NEWSletter 7

June 2026

SYNERGETICS – **Synergies for Green Transformation of Inland and Coastal Shipping** – the Innovation Action co-funded by the Horizon Europe programme has successfully completed 42 months of establishing synergies for inland and coastal shipping. Based on the sound understanding of the actual possibilities for greening through retrofit, **SYNERGETICS** has developed greening solutions, some of which were tested under real-life conditions, aiming at compliance with the environmental goals of the EU, while at the same time, maintaining the economic competitiveness of the inland and coastal fleets.

Figure 1: The SYNERGETICS consortium at the final event in Vienna in June 2026, which was organized back-to-back with the Danube Business Talks.

While many initiatives to promote greener shipping are already in place, they often operate in isolation and lack effective coordination. **SYNERGETICS** managed to address this challenge by connecting knowledge, technologies, and expertise across sectors and European regions, fostering a more integrated and collaborative approach to sustainable shipping. This was achieved by bringing together: research institutions, innovation centres, shipping companies, shipyards, technology providers, regulatory authorities, and industry associations.

The **key results** with respect to reduced fuel consumption and emissions are summarized as:

- Hydrodynamic optimization demonstrated the potential to lower energy demand on inland vessels by 15–35%.
- Hydrogen dual-fuel engine conversions significantly reduced diesel consumption and particulate emissions.
- Methanol-based propulsion systems proved to be a promising low-emission solution for inland waterway transport once regulatory barriers are removed.

As practical alternatives to conventional diesel propulsion, the project successfully explored and demonstrated several **innovative technologies**, including:

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- battery-electric propulsion systems;
- hydrogen dual-fuel engines;
- methanol-powered drives;
- hybrid propulsion configurations, and
- digital optimization technologies for improved operational efficiency.

A key conclusion of **SYNERGETICS** is that retrofitting existing vessels can often provide a cost-effective pathway to decarbonization, while still delivering substantial environmental benefits.

SYNERGETICS demonstrated that green shipping technologies are ready for practical application by testing them on modernized vessels in real operating conditions. The **demonstrators** included hydrogen dual-fuel engine conversion (Volvo Penta on test bed and MAN for Hydrocat 48), simulations of a methanol-powered Danube push-boat (Bad Deutsch-Altenburg) and different methanol combustion concepts on test beds, hydrodynamic optimization and development of a new powertrain for a cargo vessel (Ernst Kramer), improved onboard power management, and the use of modular battery systems (ZES-Zero Emission Services).

To support the wider adoption of the innovations elaborated and brought together, the project developed a set of practical tools for the inland and coastal shipping sectors. The **Catalogue of Greening Solutions** provides an overview of retrofit technologies, including their maturity, costs, and infrastructure needs. The **Shipowners Handbook** offers practical guidance on implementation, operational impacts, and approval procedures. In addition, the **Decision Support Tool** helps shipowners identify suitable modernization options and make informed investment decisions based on the characteristics of their vessels. Finally, **future-oriented scenarios** support regulatory and industry decision-making, accelerating the uptake of sustainable retrofit alternatives. These tools are available free of charge and will be kept alive at the project website: https://www.synergetics-project.eu/tools/

Activities

Work Package 4 – Model for a standardised procedure for regulatory approval of greening retrofit solutions

This deliverable of WP4, Task 4.5, outlines the overview of the existing and near future legal framework and it also addresses the regulatory bottlenecks that hinder the accelerated adoption of greening retrofit solutions for inland navigation vessels and coastal navigation ships in European Union (EU) territory.

The objective is to provide suggestions for streamlining approval procedures, identify gaps in existing regulations and provide clear guidance for applicants seeking approval for innovative, zero-emission technologies. Considering the international bodies governing the respective legal frameworks (EU/CCNR/CESNI for inland navigation vs. IMO for maritime shipping) the focus is more on the challenges and issues specific to inland navigation vessels, where in particular ES-TRIN is under continuous development and already covers some provisions for alternative fuels.

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

Key regulatory frameworks for coastal ships consist of International Maritime Organisation (IMO) Conventions and Codes which provide safety and environmental standards for ships using alternative fuels.

However, prescriptive regulations for methanol and hydrogen are still under development. Coastal ships operating within EU territory are also subject to EU legislative (directives and regulations) while Member States are allowed to impose additional national rules.

