

D5.3 Scenarios for Policy Makers

Synergetics | Synergies for Green Transformation of Inland and Coastal Shipping

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| List of Abbreviations

ADN	European Agreement concerning the International Carriage of Dangerous Goods by Inland Waterways
AFIR	Alternative Fuel Infrastructure Regulation
APS	Announced Pledged Scenario
CAPEX	Capital Expenditure (investment costs)
CCNR	Central Commission for the Navigation of the Rhine
CCS	Carbon Capture and Storage
CEEAG	Climate, Energy and Environmental Aid Guidelines
CEF	Connecting Europe Facility
CESNI	European Committee for drawing up Standards in the field of Inland Navigation
CII	Carbon Intensity Indicator
CO _{2e}	Carbon Dioxide Equivalent
CPP	Controllable Pitch Propellers
CSRD	Corporate Sustainability Reporting Directive
EBU	European Barge Union
EC	European Commission
ECSA	European Community Shipowners' Associations
EEDI	Energy Efficiency Design Index
EEXI	Energy Efficiency Existing ship Index
EFIP	European Federation of Inland Ports
EGD	European Green Deal
EIB	European Investment Bank
EMS	European Maritime Space
EMSW	European Maritime Single Window
ESO	European Skippers Organisation
ES-TRIN	European Standard laying down Technical Requirements for Inland Navigation vessels
ETD	Energy Taxation Directive
ETS	Emission Trading System
EU	European Union
FAME	Fatty Acid Methyl Esters
FC	Fuel Cell
FCR	Frequency Containment Reserve
FEUM	FuelEU Maritime
GBER	General Block Exemption Regulation



GHG	Greenhouse Gas emissions
GT	Gross Tonnage
HVO	Hydrogenated Vegetable Oil
ICE	Internal Combustion Engine
IMO	International Maritime Organisation
INE	Inland Navigation Europe
IWT	Inland Waterway Transport
LBM	Liquified Bio-Methane (Bio-LNG)
LMTG	future Land and Multimodal Transport Guidelines
LNG	Liquified Natural Gas
LSFO	Low Sulphur Fuel Oils (Very (VLSFO) / Ultra (ULSFO))
MCS	Megawatt Charging System
MFF	Multiannual Financial Framework
MJ	Mega Joule
NO _x	Nitrogen Oxides
NRMM	Non-Road Mobile Machinery
NZE	Net-Zero Emission scenario (fuel price scenario)
OPEX	Operational Expenditures
OPS	Onshore Power Supply
OSV	Offshore Supply Vessels
PM	Particulate Matter
RD&I	Research, Development, and Innovation
RED-III	Renewable Energy Directive III
RFNBO	Renewable Fuel of Non-Biological Origin
SCR	Selective Catalytic Reduction system
SME	Small and Medium sized Entities
SMF	Sustainable Maritime Fuels
SO _x	Sulphur Oxides
SRL	Social Readiness Level
SSMS	Smart and Sustainable Mobility Strategy
STEPS	Stated Policy Scenario (Fuel price scenario)
STIP	Sustainable Transport Investment Plan
TBER	new Transport Block Exemption Regulation
TCO	Total Cost of Ownership
TEN-T	Trans European Network Transport



toe	tons of oil equivalent
TRL	Technology Readiness Level
TTW	Tank-to-Wake
WAP	Wind Assistant Propulsion
WTT	Well-to-Tank
WTW	Well-to-Wake
ZEWT	Zero-Emission Waterborne Transport partnership



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| Executive Summary

The key message of this report on the scenarios for policy makers is that the transition to climate-neutral inland waterway transport (IWT) and coastal shipping is **technically close to maturity for the first technologies** but **not yet economically or systemically viable** under current regulatory and market conditions. The central finding of this report is that **policy is the decisive bottleneck** for large-scale deployment of zero- and low-emission solutions. Without binding policy interventions, the market conditions will not change. Setting mandatory targets, introducing carbon pricing and earmarking the revenues are key instruments and recommendations from this report to create a economically feasible transition.

1. Core Policy Challenge

Although multiple propulsion technologies (battery, renewable fuels such as HVO, hydrogen, methanol) are mature or getting closer to market-ready, their uptake is constrained by **absent business cases** due to higher CAPEX and OPEX versus fossil diesel. This is caused by the following elements:

- **Fragmented regulatory frameworks** across EU and Member States and **lack of binding emission targets and carbon pricing in IWT** and for smaller coastal vessels (<5000 GT)
- **Limited market incentives for operators and shippers**

As a result, the transition remains stuck in lab-testing and few pilots rather than starting to scale to fleet-wide deployment. The lack of demand also results in **lack of infrastructure deployment** of renewable energy supply along corridors and in ports as for such infrastructure there is no secure return on investment.

Furthermore, there are still a few technical regulations which hamper uptake of renewable energy solutions. In particular the bottleneck in the Non-Road Mobile Machinery Regulation (EU) 2016/1628 is highlighted, which does block the finalisation of technical development and commercial roll-out of methanol-fuelled Stage V engines.

2. Key Strategic Insight

The transition requires a **system-level policy approach**, combining energy supply, vessel technology, infrastructure, and market incentives. Across both sectors, IWT and coastal shipping:

- **No single technology pathway exists:** a multi-fuel approach is essential.
- **Energy efficiency and demand reduction are as important as fuel switching.**
- **Member States are decisive**, particularly in implementing EU frameworks consistently, notably directives. More specific and binding regulations are to be considered on EU level to ensure level playing field and effective policies.

3. Critical Policy Levers

The analysis shows that **three policy levers determine success**:

3.1 Carbon Pricing and Economic Signals

- Internalising CO₂ costs (e.g. ETS-2) is seen as the **most powerful driver** of competitiveness possibly combined with **mandatory targets** for renewable energy supply volumes / GHG reduction targets in IWT and coastal shipping
- Policy revenues reinvestment into the sector is essential to close CAPEX and OPEX gaps.



3.2 Stable Regulatory Framework

- A **binding EU decarbonisation target for IWT** is currently missing and urgently needed to reach the emission reduction goals.
- Regulatory bottlenecks (NRMM, ES-TRIN) delay deployment of key fuels such as renewable hydrogen and especially bio-methanol.

3.3 Targeted Investment and Infrastructure

- Public funding and coordinated corridor deployment are required to break the **"chicken-and-egg" problem** between vessels and infrastructure.
- Ports should evolve into **energy hubs** for alternative fuels and electrification seen also the need for a high-density network of refuelling / recharging stations and the market opportunity to transport renewable fuels by inland vessels.

4. Pathways for Decarbonisation

Inland Waterway Transport

- **Short term:** renewable drop-in fuels (especially HVO) offer immediate emission reductions.
- **Medium to long term:** battery-electric and methanol combustion engine solutions can approach cost parity under strong policy scenarios.
- **Long term:** hydrogen solutions become relevant for full decarbonisation but remain cost-challenging.

Coastal Shipping

- Transition pathways are constrained by **high autonomy requirements and fuel density limits**.
- **Liquid fuels (biofuels, methanol, LNG)** dominate in the short/medium term.
- **Hydrogen and electrification** are probably necessary to reach 2050 targets but require major infrastructure and regulatory support.
- Other options such as **carbon capture and storage (CCS)** may also be considered to reach 2050 goals.

5. Systemic Risks

Without decisive policy action, the report identifies key risks:

- **Loss of environmental competitiveness vs. road transport**, which is decarbonising faster, and environmental performance is expected to become a more important factors for clients of transport services. The modal shift rationale is under pressure if IWT and coastal shipping ('motorways of the sea') don't keep pace with road transport. Furthermore, decoupling from fossil fuel use is recommendable to be more resilient against geo-political issues (e.g. Strait of Hormuz situation).
- **Fragmentation between Member States**, leading to market distortions resulting in bunker tourism which undermines effective measures and creates extra transport and traffic movements.
- **Delayed investment decisions** due to policy uncertainty
- **Failure to meet EU climate neutrality objectives** across waterborne transport



6. The 2026–2027 Policy Window

A **critical decision window in 2026–2027** will determine the trajectory of the coastal and IWT sector, including:

- RED-III implementation as well as ETS-2 implementation and revenue allocation by Member States
- Revision of technical regulations (NRMM, ES-TRIN)
- Alignment with CCNR and NAIADES frameworks
- Preparation of the NAIADES IV policy action plan (2028-2035), possibly addressing EU binding regulations to be implemented for IWT.
- EU budget decisions (post-2027 MFF)

Delayed decisions will significantly reduce the feasibility of scaling the transition in time.

7. Bottom Line for Policy Makers

To unlock the transition, policy makers must shift from fragmented measures to a **coherent system framework**, combining:

- **Binding EU targets and harmonised implementation across MS**
- **Effective carbon pricing with revenue reinvestment in the IWT and coastal shipping sector;**
- **Technology-neutral support across multiple fuel pathways**
- **Large-scale infrastructure deployment at corridor level**
- **SME-accessible funding and simplified procedures**

1. Introduction

The transition towards a more sustainable Inland Waterway Transport (IWT) and coastal shipping sector requires not only technological innovation, but also a supportive policy and regulatory framework. While alternative propulsion systems and low-emission energy solutions are increasingly becoming available, their large-scale implementation is often constrained by complex regulatory procedures, fragmented governance structures, and uncertainties regarding approval processes. To accelerate the uptake of sustainable innovations and the transition of the shipping sector, policy makers and sector stakeholders need clear guidance on how existing frameworks can be adapted, how regulatory barriers can be solved effectively, and how regulations can be orchestrated from a system perspective, where instead of tackling every problem individually, the logistic systems included energy carriers, their supply, port infrastructure, technology on-board and emissions balancing and management should be treated as a whole.

Within the SYNERGETICS project WP5 focuses on facilitating the transition towards the use of alternative fuels with low-emissions and more energy-efficient waterborne transport systems. Building upon the insights generated in Task 5.2 and lessons learned from related European initiatives, Task 5.3 specifically addresses the development of scenarios and actionable pathways for policy makers. The task aims to provide a structured roadmap for implementing policies and regulations that support the adoption of sustainable alternatives in the IWT and coastal shipping sectors.

To achieve this, the task takes as starting point the overview of the current regulatory and policy frameworks from SYNERGETICS Task 1.3 and identifies the key decisions required to accelerate the uptake of clean technologies, energy efficiency measures and usage of renewable energy. Particular attention is given to the actors involved in these decision-making processes, including regulatory authorities, classification societies, CESNI/PT, CCNR, Flag States, and other relevant stakeholders, as well as the interactions and influences between them.

In addition, Task 5.3 considers the practical perspective of vessel owners and operators by presenting how they can navigate the existing regulatory landscape to obtain approval for innovative propulsion systems. This is consistent with the SYNERGETICS D5.4 Handbook and the D4.6 which also address the topic of practical implementation.

By combining regulatory analysis with stakeholder engagement and lessons learned from ongoing initiatives, the task develops policy scenarios that can support a faster and more effective transition towards sustainable inland and coastal waterborne transport.

1.1 Objectives and scope

The current transition towards a more sustainable inland waterway transport and coastal shipping sector requires a supportive and adaptive policy and regulatory framework. Within the SYNERGETICS project WP1.3 addresses this challenge by focusing on the development of actionable pathways.

Task 5.3 builds on insights gained from the project, specifically from Tasks 1.3 and 5.2, as well as lessons learned from the demonstrators in WP3 and related projects such as the PLATINA4Action project, RH2IWER project and stakeholder consultations.

The objective of Task 5.3 is to provide policy makers with a clear and structured roadmap for implementing effective policies. This is based on the analyses of existing regulatory and policy development frameworks affecting IWT and coastal shipping, identifying the key decisions required to enable changes, such as the adoption of alternative fuels and mapping the actors involved. The task also considers the practical perspective of vessel owners, examining how they can navigate regulatory procedures to obtain approval for alternative propulsion systems.



1.2 Approach and methodology

The execution of Task 5.3 is based on the previous work of SYNERGETICS. Important groundwork was done in Task 1.3 which provided the inventory of scenarios, relevant policies and regulations for both the IWT and coastal sector¹. The mid-term conference of SYNERGETICS already ensured the stakeholders involvement on the policy recommendations based on the results of Task 1.3.

Furthermore, the analyses of the Total Costs of Owner ship within the SYNERGETICS WP4 and Task 5.1-models developed in SYNERGETICS revealed major economic bottlenecks which can only be solved by means of policy interventions. Moreover, specific workshops on the technical regulations (ES-TRIN, ADN, NRMM regulations) provided a clear view on these elements.

There also has been close contact with the European Commission DG MOVE and with the findings of discussions with the NAIADES Implementation Expert Group. The viewpoints of stakeholders and the actions from NAIADES III in the field of emission reduction have been used as input to conclude on required actions and defining the roadmap. Moreover, the perspectives of key stakeholders have been taken into account, mainly based extensive stakeholder discussions in other projects and on the position papers which were prepared by these actors, also including consortium partners, as input for the Sustainable Transport Investment Plan and for the Industrial Maritime Strategy and the Ports Strategy.

In particular the PLATINA4Action project provided relevant recent reports (March 2026) on the TCO comparisons (PLATINA4Action Deliverable D4.2) and also a report (Deliverable D4.3) on the overall bottlenecks, barriers and opportunities for IWT.

For the coastal shipping sector, the policy recommendations have also been based on the TCO analyses using the Decision Support Tool from Task 5.1 and the results from Task 1.3. Furthermore, the stakeholder position of the European Community Shipowners' Associations (ECSA) has been taken into account as well as the relevant parts from the SYNERGETICS Handbook (D5.4) and the report D4.6 in relation to the technical regulations for coastal vessels.

1.3 Background SYNERGETICS D1.3 – Report on scenarios

Purpose, approach and structure of the report

The SYNERGETICS Deliverable D1.3 provides a systematic inventory and assessment of strategies, policies, legislation and scenarios relevant to the decarbonisation of IWT and coastal shipping up to 2050. Its role within SYNERGETICS is exploratory stock taking and foundational groundwork, supporting:

- scenario development,
- techno-economic modelling (WP1 and WP4), and
- policy recommendations for acceleration (WP5).

The D1.3 report applies a structured, comparative policy analysis for its stock taking, based on:

- Desk research of European, international (IMO, CCNR) and national strategies, legislation and funding schemes.
- Systematic description templates for each policy/strategy, covering:
 - scope, targets, timelines, emission accounting approach (TTW / WTW), technologies, interventions, and financing.
 - Comparison across governance levels (EU – international – Member State).

¹ [SYNERGETICS D1.3 Report on Scenarios](#)



- Cross-checking with SYNERGETICS Tasks 1.1 and 1.2, linking policy ambition to technological feasibility and energy availability.
- Target year 2050, with attention to interim milestones (2030, 2035, 2040).

Importantly, the report does not propose new policy, but identifies coherence, gaps, inconsistencies and risks in the existing framework. The core structure is as follows:

- General EU strategies and legislation affecting both IWT and coastal shipping: European Green Deal, Fit for 55, SSMS, ETS, RED-III, AFIR, EU Taxonomy, CSRD, CountEmissionsEU
- Specific policy frameworks for IWT: NAIADES III, CCNR Mannheim Declaration & Roadmap, national IWT policies.
- Specific policy frameworks for Coastal Shipping: IMO strategy, FuelEU Maritime, ETS, national maritime/coastal policies.
- Cross-comparison of measures, focusing on fuel supply regulation, infrastructure, transparency and reporting and financing instruments.
- Assessment of differences, risks and implementation gaps, especially between Member States.
- Reflection against SYNERGETICS technology and energy findings (D1.1 & D1.2).
- Overall conclusions and policy-relevant observations for future acceleration.

Inland Waterway Transport (IWT): Policy conclusions from D1.3

Strategic clarity vs. legal fragmentation

- No binding EU-level emission reduction target exists specifically for IWT. Ambitions are embedded only at general transport level (EGD, SSMS).
- CCNR is the only framework with clear, quantified targets and scenarios ($\geq 35\%$ reduction by 2035; $\geq 90\%$ by 2050, TTW).
- NAIADES III provides direction and actions, but lacks: quantified GHG trajectories, explicit emission scope (TTW vs WTW), air-pollutant targets.

Nature of EU policy intervention

EU measures affecting IWT:

- focus primarily on fuel suppliers, infrastructure, reporting and finance, not on vessel operators;
- are mostly indirect, relying on pricing signals (ETS-2), fuel mandates (RED-III) and transparency (CSRD, CountEmissionsEU);
- contrast strongly with road transport and large seagoing vessels (> 5000 GT), where direct obligations exist.

Key gaps and risks

- Strong dependence on Member State implementation, leading to uneven ambition, risk of bunker tourism, loss of level playing field along TEN-T corridors.
- Mismatch between TTW-based ETS and WTW-based RED-III, creating incoherent incentives.
- Regulatory bottlenecks (NRMM, ES-TRIN) delaying hydrogen and methanol uptake.
- Persistent TCO gap, especially on OPEX, despite CAPEX support.

Main IWT policy conclusions from D1.3

- Member States are the decisive actors for success or failure.
- Coordinated ETS-2 opt-in and harmonised RED-III implementation are critical.
- A technology-neutral, multi-pathway approach is essential.
- Internalisation of external costs + energy efficiency measures are prerequisites for market uptake.



Coastal Shipping: Policy conclusions from D1.3

Dominant role of IMO, limited EU reach

- IMO provides the primary binding framework, with net-zero GHG ambitions and strong efficiency regulation.
- EU instruments (ETS, FuelEU Maritime) apply only to vessels >5,000 GT, while most coastal vessels fall below this threshold.

Structural coverage gap

- A large share of coastal shipping lacks carbon pricing or fuel intensity obligations, weakening decarbonisation incentives.
- National policies for coastal shipping are fragmented and often underdeveloped, with few concrete implementation plans. In specific, policies targeting retrofit of ships are lacking.
- Renewable fuel availability constraints make efficiency, OPS and hybridisation indispensable, not optional.

Forward-looking signals

- Expansion of MRV to ≥ 400 GT vessels suggests future tightening.
- Possible extension of ETS and FuelEU Maritime to smaller vessels is identified as a key missing lever.
- Ports and Onshore Power Supply (OPS) policy already provide local air-quality benefits, even where climate impact is limited.

Main coastal shipping policy conclusions from D1.3

- There is a clear mismatch between climate ambition and regulatory coverage.
- Inclusion of smaller coastal vessels in ETS/FuelEU Maritime is critical for effectiveness.
- Without stronger EU-level action, coastal shipping risks lagging behind other transport modes.

Overall cross-modal conclusions from D1.3

- EU policy is strong on system instruments, but weak on vessel-level obligations for IWT and coastal shipping.
- Fragmented national implementation is the main systemic risk.
- Energy efficiency and demand reduction are as important as fuel switching.
- Alignment between EU, Member States and non-EU corridor countries is crucial.

1.4 About this deliverable

As the Task 1.3 / D1.3 report was made early 2025, an update was provided to provide the latest insights on the regulatory framework. The results are presented in chapter 2. Next, chapter 3 presents the specific findings for inland waterway transport, based on the results on the work on technology pathways from Task 5.2 / D5.2 and related work done in PLATINA4Action and the viewpoints from the key stakeholders in IWT. Subsequently, chapter 4 presents the findings for coastal shipping regarding the pathways.

Next, chapter 5 presents the policy roadmap for IWT and chapter 6 presents the policy roadmap for coastal shipping. Chapter 7 presents the overall conclusions from this report. Annexes are provided as well to provide the more detailed TCO results for the coastal vessels and further information on the stakeholder perspectives in the IWT sector serving as foundation and input for the policy roadmap for IWT.



2. Updated regulatory and policy framework

2.1 General developments

Since the writing and publication of the deliverable D1.3 early 2025, the European regulatory and policy landscape has continued to evolve. Accordingly, this section provides a refreshed overview of the most relevant developments.

One of the main developments concerns the ongoing implementation of the Renewable Energy Directive (RED III)² in Member States of the European Union. This implementation strengthens binding targets for renewable energy use across sectors, including transport. Member States are currently translating these requirements into national legislation, with a stronger emphasis on advanced biofuels and renewable fuels of non-biological origin (RFNBOs).

Another notable development is the implementation of the new Emissions Trading System for buildings and road transport (ETS-2). Originally planned for an earlier start, its implementation has now been postponed to 2028, allowing additional time for market preparation and the establishment of accompanying social measures.

The revision of the Energy Taxation Directive (ETD)³ remains under negotiation. While progress has been made, agreement among Member States is still pending, particularly regarding the alignment of minimum tax rates with climate objectives and the removal of outdated exemptions for fossil fuels.

The European Commission's Omnibus initiatives (EC Omnibus) have introduced efforts to streamline regulatory requirements, reduce administrative burdens, and improve coherence across existing legislative frameworks. These changes are expected to affect compliance processes and reporting obligations for industry stakeholders. This led to a reduction in the reporting requirements for the Scope 3 emissions which would cover hired transport services. Therefore, the low carbon performance of IWT compared to other modes is now less obvious and transparent for clients because of reduced reporting requirements.

In parallel, several new policy initiatives have emerged. The Sustainable Transport Investment Plan⁴ (STIP) aims to mobilize public and private financing to accelerate the transition to low- and zero-emission transport systems. The Industrial Maritime Strategy focuses on strengthening the competitiveness and sustainability of Europe's maritime sector, including the uptake of clean fuels and digital technologies. Additionally, the Port Strategy does address the role of ports as energy hubs, facilitating the import, production, and distribution of alternative fuels.⁵

Together, the STIP and the new Strategies illustrate a continued shift toward a more integrated and ambitious policy framework, supporting the EU's long-term climate neutrality objectives while addressing industrial competitiveness and energy security.

The following specifications are provided regarding STIP and the two strategies regarding the relevance for IWT and coastal vessels.

² [Directive - EU - 2023/2413 - EN - RED III - EUR-Lex](#)

³ [Revision Energy Taxation Directive - Taxation and Customs Union](#)

⁴ https://transport.ec.europa.eu/transport-themes/clean-transport/sustainable-transport-investment-plan_en

⁵ See for more information on both strategies (industrial maritime and ports): [EU ports and industrial maritime strategies - Mobility and Transport](#)



2.2 EU Sustainable Transport Investment Plan

The STIP sets out how the EU will scale up renewable and low-carbon fuels, primarily for aviation and waterborne transport, to meet 2030–2050 climate targets. It focuses on investment needs, market failures, and EU / Member State support instruments needed to make these fuels commercially viable. Cross-cutting elements relevant to both IWT and coastal shipping are the following:

- Strong emphasis on fuel-side support, not fleet renewal. Heavy reliance on: Innovation Fund, InvestEU and ETS revenues
- Planned double-sided auctions to bridge the price gap between fossil and renewable fuels
- Concern over: biomass scarcity, hydrogen availability as well as administrative burden and certification (Union Database)

STIP and IWT

Key elements relevant for Inland Waterway Transport (IWT) in the STIP are the following:

- IWT is explicitly covered under waterborne transport, but does not have binding FuelEU Maritime (FEUM) targets comparable to maritime shipping.
- The sector is characterised by: Very slow fleet renewal (only ~15–20% by 2050), high reliance on diesel: at least 90% of vessels expected to still use diesel without additional measures.
- The document clearly positions renewable drop-in fuels as the primary realistic option for IWT in the medium to long term, due to: Long asset lifetimes, Limited retrofitting possibilities and Absence of fuel-specific mandates
- Relevant fuels mentioned are Hydrotreated vegetable oil (HVO), Biodiesel, Renewable diesel and in the longer term e-diesel and e-fuels. Investment focus is fuel production, not vessels or onboard technology.

The Commission announces a dedicated study in 2026 to: Assess IWT decarbonisation barriers and identify possible regulatory changes to support uptake of alternative fuels. This is the only forward-looking regulatory action specific to IWT in the document. This action is being executed by the PLATINA4Action project over summer 2026 with results expected in November 2026.

Key takeaway for IWT

STIP treats IWT as a hard-to-abate, legacy fleet sector, where drop-in renewable fuels combined with fuel-side support mechanisms (rather than mandates) are the main decarbonisation lever in the coming decades.

STIP and Coastal Shipping

Key elements relevant for coastal and short-sea shipping are the following:

- Coastal and short-sea shipping falls under FuelEU Maritime (FEUM) if the vessel size is above 5000 GT. This gives a GHG intensity reduction target: 14.5% by 2035 and 80% by 2050. It needs to be noted that FEUM drives demand rather than prescribing specific fuels.
 - The document explicitly differentiates coastal/short-sea ships from ocean-going vessels: Small and medium ports / vessels. Options are mentioned such as electric or hybrid propulsion. Furthermore: bio-diesel today, e-diesel as option for the future.

A broader fuel basket is supported: Bio-methane (LBM), e-methane, Biodiesel, e-methanol, LNG as a transitional fuel (provided methane slip is mitigated) and wind-assisted propulsion as a complementary option.

By 2035, roughly 11.3 million tons of oil equivalent (Mtoe) of Sustainable Maritime Fuels (SMF) are needed under FEUM. The current investment levels are insufficient, especially for e-SMF, driven by feedstock constraints, hydrogen cost and lack of final investment decisions.



The document mentions an estimated required investment by 2035 of EUR 34.7–46.7 billion for bio-SMF and e-SMF production. The focus again is on fuel production, not on ships or port infrastructure.

A reference is made to the EU Ports Strategy which supports ports as energy hub and will facilitate the availability of SMF (not all fuels in all ports). Tradable certificates and book-and-claim systems for SMF are explicitly considered.

Key takeaway for coastal shipping

STIP clearly sees coastal shipping as a core demand driver for SMF, supported by FEUM, with a wide technology mix and strong reliance on EU-level investment de-risking mechanisms. However, it is only valid for vessel with GT above 5000.

2.3 EU Industrial Maritime Strategy

The Communication sets out a **six-pillar EU Industrial Maritime Strategy** to:

- Strengthen Europe’s maritime manufacturing and shipping competitiveness
- Drive decarbonisation, digitalisation and security
- Safeguard strategic autonomy and resilient value chains across maritime, coastal and inland waterborne transport.

IWT is positioned as a core pillar of Europe’s clean, resilient and multimodal transport system, with strong emphasis on increasing the rate of fleet renewal and retrofits, zero-emission technologies, inland ports and dedicated funding frameworks.

Coastal and short sea shipping are framed as key enablers of decarbonised intra EU freight and passenger transport, with concrete support through fleet renewal, green lanes, electrification, simplified procedures and targeted funding.

Key elements relevant for Inland Waterway Transport (IWT)

1. IWT explicitly recognised as a strategic segment

- Europe has 42,000 km of inland waterways and around 12,000 inland navigation vessels, forming a substantial and essential part of the EU’s strategic waterborne transport system serving a wide range of industries and communities in Europe.
- IWT vessels are repeatedly mentioned alongside ferries as strategic assets for safety of supply, military mobility and industrial resilience.

