D2.3 Report on pilot synchronization

Synergetics | Synergies for Green Transformation of Inland and Coastal Shipping

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| Release Approval

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Executive Summary

This report, Deliverable 2.3 Report on Pilot Synchronization, provides an overview of Synchronization efforts within the SYNERGETICS Project. The report builds upon earlier work done in Work Package 2 Synchronization and is best consumed after reading the other WP deliverables: D2.1 and D2.2. Task 2.3 has thus been focussing on synchronization efforts, but has also evaluated many ongoing pilots.

In particular the D2.2, finalised in December 2024 and available to download from the SYNERGETICS website, already presents the main results of pilot evaluation and lessons learned. The additional 10 pilots evaluated between January 2025 until June 2025, didn't change the picture significantly and confirmed earlier findings and conclusions. The pilot evaluation framework developed in Task 2.3 proved to be a suitable instrument for a structured description of pilot evaluations in both T2.3 and T2.2.

The key bottleneck for pilots and their follow-up concerns the significant additional costs for renewable energy solutions and related technology compared to using fossil fuels. This concerns both capital costs and operational cost. This is a barrier given the lack of incentives and willingness to pay for promoting green solutions while there are no binding regulations in place to reduce fossil fuels or to internalise the external costs of climate change and air pollution. As a result, several pilots are cancelled or on hold, waiting for better framework conditions, such as regulations implemented as RED III and ETS. Especially the situation regarding the development of hydrogen fuel cell applications is suffering from the current framework conditions.

Another factor is the slow development of renewable energy infrastructure along waterways and in ports. The typical 'chicken-egg' dilemma prevails in many cases to set up such structural efficient infrastructure facilities resulting in lower prices and higher availability. However, it requires first a demand for renewable energy and stable supporting framework conditions to break-through this chicken-egg dilemma. Furthermore, the regulatory barriers in the Non-Road Mobile Machinery regulation for using hydrogen and methanol for internal combustion engines need to be mentioned. In particular the methanol application for inland navigation combustion engines will require a few years to become legally possible due to the concerns about emissions of formaldehyde.

Regarding the synchronization efforts of the task, in total five successful large workshops took place with participant numbers ranging between 50 and 150 persons to involve vessel owners/operators and innovators. The success formula was to organise them locally, close to local business activities, targeting the local vessel owners/operators in their own language and with national stakeholders. It also helped to organise the workshops back-to-back with other national events. However, information such as operational and capital costs, efficiency differences et cetera were barely disclosed because of their confidentiality and business sensitive nature. Workshops included ample time for interaction and networking.

A key instrument used was the IWT Projects Coordination Platform which was publicly launched in February 2025 at the Waterborne Days in Brussels by its coordinator (the PLATINA4Action project). This platform will continuously be used by SYNERGETICS (WP6) to continue synchronising with other EU projects and their pilot activities focussing on emission reduction of IWT.

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1. | Introduction

Task 2.3, titled "Ongoing and Future Pilots Synchronization", had the mission to evaluate ongoing and future pilots through workshops, interviews and desk studies. Further, the mission was to synchronize SYNERGETICS with these pilots with the aim to acquire information and to stimulate exchange of information. This concerned information exchange between pilots and the SYNERGETICS project but also a broader information exchange in which policy makers and other stakeholders were included. The task was operational between March 2023 and June 2025 (project month 3-30).

This task is very much related to work done in Task 2.1 and Task 2.2. This deliverable D2.3 is best consumed after having read the deliverables D2.1 and D2.2, which are both available through the download tab of the website (synergetics-project.eu).

Since the start of the project lifetime, Work Package 2 has undergone two significant changes in its plan of operation. First, lessons learned from other projects made the work package partners focus more on interviews and desk research than workshops for the detailed evaluation of identified pilots. Second, the pilot evaluations carried out under task 2.3, focussing on ongoing and future pilots, that were completed at the end of 2024 have been included already in Deliverable 2.2. This deliverable was originally only going to report upon T2.2 work, which was the evaluation of past pilots. However, at the moment of writing D2.2 it became clear that reporting on evaluations of the two types of pilots (past pilots versus ongoing/future pilots) in different reports would decrease the useability of D2.2 and essentially result in an outdated view on lessons learned from pilots. Similarly, it was deemed unfortunate that lessons learned from ongoing and future pilots would have to wait another six months before being delivered in this report D2.3. Therefore, it was decided that D2.2 contains the lessons learned from all pilot evaluations up until the end of 2024. Therefore, also the largest part of pilot evaluations for ongoing pilots were covered already in the D2.2. This implicates that D2.3 is significantly shorter and should be read as an addition to D2.2 regarding lessons learned. D2.3 does give a full overview of workshops and interviews from a Synchronization perspective.