Major bottlenecks that have been found for the inland navigation sector include the lack of detailed mandatory regulations for alternative fuels such as methanol and hydrogen, resulting in reliance on interim guidelines and case-by-case

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

Based on the current situation, recommendations for policy makers are:

- derogation procedures could be simplified by empowering competent authorities/inspection bodies to issue Union inland navigation certificates based on consensual technical assessment (CESNI) to reduce reliance on lengthy European Commission implementing acts;
- align the timelines and conditions for derogations under Directive (EU) 2016/1629 and Regulation (EU) 2016/1628 to minimise administrative delays;
- consistent standards for alternative fuels need to be ensured by fostering a coordinated regulatory approach between Directive (EU) 2016/1629, Regulation (EU) 2016/1628 and ADN Agreement;
- level playing field needs to be created by harmonising national regulations on fuel taxation, emission trading and infrastructure deployment;
- support infrastructure development and break the "chicken-and-egg" dilemma by incentivising the deployment of alternative fuel infrastructure and encouraging Member States to cooperate on strategies for alternative fuel supply and infrastructure;
- promote knowledge sharing by developing comprehensive guidance documents for applicants based on best practices from existing projects and facilitate early and close interaction between vessel owners, manufacturers and approval authorities to clarify requirements and expedite approvals.

The transition to zero-emission inland and coastal shipping is impeded by regulatory fragmentation, complex approval processes, and infrastructure gaps. Addressing these challenges requires harmonized standards, streamlined procedures, and targeted policy interventions, demanding collaboration among stakeholders and aligning regulatory frameworks.

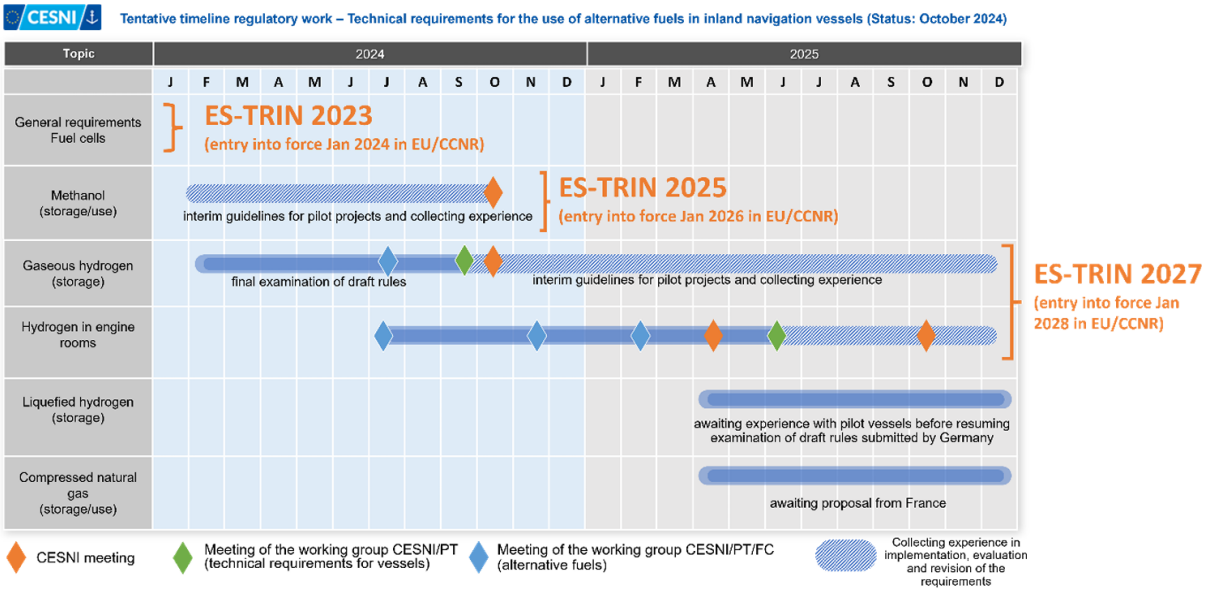

Figure 2: CESNI - tentative timeline for regulatory work concerning alternative fuels (October 2024 - https://www.cesni.eu/en/technical-requirements/)

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Work Package 4 – The Catalogue of Greening Retrofit Technologies

The **SYNERGETICS** Innovation Action aims to accelerate the green transformation of European inland and coastal shipping through the implementation of retrofit solutions. Within Work Package 4, the knowledge generated in the previous work packages was consolidated into a dynamic database, the Catalogue of Greening Retrofit Technologies.

