NEWSletter 6

December 2025

The third year of synergies

SYNERGETICS – Synergies for Green Transformation of Inland and Coastal Shipping – the Innovation Action funded by the Horizon Europe programme of the EU has successfully completed 36 months of establishing synergies for the sector of inland and coastal shipping. Based on the sound understanding of the actual possibilities for greening through retrofit, the SYNERGETICS approach aspires to provide a proper meaning to the expression "low hanging fruits" when it comes to maturity of available solutions.

2025 has proven to be again an exciting period for SYNERGETICS, with notable advancements in the majority of the ongoing demonstrations. A substantial number of deliverables has been submitted in a timely manner and is available for download at the project website. Furthermore, the SYNERGETICS consortium has demonstrated considerable proficiency in addressing the various challenges that arose, showcasing maturity and expertise.

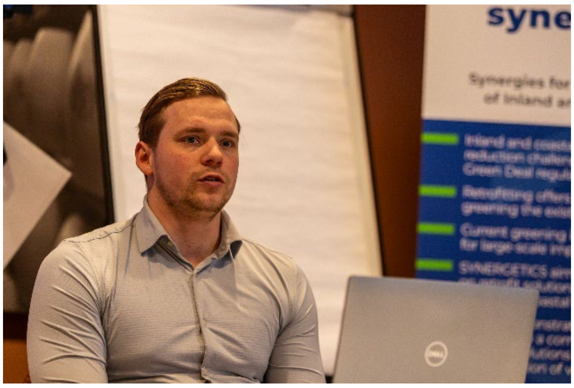
The year commenced with a presentation of SYNERGETICS at the Waterborne Days 2025, which took place in Brussels on 4 and 5 February 2025. Within the framework of PLATINA4Action, SYNERGETICS contributed to the Third Technology Transfer Workshop in Duisburg on 26-27 May 2025, and the Fourth Technology Transfer Workshop in Budapest on 3 November 2025. One highlight of the summer was the participation of SYNERGETICS in the Leading Sustainable Shipping Technology Forum (LSSTF 2025) in Graz on 26 June 2025, where a focus was set on greening developments in deep-sea and inland navigation. The second highlight was the participation in and support of the Danube Ports Days in Constanta on 16-17 September 2025, which has become already a visible brand in the community of inland waterway transport and ports. Finally, SYNERGETICS was also featured in activities of ECMAR (European Council for Maritime Applied Research).

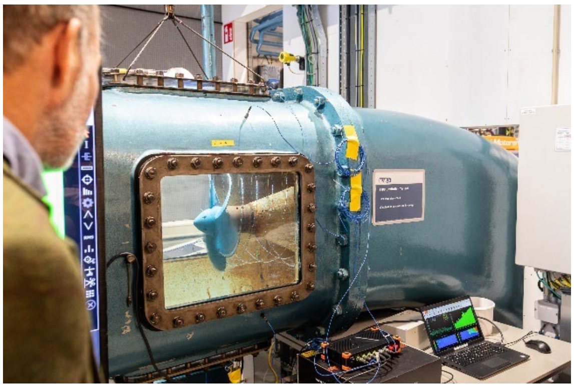
We are grateful for your support in 2025. We promise you an amazing 2026 filled with exciting synergies.

Funded by the Horizon Europe Programme of the European Union, under Grant Agreement No 101096809
Funded by the Horizon Europe guarantee of the United Kingdom, under project No 10068310
Funded by the Swiss State Secretariat for Education, Research and Innovation

General Assembly of SYNERGETICS 2025 – an optimal mix of strategic discussions and technical demonstrations

This year's General Assembly was hosted by MARIN and held in Wageningen, the Netherlands, on 2 and 3 December 2025. The highlight of the first day was the presentation of SYNERGETICS tools, in particular the Decision Support Tool which enables vessel owners to narrow down the search for an optimal greening retrofit solution for a particular vessel based on a range of parameters, including the targeted reduction of air pollutants and GHG emissions, the Total Cost of Ownership of the retrofitted vessel, etc. The Tool is web-based and will be soon available to public users. The second day was dedicated to the demonstration of the retrofit of the push boat "Bad Deutsch-Altenburg", owned by the SYNERGETICS partner viadonau, in the Zero Emission Lab (ZEL) of MARIN. Relevant operational scenarios were simulated, allowing users to experience the sailing of the push boat as if it was powered by methanol. The master of the push boat, Mr. Patrick Michna, also participated in the demonstration and gave valuable feedback to the SYNERGETICS team with respect to the behaviour of the retrofitted push boat in the simulated scenarios. Finally, the Assembly discussed the outlook for 2026, with the focus on the Handbook for Implementation of Greening Retrofit Solutions, the Scenarios for Policy Makers, as well as creating the lasting impact of the project by providing the educational materials for universities, based on the SYNERGETICS findings.