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For reference, the task description as quoted from the grant agreement is copied below.

> *"Task 2.3: Ongoing and Future Pilots Synchronization [M3-M30]*
> *Through the database set-up under T2.1, assess possibilities for cooperation with ongoing pilots and ensure that lessons learned from SYNERGETICS feed into future pilot projects.*
> - *Build a strategy to learn from current pilots and assess how to integrate their data, findings, impacts and lessons learned into the SYNERGETICS demonstrations. (SPB leads, other partners to contribute);*
> - *Developing a pilot evaluation format which can be used as blueprint in Month [M6]*
> - *Set-up a continuing contact (or: a working group) by contacting relevant ongoing pilots and already identified future pilots and organising multiple working meetings during the SYNERGETICS project. Through this continuing contact, assess possibilities for any form of cooperation that increases the strength of the pilots involved, including increasing awareness in Europe on the pilot results. The aim is to continue these working group meetings also after SYNERGETICS is finished, therefore an approach/funding model will be elaborated and discussed to enable this continuation (SPB leads, other partners to contribute).*
> - *Ensure that future pilots are fed by SYNERGETICS results by inviting partners of identified future pilots to the abovementioned workshop and the SYNERGETICS mid-term and final event. Furthermore, include future pilots in the WP7 plans for roll-out after the project lifetime and come up with a clear solution on how non-identified future pilots will get familiar with SYNERGETICS outcomes and lessons learned. (SPB leads, other partners to contribute). (SPB leads, other partners to contribute)."*

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2. | Methodology

The methodology of Task 2.3 was developed at the start of Work Package 2's working period and saw continuous development. Key pieces of the methodology were the strategy and the pilot evaluation form that were developed. Workshops have been instrumental to reach the objectives to make information available on past and ongoing pilots. The strategy, pilot evaluation format and the workshops are presented in more detail in this chapter about the methodology.

2.1 Strategy Building

At the very beginning of the T2.3 task period, relevant partners got together to discuss the strategy to learn from current pilots and how to execute the other aspects of the task. The strategy building done here in actuality laid the foundation for the work of both T2.2 and T2.3. The strategy consists of a multi-phased approach. It has already been partly discussed in D2.2 and D2.1, hereunder a summary will be provided.

The first phase consisted of the identification of interesting pilots. In practice, this work was taken up by T2.1 and resulted in the published T2.1 Pilot Database. The T2.1 assessment of identified pilots, described in detail in D2.1, provided a ranking of interest-level from the consortium and some key stakeholders. This ranking was the starting point for both T2.2 and T2.3.

After identifying interesting prospects, a strategy to get them to share information with the project was set up following the AIDA principles. Here also a "SYNERGETICS OFFER" was described as a guideline to use when explaining to external parties the benefits SYNERGETICS can offer in exchange for information. Below, a copy of the offer description made at the beginning of the working period of Task 2.3.

The SYNERGETICS OFFER can be tailor-made but shall consist of outcomes of relevant work packages:

- *WP1 can offer insight into R&D and business cases for several technologies;*
- *WP2 itself can offer connection to other external pilots;*
- *WP3 can offer lessons-learned from SYNERGETICS Demonstrations;*
- *WP4 can offer the Catalogue;*
- *WP5 can offer the Decision Support Tool, Handbook and the Scenarios for policy makers;*

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At the start of the interaction, however, not all SYNERGETICS outcomes will be ready.