Rather than providing a static overview, the Catalogue was designed as a flexible and continuously updated database to reflect the rapid technological progress in the field of sustainable shipping. It serves as a practical toolbox for a wide range of applications and stakeholders, both within and beyond the **SYNERGETICS** project.

The Catalogue complements Deliverable D4.2, "Fact Sheets of the Most Promising Retrofit Measures," which provides detailed information on the following retrofit technologies: methanol internal combustion engines (ICE), hydrogen ICE, drop-in fuels, batteries, hydrodynamic improvements, solar energy, electrification of propulsion, and fuel cells. Where relevant, each technology is assessed with respect to technical characteristics and physical properties, emission performance, regulatory frameworks for inland and seagoing vessels, onboard integration concepts, bunkering and infrastructure requirements, economic aspects, deployment considerations, and practical implementation examples.

In addition, the document summarizes the numerical data currently applied in the **SYNERGETICS** assessment tools. Estimating reliable retrofit costs remains challenging, as most green technologies—apart from drop-in fuels—have not yet reached widespread commercial deployment in the shipping sector. While many individual components are commercially available, complete onboard systems often still have a prototype or demonstration character. Cost estimates were therefore compiled from a combination of internal and external sources, validated through discussions with technology providers, and refined in dedicated stakeholder workshops. The database will be continuously updated as new market data and operational experience become available.

Beyond technology costs, the Catalogue also includes emission factors for different energy carriers and fuel pathways. As no harmonized methodology for calculating well-to-tank emissions currently exists, various approaches and data sources are compared. Future updates of the database will seek alignment with the emission factors provided by EcoTransIT World and the emerging ISO 14083 standard for greenhouse gas accounting in transport.

Furthermore, the Catalogue incorporates operational cost data for the different retrofit technologies. Overall, the **SYNERGETICS** consortium aimed to establish harmonized, transparent, and realistic assumptions that balance technical accuracy with practical applicability, thereby providing a robust basis for the project's assessment tools and future decision-making processes.

Table 1: Example of data in the Catalogue relating to equipment costs for inland vessels.

Equipment Cost	min	max
DPF&SCR,	82	115
Battery [€/kWh]	300	650
Electric engine [€/kW]	150	250
MEOH ICE [€/kW]	500	600
MEOH ICE Dual Fuel [€/kW]	500	600
H2 ICE [€/kW]	600	900
H2 ICE Dual Fuel [€/kW]	600	900
Stage V+, Euro VI ICEs [€/kW]	350	590
MEOH FC with reformer [€/kW]	2000	3000
H2 Fuel Cell [€/kW]	1500	2500
H2 Tank (350 and 500 bar) [€/kg]	500	800
Unregulated, CCNR1 and CCNR2 ICEs	150	200
Methane ICE	450	450

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Work Package 5 – Decision Support Tool for Vessel Owners

The **SYNERGETICS** Decision Support Tool for Vessel Owners is a specific tool made for owners of inland and coastal vessels. The inland vessels tool and coastal vessels tool are accessible from the same weblink. To access the tools the following link can be used which will then guide the user to the version for inland vessels or the version for coastal vessels:

https://www.synergetics-project.eu/dstool

The tool is also accessible via the Tools section of the **SYNERGETICS** website:

https://www.synergetics-project.eu/tools/

Give it a try and chose your tool!

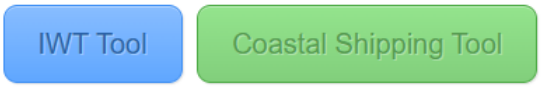

Figure 3: Interface for activation of the decision support tools for owners of inland and coastal vessels.

The **SYNERGETICS** decision support tool follows a step-by-step approach, guiding users through the required input parameters and presenting the resulting retrofit options in a structured and transparent manner. During its development, particular emphasis was placed on achieving an appropriate balance between user-friendliness and the complexity required for accurate technical and economic assessments. To support users, the tool includes an integrated user manual as well as context-sensitive information boxes that provide explanations and practical guidance. The underlying calculations are based on the data compiled in the **SYNERGETICS** Catalogue and on methodologies developed within the project.