Funded by the Horizon Europe Programme of the European Union, under Grant Agreement No 101096809
Funded by the Horizon Europe guarantee of the United Kingdom, under project No 10068310
Funded by the Swiss State Secretariat for Education, Research and Innovation

Activities

Work Package 2 – Lessons from past pilots

The Deliverable 2.3 Report on Pilot Synchronisation outlines the synchronisation work within the SYNERGETICS project and builds on earlier analyses in Deliverables D2.1 and D2.2. Most pilot evaluation results had already been established in D2.2 (December 2024); the ten additional pilots assessed between January and June 2025 confirmed the same findings. The evaluation framework developed in Task 2.3 proved robust for consistent pilot assessment.

The central barrier across pilots is the significantly higher investment and operating costs of renewable energy technologies compared to fossil-fuel solutions. With few incentives and no binding regulations to phase out fossil fuels or internalise environmental externalities, many pilots have been postponed or cancelled, especially those involving hydrogen fuel cell applications. Slow development of renewable energy infrastructure along waterways and ports further reinforces a classic "chicken-and-egg" problem: infrastructure requires demand, yet demand depends on stronger policy support. Regulatory obstacles—for example, rules preventing the use of methanol in inland combustion engines due to formaldehyde concerns—also delay progress.

Task 2.3 organized five large workshops (50 up to 150 participants each), held locally and in national languages to better involve vessel owners, operators, and innovators. These workshops fostered engagement but faced limits because confidential cost and performance data were rarely shared.

A major tool enabling ongoing coordination is the IWT Projects Coordination Platform, launched publicly by the PLATINA4Action project in February 2025. SYNERGETICS will continue using this platform to align with other EU projects and their pilot activities aimed at reducing emissions in inland waterway transport.

Work Package 3 – Aft-ship replacement of "Ernst Kramer"

The case study demonstrates that the CCNR's 2035 climate targets for inland shipping can be met with moderate effort through conventional drive system updates and aft-ship hydrodynamic optimisation. Ship monitoring identified critical operating points, and high-fidelity RANS-CFD simulations combined with parametric modelling in an automated optimisation environment enabled efficient multi-objective optimisation of hull-propulsor-waterway interactions. The redesigned aft ship achieved up to 30 % efficiency improvement in shallow water and 16-22 % in deeper waters. The redesigned aft ship features substantial modifications in the transom area, tunnel integration, and frame contour below the tunnel, which primarily influence propeller inflow. Operational analysis covering canal and Rhine navigation suggested that a dual-engine "father-son" concept, where a smaller and a bigger engine are interconnected with the propeller shaft through a special gearbox, allowing for optimum engine loads at different operational modes, could yield additional fuel savings exceeding 5 %.

	Yearly fuel consumption [l]	Fuel savings per year [%]	Fuel savings per year [l]
Calculated yearly consumption of the original vessel	**146,873**	–	–
Father-Son configuration only	**137,712**	**6**	**8,590**
Optimized aft-ship only	**125,484**	**15**	**18,274**
Father-Son configuration and Optimized aft-ship	**116,799**	**20**	**23,916**

Fuel consumption and fuel savings per year in litre and % for different retrofit solutions of the "Ernst Kramer" evaluated for a business case in the Rhine area.

Funded by the Horizon Europe Programme of the European Union, under Grant Agreement No 101096809
Funded by the Horizon Europe guarantee of the United Kingdom, under project No 10068310
Funded by the Swiss State Secretariat for Education, Research and Innovation

The economic viability depends heavily on the price difference between fossil and renewable fuels, highlighting the need for subsidies and policy support. While results are promising, further technical development is required, particularly for implementing the dual-engine gearbox design.

Work Package 4 – Cost and performance model on fleet level

The deliverable D4.4 outlines the development of a fleet-level cost and performance model, with emphasis on the underlying methodology. Building on D4.3 (Cost and performance model – Ship), the model is designed as a modular system that includes data generation, performance prediction, cost estimation, and scenario comparison—making it adaptable as new technologies and data become available.

By combining technical, operational, and economic parameters, the model assesses decarbonisation strategies for coastal and inland vessel types. It calculates emissions from Tank-to-Wake and Well-to-Wake perspectives and determines key cost indicators such as CAPEX, OPEX, and total cost of ownership. This enables detailed benchmarking of different greening pathways under realistic conditions.