Discussions with WP leaders turned out the following should be possible to offer from M13 on:

- *The Pilot database (T2.1) is interesting to lay connections for External Pilot Actors*
- *An open-visor exchange of information with SYNERGETICS-pilot actors, which can be interesting to External Pilot Actors*
- *Increasing the audience for External Pilots might be of help for External Pilot Actors if they have roll-out obligations*
- *SYNERGETICS offers interaction with regulators, policy makers etc. Might be valuable for External Pilot Actors that lack the connections.*
- *Deliverable 1.1 will offer interesting insights for External Pilot Actors.*

In hindsight, especially the Pilot Database (T2.1) proved valuable for attracting attention and interest from researchers. For vessel operators, the chance to get in contact with other operators through workshops was usually deemed most interesting. Pilots from EU-funded projects were indeed happy to increase their audience through SYNERGETICS workshops as well. In the end the strategy can be said to have worked on the broader level, but it is usually not clear why external parties did share the information. Many of them had some disclosure requirements themselves and may have done so in any case.

The next steps in building a work package and task strategy are described below. Starting with the need for a data repository: the pilot evaluation format.

2.2 Developing the Pilot Evaluation Format

Although developed under Task 2.3, the pilot evaluation format (PEF) was first extensively used during the research phase of Task 2.2. Therefore, the development of the PEF has been described in D2.2 under chapter 2.2. In order to make it possible to read this report as a standalone document, the exact text and accompanying figure are given below.

The evaluation of Pilots identified and assessed under Task 2.1 has been structured by way of the Pilot Evaluation Form (PEF). The PEF acts as a way to store the obtained information and guides the researcher through different questions that might give valuable and insightful answers regarding the pilot. The PEF has been made during multiple iterative sessions where Work Package partners decided together on the possible fields of interest and specific questions to include. Partners of WP 2 were able to use their experience in obtaining information for research purposes from actors through interviews, workshops and desk research.

Fields of interest included in the final version are:

- *General Information (name, timeframe, location etc.),*
- *Vessel Type (dimensions, type, load capacity etc.),*
- *Journey Characteristics during Pilot (# journeys, description of journeys),*
- *Pilot Information (about the tested innovation),*
- *Implementation Issues (about technical implementation),*
- *Regulatory Pathway (about the regulatory framework and permissions needed for the pilot),*

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- *Business Case (costs, benefits, etc.),*
- *Replication Potential and Other (to catch any lessons learned outside the above categories).*

Guiding the research in this way, the PEF can act as a guide for interviews, desk research and workshops, and in general to store the obtained information per pilot. Although the PEF is relatively extensive in its fields of interest and questions, it was not the expectation to fill every box it contains. Many pilots lack desirable information for multiple of the fields of interest, or specific questions cannot be filled due to sensitivity of the information. The general lessons learned of the pilot are the key target of the work in Task 2.2 and these can mostly be obtained and filled in the relative box in the PEF.

During the work in Task 2.3, the Pilot Evaluation From was again extensively used, and in the end 60 PEFs were filled. The form has proven its worth as a store of information for the project.