Special attention was given to the dimensions and weight of renewable energy propulsion systems, enabling the assessment of potential payload losses and the monetisation of their economic impacts. Similarly, the effects of additional bunkering or charging times on vessel productivity are explicitly considered. The validation of the data used within the tool is documented in the Catalogue of Greening Retrofit Technologies. In addition, extensive research on future energy price scenarios has been carried out and incorporated into the assessment framework.

The tool considers both vessel-specific and operational characteristics, including fleet family, operational profile, required autonomy, and annual energy demand. Innovative business models are also included, such as pay-per-use concepts for swappable battery containers and swappable hydrogen Multi-Element Gas Containers (MEGCs), which can significantly reduce the upfront investment required from vessel owners.

The primary objective of the tool is to provide vessel owners with an initial assessment of suitable technologies and energy carriers for achieving their emission reduction goals. Users can define their desired emission reduction target, and the tool identifies retrofit solutions capable of meeting these requirements. The shortlisted options are subsequently ranked according to their overall costs.

The following retrofit technologies and fuel options are currently included:

- modern diesel engines equipped with exhaust after-treatment systems, including selective catalytic reduction (SCR) and diesel particulate filters (DPF);
- diesel engines operating on renewable diesel (HVO100);
- methane combustion engines using liquefied natural gas (LNG) or liquefied biomethane (Bio-LNG);
- methanol combustion engines in both single-fuel and dual-fuel configurations, using either conventional or renewable methanol;
- hydrogen combustion engines in both single-fuel and dual-fuel configurations, using grey or green hydrogen supplied either through shore-based bunkering or via swappable hydrogen tank containers;
- full electric propulsion based on hydrogen fuel cells combined with fixed battery systems, using grey or green hydrogen supplied through bunkering or swappable tank containers;
- full battery-electric propulsion with fixed onboard batteries and shore-based fast charging infrastructure;
- full battery-electric propulsion based on swappable battery containers operated under a pay-per-use business model.

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The tool provides detailed results in the form of tables and graphical visualisations, all of which can be exported and stored locally in MS Word, PDF, and CSV formats. Full transparency of the underlying assumptions and input data is ensured. In addition, users are provided with follow-up guidance through direct references to the **SYNERGETICS** Catalogue, the technology fact sheets, and the Handbook for the Implementation of Greening Retrofit Solutions.

As a final step, vessel owners are encouraged to consult shipyards and technology suppliers to obtain project-specific technical advice and detailed cost quotations for the selected retrofit options.

To ensure the long-term sustainability of the decision support tool, DST and SPB/EICB will continue their close collaboration beyond the duration of the **SYNERGETICS** project. Their joint activities will focus on maintaining, updating, and further developing both the underlying database and the assessment tool. Several funding opportunities for this continuation have already been identified, including future Horizon Europe Innovation Actions, dedicated national funding schemes in Germany, the forthcoming Dutch maritime decarbonization program, with a budget of approximately EUR 240 million, as well as support through the EICB Innovation Lab and the Port of Rotterdam.

Work Package 5 – Updated Transition Pathways & Landscape of Synergies

This report describes the Updated Transition Pathways & Landscape of Synergies for decarbonizing inland waterway transport (IWT) and coastal shipping. The assumptions and scenarios from the 2021 CCNR Roadmap are revised and insights from STEERER, NEEDS, and other EU initiatives are integrated. For each technology the latest developments are summarized and the latest findings on costs and emission factors are used. Prices of energy carriers were modelled based on the World Energy Outlook 2024 published by the International Energy Agency. For the analyses reported here, mainly the Stated Policies Scenario (STEPS) and the Net Zero Emissions by 2050 (NZE) Scenario were used. The Announced Pledges Scenario (APS) is described as well, but corresponding results are left out of the report for better clarity.

The NEEDS model was used to calculate the development of technology shares for a set of vessels on pre-defined routes. Since the energy prices in each scenario are provided with a bandwidth, the simulations were performed for the STEPS and NZE scenarios with combinations of the minimum prices for conventional fuels and the maximum prices for alternative fuels and vice versa. In addition, the influence of a 60 % CAPEX funding is examined.