2. Fleet renewal, retrofitting and zero-emission transition

- Between 2020–2050, around two-thirds of the IWT fleet are expected to undergo retrofitting and one-third will be newly built (≈140 vessels/year). There is a strong policy emphasis on zero- and low-emission inland vessels as well as retrofitting as a core market for EU shipyards and equipment suppliers.

3. Follow-up to NAIADES III

- The Commission announces a follow-up programme to NAIADES III to improve IWT competitiveness, modernise inland ports, strengthen infrastructure resilience and to accelerate uptake of automation and zero-/low-emission technologies.

4. Targeted regulatory and R&I actions for IWT

- Planned amendment to the Non-Road Mobile Machinery Regulation to allow hydrogen as a reference fuel for inland navigation engines, removing a regulatory barrier for zero-emission IWT (note: for methanol the process will take longer).



- Continued and expanded Horizon Europe / ZEWT Partnership support for inland waterway technologies (decarbonisation, automation, digitalisation).

5. Dedicated financing opportunities

- IWT is explicitly mentioned as eligible for fleet renewal aid under Future Land and Multimodal Transport Guidelines (LMTG), the New Transport Block Exemption Regulation (TBER)⁶ and ETS revenue re-investing by Member States for maritime decarbonisation.

Key elements relevant for Coastal / Short Sea Shipping

1. Strategic role in EU connectivity and cohesion

- Maritime transport carries 30% of intra-EU freight, with short sea and coastal shipping explicitly highlighted as essential for territorial cohesion, island and peripheral region connectivity as well as modal shift away from road.

2. Decarbonisation measures directly affecting coastal shipping

- Coastal and short-sea segments are prioritised for FuelEU Maritime, inclusion in EU ETS, direct electrification (electric ferries, OPS) and uptake of renewable and low-carbon fuels.
- Creation of European green shipping lanes and hubs, highly relevant for short-sea and regional routes.

3. Fleet renewal and ferry focus

- Ferries and coastal vessels are explicitly prioritised for public procurement pipelines, CEF funding (2026 call) for fleet renewal and decarbonisation, dual-use ferry construction support mechanism (civil + military mobility).

4. Administrative simplification for short sea shipping

- Recognition that administrative burden disproportionately affects the smaller short sea shipping companies compared to larger deep sea shipping entities, due to less personnel capacity and financial means.
- Measures include:
 - Full implementation of the European Maritime Single Window (EMSW)
 - Simplification and reduction of reporting data requirements
 - Interconnection with the future EU Customs Data Hub.

5. Ports and coastal infrastructure

- Coastal shipping benefits indirectly from the EU Ports Strategy⁷, investments in onshore power supply, as well as electrification and grid connections in ports.

⁶ [LMTG and TBER - Competition Policy - European Commission](#)

⁷ [EU ports and industrial maritime strategies - Mobility and Transport](#)



2.4 EU Port Strategy

The Port Strategy sets out a comprehensive framework to future-proof EU ports as competitive, secure, sustainable and resilient transport and energy hubs. It responds to geopolitical pressure, decarbonisation needs, congestion, digital vulnerabilities and investment gaps.

The strategy is structured around **five pillars**:

1. **Competitiveness, innovation & digitalisation**
– strengthen hinterland connections, deploy innovation beyond pilots, improve data sharing, ensure fair competition and protect against high-risk foreign influence.
2. **Energy transition, sustainability & clean industries**
– electrification (OPS), alternative fuels, grid connections, ports as energy and industrial hubs, faster permitting.
3. **Protection, security & resilience**
– address organised crime, cyber threats, hybrid threats, climate risks; extend security measures to inland ports.
4. **Access to finance & investment**
– targeted EU funding (CEF, ETS revenues, EIB, future ECF), with strong focus on public value and small/medium ports.
5. **Social cohesion, skills & quality jobs**
– workforce skills, port-city relations, support for smaller ports, safe handling of alternative fuels.

Ports are explicitly framed as **multimodal nodes, energy hubs, and critical infrastructure**, not just maritime assets.

The strategy strongly reinforces IWT as a structural solution for modal shift, a resilience and security asset and a policy priority post-2027 via a dedicated IWT Action Plan (Annex 2).

The strategy positions short sea shipping as a backbone of sustainable EU maritime logistics, tightly linked to port electrification, alternative fuels and port collaboration with strong policy and funding backing, notably for smaller coastal ports.

Key elements relevant for Inland Waterway Transport (IWT) from the Ports Strategy

Strategic recognition of inland ports and IWT

- Inland ports are explicitly included throughout the strategy as part of the EU port system and TEN-T (223 inland ports).
- Inland ports are recognised as essential for modal shift, resilience, military mobility and supply chains.

Hinterland connectivity & modal shift (core relevance)

- Inefficient rail and inland waterway connections are explicitly identified as a major cause of congestion and inefficiency in ports.
- The strategy calls for higher priority to inland waterways in hinterland connectivity, both by Member States and port authorities.
- Port concessions and land-use planning should allow flexibility to expand inland connectivity.

European Maritime Space & policy follow-up

- The upcoming European Maritime Space (EMS) work plan will:
 - Promote integration with rail and inland waterway transport



- Focus on smaller ports, including inland ports
- Upgrade infrastructure to enable multimodal flows
- The Commission will propose an Action Plan on IWT for 2028-2034, with a specific focus on inland ports.

Security & resilience extended to inland ports

- Security measures (anti-crime, drug trafficking, background checks, cyber) will be explicitly extended to inland ports, including those not covered by the ISPS Code. [\]](#)
- Inland waterways are included in resilience planning, with a target of achieving “Good Navigation Status” by 2030.

Funding opportunities

- Inland ports are eligible under: CEF / future CEF3 (multimodal, rail–IWT interfaces), ETS revenues for decarbonisation, EIB financing and advisory (explicitly mentioned for inland ports)

Key elements relevant for Coastal / Short Sea Shipping from the Ports Strategy

Short sea shipping as a competitiveness tool

- Short sea shipping is positioned as a core instrument to relieve congestion, improve resilience, and support EU trade, especially intra-EU and Mediterranean flows.
- The EMS work plan will prioritise sustainable and green short sea shipping hubs and links.

Focus on smaller and coastal ports

- Special emphasis is placed on small and medium-sized coastal ports and ports in islands, outermost and remote regions
- These ports are key nodes for short sea shipping, passengers, energy and regional cohesion.

Energy transition & fuels (very relevant)

- Coastal ports are central to OPS deployment and alternative fuel bunkering (RFNBOs, biofuels, low-carbon fuels)
- AFIR revision, FuelEU Maritime and ETS revenues are explicitly aligned to support shipping decarbonisation via ports.

Port-to-port collaboration

- The strategy promotes collaboration between ports, especially for short sea shipping corridors, green shipping hubs and replication of solutions across smaller ports

Resilience and climate adaptation

- Coastal ports are highlighted as particularly exposed to climate risks (storms, sea level rise, salinity).
- Ports are encouraged to develop climate resilience plans, relevant for coastal and short sea hubs.

Funding

- Coastal/short sea projects are prioritised under CEF (including a 2026 OPS call), ETS revenues for maritime decarbonisation and Cohesion policy for islands and coastal regions



2.5 Technical regulations

In the SYNERGETICS project, important deliverables have been designed to support vessel owners in navigating the regulatory framework to obtain approval for alternative propulsion options:

- SYNERGETICS D4.6 Model for a standardised procedure for regulatory approval of greening retrofit solutions the catalogue of greening retrofit solutions examines the current and emerging legal framework governing greening retrofit solutions for inland navigation vessels and coastal ships within the EU. There was a particular focus on regulatory barriers slowing the adoption of zero-emission technologies such as methanol and hydrogen. It reviews the key EU, CCNR, CESNI, and IMO regulations that apply to inland and coastal shipping, highlighting that while some provisions for alternative fuels already exist, detailed and harmonised rules remain limited. As a result, many projects still depend on interim guidelines, exemptions, and case-by-case approvals, creating legal uncertainty and lengthy administrative procedures. Additional challenges include fragmented national approaches, strict testing requirements, and insufficient alternative fuel infrastructure. The report concludes that accelerating the transition to zero-emission shipping requires stronger regulatory alignment, simplified approval procedures, and coordinated infrastructure development across Europe.
- SYNERGETICS D5.4: The Handbook provides practical guidance for inland waterway and coastal vessel owners and operators on selecting and implementing retrofit solutions to reduce emissions and support decarbonisation. Building on the technical, regulatory and economic findings of the SYNERGETICS project, it explains the regulatory requirements, operational implications and economic feasibility of a wide range of retrofit technologies and fuels, including HVO and other low-carbon fuels, battery-electric and hybrid propulsion, methanol and hydrogen systems, LNG/Bio-LNG solutions, engine renewals, exhaust after-treatment technologies, and energy-efficiency measures. The Handbook distinguishes clearly between inland and coastal shipping due to their differing regulatory frameworks and operational conditions, while also introducing “fleet families” to provide vessel-specific guidance. It concludes that no single solution fits all vessel types.

The reports can be downloaded from the website of SYNERGETICS:
[SYNERGETICS Project EU | Synergies Green Transformation](#)



3. Insights from pathways and assessments for IWT

The SYNERGETICS project showed that the pathways for IWT will depend heavily on policy interventions if the emission targets need to be achieved. The results as presented in SYNERGETICS D5.2 point towards a very significant difference when assuming higher internalisation of CO₂e costs while at the same time making available grant schemes for the acceleration in the uptake of technologies and renewable energy carriers which drastically reduce the emissions to air by IWT.

In PLATINA4Action⁸ Deliverable 4.2 the Decision Support Tool of SYNERGETICS (result of Task 5.1) was applied to make further economic assessments for different energy carriers and technologies at different scenarios. The scenarios varied between the energy price scenarios (STEPS and NZE) and between assumptions for the level of grant schemes to be available to reduce the capital investment barrier. The economic assessment was performed for different representative vessel types, to provide a broader picture on the situation.

3.1 Updated pathways from SYNERGETICS

The analysis of fuel transition pathways for inland waterway transport was conducted using a combination of scenario-based modelling and a structured assessment of economic, technological, and operational factors. The Stated Policies Scenario (STEPS) and Net Zero Emissions Scenario (NZE) of IEA's World Energy Outlook 2024 served as the primary frameworks to evaluate how cost competitiveness, fuel availability, and **policy measures such as CO₂ cost internalisation** influence the adoption of renewable energy.

First, the two scenarios were simulated using the model from the NEEDS⁹ project: In the STEPS scenario simulation, which assumes maximum fossil fuel and minimum renewable fuel costs, alternative fuels initially struggle to compete with conventional options like fossil diesel and LNG. Only smaller vessels operating on shorter routes, such as motor vessels and motor tankers, adopt electricity early due to its relatively low operational expenditures (OPEX) and relatively low capital expenditures (CAPEX). For the broader fleet, the transition to biofuels, such as bio-LNG, occurs only when these alternatives become cheaper and more widely accepted. The model simplifies the transition process by allowing ships to switch fuels immediately when cost-competitive options are available at ports. However, in reality, supply and demand market dynamics would result in a more gradual shift. Despite these limitations, the STEPS scenario demonstrates that the fleet largely relies on conventional alternatives, including LNG, battery-electric systems, and biofuels, with transitions primarily driven by energy price fluctuations.

In contrast, the NZE scenario reflects a more accelerated shift toward low-carbon alternatives. Rising fossil fuel costs because of higher internalised CO₂e costs, lower priced renewable energy options and improved readiness levels (TRL, SRL, and port availability) drive the early adoption of biofuels as transitional solutions. Battery-electric systems gain significant traction, increasing their share in the fleet from 27 % to 50 %, particularly for fixed- and short-route vessels. However, the inclusion of batteries reduces payload and autonomy, necessitating a 13 % increase in the inland fleet size to maintain cargo capacity. The model prioritizes battery swapping due to its lower CAPEX, though real-world regulations, such as ADN legislation, would likely favour on-board battery charging for motor tankers or more renewable fuel such as methanol and HVO. Dual-fuel methanol engines are expected to play a significant role, replacing LNG and HVO for 40 % of the fleet, particularly in coupled convoys, push boats, and long-route motor vessels. The methanol ICE option offers acceptable energy density at lower costs compared to battery and hydrogen options. Despite improvements in technology readiness, hydrogen

⁸ See: https://platina4action.iwtprojects.eu/wp-content/uploads/2026/04/260331_PLATINA4Action_D4.2_TCO-and-economic-scenario-analysis.pdf

⁹ <https://needs.application.marin.nl/dashboard>



applications and renewable electricity for charging remain economically unviable due to their high OPEX and CAPEX, highlighting the critical role of cost competitiveness in renewable energy fuel adoption.

The internalization of CO₂ costs further influences the transition dynamics. In the STEPS scenario, fossil fuels remain cost-competitive for a longer period, delaying the shift to renewable energy options. In the NZE scenario, higher fossil fuel prices, driven by carbon pricing, accelerate the adoption of biofuels and electricity. However, on average, hydrogen remains economically unattractive without further cost reductions, underscoring that while CO₂ cost internalization shifts the cost balance in favour of low-carbon alternatives, economic viability remains the decisive factor for adoption. A low price of green hydrogen will be crucial for the viability of this option compared to the other options such as battery-electric sailing and usage of renewable or e-diesel and methanol.

To assess the sensitivity of fuel adoption to price volatility, the simulation analysed minimum and maximum cost scenarios for diesel, LNG, and alternative fuels. Under the minimum conventional – maximum alternative cost combination, only biofuel versions of conventional fuels (e.g., bio-LNG, HVO) and a 25 % share of battery-electric vessels are adopted, highlighting the limited attractiveness of alternatives under high-cost conditions. Conversely, the maximum conventional – minimum alternative cost combination delays the uptake of biofuels despite the introduction of dual-fuel methanol, emphasizing the importance of transitional fuels in bridging the gap between fossil and low-carbon alternatives.

The role of CAPEX subsidies was also investigated, particularly in scenarios with minimum conventional and maximum alternative fuel costs. In the STEPS scenario, a 60 % CAPEX subsidy had almost no noticeable impact, as cost competitiveness remained dominated by OPEX. However, in the NZE scenario, the subsidy accelerated the adoption of capital-intensive alternatives such as fixed batteries, reduced the use of HVO, and increased the uptake of hydrogen, methanol, and electricity. Under extreme conditions, where both fuel costs and CAPEX were reduced, the share of HVO dropped to approximately 7 % by 2050. Nevertheless, even with a 60 % CAPEX reduction, options like hydrogen applications remained economically unviable at averaged prices for hydrogen as fuel due to high OPEX. This demonstrates that CAPEX subsidies alone are insufficient to drive significant adoption of hydrogen solutions. Effective subsidy schemes would address both CAPEX and OPEX to stimulate uptake, targeting specific alternative fuels and ensuring economic viability across the value chain.

After analysing the results of the NEEDS model and the CCNR pathways (BAU, Conservative and Innovative) for the STEPS and NZE scenarios, a SYNERGETICS Expert scenario was developed. This Expert Scenario incorporated the lessons learned and findings from the CCNR study, the NEEDS model, and recent sector developments. Here the newly developed SYNFEED model from WP4 was used for calculation (description in D5.2).

Unlike in the CCNR study from 2020, the SYNERGETICS Expert Scenario does not aim to meet specific emission targets in a certain year. Instead, it does focus on achieving favourable outcomes in terms of emissions and costs under optimistic boundary conditions. Similar to runs with the NEEDS model, a 60 % CAPEX subsidy is assumed, linked to the revenues from CO₂e costs internalisation. This package strongly incentivises shipowners to adopt alternative propulsion systems.

Moreover, the SYNERGETICS Expert Scenario anticipates a 30 % reduction in component costs for alternative propulsion technologies by 2050. In the simulation STEPS scenario was used to apply energy price developments, assuming a positive trend for renewable energy prices while fossil fuel prices continue to rise because of internalising CO₂e costs, which accelerates the transition over time. Improvements in energy efficiency, driven by both technical advancements and operational measures, are expected to result in a 30% increase in efficiency by 2050. However, if these assumptions are not fully met, the likelihood of achieving the calculated emission reductions in the SYNERGETICS scenario decreases significantly, potentially rendering it infeasible.

3.2 Zero-emission breakthrough assessment by PLATINA4Action

Introduction and approach

The Deliverable D4.2 of the PLATINA4Action project analysed the economic feasibility of selected propulsion technologies which lead to a (near) zero-emission performance by inland waterway transport (IWT). It also presents the potential, i.e. impact on modal share and savings of external costs. Deliverable¹⁰ D4.3 focussed on the barriers and opportunities, not only looking at the economics (based on D4.2) but also on other barriers.

Using SYNERGETICS Total Cost of Ownership (TCO) models from Task 5.1 for multiple vessel types, operational profiles, energy price scenarios and policy contexts, the report assesses the conditions under which zero-emission solutions can become competitive with conventional diesel propulsion. Particular attention is given to sensitivity factors, critical cost drivers, benefits and potential of breakthrough and policy intervention scenarios and the scale of financial resources required to enable market uptake. For the approximate impact on modal share and external costs, the Digital Twin instrument is applied, which was developed in WP2 of PLATINA4Action.

The models understandably assume a relatively stable macroeconomic environment for the technological transition and address uncertainty primarily through price sensitivity as well as technological, market, and financing uncertainties. However, in the period of finalising this report, the conflict between USA, Israel and Iran caused a surge in energy prices. Geo-political events and shifts may have impact on the scenarios. It therefore needs to be remarked that there can be significant positive or negative exogenous shocks which are inherently difficult to model but cannot be ignored and may materially influence transition pathways despite being outside the modelling scope.

Technologies and analytical framework

The analysis covers a representative set of zero-emission and low-emission technologies that are expected to be -ready for use from 2027 onwards and compatible with EU policy frameworks and funding instruments (notably the Innovation Fund). These include:

- battery-electric propulsion (fixed batteries and swappable batteries under pay-per-use models),
- hydrogen fuel cells
- clean combustion engines (ICE) running on renewable hydrogen
- clean combustion engines (ICE) running on renewable methanol
- clean combustion engines (ICE) running on renewable methane

A propulsion system with a Stage V diesel engine (with fossil diesel and HVO100) is used as the reference technology.

For combustion engines using hydrogen and methanol however, the EU NRMM regulation is yet a bottleneck. It needs to be seen if the methanol ICE option is realistic to assume already in 2027. However, in The Netherlands large grants are being provided to engine manufacturer to support the testing and certification process (using article 34 or 35 of the regulation for exemptions). There is a big interest from engine suppliers to use the grant scheme which may speed-up the commercial availability of these engines.

In D4.3 it is concluded that the technological pathways for IWT decarbonisation have reached high levels of maturity. Technology Readiness Levels (TRL) for most solutions are at TRL 8-9, indicating that the primary barriers are no longer strictly technological but rather systemic and operational.

¹⁰ See PLATINA4Action Report D4.3: https://platina4action.iwtprojects.eu/wp-content/uploads/2026/04/260331_PLATINA4Action_D4.3_Requirements-barriers-and-opportunities-for-industry-report.pdf



Zero-Emission Tailpipe Solutions

- Battery-electric propulsion: High efficiency (85-95%), viable through fixed systems (short-range ferries) or swappable containers (Energy-as-a-Service / Pay-per-use model)/ Yet they are costly but strong cost decreases are expected over time as well as increase of energy storage capacity per m3.
- Hydrogen Fuel Cell (H2FC): Validated for energy-intensive long-haul operations. Offers extended range but introduces complexity in storage and safety but is relatively costly.

Transitional ICE Solutions

- Hydrogen ICE: Lower capital intensity than fuel cells but hydrogen is yet not acknowledged as reference fuel for certification of combustion engines (but this will be solved soon). Hydrogen ICE is generally expected to be more cost competitive to reduce emissions compared to H2FC. There is however a lower energy efficiency of the powertrain which would be a disadvantage with high hydrogen prices. Furthermore, the storage of hydrogen takes relatively much space on board.
- Methanol ICE: Usage of methanol as fuel for combustion engines faces severe regulatory hurdles under NRMM regulations due to concerns about formaldehyde emissions. This needs an impact assessment before the legal barrier can be removed, expected to be supported by evidence gained from the Dutch subsidy scheme for testing and certification of these engines. Green methanol could be available at relatively low prices and methanol is relatively easy to store on board, although it requires twice the space compared to diesel. Methanol is an interesting option to be considered.
- HVO (Hydrotreated Vegetable Oil): In contrast to FAME, pure HVO (HVO100) is seen as a mature "drop-in" solution requiring no modification or operational constraints, delivering up to 90% well-to-wake CO₂ reduction. Combined with modern Stage V engines, usage of HVO100 is probably the most cost-effective solution to drastically reduce emissions on the short term. It is however exposed to feedstock availability risks. Therefore, more expensive synthetic e-diesel could be needed to supply the market with sufficient renewable drop-in fuel, which may make HVO on the medium and longer term more expensive than other options. The superior energy density is a benefit, especially for vessels which require a large autonomy.
- Methane ICE: Although the LNG breakthrough in IWT didn't materialise as expected in IWT, the technology is mature, Stage V engines for methane are available and all technical regulations are in place for the vessels for liquid methane (cryogenic storage). Bio-LNG can be used as drop-in fuel for fossil LNG. It can therefore be an effective option to reduce greenhouse gas emissions. The capital cost investment is however higher compared to Stage V diesel, mainly due to the cryogenic equipment. There is however a relatively large uncertainty regarding the price of Bio-LNG (or e-methane on longer term).

It is relevant to mention that for the short term, it is expected that the market will use blends of fossil fuels with renewable drop-in fuels. These can be blends with FAME (known as "B7" or "B20") or HVO (for example "HVO30"). These fuels can be offered to the market to reduce the carbon intensity (grams CO₂e per MJ on well-to-wake basis) and to fulfil the requirements from RED-III legislation. However, although generally lower in price, the use of high blends of FAME is seen as unfeasible for the medium and longer term, because of the limitations with the shelf life and the damage seen to after treatment systems (SCR). SCR is commonly used in modern Stage V engines to mitigate the emissions of nitrogen oxides (NOx). Therefore, FAME is left out of scope as solution for the further future in the pathways.

HVO100 however, is seen as the renewable drop-in fuel for Stage V engines. HVO100 has no problems with shelf life or damage to Stage V engines and can therefore be seen as a renewable drop-in fuel for modern Stage V engines, reducing both the climate change emissions and air pollutant emissions at the same time. And, in order to have HVO as a scalable option, the HVO molecules can also be made in a synthetic way using green hydrogen and carbon capture and the price bandwidth applied does include the possibility of e-diesel or e-HVO as drop-in solution.

Despite technological feasibility, the economic analysis reveals a structural deficit in the business case for (near) zero emission vessels under current market conditions. This was shown in PLATINA4Action



Deliverable 4.2. It is recommended to read this report as the economic feasibility is a crucial element for zero-emission breakthrough. This "Green Premium" manifests in both CAPEX and OPEX.

In PLATINA4Action Deliverable D4.2, TCO calculations are performed for newbuild vessels deployed from 2028 with a 20-year lifetime, across different vessel archetypes (dry cargo vessels, pushers and tankers). This includes also replacement/overhaul of battery cells and fuel cell components. These are covered as 'maintenance costs' in the TCO for these technologies.

Energy price assumptions are derived from the International Energy Agency's World Energy Outlook scenarios: the STEPS as baseline and the NZE representing a much more stringent and ambitious policy package to limit the global warming to 1.5 degrees Celsius. Policy options take into account internalisation of CO₂ costs and the availability of public grant support for capital expenditures (CAPEX). Also, in the baseline scenario (STEPS) there is already a level of CO₂ costs internalisation included.

Sensitivity and critical factors

Energy prices and CO₂ cost internalisation

After analysing the cost structure and the results for different scenario settings, it turns out that the most influential sensitivity factor is the evolution of energy prices. In particular, the fossil diesel price under increasing CO₂ cost internalisation can make a big difference to close the gap with using renewable energy solutions. Under STEPS, diesel prices already are expected to rise substantially over time due to the impact of policies such as ETS, RED III and related measures. Here it needs to be noted that in this analyses it is assumed that the implementation of ETS-2 opt-in and RED-III will be successful and effective, meaning that several (neighbouring) countries with substantial fuel supply to IWT will also implement the RED III and will also apply the opt-in for ETS-2. This is however yet to be seen as at the moment, only The Netherlands plan to implement ETS-2 also for fuel supply to IWT.

As a result of ETS-2 and RED III, the gap between operational costs of using fossil diesel costs compared with the operational costs for using renewable energy closes over time. Under NZE, this effect is significantly stronger, making several zero-emission solutions operationally competitive or even favourable within a shorter time frame.

Other conclusions are that zero-emission technologies with high energy efficiency, notably battery-electric propulsion, show strong sensitivity to electricity prices and recharging regimes. The pay-per-use option with swappable containers could be more competitive, but it depends also on the operational profile. If time needed for the recharging a fixed battery configuration leads to loss of productivity the fixed battery option will be less competitive. Moreover, the price of recharging from shore is an important element. Furthermore, hydrogen-based solutions remain highly sensitive to hydrogen price assumptions regarding the pace at which large-scale green hydrogen production reduces costs. It needs to be noted that the uncertainty of prices is quite large, especially for green hydrogen.

Capital expenditure (CAPEX)

CAPEX is a decisive break-or-make factor for zero-emission uptake. The initial investment costs for (near) zero-emission systems can be up to 6 times higher than for a conventional Stage V diesel system, depending on technology. Relatively modest capital costs are required for an electric propelled vessel using the swappable battery containers. Hydrogen fuel cell systems are consistently the most capital-intensive option.

Cost reduction trajectories for batteries, fuel cells and electric components materially affect long-term competitiveness. However, even with optimistic learning curves, high upfront investment remains a major barrier for the predominantly small and medium-sized companies active in inland navigation.

Operational impacts: downtime, payload and bunkering time

In some cases, such as the pusher of a large convoy, the required autonomy in combination with the power demand is too high to make it possible to store the required energy on board. This is in particular the case for application of battery-electric propulsion and also for using hydrogen as fuel. This is because of the relatively low energy density when storing the energy on board of vessels. Therefore, green



methanol and methane with clean combustion engines are in-scope of zero-emission solutions for these types of vessels and operational profiles.

Beyond energy and CAPEX, operational factors can significantly affect TCO outcomes. Zero-emission solutions often entail longer bunkering or charging times, additional downtime during retrofit or installation, and loss of cargo capacity due to energy storage systems. These impacts are particularly relevant for fixed-battery systems and hydrogen storage. Swappable battery and tanktainer concepts mitigate some of these effects and therefore show more robust economic performance. An issue for the very short term is the reliability of innovative / experimental systems. However, in this report, it is assumed to start with using technologies in 2028 and the reliability is at the same level compared to using diesel as fuel. This may however be optimistic, seen the slow progress with pilot vessels in this area. For example the roll-out using ZES battery packs goes much slower than expected and also the recent bankruptcy seen with pioneering company Future Proof Shipping with respect to hydrogen fuel cell application is a signal that it is difficult to get and keep pilot vessels active in operational environments.