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V:30-05-2023	
Pilot Evaluation Format	
Note: information flows are from external parties. It is probable that not all information can be obtained. This is not a big issue, as long as the key lessons learned can be identified.	
Note: extra questions can always be added by the user.	
Pilot Type:	Select from following: Alternative Fuels/Electrification/Energy Efficiency
Question	Answer
General Information	
Project Name	
Vessel Name	
Project Coordinator	
Pilot Lead Partner	
Other Partners	
Timeframe of Project	
Timeframe of the pilot	
General Location of the Pilot	
Contact information	
Website	
Vessel Type	
Principal dimensions	
Vessel Length & Width	
IWT/Coastal/Other (to specify, including if passenger vessel, tug, crane vessel or working vessel)	
Type of cargo	
Load Capacity (tonnes/PAX)	
Engines on board (# propulsion engines, # auxilliary engines / #bowthrusters)	
Type of Engines (e.g. CCNR Stage0, 1, 2 or Stage V, Euro6, NRE, hybrid, alternative fuel, other info welcome)	
Power of the Engines (per engine & total)	
Age of the engines (approximate remaining lifetime)	
What vessel characteristics (see above) were changed because of the pilot? What were the specifics before the pilot?	
Year built	
Journey Characteristics during Pilot	
Number of journeys during the pilot	
Description of the Journey (s) (port, river, canal names etc.) or operational area during the pilot.	
Cargo transported (if possible also if tug, workboat, other)	
Payload (full/half/empty) during pilot journey(s)	
Speed and/or percentage of power used by propulsion system during the pilot jouney(s)	
Runtime of innovation during the pilot (if hybrid: specify time division between options)	
Impact of weather, current, water levels? If so, specify	
Pilot Information	
What was the innovation that was tested (or: innovations that were tested) in the pilot?	
Is the pilot held on a retrofitted vessel or on a newbuilt vessel?	
What were the expectations (for instance on fuel consumption and emissions)?	
Were these expectation met?	
Was the pilot considered a success and why?	
Implementation Issues	
Technical reliability of the system tested in the pilot (+compared with the conventional solution)	
Technical durability: observed durability of all parts of the system tested in the pilot (+compared with the conventional solution)	
Space requirements compared with the conventional solution	
Installation: time needed & difficulties encoutered	
Operational changes: did the tested solution require significant deviations from normal operations?	
How was bunkering handled during the pilot? (Only if an alternative fuel was tested) E.g. truck-to-schip shore-ship etc. Please describe.	
Origin story of the fuel: was the fuel sustainably produced, what was it's origin, how did it get to the point of bunkering?	
What was the price of the fuel & what is the level of availability. Is availability of the fuel an issue for using the innovation after the pilot?	
Regulatory pathway	
Was permission for the pilot needed? If yes, how was it obtained?	
Is permission for ongoing operational use of the innovation tested in the pilot obtained?	
If not, what would be needed to obtain it?	
If yes, can other parties replicate it with relative ease?	
Which authority gave, or still needs to give, permission for the pilot and/or ongoing operational use of the innovation? (e.g. ADN, UNECE, CCNR, national/regional, other)	
Are there (other) lessons that can be drawn from this pilot when looking at regulatory aspects? Both for regulators and for other pilots trying to obtain permits/derogations/approval.	
What is/was the time needed to obtain the permit/approval/derogation?	
Business Case	
Can costs (operational & investment) be specified for the tested innovation during the pilot? If possible: compared to the conventional solution.	
What were the benefits of the pilot and can they be specified?	
Is there a current business case for the tested innovation in the pilot? (e.g. can benefits outweigh costs)	
If not, what would be needed to realise such a business case in the future? (e.g. subsidies, taxes, regulational)	
Replication Potential	
Could the results be replicated on other types of journeys? Which types, what would be needed, or why not?	
Could the results be replicated on other types of vessels? Which types, what would be needed, or why not?	
Is the innovation useful for both retrofit and newbuild or only one of the two? Why and what would be needed if it doesn't fit one or both?	
Other	
Other key lessons learned to be noted here	

Figure 1 a snapshot of the Pilot Evaluation Form (PEF)

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2.3 Workshops

As has been outlined in D2.2, at the time of writing the proposal, the views on larger workshops and their ability to extract detailed information out of many attendees were positive. At the start of the Work Package working period however, it soon turned out that these views were too optimistic. In practice, as was learned during attempts by other projects and confirmed in SYNERGETICS workshops, large-scale gatherings will provide much information but rarely succeed in getting information on the true specifics. Especially when innovations failed or had much trouble overcoming hurdles, this was the case. A general unwillingness to share information about failures with larger audiences was observed.

Since it was soon established that these were the lessons learned that might be the most valuable, the workplan was altered during the set-up of the strategy. Workshops were however not completely abandoned (still five externally focused workshops have been held) but desk research and bilaterial interviews came to play a larger role in the research phase. Workshops did provide much valuable information and were of key use to get people interested in being interviewed later on. Workshops are described in detail in chapter 4.

The continuing contact was mentioned in the original task description and meant to give a recurring setting to the WP2 workshops. However, due to the above-mentioned deviation of attention from workshops to desk research and interviews, the view on the continuing contact also changed. Furthermore, the fact that the Horizon Europe Project PLATINA4Action started working on a complementary working structure in the same period (the IWT projects cooperation platform, further described in chapter 4) meant SYNERGETICS had to anticipate this part of the workplan.

In the end, continuing contact with pilot operators was guaranteed by recurrently inviting them to the workshops and key project events such as the mid-term conference. The IWT Projects Cooperation Platform, which SYNERGETICS joined as a member, proved valuable to keep continuing contacts with public funded pilot projects and other research initiatives.

