view to facilitating approval procedures:

- In the vein of Article 9.01(6) of ES-TRIN as newly introduced with its 2025 edition it could be discussed to accomplish acceptance of provisional EU type-approvals by way of a similar provision in Article 9.01 of ES-TRIN for inland waterway vessels benefitting from a derogation in accordance with Article 25(1)(a) of Directive (EU) 2016/1629. A challenge for such approach could be that the inspection bodies and competent authorities represented in the CESNI working groups and committee are not necessarily the approval authorities addressed by Article 35 of the NRMM Regulation. Such approach might therefore, in parallel to an amendment of Article 9.01 of the ES-TRIN, require the introduction of a clause for inland navigation in Article 35(5) of the NRMM Regulation, possibly replacing the Member State-specific individual acceptance of provisional EU type approvals by a reference to a derogation adopted in line with the provisions of Article 25(1)(a) of Directive (EU) 2016/1629.
- A second route that could be explored is an interpretative one, based on the different legal characters of the concerned legal instruments. While Directive (EU) 2016/1629 addresses issuance of individual inland navigation vessel certificates, i.e., traffic permits, the NRMM Regulation addresses the placing on the market of type approved engines or engine families. As the NRMM Regulation in Article 35 for provisional EU type approvals sets a territorial restriction for the placing on the market [*in the Member State issuing the provisional EU type approval, editor's note*] but not explicitly on the use of products legally placed on the market, it could be concluded that an inland waterway vessel equipped with an internal combustion engine would be permitted to navigate the entire network of EU inland waterways – at least under the condition that the engine with the provisional EU type approval has been installed within the territory of the Member State having granted the provisional EU type approval. It shall be duly noted that such interpretative approach would need to be thoroughly checked legally, preferably in close coordination with the respective European Commission services and/or the GEME expert group. It is furthermore highly likely that such interpretation – if ever accepted – remains valid only as long as the vessel in question is operating from the Member State whose approval authority issued the provisional EU type-approval and any change to the port of registry of the vessel or to the company headquarters might probably render the provisional EU type-approval not applicable anymore.

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6.4 Harmonisation of accompanying legislation

As pointed out in 0 above, probably due to its low overall share in the modal split and a high variation of the modal split in the different Member States, it can be observed that governance of inland navigation issues apart from technical requirements is often left to the individual Member States.

However, inland navigation, despite its low overall share in the modal split, is a highly internationalised mode of transport, so it would be desirable to have harmonised rules for inland navigation for all EU inland waterways also on issues like supply of alternative fuels, emission trading and taxation of fuels for inland navigation vessels.

6.5 Other obstacles

As mentioned in 0 and 4.2.1 above, a potential obstacle for field testing of internal combustion engines falling into the scope of the NRMM Regulation is the requirement that ownership of the engine must remain with the engine manufacturer. While, according to the IVR paper on emission legislation [13], it is still open how conflicts (at least) between Dutch national law and this specific requirement might be approached, exploring the following work-around approach can be suggested:

For the purpose of field testing, the vessel where the engine shall be installed can be regarded as a test platform that is provided by the owner of the vessel. Apart from the statutory requirements imposed on such experimental operation it is therefore highly likely that some kind of contractual agreement between the vessel owner and the engine manufacturer will need to be concluded anyway. With a view to the ownership requirement stipulated by Commission Delegated Regulation (EU) 2017/654, Annex XI (1), such contractual agreement could possibly comprise a temporary transfer of legal ownership for the duration of the field test (e.g., sale-and-lease-back agreement, operation of the vessel would remain with the original vessel owner).

6.6 Coastal ships

In the maritime navigation sector, many guidelines, recommendations, papers and instructions have been developed by all relevant regulatory bodies involved in the process of the greening maritime navigation. Their purpose is to facilitate the very complex procedure of approval new technologies for which prescribed mandatory rules does not yet exist.

However, there is still a place for improvement. While reading relevant literature and preparing this deliverable, the conclusion that arose is that among the numerous instructions mentioned above, the clean guidelines for coastal ships from most of Flag Administration are still missing. Therefore, the recommendation for Flag authorities is to develop national procedures/circulars and corresponding forms (similar to the one that MCA developed) so that ship owners, designers, shipyards and other stakeholders have a clear understanding of what is expected of them, which requirements apply and how they can satisfactorily fulfil them.

It should be emphasized that the process of the approval of alternative design and arrangements is very extensive and requires a high degree of interaction between all parties involved in the process (design team, ship owner, shipyard, Flag Administration, etc.). Furthermore, alternative designs and arrangements may require more resources and have a longer timeline compared to a conventional project. To manage this risk, very early and close interaction with the Flag Administration to clarify the approval scope and process in details is very important.