The Landscape of Synergies section examines the interdependencies between policy, technology, and infrastructure. It notes that the adoption of hydrogen, methanol, and battery-electric propulsion is influenced by regulatory frameworks, infrastructure availability, and economic factors. For instance, the lack of bunkering facilities for hydrogen and methanol, as well as the need for standardized charging infrastructure for battery-electric systems, are key barriers to their widespread adoption.

The report suggests that a coordinated approach is necessary to address the economic, regulatory, and infrastructure challenges of decarbonization. This includes measures such as introducing carbon pricing, providing financial (and fiscal) incentives, accelerating infrastructure development, harmonizing regulations, and fostering collaboration among stakeholders.

The report also emphasizes the importance of timely action. Given the long lifetimes of ships and technologies, delays in policy implementation could hinder progress toward the 2050 targets. The **SYNERGETICS** Expert Scenario demonstrates that, with the right policy mix, the sector can make significant strides toward its decarbonization goals.

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Work Package 5 – Scenarios for Policy Makers

The **SYNERGETICS** Deliverable D5.3 provides a comprehensive set of policy scenarios and roadmaps to support the decarbonisation of inland waterway transport (IWT) and coastal shipping. The report confirms that while a wide range of clean propulsion technologies is already technically mature, large-scale deployment remains constrained by regulatory complexity, fragmented governance, and absent economic incentives.

A key finding is that the transition is no longer primarily a technological challenge. Zero- and low-emission solutions such as battery-electric propulsion, hydrogen systems, methanol engines, and renewable drop-in fuels (e.g. HVO) are already available or close to market readiness. However, their uptake is limited by a persistent "green premium", driven by high upfront investment costs, higher operational costs, and uncertainty about future energy prices and policy frameworks.

The analysis highlights that under current conditions, zero-emission solutions are not cost-competitive with conventional diesel. Uptake depends heavily on policy intervention, such as carbon pricing for fossil fuels, setting binding targets for emission reduction, providing grants and coordinated infrastructure development. Without such measures, the transition remains limited to a few heavily subsidized pilot projects which stop after the subsidy expires.

The report also shows that there is no single technological pathway for decarbonization. Instead, a technology-neutral and multi-pathway approach is required, reflecting the diversity of vessel types, operational profiles, and regional conditions and requirements. In the short term, renewable drop-in fuels such as HVO can deliver significant emission reductions without major vessel modifications, while longer-term solutions include battery-electric systems, green hydrogen, and methanol-based propulsion.

At the policy level, key barriers include the absence of binding EU-level emission targets for IWT, inconsistent implementation of legislation across Member States, and the bottleneck in the Non-Road Mobile Machinery directive that delays certification of engines using methanol and hydrogen as fuel. In addition, there is a "chicken-and-egg" challenge for investments in production of renewable energy and supply infrastructure along waterways and in ports. Providing a denser infrastructure is however important, because of the lower energy density of most renewable energy solutions. More frequent bunkering or recharging will be needed compared to using (renewable) diesel. The chicken-and-egg dilemma shall be solved by policy makers by ensuring that there is structural demand for renewable fuels in IWT and coastal vessels and providing financial support in the building up of such bunkering and recharging networks for inland and coastal vessels.

To address these challenges, **SYNERGETICS** proposes a comprehensive policy roadmap centred on binding EU targets for IWT and coastal shipping, carbon pricing with revenue recycling, further developed technical regulations, coordinated infrastructure deployment, and targeted financial support for operators. Demand-side measures and improved transparency are also essential to create market incentives.

The report emphasizes that the period 2027-2028 will be a decisive policy window, with key regulatory and funding decisions that will shape the sector's trajectory for the coming decade. Delayed action risks locking in fossil-based solutions and weakening the environmental competitiveness of waterborne transport, which undermines the strategic goal to shift cargo from roads to waterways which still have large unused capacities.

Overall, **SYNERGETICS** concludes that achieving climate neutrality in IWT and coastal shipping is technically feasible but requires coordinated and ambitious policy action. The transition must shift from isolated pilot projects toward a systemic, large-scale approach by means of combining regulation, finance, and infrastructure deployment.

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Work Package 5 – Handbook for Implementation of Greening Retrofit Solutions

This Handbook helps owners and operators of inland waterway and coastal vessels choose practical, retrofit-ready ways to reduce emissions. It translates the technical, regulatory and economic findings of **SYNERGETICS** into guidance that can be applied to existing vessels today.