2.4 Future Pilots

The inclusion of future pilots has been marked as challenging from the proposal phase onwards. Of course, a future pilot does not exist at the moment and so its members cannot yet be identified. However, the network of the consortium and the work done in Work Package 2 and other WPs so far allows for some understanding of which parties are most likely to be interested in starting an innovative pilot in the future. It is safe to assume that these parties already have some involvement in current pilots or research initiatives with which SYNERGETICS has excellent contacts through the network built in WP2, WP6 and previously existing connections from consortium partners. Furthermore, some pilots have been announced in a clear way, either in relevant media or through the planning disclosures of EU funded projects. These pilots are future pilots with clear operators and partners.

This network will be continuously involved in the project by invitations to upcoming project events such as relevant workshops at the end of 2025 held from a WP6 perspective, and will most certainly be invited to the final SYNERGETICS conference. This network has already been invited to the workshops held under WP2 in the past, and turnout there has been satisfactory.

Furthermore, agreements have been made with Work Package 6 so that a plan for future pilot engagement after the SYNERGETICS project lifetime can be included in the final PEDR update,

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to be delivered in M42. This plan is not yet set in stone but will lean upon the continuation of the SYNERGETICS website and tools after the project lifetime as has already been agreed upon by coordinator DST. The IWT Projects cooperation platform further offers possibilities to act as a repository for ended projects.

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3. | Pilot Evaluations: update with new evaluations

As stated in D2.2 Report on lessons from Past Pilots, that deliverable already reported on all T2.3 evaluation work done up until the end of 2024. Originally, D2.2 was only going to report on T2.2 pilot evaluations, thus only discussing evaluations of past pilots. Since T2.2 and T2.3 had a large overlap in their timeline, in practice both past pilots and current pilots were evaluated at the same time by the same evaluators from the consortium. At the moment of writing D2.2, there was an overarching view on pilots that could be derived from the evaluations. However, withholding the evaluation results of ongoing pilots from D2.2 would have led to an outdated report covering only parts of the entire landscape. Furthermore, the consortium concluded that the obtained lessons learned were too valuable to wait until the summer of 2025 to disclose them. Thus, it was decided to include all evaluated pilots up until the end of 2024 in D2.2. This made of D2.2 a relevant, up-to-date report with a clear message.

This section is an overview of results flowing from pilot evaluations done between the end of 2024 and the closing of Work Package 2 in June 2025. The timeframe provided a limited number of additional evaluations while the results did not deviate from the larger picture painted in deliverable D2.2. Therefore, this chapter should be seen as an add-on to that deliverable. D2.2 titled "Report on lessons from Past Pilots" is available for download on the "download" tab of synergetics-projects.eu[1].

Nevertheless, 10 new pilots were evaluated and several pilot evaluations could be updated in the last WP2 working period. Alongside with information flowing from the latest workshops this provides an interesting update.

Below are noted the new lessons learned per type of innovation. Lessons learned that are broadly discussed in D2.2 will not be touched upon if no significant changes have been encountered.

3.1 Electrification Pilots

Although issues described in D2.2 are still relevant, electrification of vessels has set a small step towards larger implementation. Notably, more operators make note of a slightly more positive situation regarding OPEX costs, and one new vessel has started operating on swappable battery containers. The active vessels are already a significant boost, but it seems that if the current network of swapping locations can be increased in the coming months a small dozen of other vessels could start operating on battery electricity within the next two years. Of course, CAPEX costs have remained high for any form of retrofitting or newbuilding of vessels, and battery packs and other subsystems needed for electrification remain especially expensive[2]. Nevertheless, the subset of the market using swappable energy containers could see significant uptake in the Netherlands if infrastructure roll-out goes to plan, subsidy

[1] Direct link: chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.synergetics-project.eu/wp-content/uploads/2025/02/SYNERGETICS_D2.2_Report-on-lessons-from-Past-Pilots_FINAL.pdf

[2] Partner SPB has access to electrification costs. Although vessel names and specifics are not to be disclosed, the general consensus can be used.