The model forms the foundation of the decision-support tool in WP5, helping the maritime sector identify effective and economically feasible decarbonisation strategies. Its flexible scenario configuration allows users to explore technological, regulatory, and market developments up to 2050 and beyond, supporting informed, strategic planning for the transition to sustainable shipping.

	Large cabin vessels	Push boats <500 kW	Push boats 500-2000 kW	Push boats ≥2000 kW	Motor-vessel dry cargo ≥110m	Motorvessel liquid cargo ≥110m	Motor-vessel dry cargo 80-109m	Motor-vessel liq-uid cargo 80-109m	Motor-vessel <80 m	Coupled convoys
MeOH-System										
Integration of MeOH-system, min	1000.00	250.00	312.50	437.50	500.00	500.00	450.00	450.00	250.00	450.00
Integration MeOH-system, max	3000.00	500.00	625.00	875.00	1000.00	1000.00	750.00	750.00	450.00	750.00
Installation MeOH engine	68.00	16.80	57.60	235.14	118.46	121.04	51.95	64.87	20.54	152.12
MEOH ICE [€/kW] min	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
MEOH ICE [€/kW] max	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Battery System										
Electrification and Installation, min	1500.00	375.00	468.75	656.25	750.00	750.00	675.00	675.00	375.00	675.00
Electrification and Installation, max	4500.00	750.00	937.50	1312.50	1500.00	1500.00	1125.00	1125.00	675.00	1125.00
Battery [€/kWh] min	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Battery [€/kWh] max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
Electric engine [€/kW] min	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10	0.10
Electric engine [€/kW] max	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15	0.15
H_2 ICE										
Electrification and Installation of H_2 System, min	1500.00	375.00	1406.25	1968.75	2250.00	2250.00	1687.50	1687.50	1012.50	1687.50
Electrification and Installation of H_2 System, max	4500.00	750.00	937.50	1312.50	1500.00	1500.00	1125.00	1125.00	675.00	1125.00
Installation H_2 engine	68.00	16.80	57.60	235.14	118.46	121.04	51.95	64.87	20.54	152.12
H_2-Tank [€/kg] (20ft container, 500kg capacity)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
MEOH ICE [€/kW], min	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
MEOH ICE [€/kW], max	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90	0.90
Fuel Cell										
Electrification and Installation of H_2 System, min	1500.00	375.00	312.50	656.25	750.00	750.00	675.00	675.00	375.00	675.00
Electrification and Installation of H_2 System, max	4500.00	750.00	937.50	1312.50	1500.00	1500.00	1125.00	1125.00	675.00	1125.00
Battery [€/kWh] min	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60	0.60
Battery [€/kWh] max	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
H_2-Tank [€/kg] (20ft container, 500kg H_2)	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80	0.80
Fuel Cell [€/kW] min	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00	2.00
Fuel Cell [€/kW] max	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00	3.00
New Diesel Engine										
Installation Diesel engine	42.50	10.50	36.00	146.97	74.04	75.65	32.47	40.55	12.84	95.07
Stage V+, Euro VI [€/kW] min	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45	0.45
Stage V+, Euro VI [€/kW] max	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74	0.74

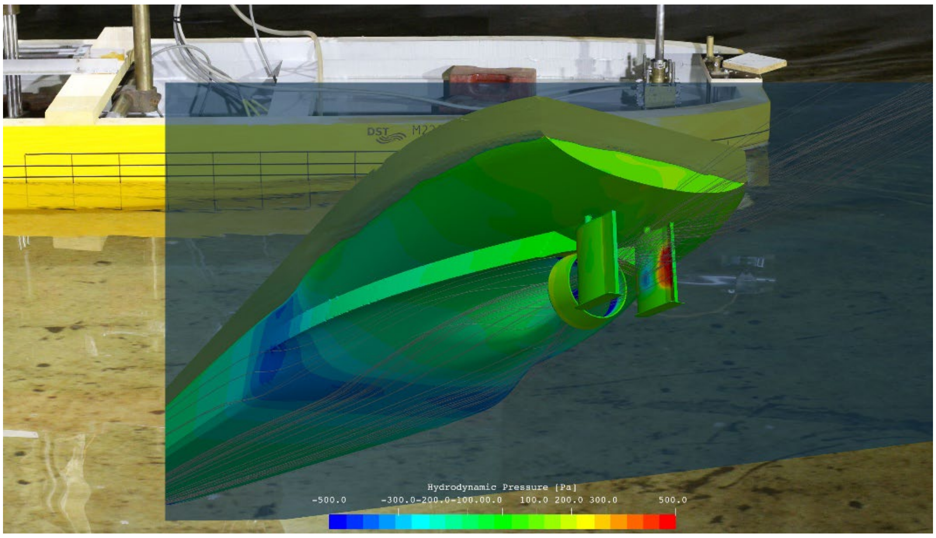
Default values for investment costs for technologies in 1000€, being subject to further validation and revision under WP5. Here, only a selection of values is given due to reasons of sufficient readability.