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7. Conclusion

The transition to zero-emission shipping—both inland and coastal—is critical for achieving the EU's climate goals, but it is currently hampered by regulatory fragmentation, complex approval processes, and infrastructure gaps. Coastal shipping, though subject to IMO and EU frameworks, faces challenges similar to those for inland navigation: interim guidelines, case-by-case approvals, and divergent national rules create legal uncertainty, delay innovation, and discourage investment.

Key shared bottlenecks:

- Lack of mandatory, harmonized standards for alternative fuels (e.g. methanol, hydrogen) and alternative energy carriers (e.g. battery-electric), leading to reliance on interim guidelines and lengthy approval processes.
- Fragmented regulatory approaches across Member States, resulting in legal uncertainty and market distortion.
- Complex, time-consuming approval procedures, including derogations, exemptions, and alternative design and arrangements (ADA), which require coordination among multiple authorities and often involve European Commission implementing acts.
- A lack of harmonization of accompanying regulatory instruments, like emission trading policies, taxation, energy supply infrastructure requirements contribute to infrastructure and market barriers, such as the "chicken-and-egg" dilemma between energy supply and demand.

2. Recommendations for Policy Makers and Industry

A. Streamline and Harmonize Approval Procedures

- Empower competent authorities to issue Union inland navigation certificates and coastal ship approvals without always requiring European Commission implementing acts.
- Align timelines and conditions for derogations and exemptions under relevant directives and regulations (e.g., Directive (EU) 2016/1629, Regulation (EU) 2016/1628, IGF Code) to minimize administrative delays.
- Simplify field testing and pilot project requirements, such as relaxing engine ownership rules in NRMM and standardizing risk assessment methodologies.

B. Develop Consistent Standards and Regulations

- Accelerate the inclusion of alternative fuels (methanol, hydrogen, ammonia) in binding EU and IMO frameworks, including ES-TRIN, the IGF Code, and MARPOL, in particular by facilitating and accelerating the approval of reference fuels
- Harmonize national regulations on emission trading, infrastructure deployment and, as far as legally possible, also fuel taxation, to create a level playing field.
- Promote mutual recognition of approvals among Member States and Flag Administrations to reduce duplication and streamline cross-border operations.

C. Support Infrastructure and Market Development

- Fully include inland navigation in all relevant legal instruments (RED III, ETS 2, Alternative fuel infrastructure) without any opt-out or opt-in clauses for the Member States (at least those with inland waterways listed in Annex I of Directive (EU) 2016/1629 or part of the TEN-T networks)
- Incentivize alternative energy infrastructure through public-private partnerships, targeted funding, and coordinated Member State strategies.

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- Break the "chicken-and-egg" dilemma by ensuring reliable energy supply and encouraging early adoption through financial and regulatory support.

D. Enhance Knowledge Sharing and Guidance

- Develop comprehensive, user-friendly guidance documents for applicants for derogations, based on best practices and lessons learned from existing projects.
- Facilitate early and close collaboration among vessel owners, manufacturers, approval authorities, and Classification Societies to clarify requirements and expedite approvals.
- Provide training and capacity building for all stakeholders to build expertise in alternative fuels and new technologies.

3. Path Forward: A Coordinated Approach

The transition to zero-emission shipping is both a technical and regulatory challenge. Success depends on:

- Short-term fixes: Simplified derogation procedures, clearer guidelines, and faster approval processes.
- Long-term solutions: Reliable and consistent standards, harmonized rules, and robust infrastructure.

By aligning EU, international, and national regulations, fostering collaboration among stakeholders, and targeting support where it is most needed, Europe can accelerate the adoption of greening retrofit solutions and achieve its climate objectives.

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Annex 1: Structured model for applications for derogation from ES-TRIN requirements

AUTHOR	SOURCE	REMARKS
Bernhard Bieringer (ANZ)	Chapter 5 - Guidelines for Applications for Derogations/Exemptions	

This Annex is intended to facilitate structuring applications for derogations from ES-TRIN requirements under the legal regimes of Directive (EU) 2016/1629 as well as of the Rhine Vessel Inspection Regulations.

It shall support vessel owners and project developers in collecting and compiling all information necessary for accelerated examination and assessment in the relevant technical expert groups (CESNI/PT or RV/G respectively).

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Application for derogation from ES-TRIN requirements

1. Vessel:

Name: …..

ENI: …..

Type: …..