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schemes remain available and regulations remain clear. Operators that take this step are not doing so because they see a current business case, but are hoping to anticipate on the future.

Regarding regulations and the business case, cost benefit calculations for these types of innovations are already seen to be including regulations like REDIII and especially the ETS-2 opt-in of fossil fuel supply in The Netherlands for the IWT operations. These regulatory measures, effectively increasing the price of fossil diesel, are thus already contributing to business cases of alternative technologies by reducing the price gap between diesel and its alternatives in the future. After all, due to the long lifetime of vessels, business case calculations concerning retrofitting span a multitude of years.

3.2 Alternative fuel pilots

Regarding alternative fuels, new pilot evaluations mostly resulted in the same lessons learned as described in D2.2. For hydrogen the business case remains an uphill battle from both CAPEX and OPEX perspectives. The trend of cancelled pilot plans and failing pilots could be seen to continue since the consortium was notified by several pilot projects of their imminent halting of operations. For EU projects this is usually in the form of a suspension that can be lifted if the outlook of the project improves. Again, the task partners note the tendency to keep negative results a secret, which leads to the unavailability of the lessons learned and which makes it harder to enlist help from stakeholders who might be unaware of the precarious state of the pilot. The key bottleneck however are the additional costs, both CAPEX and OPEX, involved when switching to hydrogen. Vessel owners/operators and clients are not able to cover these additional costs. For methanol the picture remains unchanged.

Further of note is that the task has evaluated its first ammonia fuel cell pilot where an offshore tug is going to be retrofitted to an ammonia powered solution. Although regulatory approval could be obtained, the fuel cell development faced obstacles and was both more time consuming and cost intensive than expected since the immature value chain of solid oxide fuel cells. This has made the fuel cell provider drop out of the project. Currently, solutions are being evaluated and the project might make the switch to a dual-fuel ammonia internal combustion engine to complete its objectives.

The regulatory framework which hampered the introduction of hydrogen and methanol internal combustion engines to the IWT market has not changed significantly yet. However, it has become clear that the revised NRMM regulation will probably include mono-fuel hydrogen as a reference fuel, which will make it easier for manufacturers to develop hydrogen internal combustion engines for the inland waterway fleet. Current options to certify engines under exemption articles of the NRMM regulation are difficult to implement because prescribed ways of instrumentation usage, calculation methodology and some reporting templates are not adapted to hydrogen implementation yet[3].

Methanol will most probably not be included on short term due to ongoing concerns for formaldehyde emissions. It requires doing an Impact Assessment study first before a decision can be made on methanol as reference fuel and the applicable limit values for formaldehyde emissions. Here, it must also be noted that the Dutch government intends to start a subsidy

[3] See for more information: www.euromot.eu/wp-content/uploads/2024/09/EUROMOT-Annex-to-Guidance-on-Article-35-July-2024.pdf

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scheme for manufacturers to bring hydrogen engines to the IWT market under current regulations (thus needing to make use of Article 35 of the current NRMM regulation[4]). The scheme is also set to provide subsidies for manufacturers to test methanol engines on formaldehyde emissions. This means there is some hope for first entry of market ready hydrogen engines in the coming years and, if emission levels allow, methanol engines might enter the IWT market a couple years later.

Also regarding the regulatory framework, more information has been found covering the customs and/or tax issues surrounding the usage of HVO in blends with regular EN590 diesel. The challenges seem to appear only when mixing regular diesel with HVO, not when sailing with HVO100 (=100% HVO) and are rooted in the tax exemption on regular diesel. Since EN590 diesel is tax exempt in the EU, it is mandatory for fuel providers to provide EN590 only in the colour red. Coloured diesels are used to make a visual distinction between tax exempt diesels and diesels without tax exemptions. It is illegal to mix coloured and non-coloured diesels. Since HVO itself is not coloured, it is in practice illegal to add HVO to a fuel tank that already contains EN590 diesel. This practice would leave involved parties (supplier, vessel operator) liable to legal charges. No cases of actions by law enforcement against such practices have yet appeared, but it remains an issue that should be solved. In essence, this regulatory situation permits a switch to HVO only under the condition that the supply of HVO is permanently guaranteed, which is currently not the case in particular for long range transport operations.