Its aim is to bridge research and day-to-day decision-making. For each shortlisted retrofit option – alternative fuels, battery-electric propulsion, hybrid concepts and energy-efficiency measures – the Handbook sets out applicability, the regulatory pathway, operational constraints and economic feasibility. Together these allow retrofit choices to be matched to the rules that apply and to the way the vessel is actually operated.

Inland and coastal vessels are treated separately. They sit under different legal frameworks (CCNR/CESNI and the EU NRMM Regulation for IWT; IMO/MARPOL/SOLAS and EU instruments for coastal), face different safety and certification regimes, and differ in autonomy, fuel availability and on-board space. Each chapter is therefore structured around this split between IWT and coastal vessels.

The scope matches the **SYNERGETICS** Catalogue of Greening Retrofit Technologies (WP4) and the Decision Support Tool developed in Task 5.1. The Tool produces a vessel-specific shortlist of economically attractive greening solutions from a few user inputs; the Handbook provides the technical, regulatory and operational depth behind that shortlist. It can be read stand-alone but is primarily designed as the follow-up reference after using the Tool.

The Handbook covers retrofits of existing vessels only and limits itself to technologies whose technology readiness level (TRL) is high enough for near-term deployment or full-scale demonstration. Most of these measures are still voluntary today, but will become increasingly difficult to avoid as EU, IMO and national emission rules tighten.

A wide range of greening retrofit solutions is addressed, including:

- engine renewal to modern emission standards (NRMM Stage V for IWT, IMO Tier III and ULEV concepts for coastal vessels);
- exhaust after-treatment solutions such as SCR and DPF systems;
- renewable and low-carbon drop-in fuels, notably HVO, with discussion of future e-diesel pathways;
- full and hybrid battery-electric propulsion concepts, including fixed and swappable battery systems;
- methanol solutions (single-fuel ICE, dual-fuel ICE, and methanol fuel cells);
- hydrogen solutions (combustion engines and fuel cells, with fixed or swappable storage);
- methane solutions, including LNG and bio-LNG;
- complementary energy-efficiency measures, such as solar panels and hydrodynamic improvements.

To reflect the strong diversity of the European fleet, the Handbook applies the concept of "fleet families". This approach groups vessels with similar characteristics and operational constraints, enabling more targeted guidance. For IWT vessels, the fleet families follow established classifications developed by CCNR-related studies, while for coastal shipping **SYNERGETICS** provides one of the first structured compilations.

Each technology chapter contains a dedicated regulatory assessment. For inland navigation this means the interaction of ES-TRIN, the ADN, and the NRMM Regulation, including the derogation routes used for innovative fuels such as methanol and hydrogen. For coastal vessels this means the layered framework of IMO instruments (MARPOL, SOLAS, IGF Code), EU instruments (MRV, EU-ETS, FuelEU Maritime), and flag-state requirements. Approval pathways, safety-assessment processes and the consequences for certification are described where relevant.

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No single solution fits every vessel. In short: HVO is the easiest drop-in for much of the existing fleet; battery-electric is best where routes are short, fixed and have predictable port calls (ferries, certain inland container ships); methanol and hydrogen offer long-term decarbonization but at higher CAPEX, with extra safety measures and more complex approvals; LNG is a short-term transitional fuel, while Bio-LNG remains relevant in the medium and long term, especially for high-energy-demand vessels with room for cryogenic tanks.

Energy efficiency is treated as an enabler for every other pathway, not an alternative. Hydrodynamic optimization, propeller upgrades and aft-ship replacement reduce energy demand, which in turn cuts operating cost and downsizes the alternative-fuel or energy-storage system needed. Efficiency is therefore presented as a synergetic measure for cost-effective decarbonization.

The main aim of **SYNERGETICS** is to achieve emission reductions. The technologies and solution presented in the Handbook have different impacts on emissions. The Handbook shows that emission savings vary strongly by technology and by vessel type, and that the biggest gains are achieved when the technology matches the vessel's route, power demand and available infrastructure.

Work Package 6 – Teaching Material

The **SYNERGETICS** Teaching Module Series aim to make the project's results broadly accessible as free, reusable teaching material.