Scenarios for policy intervention and investment support

The calculations made in PLATINA4Action D4.2 show that for the year 2028, (near) zero-emission solutions are generally not cost-competitive with fossil diesel under STEPS assumptions. This while the STEPS scenario already includes (first) impacts of ETS-2 and RED-III by 2028 in terms of increased fuel cost due to carbon pricing, following the decision making in The Netherlands. So even with some carbon pricing being included in the price prediction of fossil diesel, zero-emission alternative fuels show no competitiveness with fossil diesel. However, over the full 2028–2048 period, HVO100 becomes competitive or favourable due to rising diesel prices and phasing out sales of fossil diesel by 2044 (effect of ETS2). But it is clear from the calculations that most zero-emission options retain a cost gap without additional support. It needs to be noted however, that measures such as RED-III will require a minimum share of renewable energy to be used in transport. This means that fuel suppliers will be obliged to sell a certain amount of renewable fuels in order to meet their targets. This is at least foreseen also for fuel supply to IWT in The Netherlands, which compared to other countries in Europe has a quite large share in the overall fuel bunkering market to inland vessels in Europe. It is likely that this will mainly be achieved towards 2030 by blends of FAME and HVO with fossil diesel, with marginal contributions from using electricity and green hydrogen.

Under the NZE scenario, stringent climate policies and **high internalised CO₂ costs substantially improve the relative economics of zero-emission solutions**. Battery-electric systems with swappable batteries and engines running on renewable methanol approach or achieve TCO parity with fossil diesel, while hydrogen combustion improves but remains borderline, much depending on the hydrogen price. Hydrogen fuel cells remain the least competitive option due to high CAPEX and maintenance costs. In NZE the prices of renewable energy solutions are expected to be lower than in the STEPS scenario. As a result, vessels using renewable energy will be more competitive in the NZE scenario compared to the STEPS scenario. This also explains a positive impact on modal share when selecting the NZE scenario instead of the STEPS scenario.

Investment support through grants

Next to internalising the CO₂ costs in the fossil fuel prices, providing grant support for CAPEX proves to be an effective policy lever. Simulations assuming 60% CAPEX funding, consistent with the upper range of Innovation Fund support, show that:

- Renewable methanol single-fuel engines and battery-electric solutions with swappable batteries can reach TCO parity with fossil diesel even under STEPS scenario conditions for energy prices.
- Fixed-battery systems and hydrogen combustion engines see substantial improvement but may still face gaps depending on energy price assumptions at STEPS.
- Hydrogen fuel cell solutions, while improved, generally remain non-competitive without additional targeted support or further cost reductions.

The results indicate that combining CO₂ cost internalisation with targeted CAPEX grants is critical to accelerate early deployment and to create economies of scale.



Potential for breakthrough and impact of policy interventions

The analyses and calculations on modal share impacts are based on the digital twin modelling instrument. In combination with assumptions as well as scenarios, future development paths are defined. Considering this it needs to be noted, that evaluations based on such modelling need to be seen as indications for impacts to be expected.

The indicative simulations with the Digital Twin show that **modal share increase for IWT is depending significantly on the energy transition policies for IWT**. A positive response is seen when running scenarios which include strong policy measures in the EU to internalise the CO₂e emissions costs and to upscale renewable energy supply, a situation reflected by the NZE scenario. According to the output from the Digital Twin, the modal share of IWT will be significantly higher when applying the NZE scenario compared to the STEPS scenario. This is in particular seen in the results for the container transports market and the market for transportation of liquid bulk cargo.

The underlying reason is that the **prices of renewable energy for IWT are lower in NZE scenario compared to STEPS scenario**. The energy prices can be influenced directly by policy makers by means of internalising CO₂e costs. This was illustrated by simulating the Net Zero Emission scenario according to the International Energy Agency, internalising CO₂e costs up to 880 euro per ton CO₂e by 2050 and more optimistic prices for alternative fuels such as methanol and hydrogen because of supporting mechanisms for production and supply of these renewable fuels.

The simulated policy measure to provide 60% CAPEX support would also give a significant impact on the competitiveness of IWT and thus on the modal share. The indicative calculations of the external costs also point towards a strong socio-economic benefit.

It was seen from the calculations with the Digital Twin that external costs of the mission costs are currently quite large. It makes sense from a socio-economic viewpoint to reduce these costs. In particular also the external costs for air pollution of IWT are still significant today, because not many vessels are yet equipped with modern engines with aftertreatment systems to drastically reduce the NO_x and PM emissions. These returning external cost savings provide a solid argument to spend financial resources for providing CAPEX support to accelerate the uptake of clean technologies. Furthermore, required funds for such CAPEX support schemes can be raised by means of the revenues from CO₂e pricing, such as an ETS-2 applied for fossil fuel sold to inland navigation in the EU.

However, by 2050 all modes are expected to have massively reduced the external costs from climate change and air pollution emissions. But it becomes relevant that other external costs remain, such as cost from noise and congestion and from accidents. Modal shift from road to IWT therefore would still result in less costs for society due to less noise and congestion cost and higher safety levels when using IWT instead of road transport.

The analysis highlights the importance of EU-level instruments such as the ETS, RED-III and the Innovation Fund. It is important to combine these instruments complemented by national grant schemes, to de-risk investments for early movers. As the energy costs take a large share in the TCO, also OPEX support measures may be considered. The Innovation Fund can provide both CAPEX and OPEX support. Revenues from ETS-related mechanisms can be strategically recycled into funding support, aligning climate policy with industrial transition objectives. Without such coordinated financial support, uptake is likely to remain limited to niche cases and pilot projects.

However, when assuming the implementation of RED-III with specific targets for energy supply to IWT, possibly complemented by ETS-2 opt-in, there will be a steady growth in the use of renewable energy across the entire fleet. However, in the early years this will in most cases amount to relatively low percentages of blending FAME or HVO, gradually increasing to 14.5% CO₂ reduction at fleet level by 2030 of 29% share of renewable fuels (including multipliers). This effect of RED-III is still far from fully zero-emission. However, when assuming the ETS-2 opt-in to be applied across Europe, fossil fuel would be phased out by 2045. This corresponds with the STEPS scenario.



Lessons from the frontrunners

A small group of early adopters has already deployed breakthrough concepts, as can be seen in the PLATINA4Action report D4.1. Although the companies benefit from a lot of attention and positive attention and public relations (PR), their experiences generally reveal a distinct "first-mover disadvantage" bearing prototype costs, regulatory uncertainty, and operational inefficiencies. Their experiences serve as a "living lab" that validates technical feasibility and gains in energy efficiency and emissions reduction, while exposing systemic fractures. Beyond the challenges, frontrunners also report positive outcomes: improved corporate image, stronger sustainability credentials, learning-by-doing benefits, and in several cases lower energy consumption than the diesel baseline.

Zero-emission technologies fundamentally alter the operational profile of vessels. Operators must navigate trade-offs between:

- Range: Lower energy density of batteries/hydrogen vs. diesel limits operational radius
- Payload: Energy storage systems impose weight and volume penalties, reducing cargo capacity
- Turnaround time: Charging/bunkering takes more time and logistics require robust digital planning and infrastructure (cranes, high-power connections) not available at all ports

Regulatory obstacles and shortcomings

Although much work is being done on the technical requirements for vessels (ES-TRIN), and derogations and exemptions can be provided for experimental vessels and engines, the current regulatory landscape is seen as not fit for innovation:

- The main issue here is the lack of EU binding regulations for inland navigation to effectively internalise external costs (e.g. CO₂e emission costs) or to set mandatory emission reduction targets. As a result, there is no economic benefit for vessel owners to invest in innovative clean technologies and to use renewable energy. There is a market failure in this respect. If the emission reduction targets need to be reached (e.g. a 90% reduction by year 2050), there is a clear need for binding regulations which result in a level playing field for all modes of transport, all EU member states and also to address non-EU countries on major corridors. As result of absent economic feasibility and perspective, there are also limited investments in developing clean technologies for IWT by suppliers, especially as the market is relatively small. Also the infrastructure network for supply of renewable energy develops slow as result of lack of demand and clear outlook how the energy market will develop for IWT.
- For combustion engines (ICE) using hydrogen and methanol, there are certification bottlenecks: NRMM regulation does not recognize hydrogen or methanol as reference fuels, forcing costly and complex exemption processes. It is expected and confirmed that this legal barrier will be lifted soon for hydrogen ICE. However, for methanol it requires more time and work because of concerns about the formaldehyde emissions which needs further impact assessments and evidence to be collected. The Dutch grant scheme is envisaged to provide evidence.
- While for usage of batteries, methanol and LNG the technical regulations for vessels are completed (ES-TRIN 2025 is in force since 1.1.2026), there are still some limitations. For example, until 2028, every vessel using compressed hydrogen, requires derogations from CCNR / EC or national authorities until ES-TRIN 2027 will enter into force. Acquiring the derogation from CCNR takes 6 months while a derogation from EC takes years.

Key Insight: Frontrunners have proven the hardware works, but many other elements such as regulations, financing, infrastructure are incompatible. The market must transition from a model based on exceptions to a model based on a clear goal-based framework with accompanying standards and regulations.

Furthermore, the limited market size needs to be taken into account to allow economies of scale. A strategy will be beneficial, like the cross-sector learning approach (see more on this below), to focus on roll-out of specific solutions on major corridors with large deployment projects to get through the



chicken-egg dilemma. Accordingly, the transition can not be treated as a uniform European undertaking. A "one-size-fits-all" approach will fail regarding the technology to implement. What works on a major international corridor like the Rhine is often inapplicable on the Danube or in canal networks with smaller waterway dimensions. Furthermore, it needs to be kept in mind that also within a geographical area like the Rhine region, there are many different vessel types carrying various types of cargo and having different operational profiles. A local operating ferry is quite different from an international operating coupled convoy on the spot market.

Some combinations of vessel types and operational profiles are therefore more suitable for full electrification while others do require a high autonomy and high energy storage on board. The latter is for example the case for large push convoys on the Rhine or Danube and for dry bulk cargo transport operators which work on the spot market. Another element to take into account is the density of volume and traffic, which is important for the commercial viability to deploy energy infrastructure along waterways and in ports.

Emerging opportunities

New business models: from ownership to access

The high CAPEX barrier can be addressed through decoupling energy storage from the vessel, using a multi-purpose swappable container. This results in a transitioning from CAPEX-heavy to OPEX-driven operational models:

- Pay-per-Use / Energy-as-a-Service: Operator pays per kWh consumed + container rental. Converts fixed capital to variable operational cost, transfers technology risk to service provider.
- Revenue stacking: Mobile battery containers can for example be used by other type of clients requiring off-grid power (e.g. festivals, construction sites) and can provide grid balancing services (Frequency Containment Reserve (FCR)), which generates an extra revenue stream outside the transport sector, resulting in better utilisation, higher overall revenues and net lower cost.
- Technology flexibility: Standardised modular interfaces allow vessel owners to lease batteries today and potentially switch to other fuels in future without hull modifications (e.g. flexible usage of batteries or generator sets using renewable fuels to propel electric motors of the vessel).

Cross-sectoral synergies

IWT alone lacks volume to drive technology cost reductions. Critical opportunities exist in coupling:

- Seaport integration: Ports developing methanol infrastructure for FuelEU Maritime compliance can serve IWT as "off takers." Projects like MAGPIE (Rotterdam) and PIONEERS (Antwerp-Bruges) create IWT bunkering infrastructure as byproduct.
- Heavy-duty road transport: Shared need for Megawatt Charging Systems (MCS) and hydrogen stations. Strategic co-location at trimodal terminals improves infrastructure business case.
- Component standardisation: Adapt automotive grade fuel cells and batteries for marine use, benefiting from larger industry cost reductions.
- ICE development: Leverage other industries, such as the heavy duty automotive sector R&D for hydrogen and methanol internal combustion engines, developing "marinised" options at shared cost. Other examples can be found also within the scope of NRMM with NRE engines being marinated for application in inland vessels.



Critical gaps to be addressed in the next EU Multiannual Financial Framework (MFF)(2028-2035)

Three critical gaps are identified:

1. The OPEX gap: Without significant OPEX support for SMEs, CAPEX grants may create stranded assets, cheap to build using CAPEX grants but too expensive to operate.
2. SME accessibility: Administrative burden not fit for IWT sector structure which consists of a lot of companies owning and operating 1 or 2 vessels. Future instruments need simplified "one-stop-shop" schemes or dedicated national envelopes with SME-focused intermediaries.
3. Standardisation funding: EU instruments promote novelty, but industry requires funding for standardisation (battery containers, shore power interfaces and incremental innovation) to reduce investment risk.

EU Competitiveness Fund opportunity: The proposed fund could address supply-side barriers through industrialisation of zero-emission vessel production—moving from one-off piloting to serial modular manufacturing. This gap is unfilled by ZEWT (R&I focus) or CEF (infrastructure focus).

Conclusions from PLATINA4Action assessments

1. Technology is ready, economics are not because of lacking regulatory framework

Zero-emission technologies have reached TRL 8-9. The barrier is no longer technical feasibility but commercial viability under current market conditions and current regulatory framework.

2. Market forces alone will not deliver the transition

The TCO gap of >30% requires policy intervention through carbon pricing, mandatory CO₂e reduction targets, high-intensity grants (60%+), and OPEX gap support mechanisms.

3. The industry is waiting

95% of fleet operators are rational risk-assessors, not technology sceptics. They need de-risked investment conditions and a clear economic benefit (return on investment) to invest. Innovative solutions need to become cheaper or more attractive compared to using fossil diesel.

4. Regional differentiation and fleet differentiation are essential.

Technology-neutral policies supporting both electrification and liquid fuels/ICE are required for a cohesive European strategy, taking into account the diversity in the vessel types and sizes and the diversity in operational profiles.

5. Systemic transition requires systemic intervention.

Moving from exceptions (derogations, pilot grants) and lack of incentives and regulations to a clear and long-term framework with binding EU targets and regulations for emission reduction in IWT, structural carbon pricing, NRMM regulation revision, foreseen evolutions of ES-TRIN rules is the precondition for mass adoption.



3.3 Stakeholder consultations and viewpoints

3.3.1 IWT sector input for Sustainable Transport Investment Plan (STIP)

PLATINA4Action together with INE, EBU, EFIP, and ESO prepared a statement¹¹ in April 2025 addressing the European Commission about the ambitions for the IWT and Ports in view of the development of the EU Sustainable Transport Investment Plan (STIP). The general statement is that the decarbonisation of inland waterway transport (IWT) is within reach — but there is a need for the right framework to make it happen. The inland waterway transport and inland ports sectors urge the European Commission and Member States to act with ambition in the Sustainable Transport Investment Plan with the following key messages:

- Prioritised support for HVO as a renewable fuel for IWT
- Regulatory certainty to enable a short-term shift
- Pro-innovation funding to de-risk long-term investment
- IWT: the ideal carrier for large-volume shipments of renewable fuels

The sector states that a near-term transition to zero greenhouse gas (GHG) emissions in inland waterway transport is technically seen within reach through the widespread adoption of Hydrotreated Vegetable Oil (HVO). HVO as renewable drop-in fuel enables full decarbonisation and can be used immediately in existing and modern internal combustion engines to replace fossil diesel. Moreover, HVO is fully compatible with the current refuelling infrastructure. However, although this shift to HVO can be made on a very short term as 'drop-in' solution for existing vessels and bunker infrastructure, it is currently hindered by the inability to pass on the considerably higher price of HVO to customers, leading to competitive disadvantages compared to fossil fuel users.

In order to capitalise on the benefits and opportunities presented by HVO in the short term, it is essential to prioritise support for an annual supply of 1.6 million tons HVO for IWT at competitive pricing with diesel. **This should be backed by a stable EU regulatory framework and coordinated efforts of EU Member States.** This approach would deliver a viable business case to barge operators and represent a major step forward in the decarbonisation of IWT, aligning with the EU Green Deal and supporting the objectives of a modal shift.

Creating dependency on HVO as the sole energy source carries potential risks in terms of availability (demand competition from other modes and sectors) and price volatility. Consequently, it is recommended that other alternative fuel solutions such as battery-electric propulsion, methanol and hydrogen should be developed concurrently to mitigate these risks and ensure resilience.

The higher costs of these zero-emission energy solutions, both in terms of operation and capital, mean that **regulation complemented by funding will be key** to overcoming implementation barriers, ensuring legal certainty, fostering investment and expanding renewable fuel supply networks.

A stable, **technology-neutral regulatory framework** combined with **incentives** for innovation is essential to achieving full decarbonisation and securing the long-term sustainability and resilience of inland navigation.

¹¹ See: https://platina4action.iwtprojects.eu/20250407-stip-iwt-ports-statement_final-version/



A recommended policy roadmap was also included in the paper for STIP by the stakeholders:

Table 1, recommended policy roadmap according to the STIP stakeholder position paper

Policy Action	EC	MS	IWT sector	Waterborne technology sector	Energy suppliers	Timeline
Secure availability of annual supply of 1.6 million tonnes of HVO at competitive pricing for IWT (compared with diesel and other modes)	X	X			X	As of 2025
Safeguard coordinated implementation between Member States of REDIII in IWT	X	X			X	As of 2025
Create predictable technology-neutral legal framework for emission reduction: • EU-wide ETS2 opt-in with revenues earmarked for IWT (incl. SMEs) OR • EU-wide equivalent framework	X	X				Before 2030
Harmonise and improve taxation regime ensuring competitive pricing for renewable energy, including exemptions for clean fuels and onshore power (ETD)	X	X				Before 2030
Amend NRMM Regulation to include hydrogen and methanol as reference fuels for certification of combustion engines	X	X				As of 2025
Create RTD and innovation funding opportunities ensuring SME-friendly access and lower-cost renewable energy systems and refuelling	X		X			New MFF
Create dedicated IWT investment fund for owners/operators pooling national and EU funding schemes together in large deployment projects	X	X	X	X	X	By 2030
Ensure active state aid implementation by Member States of GBER ¹² and CEEAG ¹³ to de-risk investments with high co-funding rates		X				By 2030

¹² [Regulation - 651/2014 - EN - General Block Exemption Regulation - EUR-Lex](#)

¹³ [EUR-Lex - 52022XC0218\(03\) - EN - EUR-Lex](#)



3.3.2 IWT sector input for Industrial Maritime and Port Strategies

PLATINA4Action, INE, EBU, ESO, IWT Platform, EFIP, Waterborne TP and EICB prepared an input paper addressing the European Commission to provide input for the Industrial Maritime Strategy and the Port Strategy. The key findings from the document¹⁴ with respect to the emission reduction of the fleet and decarbonisation of IWT are the following:

1. IWT is already a low-emission mode but needs accelerated decarbonisation

Inland waterway transport is energy-efficient and low-emission compared to road and rail, and is essential for Europe's climate neutrality, clean industry and modal shift objectives. Despite this advantage, full decarbonisation will not happen without targeted policy support, as the current fleet consists largely of conventional diesel engines and SME operators face narrow margins.

2. Short-term GHG reductions are technically feasible today

Immediate GHG reductions up to full decarbonisation are achievable using sustainable drop-in fuels, notably HVO100, without changes to engines or infrastructure. Air pollutant emissions (NO_x, PM) can be significantly reduced through replacement of old engines by Stage V engines or retrofitting with catalysts and particulate filters. Moreover, shore-side electricity (OPS) can eliminate emissions and noise from stationary vessels.

The key barrier identified:

The higher cost of sustainable fuels (HVO) and usage of electricity (OPS) currently cannot be passed on to customers, creating a competitive disadvantage versus fossil fuels.

3. Long-term decarbonisation requires multiple zero-emission pathways

Relying solely on renewable drop-in fuels poses **price and supply risks**. Therefore, parallel development and deployment of zero-emission propulsion systems is essential, including:

- Battery-electric propulsion (especially for short-range, urban, shuttle and passenger services),
- Hydrogen and green methanol, including internal combustion engine and fuel-cell solutions.

Inland ports play a central enabling role as hubs for renewable energy supply, storage, bunkering, charging and grid integration.

4. Infrastructure and ports are critical enablers

Inland ports are identified as vital nodes in future green energy corridors, supporting the following areas: alternative fuel bunkering, shore power, battery exchange systems, renewable energy storage. IWT is well positioned to transport large volumes of renewable fuels, supporting the broader energy transition.

Key recommendations from the paper are based on the recommendations from STIP:

A. Policy and regulatory framework

- Establish a technology-neutral EU emission reduction framework for IWT to create a level playing field. Options include an EU-wide ETS2 opt-in for IWT, provided revenues are earmarked for the sector (especially SMEs), and an equivalent EU-wide emission reduction mechanism.
- Coordinate EU and Member State implementation of RED III for inland navigation.
- Revise the Energy Taxation Directive (ETD): Exempt clean renewable fuels and onshore power from taxation.

¹⁴ <https://platina4action.iwtprojects.eu/250521-iwtports-contribution-to-industrial-maritime-and-port-strategies-2/>



- Amend the NRMM Regulation to include hydrogen and methanol as reference fuels for engine certification.

B. Fuel and energy supply

- Ensure a reliable annual supply of ~1.6 million tonnes of HVO100 for IWT at prices competitive with diesel.
- Support scaling of hydrogen, methanol and electricity supply networks along waterways and in ports.
- Include inland waterways explicitly in European green energy corridors.

C. Investment, funding and market uptake

- Create a dedicated IWT investment fund pooling with European and national funding to support fleet retrofitting, zero-emission vessels and large-scale deployment projects.
- Ensure SME-friendly access to EU funds and State aid (GBER, CEEAG).
- Increase funding for zero-emission vessels, alternative fuel infrastructure, shore power and charging infrastructure.

D. Research, innovation and deployment

- Continue and extend the Zero-Emission Waterborne Transport (ZEWT) partnership in the next MFF (post-2027).
- Support RD&I across multiple technology pathways, avoiding premature technology lock-in.
- Fund demonstration and deployment projects to de-risk investment and speed up market uptake.

Overall conclusion

The document concludes that decarbonising inland waterway transport is both technically feasible and strategically essential. However, it will only succeed through coordinated action combining immediate measures (drop-in fuels and retrofits), medium- and long-term zero-emission technologies, strong, technology-neutral regulation, dedicated funding and predictable investment frameworks and a central role for inland ports as energy and logistics hubs.



4. Insights from the pathways – coastal shipping

Due to a lack of data availability on the coastal fleet, especially regarding the fixed costs related to the vessel, no detailed pathways were modelled as was done for the IWT sector. To be still able to outline the insights that were gained during the SYNERGETICS project the chapter below includes a qualitative assessment of the coastal fleet based on sample calculations using the Decision Support Tool that has been developed as part of SYNERGETICS Task 5.1.

4.1 Methodology

The methodology used within the Decision Support Tool calculations is described in detail in Deliverable 5.1 of SYNERGETICS¹⁵. A summary is presented in this chapter.

The tool uses the TCO and GHG emissions as well as air pollutant emissions to compare different greening solutions. It presents the top three best solutions which are determined by the lowest TCO while achieving the pre-defined GHG emission reductions. In the quantitative assessment these top three solutions will be the main outcome in describing possible technology pathways for the coastal sector.

TCO generated by the Decision Support Tool is the sum of six cost factors. These cost factors include:

- Capital costs
- Operational costs
- Maintenance costs
- Downtime costs
- Costs due to loss of payload
- Costs due to increased bunker times

Of these six cost factors the costs due to loss of payload and increased bunker time are only included when relevant, while the other four cost factors are always included in the calculation.

Capital costs

The capital costs represent the yearly payments stemming from the initial investment sum. The initial investment sum covers the expenditures for purchasing the hardware, the installation cost and the design cost. The annual capital costs are calculated by dividing the overall investment by the economic lifetime (the depreciation period) combined with the average interest costs that have to be paid at yearly basis.

The total hardware cost depends on a number of parameters, which include the installed power, yearly fuel consumption and the required autonomy. The installed power is used to determine the cost of the engine and other related elements within the propulsion system. The fuel consumption and the required autonomy determine the fuel storage capacity that is required. Where the yearly fuel consumption determines the amount of fuel that the vessel consumes in a specific timeframe, the required autonomy determines how long a vessel needs to be able to sail without having to bunker or recharge. The autonomy is especially relevant for alternative fuel solutions that have limited infrastructure availability and where the energy density is relatively low (e.g. batteries and hydrogen) compared to conventional fossil fuel. By multiplying the fuel consumption per day with the required autonomy in days the energy /fuel capacity can be calculated. The calculated capacity is then used to calculate the cost of the energy storage system by using the pre-determined cost per unit of storage cost factor. Summing the cost of the propulsion system with the cost of the energy storage system will give the total hardware cost.

¹⁵ [D5.1 Decision Support Tool for Vessel Owners](#)



Operational cost

The operational costs are based on the sailing profile of the vessel, which in the tool concerns the annual energy or fuel consumption. This approach is a simplistic methodology, but since the TCO is calculated over the entire economic depreciation period it still presents the exact operational cost value for the TCO calculation. In the case of ICE, the operational costs also include the cost of the AdBlue consumption, which is required to comply with the Tier III NO_x emission limits. So, the operational cost calculation is simply the sum of the yearly fuel price times the yearly fuel consumption for each year within the selected TCO calculation period.

It is important to note that the fuel price is not constant over this selected period. The tool includes different price scenario's including price forecasts up until 2050. The different price scenario's all include different policy measures that influence the price, leading to different price forecasts per scenario. The first price scenario is STEPS which includes only policy measures that are currently in place like the RED-III and ETS, the second scenario is APS (Announced Pledged Scenario) which also include all policy measures that have been announced by governmental bodies, and the final scenario it which includes very strict policy measures to insure that the global warming is limited to 1.5 °C. These policy measures are quantified by CO₂ pricing, so the stricter the policy scenario the higher the CO₂ pricing becomes.

Maintenance cost

Calculating the precise maintenance cost can become verily complex since it is dependent on factors like unpredictable external hazards, hardware price developments and hardware performance development. In the Decision Support Tool, a more simplistic approach is used to calculate the maintenance cost based on the assumptions from the WP4 Catalogue¹⁶ D4.5. Here it is assumed that the yearly maintenance cost can be estimated using a fixed percentage of the total investment cost. This approach is in line with the approach used in the CCNR study¹⁷ of 2021.

Downtime cost

The downtime cost contributes only a singular time and is not a yearly reoccurring cost factor. The downtime cost is attributed to the retrofit time and includes the fixed cost and the reduced profit due to a reduced operational activity during the retrofit construction time. Generally, its takes between 20 to 60 days to retrofit a vessel depending on the type of greening solution. Compared to the time period in which the TCO is calculated the time period of the retrofit construction is only a fraction combined with the fact that no personnel costs have to be paid during this time period the cost contribution of the downtime cost to the total TCO is limited. The shorter the selected depreciation period is the larger the relative contribution of the downtime cost gets.