3.3 Areas of interest

The areas of interest were identified in D2.2 following analysis of the evaluated pilots and forth flowing lessons learned. They consisted of Technological Implementation, Infrastructure, Regulatory Framework and the Business case. A broader overview of the areas of interest is included in D2.2, below a short summary and an update following lessons learned.

Technological Implementation was found to be mainly characterized by technical specifications of alternative propulsion systems that limit the operational use of these alternatives in different meaningful ways which almost always impacts the business case negatively. A main issue is energy density of alternative fuels, which offer less propulsion power per measure of volume and weight compared to regular diesel. Infrastructure appeared as an area of interest because of necessary changes between bunkering of regular fossil diesel and taking on board of alternative fuels (or electricity). Alternative solutions currently lack a broad network of bunkering points- a problem which is exacerbated by the fact that lower energy density of alternative solutions might incur the need of more frequent bunkering and thus denser networks. The Regulatory Framework was broadly discussed as an area of interest that is a necessity for legal uptake of new solutions. Regulators were seen as cooperative, but timing is not always satisfactory and temporary solutions might be costly and time intensive.

All these areas of interest culminate in the business case area of interest, which is key for implementation. Aforementioned issues in other areas of interest contribute to expensive alternative solutions both in CAPEX and in OPEX. Difficulties regarding unwillingness to pay for extra costs for carbon reductions from the sector's customers combine into a challenging state of play from an economic perspective. Several parties recently addressed the so-called over

[4] https://eur-lex.europa.eu/eli/reg/2016/1628/oj

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dimensioning of the legal framework. Their view suggests that rules and regulations are broadly set up too all encompassing and implemented too strictly. The reason behind this would be a perceived lack of understanding of the innovations. Task partners feel the need to make note of this view, but also of the fact that clear evidence for these claims has not yet been obtained.

Technological implementation saw no notifiable steps forward in the limited time period between the moment of writing and the publication of D2.2. The most recent Work Programme (2025) of the Horizon Europe programme includes some relevant waterborne transport related topics. Especially the Zero Emission Waterborne Transport topics (ZEWT partnership) offer challenges to bring alternative propulsion options forward from their current state of the art. Especially the topic *HORIZON-CL5-2025-01-D5-11: Demonstration of battery energy storage systems in existing and new vessels via novel energy storage and ship design concepts (ZEWT Partnership)* is promising since it demands a 40% increase in operational autonomy compared to state of the art for battery electric vessels in the year 2024. This would be a significant step forward and certainly increase the number of suitable use cases for this technology. However, it still needs to be seen if a successful project can take on the challenge. Results for this topic are multiple years away.

The Infrastructure area of interest saw only limited updates as well. Due to increased efforts by the company Zero Emission Services (ZES), the Netherlands will soon host more than three swapping locations for battery containers. Otherwise, no significant news was discovered during pilot (re)evaluations. The regulatory framework area of interest saw some updates, as discussed under 3.2, which are relevant and might solve regulatory challenges in bringing internal combustion engines running on methanol or mono-fuel hydrogen to the IWT market. Discussed under 3.2 was as well the illegality of blending regular IWT diesel, which is coloured due to its tax status, with HVO, which is not coloured.

In the Business Case area of interest, the general view of the situation – which was negative – that emerged from the work reported upon in D2.2 did not improve. Further, the Omnibus proposal from European Commission (February 2025) aims to reduce the reporting requirements from CSRD by companies. This does not help either to put pressure on the market to reduce the GHG and air pollutant emissions. Further discussion with operators and other indicators did not show a significant decrease in cost factors or improving willingness to pay for the extra decarbonisation costs from customers. On the contrary, the willingness to pay seems lower rather than higher since December 2024.

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4. Synchronisation efforts in WP2

SYNERGETICS Synchronisation efforts in Work Package 2 were done by workshops, membership of the IWT Projects Cooperation Platform and interviews. Workshops provided interaction between the project and pilot operators, pilot operators amongst themselves and between pilot operators and other stakeholders such as regular barge operators and policymakers. In total, five workshops have been held where synchronisation was stimulated with a number of participants ranging between 50-150 persons. Workshops proved valuable to stimulate the sharing of information and cooperation between attendees. Workshops thus had a positive impact on the pilot evaluations.