The material is designed for lecturers at Bachelor and Master level across multiple disciplines — including engineering (naval architecture, mechanical, electrical), economics, energy and environmental technology, and policy-related programmes. Secondary audiences include ship crews and industry decision-makers.

The modules are organized as a matrix. Thematic sections (rows of the matrix) cover topics such as energy carrier production or demonstrator projects, while columns differentiate between three renewable energy carriers: electricity, hydrogen, and methanol. This creates targeted modules for specific discipline-topic combinations. Where a split by energy carrier is not meaningful, a single "Section Block" module covers the entire topic.

Table 2: Presentation of **SYNERGETICS** teaching material in matrix format.

ID	Section Topic / Energy Carrier	A Modules Electricity	B Modules Hydrogen	C Modules Methanol	SB
1	Intro / How to use the Material				SB.1
2	IWT and Coastal Shipping: Greening Potential for Retrofit				SB.2
3	Production and Supply of Energy Carrier (WTT)	A.3	B.3	C.3	
4	Alternative Energy Carriers for Inland and Coastal Shipping (TTW and WTW)	A.4	B.4	C.4	
5	Propulsion and Storage Technology on Ship, Energy Carrier Handling	A.5	B.5	C.5	
6	Selected Demonstrators	A.6	B.6	C.6	
7	Hydrodynamic Improvements				SB.7
8	Regulatory Framework Technology Application	A.8	B.8	C.8	
9	Implementation of Greening Technologies for IWT, incl. ship crews				SB.9
10	Economics and Scenarios				SB.10

Each module is a self-contained PowerPoint file that can be used independently, combined with others into a full course, or integrated as a single-lesson add-on. Users may supplement slides with their own content but should not alter the original text or figures. All materials are free of charge; partial use requires citation of the source.

The modules are complemented by the **SYNERGETICS** online Catalogue of Greening Retrofit Solutions, the **SYNERGETICS** Handbook for Implementation of Greening

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Retrofit Solutions, the Decision Support Tool and policy scenarios, all available at www.synergetics-project.eu/tools, supporting both classroom teaching and self-study.

Are you interested? Get free access to the Teaching Material by contacting

elimar.frank@ost.ch.

Events

Final Event

On 10 June 2026, the Innovation Action **SYNERGETICS** held its final event in Vienna back-to-back with the **Danube Business Talks**, bringing together project partners, stakeholders and experts to reflect on more than three years of collaboration dedicated to the decarbonization of inland and coastal shipping.

Figure 4: The **SYNERGETICS** consortium at the final event in Vienna in June 2026, which was organized back-to-back with the Danube Business Talks (left). The project coordinator of **SYNERGETICS**, **Benjamin Friedhoff (DST)**, moderating the final event (right).

Following 42 months of intensive work, **SYNERGETICS** has successfully demonstrated that retrofitting existing inland and coastal vessels can provide an economically attractive and effective pathway towards reducing emissions while maintaining the competitiveness of European fleets.

Key results showed significant potential for reducing fuel consumption and emissions. Hydrodynamic optimization measures achieved energy savings of 15–35%, while hydrogen dual-fuel operation significantly reduced diesel consumption and particulate emissions. Methanol-based propulsion systems also proved to be a promising low-emission option for inland navigation.

Participants were welcomed on board the viadonau demonstrator vessel Bad Deutsch-Altenburg in the morning, which was presented by **Cristian Chirita (viadonau).** After the visit to the vessel, the project's final activities and achievements were discussed during the sessions held at Tech Gate Vienna.

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Figure 5: The demonstrator pusher Bad-Deutsch-Altenburg hosting the arrival of the **SYNERGETICS** consortium.

Figure 6: **Martin Quispel (EICB)** presenting the **SYNERGETICS** greening scenarios and how to accelerate their implementation (left). **Daan Siebenheller (EICB)** demonstrating the application of the Decision Support Tool for Vessel Owners (right).

The afternoon program featured two „Landscapes of Synergies" panel discussions, which provided an opportunity to look beyond the project itself and discuss the broader framework required for the successful green transition of inland and coastal shipping.