Funded by the Horizon Europe Programme of the European Union, under Grant Agreement No 101096809
Funded by the Horizon Europe guarantee of the United Kingdom, under project No 10068310
Funded by the Swiss State Secretariat for Education, Research and Innovation

Scientific papers

The paper "Replacing Fossil Diesel for All European Inland Waterway Transport: A Prospective Pathway Analysis on Remaining Emissions and Costs by Florin Thalmann and Elimar Frank" analyses how Europe's inland waterway transport could switch to cleaner energy carriers. The European inland waterway transport consumes about 6.2 TWh of fossil diesel per year. To reduce greenhouse gas (GHG) emissions in accordance with the European reduction goals, the fossil diesel must be substituted by alternative energy carriers. The direct use of electricity (battery-based), e-hydrogen and e-methanol are identified as most suitable for this large-scale (retrofit) transition. The remaining emissions and costs are assessed from a Well-to-Wake perspective using a modular modelling framework which has been set up within the European innovation action project SYNERGETICS. The Well-to-Wake GHG emissions of the examined alternatives range from 20 to 380 gCO2e(fossil)/kWh for the year 2020. The kWh refer to the energy content of the fuel under consideration. Although there will not be net zero supply paths, the GHG emissions can be significantly reduced compared to fossil diesel with 350 gCO2e(fossil)/kWh. Unlike for fossil diesel, the remaining GHG emissions will be dominated by the Well-to-Tank part. Thus, well-chosen supply paths become even more important in the future. In fact, a full Well-to-Wake perspective should be applied where possible. The costs range from 0.25 to 0.60 EUR/kWh for the year 2020, compared to 0.05 EUR/kWh for fossil diesel. Hence, effective policies and regulations are needed to tackle this cost difference. Battery-electric powered vessels show lower nitrogen oxide (NOx) and particulate matter (PM) emissions than those powered by fossil diesel. However, e-hydrogen and e-methanol vessels have higher NOx and PM emissions due to the more complex supply paths. Bio-based options lack sustainable biomass capacities.

The paper "Multi-objective CFD Optimisation to Demonstrate the Potential of aft-Ship Replacement as an Extreme Retrofitting Option in IWT by Jan Kaufmann, Simon Hauschulz and Benjamin Friedhoff" evaluates how much hydrodynamic improvement—and thus power savings—can be achieved even in aging ships. Ship hydrodynamics is a core discipline in marine engineering. In addition to the seakeeping and manoeuvrability, the power demand for propulsion is subject of every ship's design. Nevertheless, the possibilities for reducing the energy demand are far from exhausted and are becoming increasingly relevant. Experimental and numerical methods allow thorough optimisation, while, in the context of the decarbonisation of the transport sector and the associated rise in energy costs, the relevance of optimisation objectives is shifting. The possibilities for holistic optimisation are limited for the existing fleet. However, considerable hydrodynamic savings are possible. This also includes what at first glance appears to be an extremely radical measure: the so-called aft-ship replacement. This article presents the approach and potential based on a case study for a typical 50-year-old inland waterway vessel. The hull geometry of the existing vessel and corresponding power demands in realistic water depths served as the baseline for parametric form optimisation with an automated meshing and CFD workflow.



Funded by the Horizon Europe Programme of the European Union, under Grant Agreement No 101096809
Funded by the Horizon Europe guarantee of the United Kingdom, under project No 10068310
Funded by the Swiss State Secretariat for Education, Research and Innovation

Events

Workshop on regulatory procedures

On 30 October 2025, a workshop was organised at the premises of **DST** dedicated to possibilities for streamlining of regulatory procedures for an accelerated uptake of retrofit technologies for greening of inland vessels and coastal ships.