The fixed costs are calculated by multiplying the daily capital costs (including both the capital costs of the propulsion system and the vessel) and the daily insurance costs with the total downtime days. The reduced profit, also referred to as the opportunity cost, is calculated by multiplying the downtime days with the daily profit. By summing these two cost factors the total downtime cost is calculated. The final equation will then look as follow:

$$Downtime\ cost = \frac{Yearly\ capital\ cost_{total} + Yearly\ insurance\ cost + yearly\ profit}{365} \cdot downtime\ days$$

¹⁶ See D4.5 page 31 (section 5.4 other costs): https://www.synergetics-project.eu/wp-content/uploads/2026/01/SYNERGETICS_D4.5_The-Catalogue-of-greening-retrofit-solutions_FINAL.pdf

¹⁷ Friederike Dahlke-Wallat, Benjamin Friedhoff, Salih Karaarslan, Sophie Martens, and Martin Quispel, ‘Study “Assessment of technologies in view of zero-emission IWT Edition 2”’, Part of the overarching study “Financing the energy transition towards a zero-emission Europe-an IWT sector“, CCNR, 2021.



Payload loss

As mentioned before, the cost due to a loss of payload is only included in case it is relevant. Most alternative fuel systems require extra space and tend to be heavier as well, when compared to fuel systems using conventional fuels, such as ULSFO. This can be due to factors like lower energy density, physical density, increased safety measures, etc. If there is no extra space left on board or a vessel is already constricted by weight limitations in its daily operation these factors can reduce the maximum payload. However, it can also be that, for example, there is available space at the front of the vessel or that the maximum cargo weight that can be transported by a vessel is never reached anyway. In this case there will be no loss of payload and there will be no cost impact because of more weight or space needed to accommodate the powertrain and energy storage on board. Since this is very vessel-specific this factor can be switched on or off in the Decision Support Tool.

In case the factor is deemed relevant the loss of payload is calculated using the following steps:

1. The size/weight of the propulsion system for both the LSFOs and greening solution are calculated.
2. The difference between the LSFO propulsion system and the greening solution is calculated.
3. In case weight is used the deadweight tonnage of the vessel is calculated into the maximum cargo payload.
4. The difference in propulsion system size/weight is subtracted maximum cargo payload.
5. The payload loss fraction is calculated by dividing the calculated new cargo payload by the initial maximum cargo payload.
6. The payload loss fraction is multiplied by the yearly revenue and a correction factor which gives the payload loss

The correction factor that is used in the final step corrects for the fact that vessels do not sail at their maximum load capacity all the time. When a vessel does not sail at its maximum load capacity, or close to, extra space/weight requirements would generally not lead to a loss of payload. This correction factor is a simplistic approach calculate a more accurate value for the payload loss. For more accurate payload loss calculations the complete layout of the vessel is required.

Bunker time loss

The final cost factor is the bunker time loss, which is included when relevant. Alternative fuels generally have a longer bunkering time compared to bunkering LSFOs. As an example, for methanol more bunker time is needed to get the same amount of energy on board compared to LSFOs. Extra bunkering time may lead to a reduction of commercial activities, which consequently results in reduced revenue. However, for exploitation profiles where the vessel is at berth a significant part of the day a few hours of extra bunker time would not significantly affect its operational activity. In case it does affect the commercial activities, the following steps are used to calculate the related costs:

1. The bunker time of LSFOs and the alternative fuels are calculated by multiplying the fuel storage capacity with the bunker speed.
2. The difference in bunker time is then calculated by subtracting the two values from each other
3. The bunker time difference is then multiplied by the sum of the fixed cost (including the daily insurance cost, the daily capital cost of the vessel and the alternative fuel system, and the personnel cost) and the daily revenue.

To model the coastal fleet in scope of SYNERGETICS the tool described above is used to calculate for each vessel type the top three best solution for the years 2025, 2035, and 2050 using the STEPS price scenario. To include stricter emission reduction targets each of these time periods will have a different emission reduction target that increase over time. In the Decision Support Tool one can filter using three different emission types, which are CO_{2e}, NO_x and PM. For the analysis the PM is not used since no PM limits exist within the IMO standards. For the NO_x the reduction is simulated by first using a Tier



II engine as reference engine for each vessel type and by 2030 to use a Tier III reference engine type. This means that by 2030 all vessels comply with the NOx Tier III emission limits set by the IMO. Then for the CO_{2e} the EU Taxonomy targets for maritime vessels are followed. The EU taxonomy, which outlines the standards for being eligible for green EU subsidies, has set emission reduction targets that increase over time based on the WTW CO_{2e} emission intensity of a fuel in g CO_{2e}/MJ¹⁸. The emissive intensity targets for seagoing vessels are:

- 76.4 g CO_{2e}/MJ until 31 December 2029
- 61.1 g CO_{2e}/MJ from 1 January 2030 until 31 December 2034
- 45.8 g CO_{2e}/MJ from 1 January 2035 until 31 December 2039
- 30.6 g CO_{2e}/MJ from 1 January 2040 until 31 December 2044
- 15.3 g CO_{2e}/MJ from 1 January 2045

Assuming MGO as a reference, the CO_{2e} emission intensity for MGO is 93.93 g CO_{2e}/MJ¹⁹. This results in the following emission settings for the selected time frames:

- 20% in the 2025 time frame
- 35% in the 2035 time frame;
- 85% in the 2050 time frame.

For the rest of the input default values are used, as illustrated in the tables below. The fuel consumption and installed power are based on average values for these vessel types. The autonomy is based on the minimum amount of days that these vessel types sail without bunkering. Since greening solutions often result in lower possible autonomies the minimum selected values are used instead of the general desired autonomy. The autonomy is maximized at 1 month in the Decision Support Tool to prevent the CAPEX values from getting too large. In case vessels have a minimum autonomy of over a month the value used for the calculation is set to 31 days. In practice this does not have an impact on the results, since all alternative fuels except bio-diesel are not suitable to be used when requiring more than a month of autonomy.

Table 2, General default input values for each vessel type

DEPRECIATION TIME	INTEREST RATE
20 Years	6%

Table 3, Fuel consumption and installed power default settings per vessel type

VESSEL TYPE	FUEL CONSUMPTION [TON/YEAR]	INSTALLED POWER [KW]	AUTONOMY [DAYS]
Dry cargo (L < 80 m)	190	790	7
Dry cargo (80 m ≤ L < 90 m)	383	1640	7
Dry cargo (90 m ≤ L < 100 m)	446	2060	7

¹⁸ [Sea and coastal freight water transport, vessels for port operations and auxiliary activities](#)

¹⁹ [Emission Properties for EU ETS, FuelEU and IMO Net-Zero — Sustainable Ships](#)



Dry cargo (L ≥ 100 m and m < 5000 GT)	848	2440	7
Ferries (0 kW ≤ P < 1000 kW)	244	710	4
Ferries (1000 kW ≤ P < 2000 kW)	559	1630	4
Ferries (2000 kW ≤ P < 3000 kW)	840	2450	4
Ferries (3000 kW ≤ P < 4000 kW)	1199	3600	4
Ferries (4000 kW ≤ P < 8000 kW)	972	5110	4
OSVs (m < 2000 GT)	663	3450	14
OSVs (2000 GT ≤ m < 3000 GT)	883	4600	14
OSVs (3000 GT ≤ m < 4000 GT)	1239	6440	14
OSVs (m ≥ 4000 GT)	1385	7210	14
Fishing Vessels VL0012	4	120	1
Fishing Vessels VL1224	15	230	4
Fishing Vessels VL2440	106	460	14
Fishing Vessels VL40XX	830	2450	>31

The cost due to loss of payload and increased bunker time are not included due to limited availability of vessel specific cost data. The data gathered from these calculations is then used to qualitatively assess the technology pathways for the coastal fleet.



4.2 Results

The results on the top 3 most cost-effective technologies based on the TCO per vessel type from the calculations described in chapter 4.1 are shown in Annex I. This Annex provides detailed tables and figures per vessel that can be used to study the technology share over time for a specific vessel type. Figure 1 presents the aggregated visualised summary of these results to study the overarching coastal vessel technology share trends. In this figure each occurrence per technology is plotted per time frame subdivided into rank 1, rank 2 and rank 3, where the rank corresponds to the cost-effectiveness of a solution for a specific vessel type and the number of occurrences shows the amount of times each technology appears in rank 1, 2 or 3.

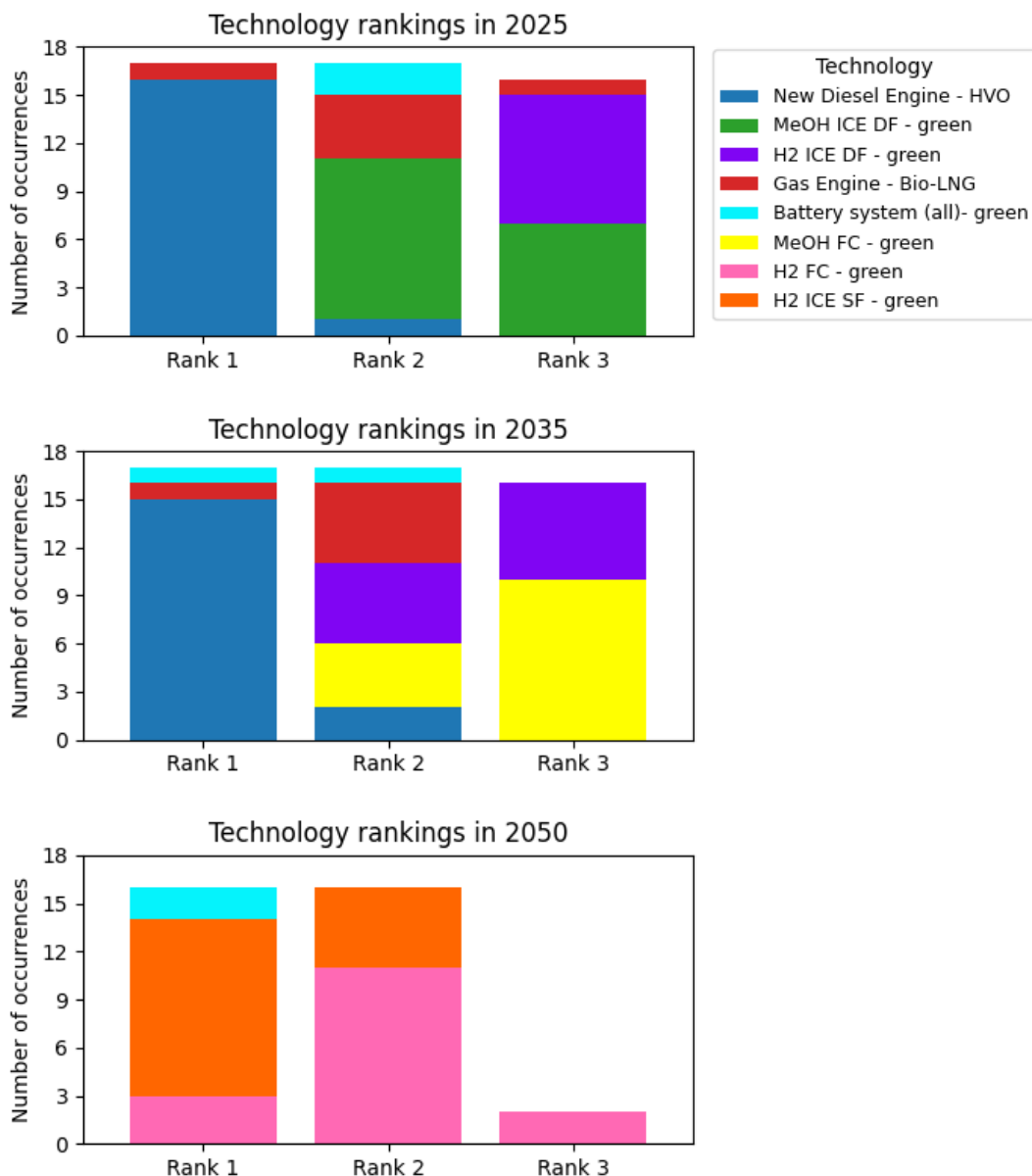


Figure 1, Visualized summary of the calculated top three most cost-effective solutions, where each rank denoted if the technology is the number 1, 2 or 3 most cost-effective solution.



When analysing the figure, it is shown that most vessel types show similar trends in which technologies are in the top 3 in the three different time periods. According to the calculations Bio-Diesel will be the dominant solution in the 2025 and 2035 timeframe. There are a couple of factors that cause this. The obvious one is that Bio-Diesel is still relatively cheap compared to other alternative fuels and unlike battery electric sailing, for example, there is no change in hardware needed other than, if not already done, upgrading the existing Tier II engine to a Tier III engine.

A second factor is that coastal vessels generally have a high autonomy. Bio-Diesel has just like diesel a high energy density which makes it possible to reach these levels of autonomy. Other alternative fuels like electricity and hydrogen on the other hand require large and heavy fuel storage systems that can only hold a fraction of the energy of diesel in the same volume. So to be able to maintain this large autonomy and at the same time reduce emissions, Bio-Diesel would, therefore, be suitable solution.

Another solution that stands out is Bio-LNG. The reason why LNG was introduced as fuel for propulsion a decade ago was due to the fact that it was expected to be cheaper compared to diesel. By substituting LNG with Bio-LNG it is possible to reach significant GHG emission reduction, similar or better than the reduction impact of Bio-Diesel. The advantage of Bio-LNG is that it just like with diesel is capable of reaching larger autonomies. The downside, however, is that the cryogenic tank that is required to hold the Bio-LNG is quite expensive so the cost benefit of using Bio-LNG only counts for vessel with a large fuel consumption in case Bio-LNG is cheaper compared to Bio-Diesel. Furthermore, a complexity of using (Bio-)LNG is the place of the cryogenic tank. This can lead to issues with loss of payload or space for passengers, or having not a suitable space available at all to accommodate the fuel tank (e.g. for small coastal vessels).

Besides Bio-LNG and Bio-Diesel it is mostly Bio-Methanol that is visible in the top three best solutions in the 2025 and 2035 time frame. Important to note here is that in the 2025 time frame it is the MeOH Dual-Fuel solution that is the most cost effective, which gradually transitions into Single-Fuel use to meet the emission requirements, but in the 2035 time frame it is the MeOH fuel cell solution that appears in the top 3. This is because the emission reduction that is reached by a Bio-Methanol ICE is below the 35% reduction threshold set for the 2035 timeframe. While both solutions use methanol as a fuel they have a completely different powertrain. This makes the graduate transition from one solution into the other to comply with emission limits much more complex compared to Bio-LNG and Bio-Diesel.

The downside of these three fuel types is that, using today's well-to-wake emission factors, none of them comply with the 85% WTW emission reduction target set for 2045 onwards. This leaves only the hydrogen and battery electric solutions, where the hydrogen-based technologies are often the only technologies that both fit on the vessel and meet the emission limits set in the 2050 time frame. Hydrogen Dual-Fuel and Single fuel could offer a great substitute for the existing ICE in the 2035 time period, while the hydrogen fuel cell solutions only appear in the top three from 2050 onwards. This is because these solutions also include high investment cost on top of the high fuel price. So even though hydrogen technologies might not be the most cost-effective technologies in the upcoming decade, it seems to be a fuel type of importance to reach the EU-Taxonomy goal of 85% reduction from 2045 onwards. On the other hand, ammonia could be an option as well as a suitable hydrogen carrier (instead of compressed hydrogen), but this option was not assessed in SYNERGETICS.

It is good to note here that even though hydrogen solutions are included in the top three most cost-effective technologies for the OSVs it is likely not feasible to maintain their current autonomy. To reach the 14 days autonomy the storage system on board for the hydrogen will be too large. In the calculation it was estimated that for the smallest OSV in total twenty (!) 40-foot ISO containers are required to fuel the vessel for 14 days, which increases up to about sixty (!) 40-foot ISO containers for the largest OSV vessel type category. This storage capacity issue due to larger autonomies in the coastal sector is also the reason why battery electric sailing is only in the top three solutions for small fishing vessels.

So while battery electric could be competitive with fossil fuels, especially for vessel with a fuel consumption per installed power ratio, it is mostly limited by the amount and size of the batteries it requires to achieve the required autonomy. Electricity is already relatively cheap and when fossil fuel price will increase due to the ETS and RED-III the OPEX cost for electricity will be lower than for fossil diesel. The



batteries it requires to store the electricity, however, are currently still expensive, very heavy, and large in size with a low energy density compared to fossil fuels. This reduces the possible autonomy of a vessel drastically and increases the initial investment price. The two smallest fishing vessel types have a low power demand, minimum fuel consumption and low autonomies. This is a combination that is perfectly suited for battery electric sailing. It was calculated that for these vessel types it is even economically favourable to sail on electricity for these vessel types from 2035 onwards. For the rest of the vessel types the amount of battery storage capacity that is needed to power the vessel is just too much for the required autonomies. However, it may be seen into what extent there are options to reduce the autonomy, for example with a higher density network of swapping points, possibly even considering floating battery exchange terminals or recharging facilities off-shore.

What complicates the results in practice is that although the Decision Support Tool only focusses on single fuel solutions, in practice hybrid fuel solutions are also possible. By combining battery packs or smaller hydrogen powered engines with Bio-LNG or Bio-Diesel, for example, it is possible to reach higher WTW emission reductions than when using single fuel solutions. These combinations are especially powerful when a vessel has the possibility to switch to a zero-emission propulsion when entering the harbour or other sensitive areas where humans and ocean species are in close proximity, but still having the possibility of achieving higher autonomies outside these areas. Other solutions like Carbon Capture and Storage (CCS), more efficient vessel designs, or Wind Assisted Propulsion (WAP), for example, could reduce the energy demand and emissions even further while maintaining the current autonomies. Based on the calculated TCOs for the different vessels and technologies shown in Annex I, these hybrid fuel solutions seem more realistic for the coastal vessel than using only single fuel solutions due to the significant lower prices of Bio-LNG and Bio-Diesel.

Combining the results from above the calculations show that with the current autonomies Bio-Diesel, Bio-Methane and Bio-Methanol are the most suitable transition fuels for the upcoming two decades, however, to reach at least 85% WTW emission reduction single or hybrid fuel solutions with hydrogen and battery electric sailing will become the dominant technology, which will likely result in the need for other supporting technologies like CCS and WAP or a drastic change in the autonomies of the vessels.



4.3 Stakeholder consultations coastal vessels

4.3.1 Position of owners of coastal shipping vessels (ECSA)

The most relevant stakeholder for the coastal vessels owners is ECSA²⁰. ECSA's position and views regarding the energy transition and emission reduction are presented below, based on the information and position papers published on the website.

1. Full commitment to climate neutrality by 2050

ECSA states that European shipowners are fully committed to supporting the EU objective of becoming climate-neutral by 2050, in line with both EU climate policy and the IMO's net-zero GHG target for international shipping. According to ECSA, the key challenge is no longer *whether* shipping will decarbonise, but *how* this transition can be realistically achieved for the existing fleet, including short-sea and coastal vessels.

2. Clean fuel availability is the critical bottleneck

ECSA consistently stresses that the main barrier to emission reduction is the lack of available and affordable clean fuels, which directly affects coastal and short-sea operations:

- Low- and zero-carbon maritime fuels are currently up to 4–5 times more expensive than conventional fuels.
- Without sufficient fuel supply at scale, shipowners cannot comply with FuelEU Maritime or broader decarbonisation targets.

ECSA therefore calls for:

- Mandatory obligations on fuel suppliers (not only on shipowners),
- Strong implementation of FuelEU Maritime and RED III,
- Development of port-based energy hubs and fuel infrastructure across Europe.

3. Pragmatic transition for the existing (coastal) fleet

ECSA underlines that most of today's fleet will remain in operation for decades. For this reason, emission reduction must rely on technology-neutral and fleet-compatible solutions, especially relevant for coastal and short-sea ships:

- Use of drop-in low-carbon fuels requiring limited retrofit,
- Energy-efficiency improvements,
- Transitional solutions such as onboard carbon capture, where appropriate.

ECSA explicitly warns that full fleet renewal is not economically or practically feasible in the short to medium term.

4. ETS revenues must fund the maritime energy transition

ECSA strongly argues that since shipping is included in the EU Emissions Trading System (EU ETS), the resulting revenues should be reinvested into maritime decarbonisation, including coastal shipping:

- ETS revenues should help bridge the price gap between conventional and clean fuels,

²⁰ <https://ecsa.eu/>



- Funding should be channelled through mechanisms such as the Innovation Fund, national schemes and dedicated maritime calls,
- Administrative burdens should be reduced so that SMEs and smaller shipowners (typical in coastal shipping) can access funding.

ECSA also calls for avoiding double regulation and double payment under EU ETS and FuelEU Maritime.

5. Alignment between EU and IMO rules is essential

ECSA repeatedly stresses that shipping is a **global and cross-border activity**, which also applies to coastal and short-sea shipping. Fragmented regional regulation would lead to a distortion of competition and increase costs. Therefore, ECSA calls for:

- Full alignment of EU legislation with IMO instruments,
- A single, globally consistent regulatory framework for GHG reduction in shipping.



5. Policy roadmap for IWT

This chapter sets out a policy roadmap for the energy transition of inland waterway transport (IWT) in the European Union. It is structured to move from evidence to action: the evidence base and approach (5.1); a diagnosis describing the transition challenges (5.2); the strategic principles that should guide policy choices (5.3); the actions themselves, organised by policy level (5.4); the critical 2026–2027 decision window in which most short-term actions must be triggered (5.5); and the bottom-line message for decision-makers (5.6). The policy roadmap is based on various sources and the policy relevant elements are summarised for different sources in the Annex I of this report.

5.1 Approach and evidence base

The roadmap synthesises three convergent input streams. First, the regulatory and pathway analysis in SYNERGETICS Deliverable 1.3 ("Report on Scenarios"), presented and discussed with stakeholders at the SYNERGETICS mid-term conference in Brussels in 2024. Second, the NAIADES III monitoring conducted by the NAIADES III Expert Group through the PLATINA4Action consortium, capturing implementation experience to date and Member State feedback. Third, the strategic positioning input prepared by EU IWT sector representative organisations for the European Commission's Sustainable Transport Investment Plan, Industrial Maritime Strategy and Port Strategy. Across the three streams the policy diagnosis converges, which gives confidence in the roadmap that follows.

The roadmap is anchored in the quantitative evidence presented in Chapter 3. The SYNERGETICS pathway and TCO analysis examined alternative propulsion options for representative IWT vessels under the IEA STEPS energy-price scenario, with the following central findings:

- HVO can be used already on short term as drop-in solution but requires a mechanism to offset the extra costs compared to fossil diesel to unleash the potential. Moreover, seen the concerns about availability of HVO (feedstock competition) it is recommended to develop other options in parallel.
- Renewable methanol single-fuel engines and battery-electric solutions with swappable batteries can reach TCO parity with fossil diesel under STEPS, even without additional support.
- Fixed-battery systems and hydrogen combustion engines see substantial TCO improvement but face residual gaps depending on operational profile and energy-price assumptions.
- Hydrogen fuel cell solutions, while improved, generally remain non-competitive without targeted support or further cost reductions.

These differentiated outcomes shape the roadmap. The actions below are sequenced so that the largest near-term levers — those that unblock technologies which are nearly TCO-competitive (renewable methanol combustion and swappable-battery solutions) — are prioritised in the short term, while sustained RD&I and demonstration support is maintained for technologies that remain further from market viability (hydrogen fuel cells). The roadmap is therefore not a generic policy wish list but a sequenced response to where the SYNERGETICS evidence base shows the largest gaps between technology readiness and market viability.



5.2 Diagnosis: a systemic transition challenge

The strongest single conclusion across SYNERGETICS, NAIADES III and PLATINA4Action is that **technology readiness is not the principal bottleneck for IWT decarbonisation**. The barriers are systemic, mutually reinforcing, and lie outside the technical domain. They fall into five categories.

5.2.1 Weak or absent economic case

For most IWT operators, zero-emission solutions remain economically inferior to fossil diesel under current conditions. Only in specific niches such as short distance ferries or inland vessels used for construction works, they may be a client in place which is willing to pay the 'green premium'. However, in regular commercial environment, this is not the case. The TCO analysis in Chapter 3 confirms that, while renewable methanol single-fuel and swappable-battery solutions can reach parity, fixed-battery and hydrogen combustion solutions face residual cost gaps, and hydrogen fuel cells require targeted support. The IWT sector has no binding EU emission-reduction obligation comparable to road transport (CO₂ standards for vehicles) or large maritime vessels (FuelEU Maritime, EU ETS), and no internalised carbon price in most Member States. The result is a market failure: operators cannot recover the additional capital and operating costs of clean technologies through commercial freight rates, and suppliers are reluctant to invest in clean-technology development for a market that lacks economic pull. The same goes for energy suppliers and renewable energy network development for IWT along waterways and in ports.

5.2.2 Fragmented regulation and State aid

Where EU rules do exist, they are inconsistent across instruments and across Member States. The NRMM Regulation (EU) 2016/1628 does not recognise hydrogen or methanol as reference fuels, basically blocking certification of combustion engines on these fuels and forcing complex exemption procedures. ES-TRIN 2025 covers batteries, methanol and LNG but still requires individual derogations for compressed hydrogen until ES-TRIN 2027 enters into force; CCNR derogations take six months and EC derogations several years. RED III and ETS-2 leave large discretion to Member States, creating divergent national implementation that risks bunker tourism, competitive distortion and emission leakage. State aid frameworks (GBER, CEEAG, TBER, LMTG) are not adapted to IWT investment profiles, and the SME structure of the sector — a large share of the fleet is owned and operated by single-vessel or two-vessel family businesses — makes most EU funding administratively inaccessible.

5.2.3 Infrastructure deficit

Vessel-side technology readiness is meaningless without bunkering and charging infrastructure on the relevant corridors. AFIR addresses part of this, but national execution is slow and IWT is treated unevenly relative to road and large maritime. Shore power, megawatt charging, hydrogen and methanol bunkering remain concentrated at a few seaports rather than deployed along inland corridors. The chicken-and-egg problem — operators will not invest in new vessels without infrastructure; infrastructure operators will not deploy without demand — has not been broken at corridor level. Initiatives such as MAGPIE in Rotterdam and PIONEERS in Antwerp–Bruges create useful seaport bunkering infrastructure with IWT spillover, but they do not by themselves resolve the inland-corridor coverage gap. Most important is to create a stable outlook first by setting clear and binding EU targets for IWT for the next decades.