The first panel, Policy, Regulations and Applied Science, moderated by **Prof. Elimar Frank (OST)**, brought together representatives from the European Commission, the Central Commission for the Navigation of the Rhine and industry. **Muhammed Elemenler (European Commission)**, **Benjamin Boyer (CCNR)** and **Igor Sauperl (LEC GmbH)** discussed the importance of aligning research, regulation and technological development to accelerate the deployment of low-emission solutions and to create a supportive framework for innovation.

The second panel, European Greening Retrofit Projects, moderated by **Niels Kreukniet (EICB)**, focused on experiences and lessons learned from several European initiatives. **Alessandro Iafrati (CNR, RETROFIT55)** and **Benjamin Friedhoff (DST)** exchanged views on retrofit pathways, alternative fuels and the importance of cooperation between projects in order to maximize impact and support the transition towards climate-neutral waterborne transport.

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Figure 7: **Igor Bačkalov (DST)** initiating the panel discussions of the afternoon session (left). **Elimar Frank (OST)**, **Benjamin Boyer (CCNR)**, **Igor Sauperl (LEC)** and **Muhammed Elemenler (European Commission)** in a vivid discussion on policy, regulations, and applied science.

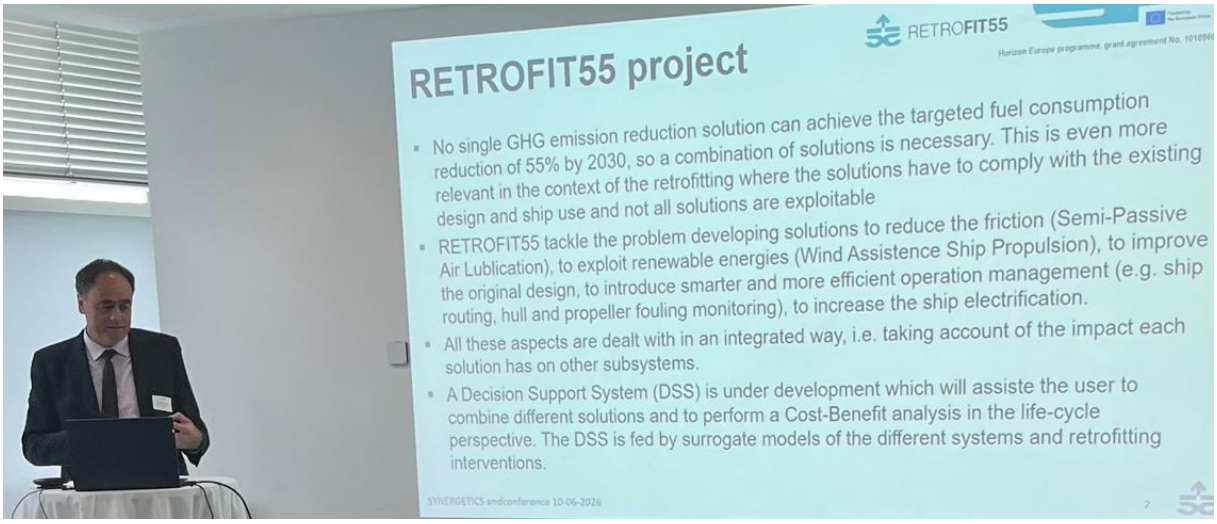

Figure 8: **Alessandro Iafrati (CNR)** presenting the outcomes of the RETROFIT55 project.

Beyond the demonstrations, the project developed a number of practical tools to support the large-scale uptake of retrofit solutions in inland and coastal shipping.

The **Catalogue of Greening Retrofit Solutions** provides an overview of available technologies together with information on technology readiness, costs and infrastructure requirements. The **Handbook for Implementation of Greening Retrofit Solutions** offers practical guidance on implementation, operational impacts and approval procedures. In addition, the **Decision Support Tool** helps vessel owners identify suitable retrofit measures and make informed investment decisions based on the characteristics of their vessels. **Future-oriented scenarios** were also developed to support policy and industry decision-making and accelerate the deployment of sustainable retrofit solutions.

These tools will remain freely available after the end of the project and will continue to be maintained through the project website under the Tools section.

The successful completion of **SYNERGETICS** marks an important milestone for the green transformation of inland and coastal shipping. By demonstrating retrofit technologies under real operating conditions and fostering collaboration across disciplines, sectors and European projects, **SYNERGETICS** has shown that practical and economically viable solutions are already available to support the sector's transition towards a more sustainable future.

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