☐ Newbuilding (inland navigation vessel certificate not yet issued)

☐ Retrofit / conversion

☒ copy of current / last inland navigation vessel certificate attached

Main dimensions (if no copy of inland navigation vessel certificate is attached or changes are intended):

Length overall:	…..	
Breadth overall:	…..	
Max. draught:	…..	
Displacement:	…..	
Deadweight:	…..	(cargo vessels)
Max. No. of passengers:	…..	(passenger vessels)

Internal combustion engines

☐ Type-approvals in accordance with the NRMM Regulation are available

☐ Field testing exemption in accordance Article 34(4) of the NRMM Regulation

☐ requested

☐ granted (see attachment)

☐ Exemption for new technologies or new concepts in accordance with Article 35 of the NRMM Regulation

☐ requested

☐ Provisional EU type approval issued (see attachment)

☐ Implementing act adopted (see attachment)

Fuel

☐ Diesel or other fuel with flash point > 55° C

☐ Methanol

☐ Hydrogen

☐ LNG

☐ Battery-electric

☐ other – specify: …

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2. Legal regime

The present application for derogation from ES-TRIN requirements shall be processed in accordance with

☐ Directive (EU) 2016/1629 (→ Union inland navigation certificate)

- ☐ Article 25(1)(a) – equivalent safety (unlimited duration)
- ☐ Article 25 (1)(b) – adequate safety (trial purposes – limited period of time)

☐ Rhine Vessel Inspection Regulation (→ Rhine vessel certificate)

- ☐ § 2.20 No. 1 – equivalent safety (unlimited duration)
- ☐ § 2.20 No. 3 – adequate safety (trial purposes – limited period of time)

☐ The vessel is intended to carry dangerous goods. An application for exemption in accordance with

☐ 1.5.3.1 of the ADN (acceptance of equivalence for permanent validity)

- ☐ 1.5.3.2 of the ADN (limited period on a trial basis)

will be submitted to the Administrative Committee established under the ADN Agreement

In case derogation is requested under Directive (EU) 2016/1629: Navigation zone(s):

Reference: Annex 1 of Directive (EU) 2016/1629 - https://eur-lex.europa.eu/legal-content/EN/TXT/?qid=1763463555968&uri=CELEX%3A32016L1629

☐ 1

☐ 2

☐ 3

☐ R (Rhine)

☐ 4

Restricted to the following countries and/or waterways (optional):

3. Inspection body / competent authority selected for managing the application

Reference: https://listes.cesni.eu/3000-en.html

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4. Vessel owner or operator

Name:

Company seat / postal address:

Contact details:

5. Project developer

Name:

Company seat / postal address:

Contact details:

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6. Project description

[short summary]

Details see attachment …

Description of operational profile (optional):

[if not part of the detailed project description]

7. Specific provisions for which a derogation is requested

Reference: https://www.cesni.eu/en/standards-and-explanatory-notices/#01

Article	ES-TRIN requirement	Deviation	Reason for deviation

8. Suppliers of relevant parts/systems

Part / system	Supplier	Related to deviation from Article

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9. Proof of equivalent / adequate safety

General strategy for providing proof of equivalent / adequate safety (optional)

☐ Technical explanations relating to

Article	supported by
…	☐ Description … (attachment) ☐ Drawing … (attachment) ☐ Diagram … (attachment)
…	

☐ Experts' reports relating to

Article	Attachment
…	…
…	…

☐ Certificates issued by recognised Classification Societies relating to

Article	Attachment
…	…
…	…

☐ Formal risk assessment

Article	Risk assessment method
…	In accordance with Article 30.04: ☐ HAZID study ☐ FMEA study ☐ FMECA study ☐ HAZOP study ☐ other method – specify:

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…

In accordance with other legal basis:

☐ specify: …

… …

☐ Bunkering procedures

☐ Crew training measures

Remark:

While practical experience gained in other industries can certainly form a good basis for proof of equivalent or adequate safety it will probably be necessary to additionally address specific risks for inland navigation, like, for example:

- *accumulation of explosive atmospheres in below-deck compartments*
- *larger quantities of dangerous substances (alternative fuels) on board than, for example, in road transport*
- *longer bunkering cycles, therefore higher probability of boil-off necessity*
- *longer access times for external emergency services*
- *requirements concerning automatic engine shutdown and making steerageway under own power*
- *structural risks of spills of cryogenic fuels (spontaneous embrittlement of structural components)*
- *influence on vessel stability of positioning of storage devices*
- *passing of locks and mooring as part of vessel operation*

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Attachments

- ☐ Last / current inland navigation vessel certificate
- ☐ General arrangement plan
- ☐ Engine room plan
- ☐ Hazardous zones plan (cf. ES-TRIN Article 30.04(2)(b) and Article 10.04)
- ☐ Other plans:
  - ...
- ☐ Field testing exemption in accordance with Art. 34(4) of the NRMM Regulation
- ☐ Provisional EU type approval in accordance with Article 35 of the NRMM Regulation
- ☐ Implementing act on EU type approval in accordance with Article 35 of the NRMM Regulation
- ☐ Systems diagram(s) for:
  - ...
- ☐ Technical explanations
  - ...
- ☐ Experts' reports
  - ...
- ☐ Certificates issued by recognised Classification Societies
  - ...
- ☐ Formal risk assessment
  - ...
- ☐ Bunkering procedures
  - ...
- ☐ Crew training measures
  - ...

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