5.2.4 Insufficient demand-side signals

Shippers and freight forwarders have no consistent information on the emissions performance of the modes and operators they choose, and few binding incentives to prefer low-emission options. CountEmissionsEU and CSRD will improve disclosure, but only if vessel-level data is available through a harmonised emission and efficiency label, and only if disclosure is linked to commercial decisions (procurement criteria, port and lock dues, logistics contracts). At present, low-emission IWT operators cannot capture a price premium that would offset their higher costs, weakening the business case further.



5.2.5 Lack of long-term policy stability

Investment in IWT vessels has economic depreciation periods of 20–30 years. Operators cannot make these decisions on the basis of regulation that is not in place or may change every electoral cycle. Most Member States even lack concrete national IWT action plans tied to a clear funding envelope. The post-2027 EU Multiannual Financial Framework (MFF) is undecided. The CCNR Mannheim Declaration provides a long-horizon target ($\geq 90\%$ reduction by 2050 vs. 2015) but is not regulation or EU-binding and is currently scoped on a Tank-to-Wake basis only. The combination of these uncertainties drives risk-averse investment behaviour at exactly the moment when forward investment is required.

5.3 Strategic principles

Six principles should guide the design of every action in the roadmap.

Principle 1 — Binding EU targets with corridor-level coordination. Setting a binding EU IWT decarbonisation target ($\geq 90\%$ by 2050 vs. 2015, with intermediate 2030/2035/2040 milestones) is the precondition for predictable investment. Coordination must extend to corridor level (Rhine, Danube, Seine–Scheldt, and others) and where relevant to non-EU riparian states, using TEN-T governance and the River Commissions to enforce harmonisation.

Principle 2 — Carbon pricing with earmarked revenue reinvestment. Internalising the external costs of GHG emissions through ETS-2 (or an equivalent EU-wide instrument) is the most effective single lever. Revenues must be earmarked for the sector — covering both CAPEX and OPEX support — or carbon pricing will simply tax operators without enabling the transition. The Dutch experience demonstrates that reinvested ETS-2 revenue can finance vessel retrofitting and infrastructure rollout without imposing net costs on the sector.

Principle 3 — Technology neutrality with managed multi-fuel transition. The IWT fleet is heterogeneous in vessel size, operational profile, corridor characteristics and energy availability. No single propulsion option fits all segments. Policy should support multiple pathways in parallel — battery-electric (where operationally suited), renewable methanol, hydrogen combustion and fuel cell, and renewable methane — while avoiding lock-in to any single solution and limiting structural reliance on transitional drop-in biofuels (HVO) given feedstock scarcity.

Principle 4 — Energy efficiency first. Avoided energy use is cheaper than replaced energy. Hull optimisation, propulsion efficiency improvements and digital voyage planning reduce OPEX, infrastructure requirements and renewable-energy demand simultaneously. An IWT energy-efficiency framework analogous to EEDI/CII in maritime shipping (currently under development in PLATINA4Action) should become a first-order policy pillar, not a supporting measure.

Principle 5 — Life-cycle (Well-to-Wake) accounting. As IWT decarbonises, upstream emissions, material use and end-of-life impacts become dominant. Inconsistent Tank-to-Wake versus Well-to-Wake scopes across legislation create perverse incentives. RED III, CountEmissionsEU, CSRD/ESRS and the EU Taxonomy should be aligned on a Well-to-Wake basis, with explicit treatment of green hydrogen demand and battery material and recycling impacts.

Principle 6 — Public leadership unlocking private investment. Market actors will not move first at scale. Public fleet commitments (inspection vessels, ferries, public-service operations), public co-financing of corridor infrastructure at high (80–100%) intensities, and treatment of IWT as strategic dual-use infrastructure (in line with the November 2025 Military Mobility Package) are essential to break the deadlock.



5.4 Policy roadmap actions

This section organises the roadmap by policy lever rather than by source. Each lever combines a brief explanation with the specific actions and the responsible actors. Horizons are noted in brackets at the start of each action: [ST] = short term (decisions in 2026–2027); [MT] = medium term (implementation 2028–2030); [LT] = long term (scale-up post-2030). The full action set is consolidated in Table 5.1 at the end of this section.

5.4.1 Targets and accounting framework

This lever sets the regulatory ambition. Without a binding EU IWT target, every other action lacks an anchor. Without harmonised accounting, actions cannot be compared across instruments or Member States.

- **[ST]** Establish a binding EU IWT GHG-reduction target of $\geq 90\%$ by 2050 vs. 2015, with intermediate milestones for 2030, 2035 and 2040. *Lead:* European Commission. *Involved:* Member States, IWT sector, CCNR.
- **[ST]** Synchronise the EU target with the CCNR Mannheim Declaration roadmap revision (expected 2027) to avoid divergent commitments on the Rhine corridor. *Lead:* CCNR, European Commission. *Involved:* Member States, other River Commissions, IWT sector.
- **[ST]** Align all IWT-relevant instruments (RED III, CountEmissionsEU, CSRD/ESRS, EU Taxonomy) on a Well-to-Wake accounting basis. *Lead:* European Commission. *Involved:* Member States, CESNI.

5.4.2 Carbon pricing, taxation and revenue reinvestment

Carbon pricing is the single most powerful lever for closing the residual TCO gaps identified in Chapter 3. Energy taxation reform is the cheapest near-term lever for reducing OPEX of clean technologies that are already close to parity. Both must be designed jointly to avoid double burdens and to deliver coherent price signals.

- **[ST]** Establish EU-wide ETS-2 inclusion of IWT fuel supply (rather than the current opt-in arrangement). If political constraints require a phased approach, link any opt-in window to a defined sunset date for mandatory inclusion. *Lead:* European Commission. *Involved:* Member States.
- **[ST]** Mandate or strongly incentivise earmarking of ETS-2 revenues for IWT — covering CAPEX and OPEX support, infrastructure rollout, and zero-emission demonstration projects. *Lead:* Member States. *Involved:* European Commission, IWT sector.
- **[ST]** Revise the Energy Taxation Directive (ETD) to exempt clean renewable fuels and onshore power from energy taxation for IWT and coastal shipping. *Lead:* European Commission, Council of the EU. *Involved:* Member States, IWT sector, ports.
- **[MT]** Coordinate RED III implementation across Member States to prevent bunker tourism, with targeted attention to corridor-level alignment. *Lead:* European Commission. *Involved:* Member States.



5.4.3 Regulatory fitness

Regulatory bottlenecks in NRMM and ES-TRIN currently block serial deployment of hydrogen and methanol combustion engines, which can be near-term TCO-competitive, as the Chapter 3 evidence shows. State aid frameworks need adaptation to IWT investment profiles. The accounting and regulatory treatment of new business models (Energy-as-a-Service, swappable batteries) needs to catch up with the technology.

- **[ST]** Revise the NRMM Regulation (EU) 2016/1628 to recognise hydrogen and methanol as reference fuels for engine certification. The hydrogen revision is technically near-ready; methanol requires further evidence on formaldehyde emissions and should be progressed in parallel. *Lead:* European Commission. *Involved:* IWT sector, engine manufacturers, CESNI.
- **[ST]** Align NRMM, ES-TRIN and safety regulations to allow routine use of alternative fuels and reduce reliance on case-by-case derogations from CCNR or the European Commission. *Lead:* European Commission, CESNI. *Involved:* River Commissions, Member States.
- **[MT]** Adapt GBER, CEEAG, TBER and LMTG State aid frameworks to explicitly accommodate inland vessels and ports, with raised aid ceilings and reduced notification burdens for zero-/low-emission investments. *Lead:* European Commission. *Involved:* Member States.
- **[MT]** Establish a regulatory and accounting framework for Energy-as-a-Service and pay-per-use propulsion (swappable batteries, mobile battery containers, grid-services revenue stacking) to enable business models that convert CAPEX to OPEX. *Lead:* European Commission, CESNI. *Involved:* Member States, IWT sector, energy regulators (ACER/national).

5.4.4 Infrastructure deployment

Vessel technology and infrastructure must scale together. The chicken-and-egg deadlock requires coordinated public-led deployment at corridor level rather than isolated port-by-port projects. Co-location with heavy-duty road and seaport infrastructure (megawatt charging, hydrogen and methanol bunkering) materially improves the business case and should be designed in from the start.

- **[ST]** Ensure full IWT inclusion in AFIR implementation: shore-side electricity, battery charging and swapping, hydrogen and methanol bunkering. *Lead:* European Commission. *Involved:* Member States.
- **[MT]** Develop corridor-based infrastructure masterplans for the Rhine, Danube, Seine–Scheldt and other TEN-T inland corridors, with public co-funding rates of 80–100% to break the chicken-and-egg deadlock. *Lead:* Member States. *Involved:* European Commission, IWT sector, port authorities.
- **[MT]** Combine AFIR obligations with CEF-AFIF, Innovation Fund, RRF and national co-financing to deliver coordinated rollout rather than fragmented project funding. *Lead:* Member States. *Involved:* European Commission.
- **[LT]** Treat IWT vessels, ports and waterway infrastructure as strategic dual-use infrastructure under the EU Military Mobility Action Plan and CEF-Military funding eligibility. *Lead:* European Commission. *Involved:* Member States, NATO partners.



5.4.5 Finance and investment instruments

CAPEX grants alone are insufficient. The TCO findings in Chapter 3 confirm that residual gaps for several technologies are operating-cost gaps. Finance must reach SMEs, who own the majority of the IWT fleet, through simplified administrative procedures and dedicated SME envelopes. Aggregated financing vehicles and Energy-as-a-Service support can convert CAPEX barriers into manageable OPEX commitments at the operator level.

- **[ST]** Design CAPEX and OPEX support schemes for zero-/low-emission vessels accessible to family-owned SMEs through a one-stop-shop, simplified application, and dedicated national envelopes. *Lead:* Member States. *Involved:* European Commission, IWT sector.
- **[MT]** Develop aggregated financing vehicles and Energy-as-a-Service support (e.g. battery-as-a-service models) to convert CAPEX barriers into manageable OPEX commitments. *Lead:* Member States. *Involved:* European Commission, financial institutions, IWT sector.
- **[MT]** Establish a stable EU IWT investment framework for the post-2027 MFF (2028–2035), with clear envelopes for fleet retrofitting, zero-emission vessels and infrastructure. *Lead:* European Commission. *Involved:* Member States.
- **[MT]** Continue and extend the Zero-Emission Waterborne Transport (ZEWT) partnership in the next Framework Programme to maintain RD&I and demonstration funding across multiple technology pathways. *Lead:* European Commission. *Involved:* ZEWT consortium, Member States, IWT sector.

5.4.6 Demand-side measures and labelling

Supply-side support alone is insufficient. Shippers must be able to recognise and reward low-emission IWT, and emission performance must translate into commercial advantage through procurement, port and lock dues, and contract terms. An energy-efficiency framework for IWT, linked to funding eligibility, makes efficiency a first-order rather than supporting measure.

- **[ST]** Establish a harmonised EU emission and efficiency label for inland vessels via CESNI/CCNR, aligned with CountEmissionsEU, CSRD and EU Taxonomy requirements; minimise SME reporting burden through default values and streamlined tools. *Lead:* European Commission, CESNI. *Involved:* CCNR, IWT sector, ports.
- **[MT]** Mandate or incentivise emissions disclosure in logistics decision-making; link emission performance to public procurement, port and lock dues, and logistics contracts where feasible. *Lead:* Member States. *Involved:* European Commission, ports, shippers.
- **[MT]** Introduce energy-efficiency standards or targets for IWT (analogous to EEDI/CII in maritime), linked to funding eligibility under the EU Taxonomy. *Lead:* European Commission, CESNI. *Involved:* Member States, IWT sector.

5.4.7 Governance and coordination

Roadmap implementation requires sustained coordination among the European Commission, Member States, River Commissions, CESNI, and sector organisations. Without a governance mechanism, the roadmap risks becoming a list rather than a programme, with no annual accountability and no mechanism to adjust course.

- **[ST]** Establish a formal joint coordination mechanism between the European Commission, Member States, River Commissions, CESNI, and EU IWT sector organisations to monitor roadmap implementation and report annually. *Lead:* European Commission. *Involved:* Member States, River Commissions, CESNI, IWT sector.
- **[ST]** Commit Member States and EU institutions to use public fleets (inspection vessels, ferries, public-service operations) as early adopters of zero-/low-emission propulsion. *Lead:* Member States. *Involved:* European Commission, IWT sector.



5.4.8 Consolidated action overview

The following consolidates all roadmap actions, organised by policy lever and showing horizon, lead actor and involved actors. Horizons: [ST] short term (decisions 2026–2027); [MT] medium term (implementation 2028–2030); [LT] long term (scale-up post-2030).

Table 4, IWT policy roadmap actions by lever, horizon and actor

Action	Horizon	Lead actor(s)	Involved actors
5.4.1 Targets and accounting framework			
Establish a binding EU IWT GHG-reduction target (≥90% by 2050; milestones 2030/2035/2040)	ST	European Commission	Member States, IWT sector, CCNR
Synchronise EU IWT target with CCNR Mannheim Declaration roadmap revision (2027)	ST	CCNR, European Commission	Member States, other River Commissions, IWT sector
Align IWT instruments (RED III, CountEmissionsEU, CSRD/ESRS, Taxonomy) on Well-to-Wake basis	ST	European Commission	Member States, CESNI
5.4.2 Carbon pricing, taxation and revenue recycling			
Establish EU-wide ETS-2 inclusion of IWT fuel supply	ST	European Commission	Member States
Earmark ETS-2 revenues for IWT CAPEX/OPEX support, infrastructure and demonstration	ST	Member States	European Commission, IWT sector
Revise Energy Taxation Directive (ETD) to exempt clean renewable fuels and onshore power	ST	European Commission, Council of the EU	Member States, IWT sector, ports
Coordinate RED III implementation across Member States to prevent bunker tourism	MT	European Commission	Member States
5.4.3 Regulatory fitness			
Revise NRMM Regulation to recognise hydrogen and methanol as reference fuels	ST	European Commission	IWT sector, engine manufacturers, CESNI
Align NRMM, ES-TRIN and safety regulations to reduce reliance on derogations	ST	European Commission, CESNI	River Commissions, Member States
Adapt State aid frameworks (GBER, CEEAG, TBER, LMTG) for inland vessels and ports	MT	European Commission	Member States
Establish regulatory framework for Energy-as-a-Service and pay-per-use propulsion	MT	European Commission, CESNI	Member States, IWT sector, ACER/national regulators



5.4.4 Infrastructure deployment			
Ensure full IWT inclusion in AFIR implementation (shore power, charging, H ₂ /methanol bunkering)	ST	European Commission	Member States
Develop corridor-based infrastructure masterplans (Rhine, Danube, Seine–Scheldt, other TEN-T) with 80–100% co-funding	MT	Member States	European Commission, IWT sector, port authorities
Combine AFIR, CEF-AFIF, Innovation Fund, RRF and national co-financing for coordinated rollout	MT	Member States	European Commission
Treat IWT as strategic dual-use infrastructure under EU Military Mobility Action Plan	LT	European Commission	Member States, NATO partners
5.4.5 Finance and investment instruments			
Design SME-accessible CAPEX/OPEX support (one-stop-shop, dedicated national envelopes)	ST	Member States	European Commission, IWT sector
Develop aggregated financing vehicles and Energy-as-a-Service support	MT	Member States	European Commission, financial institutions, IWT sector
Establish stable EU IWT investment framework for post-2027 MFF (2028–2035)	MT	European Commission	Member States
Continue and extend ZEWT partnership in next Framework Programme	MT	European Commission	ZEWT consortium, Member States, IWT sector
5.4.6 Demand-side measures and labelling			
Establish harmonised EU emission and efficiency label for inland vessels via CESNI/CCNR	ST	European Commission, CESNI	CCNR, IWT sector, ports
Link emission performance to public procurement, port/lock dues, and logistics contracts	MT	Member States	European Commission, ports, shippers
Introduce energy-efficiency standards/targets for IWT linked to EU Taxonomy eligibility	MT	European Commission, CESNI	Member States, IWT sector
5.4.7 Governance and coordination			
Establish joint coordination mechanism (EC, MS, River Commissions, CESNI, sector) with annual reporting	ST	European Commission	Member States, River Commissions, CESNI, IWT sector
Commit Member States and EU institutions to use public fleets as early adopters	ST	Member States	European Commission, IWT sector



5.5 The 2026–2027 decision window

The short-term horizon is concentrated in a narrow window: 2026–2027. Several major regulatory and budgetary milestones converge in this period, and decisions taken in it will lock in the regulatory and funding conditions for the next decade. Decisions postponed beyond it will arrive too late to affect the operational fleet during the period in which it must decarbonise.

The converging milestones are:

- **ETS-2 entry into force** (currently 2028 after the 2025 delay) and the design of revenue-recycling mechanisms in Member States.
- **NRMM Regulation revision** for hydrogen (technically advanced) and methanol (requiring further impact assessment on formaldehyde).
- **ES-TRIN 2027 entry into force** lifting the compressed-hydrogen derogation requirement.
- **Post-2027 MFF negotiation** determining EU funding envelopes for fleet and infrastructure 2028–2034.
- **CCNR Mannheim Declaration roadmap revision** (expected 2027) setting the binding target for the Rhine corridor.
- **NAIADES III implementation review** and shaping of any successor framework.

The critical-path actions for this window are, in order of dependency:

1. Binding EU IWT GHG target (5.4.1) — anchor for everything that follows.
2. ETS-2 inclusion and revenue earmarking design (5.4.2) — without these, no business case.
3. NRMM revision (5.4.3) — without this, technologies that are TCO-competitive cannot be deployed at scale.
4. ETD revision (5.4.2) — fastest near-term OPEX lever for technologies near parity.
5. AFIR implementation and corridor masterplans (5.4.4) — without infrastructure, vessels are stranded.



5.6 Bottom line for IWT policy decision-makers

The IWT energy transition is no longer a technology-development problem; it is a policy-design and execution problem. The roadmap above must **shift focus from individual projects to system design**. The roles are clear:

- **The European Commission** is decisive on framework conditions: targets, carbon pricing, regulatory fitness, State aid coherence, infrastructure obligations, and life-cycle accounting standards.
- **The Member States** are decisive on execution: implementation of EU instruments, national funding envelopes, public fleet commitments, corridor masterplans, and revenue recycling.
- **The River Commissions and CESNI** are decisive on technical regulation: ES-TRIN, emission and efficiency labelling, certification, and corridor harmonisation including non-EU riparian states.
- **The IWT sector** transitions from technology testing to scaling, aggregation and market transformation once the framework conditions are in place.

The risk of inaction is concrete. Under ETS-2 and accelerating CO₂ standards for road vehicles, road haulage will continue to decarbonise rapidly. If IWT does not move at comparable pace, its societal advantage in the modal mix erodes — and with it, the case for shifting freight from road to water that has anchored EU transport policy for thirty years. The 2026–2027 window is the last opportunity to set IWT on a credible decarbonisation trajectory before that erosion becomes irreversible.



6. Policy roadmap for coastal shipping

In contrast to the IWT sector where detailed discussions have been taking place and extensive research has been conducted over the past years to improve upon policy its regulations and strategies, the coastal sector was yet not very much discussed or addressed in the policy decisions and strategies.

This chapter outlines a policy roadmap for coastal vessels which aims at ensuring the inclusion and strengthening of the coastal vessel sector in the sustainability goals and strategies of the EU. This is done by first outlining the sources of knowledge on which the policy recommendations are based (6.1), and secondly the current challenges and bottlenecks are described (6.2). Next, this will be followed by a policy roadmap for coastal vessels describing how to tackle these challenges and bottlenecks (6.3), and finally a summary of the main points of attention and the policy recommendations are provided (6.4).

6.1 Approach and evidence base

With limited available data on the coastal vessels that are in scope of SYNERGETICS most of the knowledge is based on the previous work done in the SYNERGETICS project. In Deliverable D1.3 the policy landscape of the coastal part has been studied which already led to some early findings that are integrated in the policy roadmap. The knowledge gained from this policy stocktaking exercise was strengthened with the study on the regulatory framework for obtaining a certificate of approval in D4.6. The findings of these policy studies were combined with the results described in chapter 4.2 of this report which were acquired from the developed dataset and calculation methodology of D5.1. Together with the literature study done in chapter 2 of this report this resulted in the policy roadmap described in chapter 6.3.

To have some form of validation on the obtained policy recommendation the ECSA viewpoints have been taken into account, as described in chapter 4.3. The ECSA is a European wide organisation representing stakeholders from 21 EU member states with the mission to stimulate the shipping industry to reach climate neutrality in 2050. With them being the most relevant stakeholder for coastal vessel owners, they form a crucial source of information and, therefore, the below described policy roadmap should be aligning with their position on the energy transition.

6.2 Challenges and bottlenecks in the coastal sector

From the sources described in chapter 6.1 a number of challenges and bottlenecks have been identified, both on a technological and policy level. The first part of the chapter (6.2.1) focusses on the technological complexities and the second part (6.2.2) will dive more into details of the policy measures that need improvement.

6.2.1 Technology-related challenges and bottlenecks

From the analysis done in chapter 4 it became clear that **due to the current high autonomy that coastal vessels have, the use of gaseous and battery electric solutions forms a challenge.** When looking at Figure 1 it is shown that battery electric solutions only occur a few times, even though **battery electric sailing is almost always in the top three most cost-effective solutions.** The reason for this is because the battery storage capacity that is required on board is way too large and heavy to accommodate. Although hydrogen can be stored at 700 bar to increase the energy density also for gaseous hydrogen the same problem applies. Next to that, hydrogen also has another disadvantage as the TCO calculations point towards hydrogen being an expensive fuel type with a low cost-effectiveness to reduce the GHG emissions, especially if zero-emission tailpipe performance is not required.

Due to this the focus for the coastal vessels should be mainly on liquid renewable fuel options such as HVO (of FAME), Bio-LNG and Bio-Methanol for the near future. These fuels offer comparable autonomy capabilities, while at the same time reduce emissions. The advantage of this is that the current bunker



locations can be used or adapted to become capable of supplying the alternative fuels. Here for Bio-LNG and Bio-Methanol a bit more work is needed at the bunker infrastructure side compared to the usage of drop-in diesels such as HVO and FAME.

The downside of **the current liquid fuels** that have been assessed in SYNERGETICS, however, is that **they do not meet the 85% emission reduction target set from 2045** onwards if we assume the current well-to-wake emission factors for these fuels. So, the current technology options either do not have sufficient emission reduction potential or they provide for a too low autonomy. This creates a bottleneck in the green transition because no solution can provide both future readiness as well as a large autonomy for the continuation of the current day-to-day operation. As a consequence of this most vessel owners will wait with investing in green technologies until more certainty for the future will become apparent to them.

To reduce this challenge, it is imperative to **put focus on reducing the WTT emissions of liquid fuels** further instead of just focussing on the TTW part of the emissions, in combination with the introduction of technologies that improve the overall energy efficiency, **or to include a CCS system on board** and to adapt regulations to acknowledge CCS as a legitimate option to reduce GHG emissions.

Energy efficiency gains can for example come from smart hull designs, by using state-of-the-art controllable pitch propellers (CPP), or wind assisted propulsion systems (WASP) leading to a reduced fuel consumption. This not only decreases the total emissions, but it could also improve the business case. Fuel cost is often the biggest expense when it comes to alternative fuels, so by increasing the efficiency the competitiveness of the vessel will increase. Regulations like EEDI, EEXI, CII and SEEMP already focus on increasing the energy efficiency. By combining these regulations with targeted subsidies for emission reduction the use of alternative liquid fuels could be stimulated.

Not only the energy efficiency of the vessel should be stimulated using subsidies, but also systems like on-board CCS should be incentivised more by coastal vessel regulations and subsidies. The reason why liquid bio-fuels often reach significant reduction rate is mostly due to the way their WTW is calculated. The WTW emissions of bio-fuels are approached as a closed loop system. When the feedstock grows they take up GHG emissions and when they are used as fuel that emit them. In this closed loop only the emissions that arise within the transport chain and production processes of the bio-fuels remain in the WTW emissions. Looking at this from a TTW perspective it still means that GHG emissions are emitted. **By including CCS these bio-genic emissions can be captured, sold and be re-used for other purposes (e.g. production of synthetic e-fuels) which could even lead to negative emissions in the WTW approach.** It is, therefore, especially for the larger vessels a relevant solution to reduce emissions while still being able to use liquid fuels for a longer period of time. CCS systems are generally large and expensive so they are mostly suited more suitable for bigger vessels in combination with appropriate subsidies.

Liquid fuels that are currently not in scope of SYNERGETICS are **ammonia and liquid hydrogen**, because they are still in a developing phase with multiple challenges and bottlenecks that need to be solved before large scale deployment can begin. Although some promising demo cases are in progress safety and infrastructure issues remain a large bottleneck for these solutions. The benefit, however, of both of these solutions are that they are in liquid form which leads to significant higher energy densities than gaseous hydrogen or battery packs. Besides that, both solutions do not contain any CO₂ so the CO_{2e} emissions will be zero on a TTW basis and very marginal on a WTT basis if green electricity is used during production. Ammonia is already used in several sectors and production; transport and supply facilities already exist. Liquid hydrogen facilities on the other hand are still in development and only exist in small numbers. Even though these two solutions come with the necessary challenges it is still worth perusing due to their promising emission profile in combination with the higher energy densities compared to the current in scope zero-emission solutions.

While using liquid fuels seems more in line with the current autonomy requirements and bunker infrastructure of the coastal fleet deviating from this operational profile is also an option that can be explored. When reducing the autonomy of vessel types battery electric sailing and gaseous hydrogen become relevant technologies again. In Figure 1 it is shown that battery electric occurs twice in each time frame



as one of the top three most cost-effective solutions. This is for the two types smaller fishing vessels. The reason that battery electric sailing is possible here is because low fuel consumptions in combination with low autonomies makes it possible to fit the required storage capacity on board. So, by ensuring that reducing the autonomy and, therefore, reducing the required storage capacity battery electric sailing becomes a relevant solution for the coastal fleet.

A study shows that with the correct infrastructure **50% of the ferries could be electrified to sail zero emission**²¹. In order to achieve these lower autonomies to facilitate battery electric sailing or using gaseous hydrogen for propulsion **new infrastructure is needed**. An example case where the infrastructure was developed in accordance with the needs to electrify are the ForSea ferries between Denmark and Sweden. Here a 10 MW charger that is plugged in by an automatic robot arm was developed to fast charge the large energy demand that these ferries with 6 MW installed power have²². Another example is a ferry developed by CMBTech in Japan, where the hydrogen storage tank can be loaded and unloaded using a trailer that drives it onto the ship via ramp²³. These **innovative ways of bunkering or recharging** result in the possibility of also using gaseous and battery electric solution without losing a lot of time with bunkering.