The workshop featured presentations on the role of the regulatory procedures in retrofit of shipping from the point of view of classification societies, national administrations, international regulatory bodies, and industry representatives:

Bernhard Bieringer (Kanzlei Anzböck) and **Vedran Klisarić (CRS)** presented an analysis of existing bottlenecks and discussed possible options streamlining of regulatory procedures for greening retrofit solutions in inland navigation and coastal shipping;

Cristian Chirita (**viadonau**) presented the feasibility study for the retrofit of the push boat Bad Deutsch-Altenburg;

Annelies van Dijk-Volker (NL Ministerie van Infrastructuur en Waterstaat, Maritime Affairs Department) talked about practical experiences with the greening pilot projects in obtaining derogations from the CCNR;

Dirk Fischer (Argo-Anleg GmbH) provided insights in the status of hydrogen-based retrofit projects;

Bengt Ramne (ScandiNAOS AB) offered industry perspectives on type approval of methanol engines under the NRMM Regulation and showed results of formaldehyde emission measurements;

Patrizio Di Francesco (RINA) presented the approval process for the use of hydrogen in enhancing combustion in existing engines for coastal navigation.

The presentations were followed by a discussion on the possibilities for reducing the regulatory obstacles for implementation of novel greening technologies which are not yet or are just partly considered by the existing regulatory framework.

The main challenges identified comprise:

- slow and administratively cumbersome processes,
- conflicting requirements of applicable regulations,
- inadequate support in the existing procedures.

Danube Port Days 2025

The Danube Ports Days 2025, organised by **Pro Danube**, hosted by the **Constanta Port**, and supported by the EU-funded projects Innovation Action SYNERGETICS, PIONEERS Ports, Green Inland Ports, and the Danube Port Networks brought together policymakers, industry leaders and experts to discuss and evaluate innovative solutions aimed at achieving sustainability and digitalisation within inland ports and inland waterway transport.

On the first day, **Benjamin Friedhoff**, project coordinator of SYNERGETICS from **DST**, provided a presentation on the demonstrations performed and tools being developed within the scope of the project.

Martin Quispel of SYNERGETICS partner **EICB** presented the first version of the Decision Support Tool for vessel owners. This tool assists end-users in selecting greening solutions for their existing vessels. The innovative elements are the economic impacts on productivity of the vessel as a result of additional time needed for bunkering and/or loss of payload when using renewable energy solutions. Valuable feedback was collected and processed in the 2nd version, presented early November in Budapest. Final publication is scheduled for December 2025.

The panel discussions that took place on the second day focused on the subjects of digitalisation and innovative solutions for the purpose of fostering energy efficiency. **Bengt Ramne** of SYNERGETICS partner **ScandiNAOS** presented the advantages of the retrofit to methanol propulsion in terms of emissions reduction of the inland and coastal vessels.

The presentations can be found here.

Funded by the Horizon Europe Programme of the European Union, under Grant Agreement No 101096809
Funded by the Horizon Europe guarantee of the United Kingdom, under project No 10068310
Funded by the Swiss State Secretariat for Education, Research and Innovation

Coordinator:

DST – Entwicklungszentrum für Schiffstechnik und Transportsysteme e. V. (DE)

Partners:

SPB – Stichting Projecten Binnenvaart (NL)
Scandinaos AB (SE)
MARIN – Maritime Research Institute Netherlands (NL)
viadonau – Österreichische Wasserstraßen-GmbH (AT)
TTS – Transport Trade Services GmbH (AT)
ZT Büro Anzböck Richard (AT)
EUFRAK – Euroconsults Berlin GmbH (DE)
CRS – Hrvatski Registar Brodova (HR)
OST – Ostschweizer Fachhochschule (CH)
Argo-Anleg GmbH (DE)
FPS – Future Proof Shipping (NL)
Mercurius Shipbuilding BV (NL)
ZES – Zero Emission Services (NL)
Compagnie Fluviale de Transport (FR)
Sogestran (FR)
Koedood Diesel Service BV (NL)
CMB – Revolve Technologies Ltd. (UK)

Contact

DST – Entwicklungszentrum für Schiffstechnik und Transportsysteme e. V.
www.dst-org.de

Benjamin Friedhoff
Phone: +49-203-99369-29
E-Mail: friedhoff@dst-org.de

Igor Bačkalov
Phone: +49-203-99369-27
E-Mail: backalov@dst-org.de

Project website: www.synergetics-project.eu

Funded by the Horizon Europe Programme of the European Union, under Grant Agreement No 101096809
Funded by the Horizon Europe guarantee of the United Kingdom, under project No 10068310
Funded by the Swiss State Secretariat for Education, Research and Innovation