Here it should be noted that ferries generally have more opportunity to dock at land, where other vessels like OSV and large fishing vessels often do not have this opportunity without compromising their day-to-day operation. For these types of vessels, it is crucial that innovative ways of bunkering or recharging at sea are developed. Examples of this are the charging cranes that are being developed as part of the EU MAGPIE project, or the charging or hydrogen refuelling stations can be deployed at off-shore wind mill parks. Developing these types of infrastructural solutions should be a key focus in the energy transition of coastal vessel. Currently the infrastructure is by far not sufficiently ready for the energy transition and forms a large bottleneck in the energy transition.

6.2.2 Policy related challenges and bottlenecks

Not all bottlenecks are technology related. Currently policy misalignments between all the different regulatory bodies to which coastal vessel have to adhere to also cause barriers in the energy transition. The main element here is the lack of internalisation of costs of GHG emissions and the lack of binding emission reduction targets for vessels below 5000GT. Although it is expected in the STEPS scenario that such internalisation and policies take place to allow the usage of renewable energy, this is yet not the reality. Therefore, if policy makers want also smaller vessels below 5000 GT to effectively reduce emissions, they also need to be subjected to policy regulations such as the ETS and FuelEU Maritime. This was also already one of the conclusions from the Task 1.3 deliverable.

Another point of attention is level playing field of RED-III when it comes to fuels being bunkered in seaports. Different implementation between Member States of the EU may lead to bunker tourism, where operators of coastal vessels look for fuels at the lowest price. This however may compromise the objective of RED-III which aims for increased use of renewable energy and reduction of GHG emissions by providing obligations to fuel suppliers to sell renewable energy or to achieve pre-defined emission reductions on WTW basis.

Another policy element is the access to funding for providing grants to capital investments, for both vessels as well as new infrastructure. EU measures such as ETS generate revenues which can effectively be used to help the coastal sector to decarbonise and to also reduce air pollutant emissions at the same time.

²¹ Transport & Environment, “Full Charge Ahead: Investigating the potential to electrify Europe’s ferries,” *T&E*, May 2026.

²² [Riviera - News Content Hub - ForSea Ferries battery conversion: a ‘big little journey’](#)

²³ [VESSEL REVIEW | HydroBingo – World’s first hydrogen ferry starts operating in Japan](#)



Another element is to align the EU policy with the IMO policy for coastal vessels. It makes sense to safeguard the level playing field and to ensure an economy of scale by synchronising the policy ambitions. This is also important for the competitiveness of the EU.

6.3 Policy roadmap

To overcome the identified challenges and bottlenecks as described in chapter 6.2 a shift in the current policy framework of the coastal vessel sector is required. The policy roadmap described below can be used as a guideline to accommodate this shift. For each policy recommendation it is included in which timeline this action should be completed, denoted by [ST] = short term (decisions in 2026–2027); [MT] = medium term (implementation 2028–2030); [LT] = long term (scale-up post-2030).

6.3.1 Comprehensive study on the coastal fleet

With all the fragmented regulatory bodies that influence the sector, harmonization of these policy frameworks is essential for the energy transition in the coastal sector. To harmonize the policy framework a detailed study to the exact definition of a coastal vessel and its vessel types is necessary. With this information a comprehensive policy framework can be developed that accounts for the needs of each fleet family within the sector.

- **[ST]** Identify the different fleet families within the coastal sector by assignment of a comprehensive study that includes gross tonnage, installed power and fuel consumption per fleet family. *Lead: European Commission. Involved: Member States, research entities, AIS/EMSA*
- **[ST]** Identify, which policy measure is relevant for which fleet family based on their sailing profile, gross tonnage and emission profile. *Lead: European Commission. Involved: Member States*
- **[MT]** Synchronise the fragmented policy frameworks of the coastal fleet between the different regulatory bodies. *Lead: European Commission. Involved: Member States, IMO, Certification bodies.*

6.3.2 Regulatory improvements

Not only is the policy landscape, for which coastal vessels are subjected, too fragmented between different regulatory bodies; also policy regulation within the same regulatory body were found to misalign with each other. To maximize the policy impact, these misalignments need to be solved.

- **[ST]** Explore options and make an impact assessment to revise the ETS1, FuelEU Maritime, and MRV to include all relevant fleet families (also below 5000 GT) in each policy framework based on the comprehensive coastal vessel sector study described in chapter 6.3.1 and explore also possibilities to address options such as CCS and WASP. *Lead: European Commission. Involved: Member States*
- **[ST]** Explore options and make an impact assessment to revise the Renewable Energy Directive to ensure a level playing field between bunker (sea)ports in Europe for fossil and renewable fuels. *Lead: European Commission. Involved: Member States*



6.3.3 Uptake of sustainable liquid fuels

As mentioned in chapter 6.2 liquid fuel with high energy densities match the current autonomy requirements of the coastal sector the best. To stimulate the energy transition, the focus in the short and medium term should, therefore, be on liquid fuels.

- **[ST]** Address in RD&I programmes and establish a fund that subsidises both direct emission reduction and research in how to reduce the Well-to-Tank emissions in the provision chain of liquid biofuels. *Lead: European Commission. Involved: Member States.*
- **[ST]** Address in RD&I programmes and establish a fund that subsidises on-board CCS systems to reduce TTW emissions of liquid bio-fuels *Lead: European Commission. Involved: Member States.*
- **[ST]** Address in RD&I programmes and establish a fund that subsidises energy efficiency technologies and hybrid systems *Lead: European Commission. Involved: Member States.*
- **[ST]** Address in RD&I programmes the further development of ammonia and liquid hydrogen propulsion systems *Lead: European Commission. Involved: Member States, IMO.*
- **[MT]** Develop a regulatory framework and technical requirements for liquid hydrogen and ammonia *Lead: IMO. Involved: Member States, Certification bodies, European Commission, Ports.*

6.3.4 Uptake of hydrogen propulsion and battery electric sailing

While the liquid biofuels offer a great short term and mid-term solution, hydrogen propulsion and battery electric sailing will become relevant technologies in the mid-term and long term in order to achieve net zero by 2050. So, at a later stage the focus should gradually shift towards these types of solutions.

- **[ST]** Include hydrogen in subsidy schemes and policy frameworks to kick-start the marine battery and hydrogen industry. *Lead: European Commission. Involved: Member States.*
- **[MT]** Establish a fund to develop the infrastructure for hydrogen bunkering and electricity charging. Also include research funds to develop innovative ways to bunker or recharge off-shore instead of only on-shore. *Lead: European Commission. Involved: Member States, IMO, research entities, Ports.*
- **[LT]** Shift the focus of funds and policy requirements towards hydrogen propulsion and battery electric sailing solutions to enhance emission reduction. *Lead: European Commission. Involved: Member States, IMO.*

6.3.5 Business case related policy recommendations

A reoccurring bottleneck in the energy transition in almost every sector is that the costs of alternative fuels are higher compared to diesel. This can lead to non-closing business cases which hinders the uptake of alternative fuels. Different solutions have been identified to overcome this challenge.

- **[MT]** Establish an operational cost subsidy scheme that is accessible to every vessel owner and not just to large consortia, like in the case of Innovation Fund. *Lead: European Commission. Involved: Member States.*
- **[MT]** Design tailor-made subsidy schemes per vessel type based on the sailing profiles that have been identified in the comprehensive coastal vessel sector study outlined in chapter 6.3.1. *Lead: European Commission. Involved: Member States, subsidy experts.*
- **[MT]** Conduct research to the possibility of pooling companies to strengthen their combined investment margin and to pool the efforts. *Lead: Member States. Involved: Branch organisations, vessel owners*



6.4 Bottom line for coastal vessel policy decision-makers

The coastal vessel sector that is in scope of SYNERGETICS currently faces a fragmented regulatory framework landscape, while at the same time being excluded from most impactful EU regulations such as FuelEU Maritime and ETS.

This reduces the stimulus for greening and, therefore, hinders the energy transition within the coastal sector. With the guidance of the policy roadmap outlined in chapter 6.3 the current policy landscape should transition towards a harmonized policy landscape between the different regulatory bodies and strengthen the sustainability target for this sector to stimulate green technology uptake. To accomplish this the different actors have to follow responsibilities:

- **The IMO** has to provide clear technical and regulatory requirements for the relevant alternative fuels, also including new fuel types like ammonia and liquid hydrogen. These regulations have to be aligned with the EU and their member states to prevent high fragmentation of regulatory obligations.
- **The European Commission** has to align its regulation with the IMO and Member States and to include a larger part of the coastal fleet (so also vessels below 5000 GT) into their regulatory framework regarding emission reduction to enhance the uptake of alternative fuels. Besides the clear regulatory framework, they should establish RD&I programmes and subsidy schemes for innovation roll-out regarding infrastructure and alternative fuel propulsion systems to meet the specific needs of the coastal sector.
- **Member States** should align their policy regulations, like their certification of approval policies for example, so that sailing between different territories becomes easier and to avoid market disruptions (e.g. coordination on RED-III implementation). They should also establish national subsidy schemes to stimulate the uptake of alternative fuels within their fleets.
- **The coastal vessel sector** transitions from technology testing to scaling, aggregation and market transformation once the framework conditions are in place. Also, the collaboration between ports, research entities, and other relevant stakeholders should be enhanced to develop the required infrastructure and to increase innovation.

If the current trajectory regarding the energy transition will remain the coastal sector will not reach climate neutrality in 2050. Trains and trucks are however switching to alternative fuels in a rapid pace while the coastal vessel sector hardly has any best practices or credible pathways in this area. Immediate action by the different actors is imperative to keep the coastal sector competitive and to keep the 'licence-to-operate' from a broader socio-economic viewpoint.



7. Conclusions

This report provides a comprehensive assessment of the technological, economic and regulatory pathways for the decarbonisation of inland waterway transport (IWT) and coastal shipping. Bringing together policy analysis, techno-economic modelling, and stakeholder perspectives, a clear and consistent conclusion emerges: **the transition is no longer significantly constrained by technology, but by the absence of a coherent and effective policy framework.**

7.1 A transition ready to scale—but blocked at system level

Across both IWT and coastal shipping, the analysis confirms that a wide range of propulsion technologies—including battery-electric systems, hydrogen, methanol and renewable drop-in fuels—have reached a medium to high level of technological maturity.

However, this technological readiness has not yet translated into large-scale deployment. The underlying reason is structural:

- **Total cost of ownership remains unfavourable** for most zero-emission solutions under current market conditions
- **Infrastructure for alternative fuels and electrification is insufficient and unevenly distributed**
- **Regulatory frameworks are fragmented and not aligned across Member States and instruments**

As a result, the transition is largely confined to pilot projects and early adopters, rather than advancing to system-wide transformation.

7.2 A systemic policy gap across both sectors

A central finding of this report is that **policy constitutes the decisive bottleneck** for decarbonisation. For inland waterway transport, the absence of a **binding EU-level emission reduction target and consistent carbon pricing framework** limits investment certainty and prevents market uptake of clean technologies.

For coastal shipping, the challenge is compounded by **limited regulatory coverage**, particularly for vessels below 5,000 GT, resulting in weak incentives for decarbonisation.

Across both sectors, the policy landscape is characterised by:

- Weak or indirect demand-side obligations
- Diverging implementation across Member States
- Misalignment between key instruments (e.g. ETS, RED III, FuelEU Maritime, national measures)

This fragmentation creates market distortion risks and prevents the emergence of a level playing field along key transport corridors.



7.3 Multiple pathways, no single solution

The analysis clearly demonstrates that **no single technological pathway can deliver full decarbonisation across all vessel types and operational profiles.**

Instead, a **multi-pathway transition** is required:

- **Up to 2030:**
Renewable drop-in fuels, particularly HVO, provide immediate emission reductions without requiring major infrastructure or fleet changes.
- **2030–2040 period:**
Battery-electric propulsion (where operationally feasible), methanol and hybrid solutions can achieve substantial reductions, especially under supportive policy conditions.
- **Beyond 2040:**
Hydrogen-based solutions and full electrification become necessary to reach climate neutrality, although they require significant cost reductions and infrastructure development.

For coastal shipping in particular, operational requirements such as high autonomy reinforce the importance of liquid fuels in the transition phase, while zero-emission solutions become critical in the longer term. Options for CCS may also be developed and applied to further reduce GHG emissions.

7.4 Economic viability as the key condition for scale

The Total Cost of Ownership (TCO) analyses confirm that **closing the economic gap with fossil diesel is the central condition for large-scale deployment.**

The results show that:

- **Carbon pricing and internalisation of CO₂ costs are the most powerful drivers of competitiveness**
- **CAPEX support (e.g. grants) significantly accelerates market uptake**, especially for early movers
- **Energy prices and fuel availability remain critical uncertainties**, particularly for hydrogen and synthetic fuels

Without a robust policy framework combining these elements, market forces alone will not deliver the required transition.

7.5 Infrastructure and corridors as critical enablers

A consistent finding across all analyses is that **infrastructure deployment is lagging behind technological development and represents a key bottleneck.**

Ports and inland terminals must evolve into integrated **energy hubs**, providing access to electricity, hydrogen, methanol and other alternative fuels.

Importantly, infrastructure must be developed at **corridor level**, reflecting the operational reality of both IWT and coastal shipping. Fragmented and isolated interventions will not be sufficient to create viable business cases or enable large-scale adoption.

7.6 Risks of delayed or insufficient policy action

The report identifies several significant risks if current policy gaps are not addressed:

- **Loss of competitiveness of waterborne transport**, particularly relative to road transport, which is decarbonising faster
- **Fragmentation of the internal market**, leading to inefficiencies such as bunker tourism



- **Delayed or cancelled investment decisions**, driven by regulatory uncertainty
- **Failure to meet EU climate targets for transport**, undermining broader Green Deal objectives

These risks underline the urgency of coordinated policy intervention.

7.7 A narrow window for decisive action

The period **2026–2027** represents a **critical decision window** for shaping the future of both sectors.

Key decisions during this period—including carbon pricing mechanisms, regulatory revisions, and EU budget allocations—will determine whether the transition can scale in time to meet 2030 and 2050 targets.

Delays in this window would significantly reduce the feasibility of achieving climate neutrality in waterborne transport.

7.8 Final message for policy makers

The overarching conclusion of this report is that **the transition to climate-neutral inland and coastal waterborne transport requires a shift from fragmented measures to a coherent, system-level policy framework.**

Such a framework must combine:

- **Binding targets and harmonised implementation across the EU**
- **Effective carbon pricing with reinvestment into the sector**
- **Technology-neutral support for multiple fuel pathways**
- **Large-scale, corridor-based infrastructure deployment**
- **Accessible funding mechanisms, particularly for SMEs**

Only through such an integrated approach the transition can move from pilot projects to full-scale deployment, ensuring that inland waterway transport and coastal shipping remain competitive, resilient, and aligned with Europe's climate neutrality objectives.



Annex I: Results TCO calculation for coastal vessel path-ways

Table 5, Dry cargo (L < 80 m):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	292390	447987	370189
2	MeOH ICE DF - green	409092	826137	617615
3	Gas Engine - Bio-LNG	450274	880606	665440
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	319681	480394	400038
2	Gas Engine - Bio-LNG	428259	812728	620494
3	MeOH FC - green	525025	1003546	764286
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	498002	835772	666887
2	H2 FC - green	495174	924588	709881

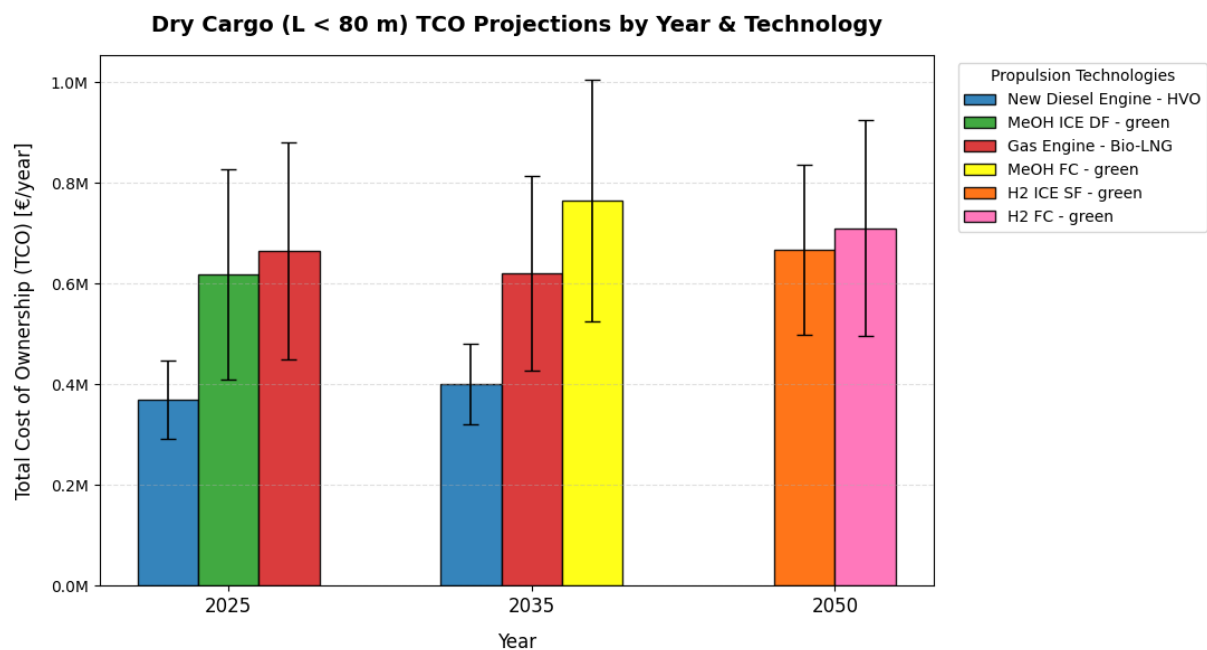


Figure 2, Visualized of the top 3 most cost-effective technologies for the vessel type Dry Cargo (L < 80m) calculated in the year 2025, 2035 and 2050.



Table 6, Dry cargo (80 m ≤ L < 90 m):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	594873	911476	753175
2	MeOH ICE DF - green	835844	1680901	1258373
3	H2 ICE DF - green	888686	2524860	1706773
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	649886	976804	813345
2	MeOH FC - green	1076612	2049211	1562912
3	H2 ICE DF - green	929858	2290990	1610424
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	1014205	1698735	1356470
2	H2 FC - green	1009138	1880073	1444606

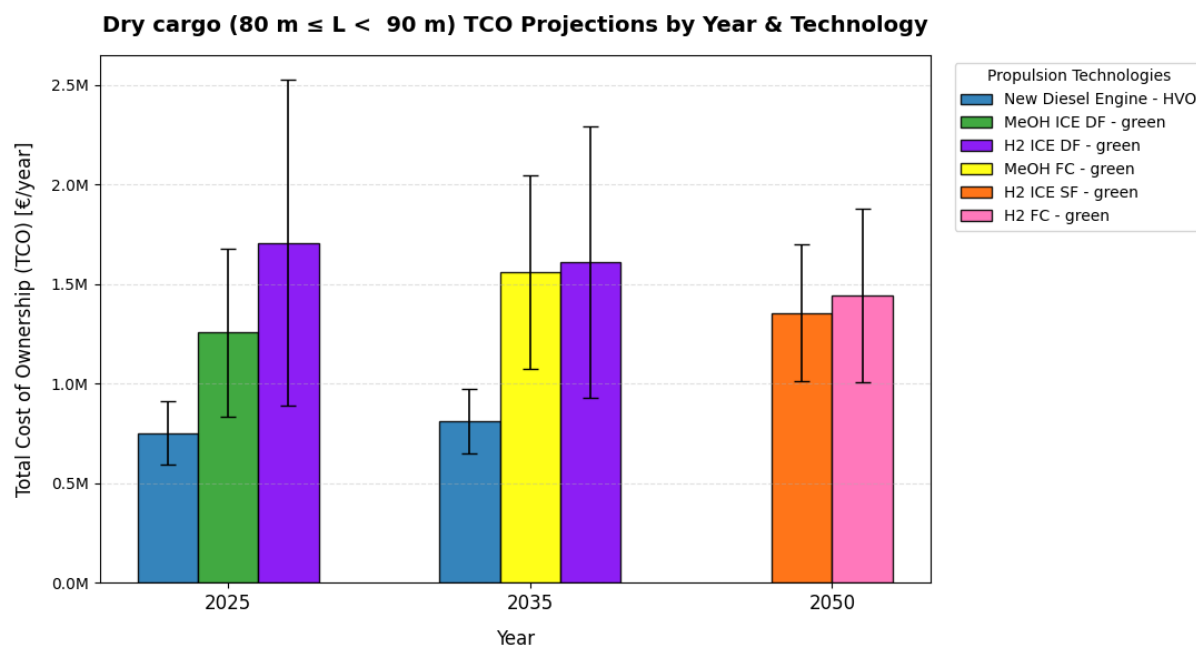


Figure 3, Visualized of the top 3 most cost-effective technologies for the vessel type Dry cargo (80 m ≤ L < 90 m) calculated in the year 2025, 2035 and 2050.



Table 7, Dry cargo (90 m ≤ L < 100 m):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	707029	1083414	895221,5
2	Gas Engine - Bio-LNG	785385	1774975	1280180
3	MeOH ICE DF - green	1002622	1998126	1500374
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	771091	1159487	965289
2	Gas Engine - Bio-LNG	733709	1585639	1159674
3	MeOH FC - green	1301421	2454896	1878159
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	1210449	2018321	1614385
2	H2 FC - green	1206808	2236918	1721863

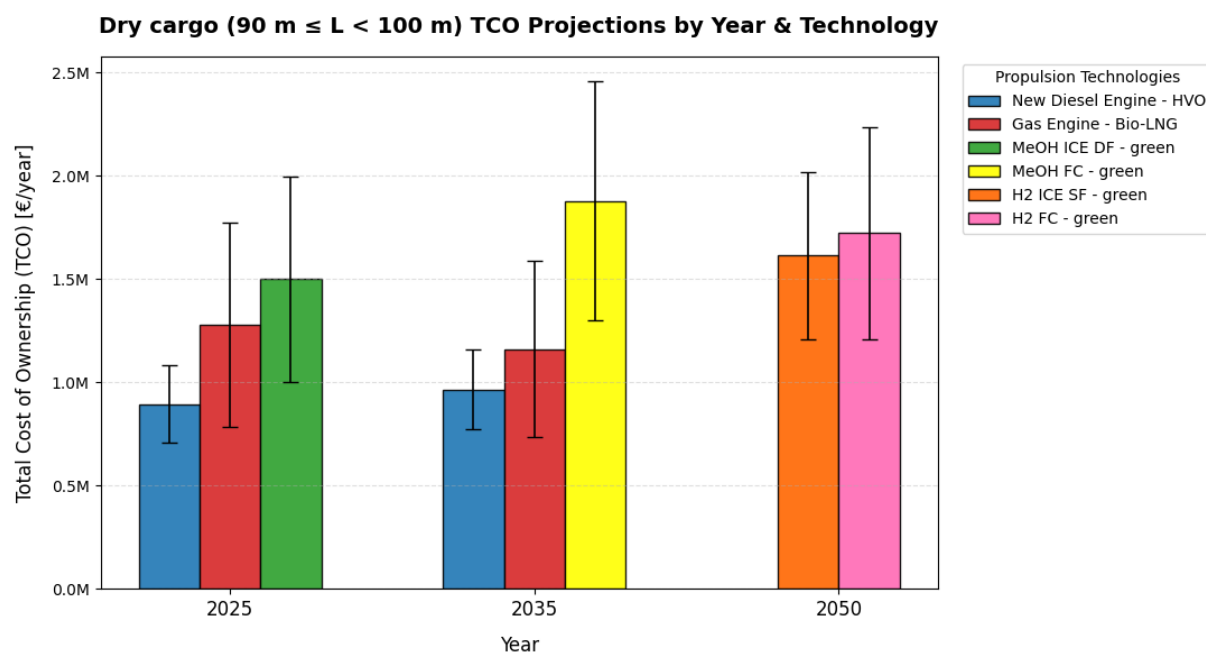


Figure 4, Visualized of the top 3 most cost-effective technologies for the vessel type Dry cargo (90 m ≤ L < 100 m) calculated in the year 2025, 2035 and 2050.



Table 8, Dry cargo (L ≥ 100 m and m < 5000 GT):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1263663	1918555	1591109
2	Gas Engine - Bio-LNG	1341972	3132140	2237056
3	MeOH ICE DF - green	1791314	3619723	2705519
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1385467	2063197	1724332
2	Gas Engine - Bio-LNG	1243717	2829187	2036452
3	MeOH FC - green	2171940	4200842	3186391
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	2209256	3688922	2949089
2	H2 FC - green	2164244	4022485	3093365

Dry cargo (L ≥ 100 m and m < 5000 GT) TCO Projections by Year & Technology

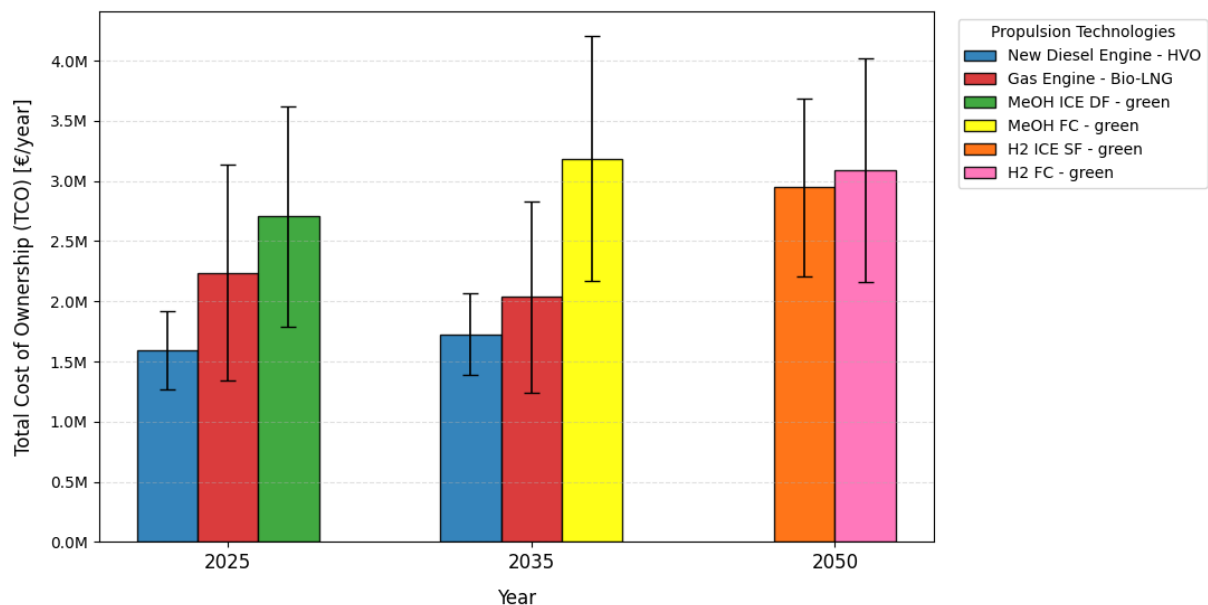


Figure 5, Visualized of the top 3 most cost-effective technologies for the vessel type Dry cargo (L ≥ 100 m and m < 5000 GT) calculated in the year 2025, 2035 and 2050.



Table 9, Ferries (0 kW ≤ P < 1000 kW):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	Gas Engine - Bio-LNG	480590	1011199	745895
2	New Diesel Engine - HVO	637549	894689	766119
3	MeOH ICE DF - green	1304547	2050402	1677475
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	Gas Engine - Bio-LNG	454675	907537	681106
2	New Diesel Engine - HVO	679167	940689	809928
3	MeOH FC - green	1382432	2002570	1692501
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 FC - green	1387408	2047694	1717551
2	H2 ICE SF - green	1494228	2064520	1779374

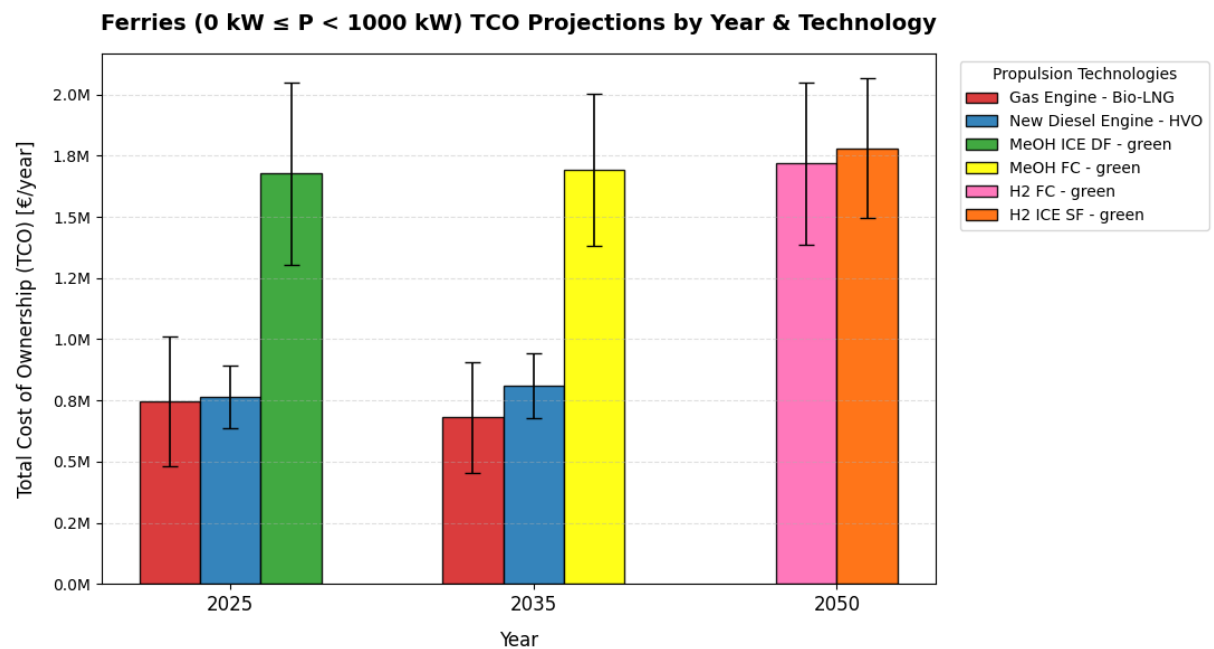


Figure 6, Visualized of the top 3 most cost-effective technologies for the vessel type Ferries (0 kW ≤ P < 1000 kW) calculated in the year 2025, 2035 and 2050.



Table 10, Ferries (1000 kW ≤ P < 2000 kW):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	766154	1181737	973945,5
2	Gas Engine - Bio-LNG	862973	2070710	1466842
3	MeOH ICE DF - green	986395	2138049	1562222
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	846447	1277085	1061766
2	Gas Engine - Bio-LNG	798204	1871004	1334604
3	MeOH FC - green	1050380	2113011	1581696
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 FC - green	1155044	2165565	1660305
2	H2 ICE SF - green	1234283	2154650	1694467

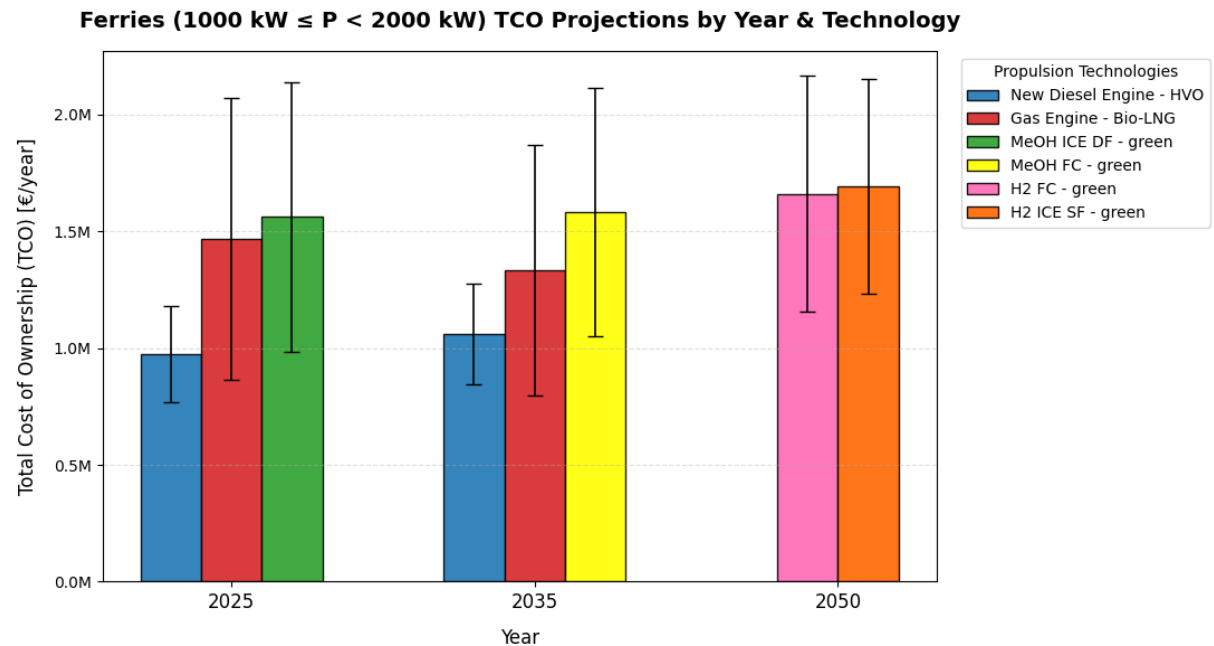


Figure 7, Visualized of the top 3 most cost-effective technologies for the vessel type Ferries (1000 kW ≤ P < 2000 kW) calculated in the year 2025, 2035 and 2050.



Table 11, Ferries (2000 kW ≤ P < 3000 kW):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1169378	1798409	1483894
2	MeOH ICE DF - green	1534346	3279426	2406886
3	H2 ICE DF - green	1634345	5092916	3363631
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1290032	1941686	1615859
2	MeOH FC - green	1628967	3237912	2433440
3	H2 ICE DF - green	1724645	4579991	3152318
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 FC - green	1790242	3325666	2557954
2	H2 ICE SF - green	1914076	3311944	2613010

Ferries (2000 kW ≤ P < 3000 kW) TCO Projections by Year & Technology

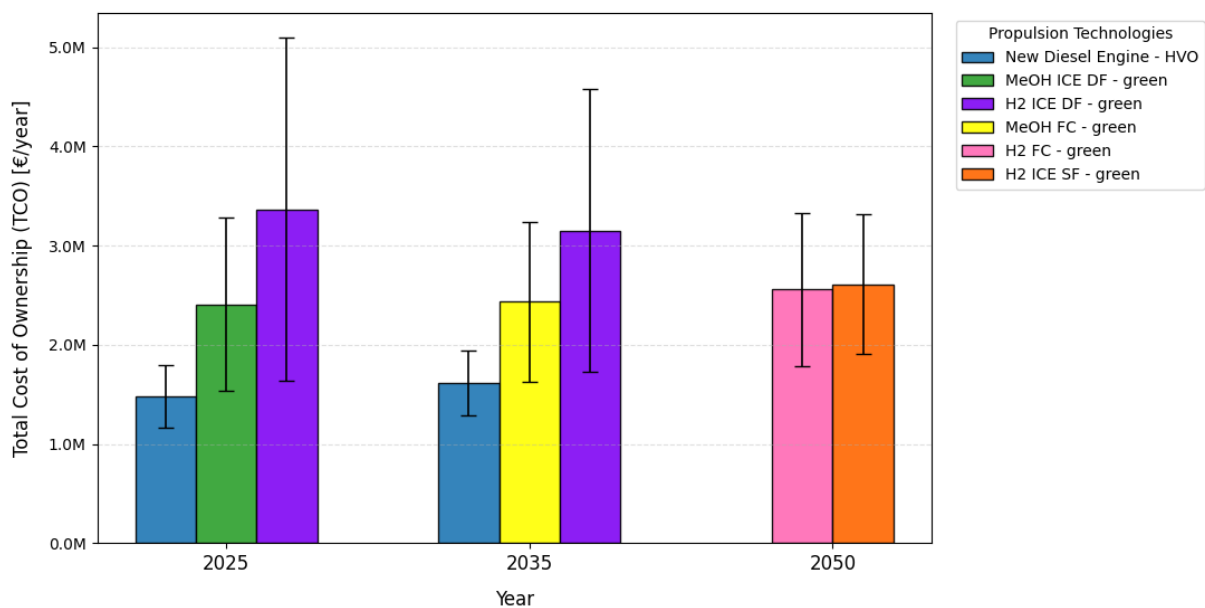


Figure 8, Visualized of the top 3 most cost-effective technologies for the vessel type Ferries (2000 kW ≤ P < 3000 kW) calculated in the year 2025, 2035 and 2050.



Table 12, Ferries (3000 kW ≤ P < 4000 kW):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1169378	1798409	1483894
2	MeOH ICE DF - green	1534346	3279426	2406886
3	H2 ICE DF - green	1634345	5092916	3363631
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1312655	1956768	1634712
2	H2 ICE DF - green	1764545	2753516	2259031
3	MeOH FC - green	1894407	3344088	2619248
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	1775826	2897194	2336510
2	H2 FC - green	1679642	2993866	2336754

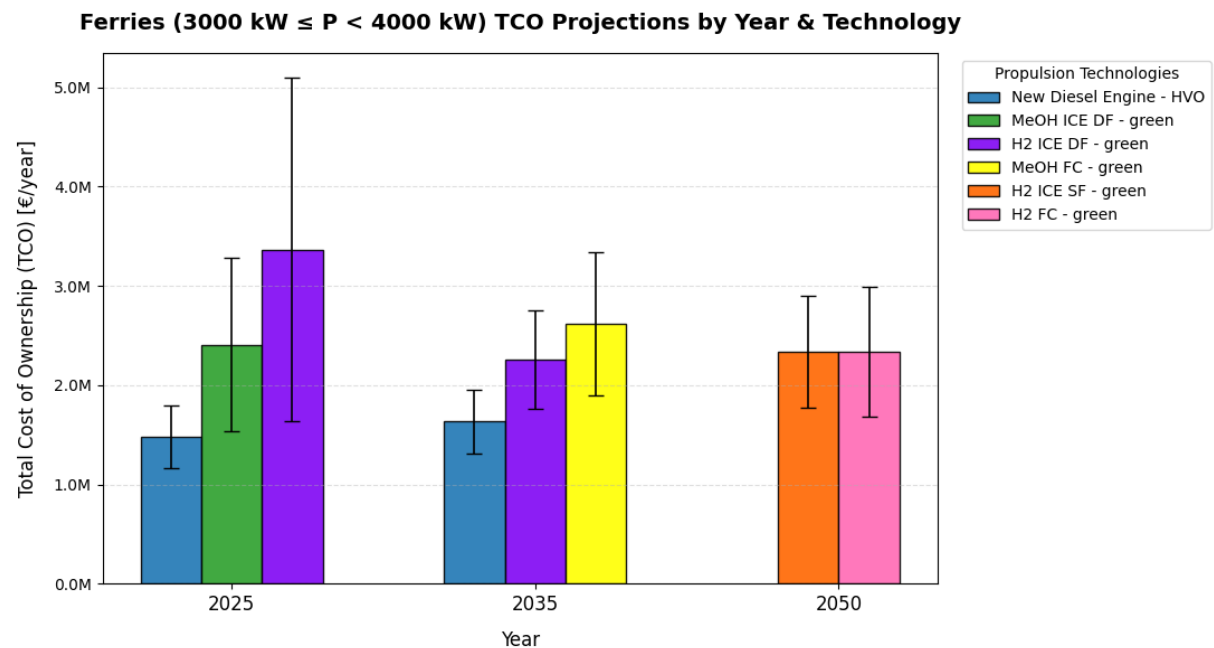


Figure 9, Visualized of the top 3 most cost-effective technologies for the vessel type Ferries (3000 kW ≤ P < 4000 kW) calculated in the year 2025, 2035 and 2050.



Table 13, Ferries (4000 kW ≤ P < 8000 kW):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1551450	2391431	1971441
2	MeOH ICE DF - green	2166204	4344135	3255170
3	H2 ICE DF - green	2276548	6475236	4375892
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1691064	2557223	2124144
2	MeOH FC - green	2556410	4722293	3639352
3	H2 ICE DF - green	2381038	5881709	4131374
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	2600211	4365418	3482815
2	H2 FC - green	2495994	4496576	3496285

Ferries (4000 kW ≤ P < 8000 kW) TCO Projections by Year & Technology

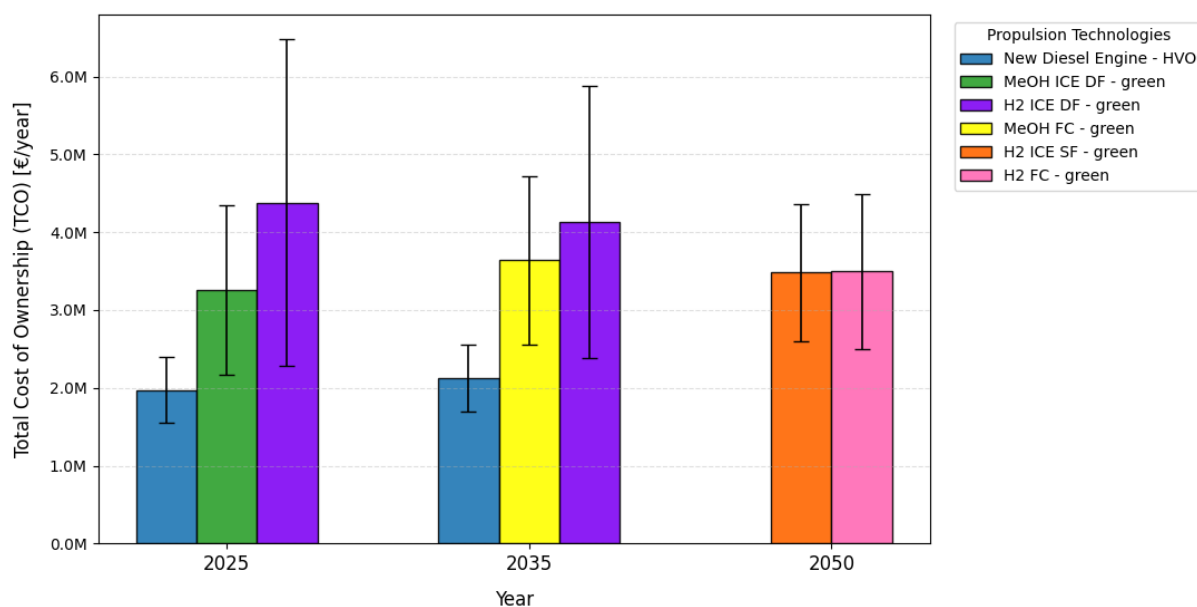


Figure 10, Visualized of the top 3 most cost-effective technologies for the vessel type Ferries (4000 kW ≤ P < 8000 kW) calculated in the year 2025, 2035 and 2050.



Table 14, OSVs (m < 2000 GT):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1087980	1667389	1377685
2	Gas Engine - Bio-LNG	1138232	2558054	1848143
3	MeOH ICE DF - green	1566123	3075549	2320836
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1201067	1792380	1496724
2	Gas Engine - Bio-LNG	1067814	2276382	1672098
3	H2 ICE DF - green	1761523	2701756	2231640
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	1766294	2776754	2271524
2	H2 FC - green	1977057	3796287	2886672

OSVs (m < 2000 GT) TCO Projections by Year & Technology

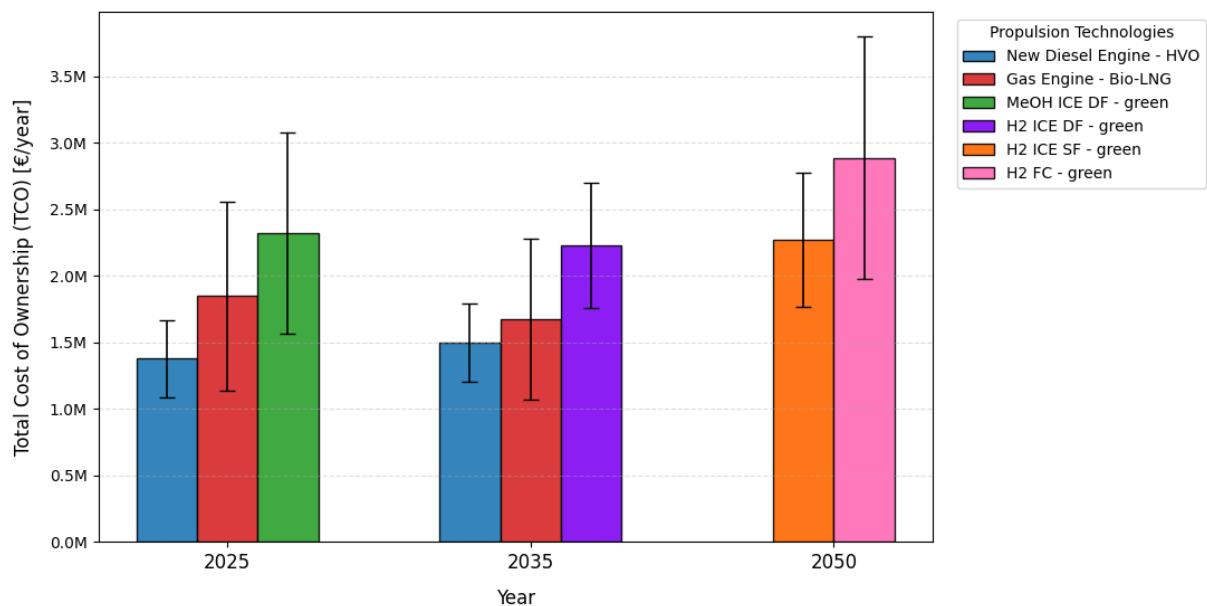


Figure 11, Visualized of the top 3 most cost-effective technologies for the vessel type OSVs (m < 2000 GT) calculated in the year 2025, 2035 and 2050.



Table 15, OSVs (2000 GT ≤ m < 3000 GT):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1449229	2221101	1835165
2	MeOH ICE DF - green	2086051	4096527	3091289
3	H2 ICE DF - green	2209294	6057795	4133545
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1576060	2371713	1973887
2	H2 ICE DF - green	2497869	6459665	4478767
3	MeOH FC - green	3464336	6673099	5068718
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	2497869	4134432	3316151
2	H2 FC - green	2749650	5405373	4077512

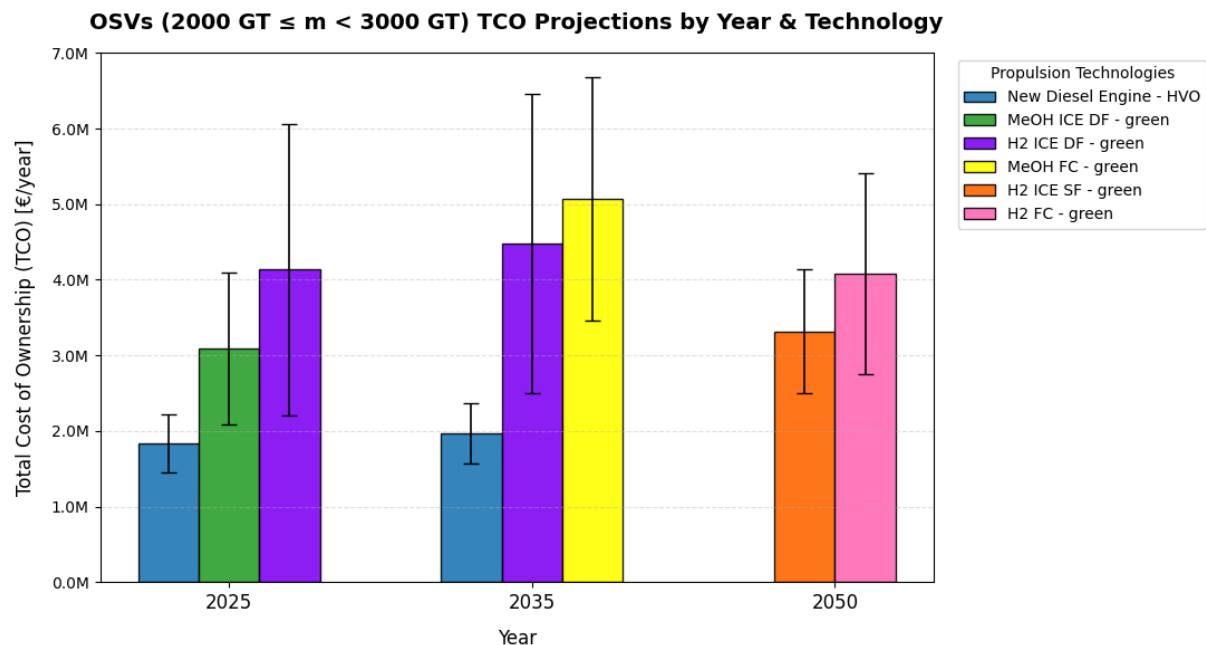


Figure 12, Visualized of the top 3 most cost-effective technologies for the vessel type OSVs (2000 GT ≤ m < 3000 GT) calculated in the year 2025, 2035 and 2050.



Table 16, OSVs (3000 GT ≤ m < 4000 GT):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	2032790	3115384	2574087
2	MeOH ICE DF - green	2925830	5746290	4336060
3	H2 ICE DF - green	3098889	8498250	5798570
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	2244124	3348963	2796544
2	H2 ICE DF - green	3290934	5047635	4169285
3	MeOH FC - green	5251404	9516246	7383825
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	3503784	5799637	4651711
2	H2 FC - green	3856845	7582419	5719632

OSVs (3000 GT ≤ m < 4000 GT) TCO Projections by Year & Technology

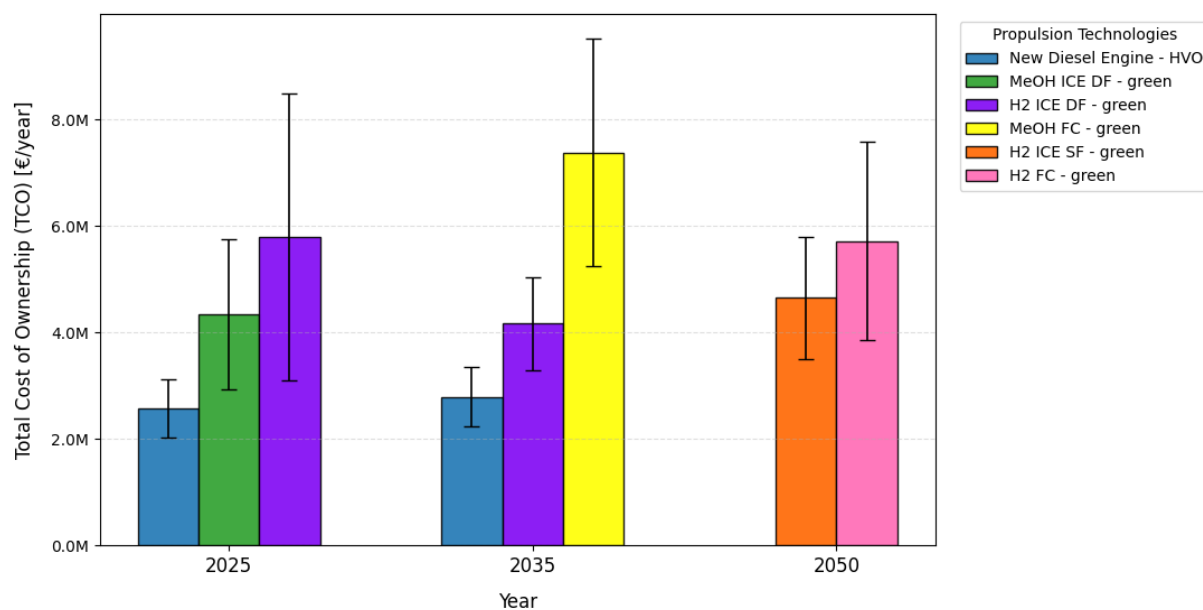


Figure 13, Visualized of the top 3 most cost-effective technologies for the vessel type OSVs (3000 GT ≤ m < 4000 GT) calculated in the year 2025, 2035 and 2050.



Table 17, 18OSVs (m ≥ 4000 GT):

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	2272597	3482902	2877750
2	MeOH ICE DF - green	3271169	6424199	4847684
3	H2 ICE DF - green	3464634	9500502	6482568
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	2471534	3719139	3095337
2	H2 ICE DF - green	3613522	8654787	6134155
3	MeOH FC - green	5433445	10463820	7948633
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	3917236	6483828	5200532
2	H2 FC - green	4311935	8476818	6394377

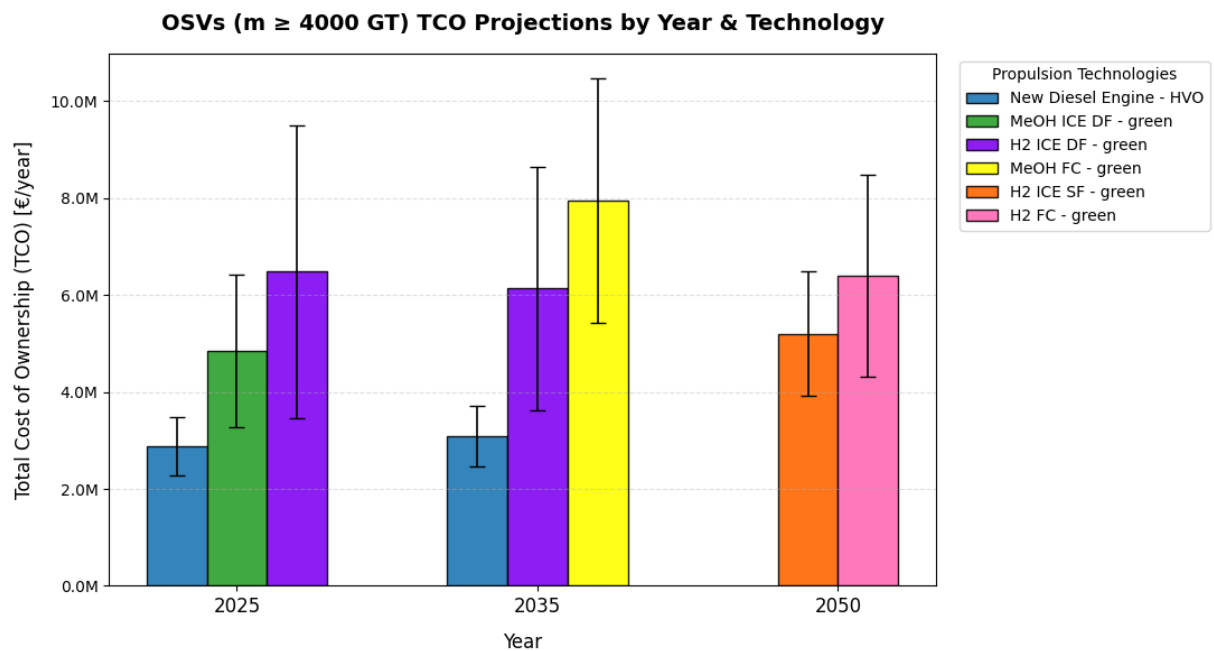


Figure 14, Visualized of the top 3 most cost-effective technologies for the vessel type OSVs (m ≥ 4000 GT) calculated in the year 2025, 2035 and 2050.



Table 19, 20Fishing Vessels VL0012:

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	16126	24739	20433
2	Battery system (all)-green	17940	26845	22393
3	MeOH ICE DF - green	29324	46082	37703
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	Battery system (all)-green	16284	23805	20045
2	New Diesel Engine - HVO	16700	25421	21061
3	H2 ICE DF - green	30561	54492	42527
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	Battery system (all)-green	17940	26845	22393
2	H2 ICE SF - green	31124	60210	45667
3	H2 FC - green	43401	78682	61042

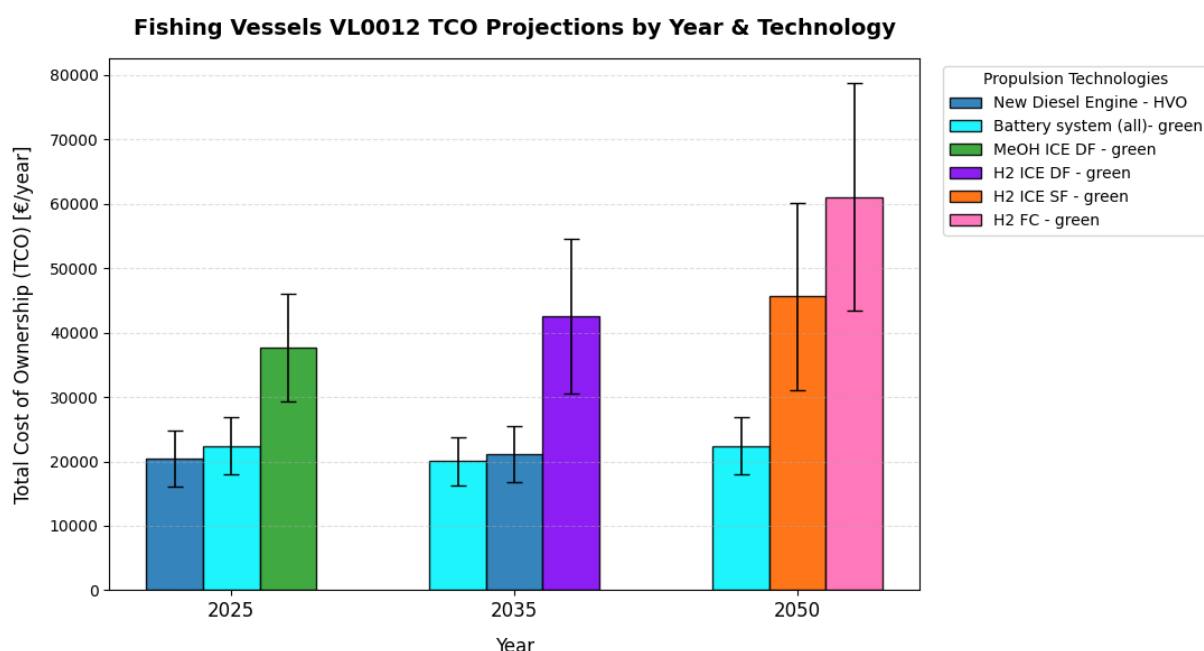


Figure 15, Visualized of the top 3 most cost-effective technologies for the vessel type Fishing Vessels VL0012 calculated in the year 2025, 2035 and 2050.



Table 21, Fishing Vessels VL1224:

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	39053	59949	49501
2	Battery system (all)-green	49375	74114	61745
3	MeOH ICE DF - green	65341	111044	88193
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	41208	62508	51858
2	Battery system (all)-green	43374	63036	53205
3	H2 ICE DF - green	69320	138094	103707
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	Battery system (all)-green	35517	49478	42498
2	H2 ICE SF - green	72088	110730	91409
3	H2 FC - green	72564	120122	96343

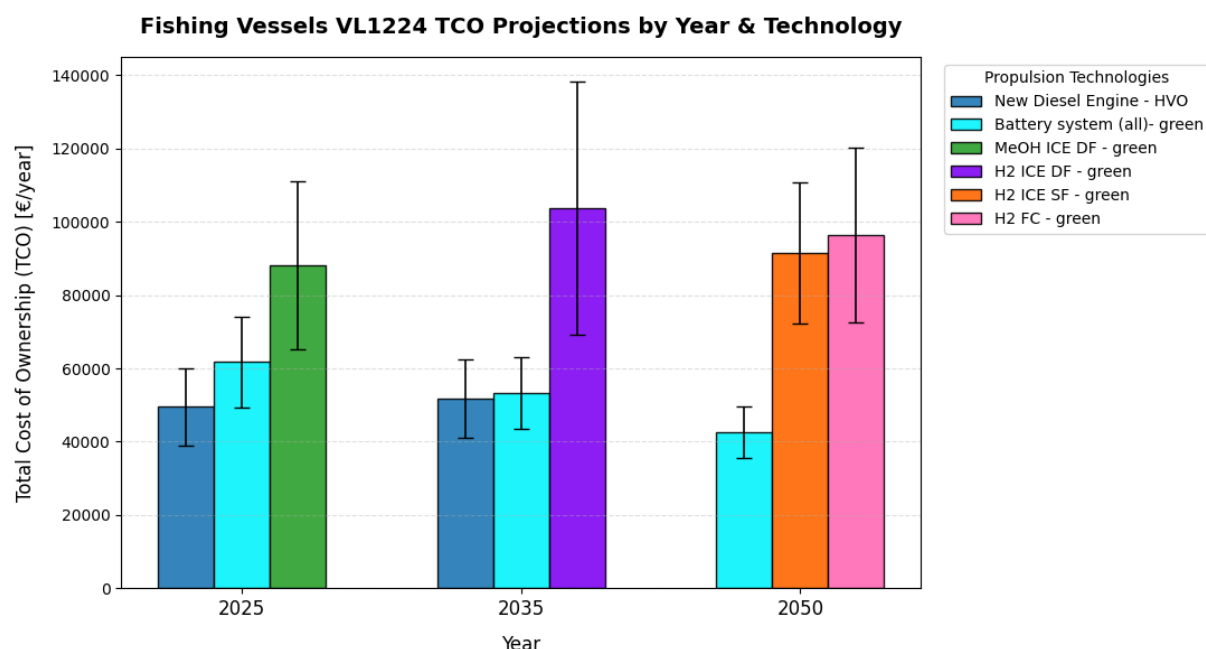


Figure 16, Visualized of the top 3 most cost-effective technologies for the vessel type Fishing Vessels VL1224 calculated in the year 2025, 2035 and 2050.



Table 22, Fishing Vessels VL2440:

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	165201	253134	209168
2	MeOH ICE DF - green	232468	466798	349633
3	H2 ICE DF - green	247094	700478	473786
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	180426	271214	225820
2	H2 ICE DF - green	258489	635752	447121
3	MeOH FC - green	386732	758992	572862
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	H2 ICE SF - green	281828	471702	376765
2	H2 FC - green	310663	619710	465187

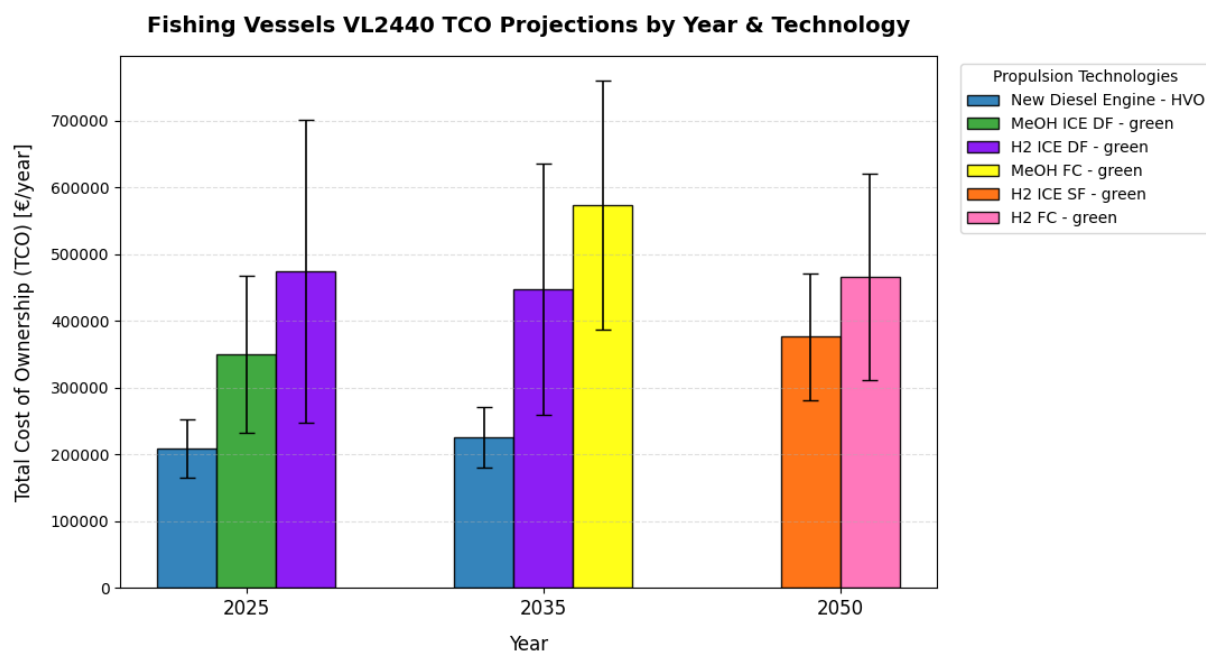


Figure 17, Visualized of the top 3 most cost-effective technologies for the vessel type Fishing Vessels VL2440 calculated in the year 2025, 2035 and 2050.



Table 23, Fishing Vessels VL40XX:

2025	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1183617	1812864	1498241
2	MeOH ICE DF - green	1595340	3342232	2468786
2035	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	New Diesel Engine - HVO	1302835	1954436	1628636
2	MeOH FC - green	4313408	9011848	6662628
2050	Technology	Minimum TCO price scenario	Maximum TCO price scenario	Average TCO price scenario
1	No technology possible	-	-	-

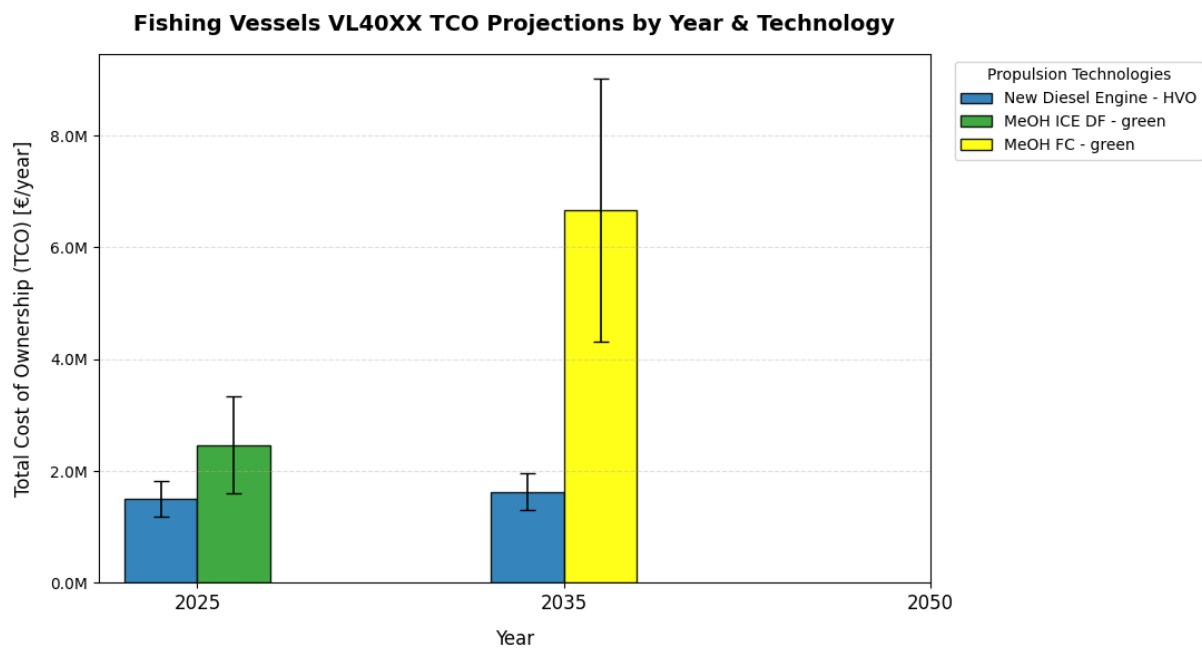


Figure 18, Visualized of the top 3 most cost-effective technologies for the vessel type Fishing Vessels VL40XX calculated in the year 2025, 2035 and 2050.



Annex II: IWT Policy roadmap input

A1.1 Insights from SYNERGETICS WP1 and mid-term conference

Within the SYNERGETICS Exploration phase (Work Package 1) Deliverable 1.3 "Report on Scenarios" the analyses were made and presented of relevant regulations for the emission reduction in IWT. Conclusions were also drawn from the assessment which led to recommendations for the policy roadmap. The results were also presented and discussed with the stakeholders during the mid-term conference in Brussels in 2024. The following conclusions and recommendation are highlighted based on the Deliverable 1.3 report.

1. Set clear, binding EU-level decarbonisation targets for IWT

Key recommendation

- The EU lacks a dedicated, binding emission-reduction target for IWT comparable to road transport or large maritime vessels.
- The CCNR Mannheim Declaration ($\geq 90\%$ reduction by 2050 vs. 2015) is currently the only framework with quantified targets, but it is not EU-binding and based on Tank-to-Wake accounting. A revision and update of the CCNR study and roadmap is expected by 2027.

Roadmap implication

- Establish an EU-wide IWT climate target
 - $\geq 90\%$ GHG reduction by 2050
 - With intermediate milestones (2030 / 2035 / 2040)
- Clarify scope consistency (Tank-to-Wake vs. Well-to-Wake) across all instruments.

2. Harmonise and strengthen Member State implementation (avoid "bunker tourism")

Key recommendation

RED-III and ETS-2 give Member States large freedom which results in severe risk of fragmented implementation resulting in market disruption undermining the desired impact of RED-III and ETS-2 policies. Divergent national choices already create competitive distortions and emission leakage (bunkering in low-regulation countries).

Roadmap implication

- Strong EU coordination mechanism for both RED-III implementation in IWT and for ETS-2 "opt-in" for inland navigation fuel supply
- Encourage corridor-level alignment (Rhine, Danube, Seine-Scheldt, etc.), including non-EU countries.
- Use TEN-T governance to enforce harmonisation.



3. Use carbon pricing as a cornerstone, coupled with earmarked return flows

Key recommendation

- Lack of a business case is the core bottleneck for emission reduction and energy transition.
- ETS (and ETS-2) is seen as the most effective instrument to internalise external costs of GHG emissions.
- The Dutch example shows how ETS-2 revenues can be recycled back into the sector.

Roadmap implication

- Promote EU-wide ETS-2 inclusion of IWT fuel supply.
- Mandate or incentivise earmarking ETS revenues for: Vessel retrofitting (CAPEX + OPEX), Zero-emission pilots, Infrastructure rollout
- Avoid relying only on investment grants; OPEX support is essential.

4. Accelerate infrastructure deployment via AFIR + RED-III + funding synergies

Key recommendation

- Infrastructure availability is as critical as vessel technology.
- AFIR and RED-III are complementary but uptake is slow due to weak national execution.

Roadmap implication

- Prioritise: Shore power in inland ports, Electricity charging hubs, Hydrogen and methanol bunkering where relevant
- Combine: AFIR obligations, CEF-AFIF, Innovation Fund, RRF, National co-financing

5. Remove regulatory bottlenecks for hydrogen and methanol

Key recommendation

- NRMM and ES-TRIN regulations do not recognise hydrogen and methanol as standard fuels.
- This blocks engine certification and market uptake, especially for combustion-based transition solutions.

Roadmap implication

- Urgent revision of NRMM regulation: Recognise hydrogen and methanol as reference fuels
- Align ES-TRIN, NRMM, and safety regulations
- Avoid forcing premature "single-solution" pathways; support multi-fuel transition phase.

6. Maintain technology neutrality and avoid lock-in

Key recommendation

- No "one-size-fits-all" solution exists due to vessel diversity and different operational profiles and energy availability constraints
- Over-reliance on drop-in biofuels (e.g. HVO) is risky due to feedstock scarcity.

Roadmap implication

- Keep multiple pathways open in parallel: Battery-electric (where operationally suited), Hydrogen, E-/bio-methanol, E-/bio-methane
- Avoid policy-induced technology lock-in.
- Prioritise flexible and hybrid solutions during transition.



7. Integrate energy efficiency as a first policy pillar

Key recommendation

- Avoiding energy use is more cost-effective than replacing energy sources.
- Energy efficiency reduces: OPEX, Infrastructure needs and Renewable energy demand

Roadmap implication

- Introduce energy-efficiency targets or standards for IWT, analogous to EEDI in maritime shipping (as being developed in PLATINA4Action).
- Support: Hull optimisation, Propulsion efficiency and Digital voyage optimisation
- Link efficiency improvements to funding eligibility.

8. Shift focus from tank-to-wake to full life-cycle performance

Key recommendation

- Upstream emissions (WTT), material use, water consumption and manufacturing impacts are increasingly dominant.
- Current legislation is inconsistent in scope (TTW vs WTW), creating perverse incentives.

Roadmap implication

- Gradually align all IWT policies to Well-to-Wake accounting. Use: RED-III, CountEmissionsEU, CSRD / ESRS
- Explicitly address: green hydrogen water demand as well as battery material and recycling impacts seen the impact on the overall Life Cycle of these technologies and energy sources

9. Address the “chicken-and-egg” problem through coordinated public leadership

Key recommendation

- Market actors will not move first due to high risk and uncertainty.
- Many Member States lack concrete national action plans for IWT.

Roadmap implication

- Stronger role for: EU and national governments as first movers and public fleet commitments
- Combine: Infrastructure funding, Early-user support, Regulatory certainty
- Treat IWT as strategic infrastructure, not a niche market. This element became even more prominent in view of the Military Mobility Package from November 2025 and opportunities for the Dual-Use of inland waterway infrastructure, vessels and ports.



10. Close the policy gap between IWT and road / large maritime transport

Key recommendation

- IWT and small vessels face fewer binding obligations than road transport and >5000 GT ships.
- This undermines modal shift and long-term competitiveness.

Roadmap implication

- Ensure comparable regulatory pressure across modes.
- Reinforce the “polluter pays” principle consistently.
- Align emission pathways so that IWT remains a credible low-carbon alternative.

A1.2 NAIADES III and Expert Group / stakeholder views

A monitoring report was made about the NAIADES III Action Plan and members of the Expert Group for the implementation of NAIADES III have provided input and concerns regarding the progress on goals set by NAIADES III. The PLATINA4Action consortium prepared a document to present a structured overview/ Below the conclusion and recommendations are highlighted based on this document which are relevant for the topic of emission reduction and energy transition of IWT.

1. Create a credible economic case for zero-emission vessels

The transition is blocked primarily by unfavourable CAPEX and OPEX economics for zero-emission solutions compared to diesel.

Policy implications:

- Internalise external costs of fossil fuels in IWT via RED III, ETS2 (opt-in), Taxonomy, CSRD, coordinated across neighbouring countries to avoid bunker tourism.
- Ensure earmarking of revenues (e.g. ETS-related) back into fleet transition and infrastructure.
- Combine EU instruments (CEF/AFIF, Innovation Fund) with national funding to bridge CAPEX and early OPEX gaps.

2. Align and simplify the State aid framework for inland shipping

Current State aid rules are fragmented, complex, and often ill-suited to IWT investment profiles.

Policy implications:

- Adapt GBER, CEEAG, TBER and LMTG to explicitly accommodate inland vessels and ports.
- Increase aid ceilings and reduce notification burdens for: Zero-/low-emission vessel investments and for Alternative fuels and charging/bunkering infrastructure
- Ensure technological neutrality, focusing on carbon intensity rather than fuel type.



3. Remove regulatory bottlenecks for alternative fuels and innovative vessels

Existing technical legislation significantly delays market uptake.

Policy implications:

- Revise Directive (EU) 2016/1629 and its interaction with NRMM Regulation (EU) 2016/1628 to allow routine use of alternative fuels (e.g. methanol, hydrogen) and to reduce reliance on ad-hoc derogations
- Accelerate CESNI standards and alignment with EU legislation to enable serial deployment, not only pilots.

4. Accelerate roll-out of alternative fuels and electricity infrastructure

Lack of infrastructure remains a decisive barrier.

Policy implications:

- Ensure full IWT inclusion in AFIR implementation, including: Shore-side electricity, Battery charging and swapping, Hydrogen and methanol bunkering
- Prioritise corridor-based deployment covering the entire navigable network, not isolated ports.
- Support ports as energy hubs linking grids, vessels and logistics chains.

5. Establish a robust, low-burden emission measurement and labelling system

Reliable and comparable data is essential for market pull and regulation.

Policy implications:

- Finalise an internationally harmonised emission and energy-efficiency label for inland vessels via CESNI/CCNR.
- Ensure consistency between: Vessel labels, CountEmissionsEU, CSRD and EU Taxonomy requirements
- Minimise reporting burden, especially for SMEs, through default values and streamlined tools.

6. Use demand-side measures to stimulate market uptake

Supply-side support alone is insufficient.

Policy implications:

- Mandate or incentivise use of emissions disclosure and carbon footprint information in logistics decisions.
- Enable shippers to recognise and reward low-emission IWT solutions.
- Link emission performance to public procurement, port dues, and logistics contracts where feasible.

7. Ensure long-term, predictable governance and financing

Fragmentation and uncertainty slow investment decisions.

Policy implications:

- Develop a stable EU investment framework for IWT energy transition post-2027 (2028–2035).
- Simplify access for SMEs and family-owned operators.
- Strengthen coordination between the European Commission, Member States, River Commissions and sector organisations to maintain a level playing field.



Roadmap relevance – bottom line

Concluding: The NAIADES Expert Group clearly indicates that technology readiness is not the main bottleneck. The decisive levers for a policy roadmap lie in the following elements:

- Economics (pricing, funding, cost internalisation)
- Regulatory fitness (technical rules, State aid coherence)
- Infrastructure certainty
- Demand creation and transparency
- Long-term policy stability

A1.3 Input from PLATNA4Action and sector statements

The modal share of IWT is at stake because of the slow transition as result of lacking regulations and funding arrangements. While road haulage is steadily phasing out fossil fuels (due to ETS-2), massively moving towards electrification, there is no certainty that IWT can keep up with the development of road haulage. As the GHG and air pollution costs of road haulage will go down drastically, it is expected that the IWT mode will lose the advantage in the benefits to society when cargo and passenger flows are shifted from roads to inland waterways.

However, as IWT as the intrinsic advantage of a high energy efficiency there is a big potential to become competitive again, both in terms of sustainability and also in terms of transport costs. This requires that IWT is set on a path to decarbonise the operations and to reduce the air pollutant emissions at the same time. A large-scale implementation is required of emission reduction solutions in IWT.

Required conditions needed to reach large scale implementation

The PLATINA4Action analysis identifies that the conditions needed for reaching large scale implementation are the following:

- Having a clear view on the policy framework conditions and regulations at EU and MS level for the longer term to ensure that the right investments can be made and creating the market demand
- Having renewable energies supplied to inland waterway transport operators at affordable prices throughout Europe compared to fossil diesel fuel, for the short term a focus on HVO as transitional renewable energy type
- Having available the required energy infrastructure along waterways and in ports
- Having available the technological components at mature and affordable levels with particular attention to making available clean internal combustion engines using renewable hydrogen and methanol (NRMM) and hydrogen fuel cell technology and battery technology.
- Having financial support to overcome the investment barriers for vessel owners as well as new business models supported such as energy-as-a-service



Strategic actions to develop the required conditions

In order to reach these conditions as mentioned above, strategic priority actions have been identified with highest leverage to accelerate the transition. The strategic actions are in-line with the EU sector representative organisations input and commitment as put forward in their input papers for the Sustainable Transport Investment Plan, Industrial Maritime Strategy and Port Strategy of the European Commission.

First of all, there is a clear need for a long-term policy roadmap (e.g. 10-15 years) providing policy certainty. Such a policy roadmap shall address the following needs:

- Level playing field and affordable renewable energy through a binding EU approach for carbon pricing (e.g. ETS-2), promotion of renewable energy & tax reform with earmarking for IWT transition fund, providing a technologically neutral framework for emission reduction
- Development of aggregated financing vehicles & Energy-as-a-Service support and OPEX support
- Shipper-operator platforms and cooperatives for economies of scale and long-term relations
- Accelerated technical standardisation (NRMM amendment for hydrogen and methanol)
- Corridor-based infrastructure masterplans with high 80-100% co-funding to breakthrough the chicken-and-egg dilemma
- Further ES-TRIN development to address gaps in technical regulations
- Continued RD&I funding with structured knowledge transfer
- European emission passport for vessels on transparent methodologies as accompanying and supporting measure