Membership of the IWT Projects Cooperation Platform proved valuable in connecting with other EU funded projects focussing on Inland Waterway Transport and projects including pilots on decarbonisation and reduction of emissions. This is of course overlapping with WP6 work on liaising with other projects, but since these projects also run pilots, there is a significant part of this workload attributable to Work Package 2. An overview of the platform, ran by the Horizon Europe project PLATINA4Action, can be found on .

4.1 Work Package 2 workshops

4.1.1 Gorinchem: Maritime Industry Fair

On the 30th of May 2024 SYNERGETICS co-hosted a workshop with PLATINA4Action in Gorinchem during the Maritime Industry fair. Maritime Industry is the largest IWT trade fair in the Netherlands. Roughly 150 participants joined as partners from both projects and pilot operators shared and discussed about the state of the art of decarbonisation solutions for the IWT fleet. Among the participants where a significant number of barge operators and/or operators of innovation pilots.

The goal of this workshop was to reach as many vessel owners as possible and thus to make it easy for them to participate. Since almost all vessel owners in this region are Dutch and there was the occasion to organise it back-to-back with the Maritime Industry Fair, the choice was made to use Dutch as the spoken language during the workshop. To enhance visibility, a videorecording was made and shared after the event which includes subtitles in the English language.

The workshop was structured around five topics. The first topic was policy and its trajectories for a greener IWT fleet towards 2050. Here, presenters from SYNERGETICS partner SPB and the Dutch Government (Ministry of IenW) showed attendees the policy paths from the Dutch and EU governments including upcoming regulations and directives and the impact on the sector. The ministry revealed for the first time during its presentation the definitive intention to bring Dutch IWT under the ETS-2 scheme through an opt-in clause and gave details about the subsidy scheme to decarbonise the fleet that is supposed to go hand in hand with this development. During the second topic, TATA Steel, a large customer of the Dutch IWT sector, shared its vision on decarbonisation of the fleet and its drivers to stimulate the development. Both sessions had a lively Q&A session where operators and other stakeholders asked many questions.

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The third topic was sailing on battery electricity. Here, SYNERGETICS partner ZES shared the possibilities of its solution and pilot operator KOTUG told about the implementation of their E-Pusher. Both presentations clearly highlighted options to use electricity for propulsion for two different sub-segments of the IWT fleet: pushers and container vessels. This was followed by the fourth session on renewable diesels where BOVAG Energy Solutions discussed the possibilities to reduce emissions on the short term, including renewable diesel (HVO), and Finco Energy shared their knowledge about the biodiesel called FAME. The fifth and last topic focused on hydrogen as a fuel in IWT. First, SYNERGETICS partner FPS and pilot operator HTS showed the public their experience with operating and/or building hydrogen fuelled vessels. Nexus Energy and NPS Driven followed to introduce upcoming techniques to utilise hydrogen as fuel for propulsion of IWT vessels.

A key lesson learned that was shared here concerned the practice of KOTUG to buy old and/or outdated smaller IWT vessels and convert these into non-propelled barges by cutting off the hindquarters. This practice is considerably cheaper than ordering a newbuild non-propelled barge and is offering owners of older small barges an option to sell them other than for total scrap. NPS Driven presented its first steps on the path to developing an H2 Internal Combustion Engine for the IWT sector and Nexus Energy showcased its mobile energy solutions using hydrogen fuel cell technology.

The event offered many Q&A sessions that were heavily used and ended with a busy networking lunch. After lunch, attendees were free to visit the Maritime Industry fair.

Notable stakeholders attending: Dutch Government (Ministry of IenW /Transport Ministry), TATA Steel, Bovag Energy Solutions, Finco Energy, ABN AMRO, ADS van Stigt, De Wit Bunkering, Dintrans Chartering, EBU, ESO, Erasmus University, Evofenedex, Port of Rotterdam, ECT Rotterdam, Inland Terminals Group, Koninklijke Binnenvaart Nederland (KBN, Dutch shipowners association),

Notable operators/innovators attending and/or participating: ZES, KOTUG, FPS, HTS, Nexus Energy, NPS Driven, AMS Barging, CCT Moerdijk, CITBO, Contargo, Geo Shipping, MS Godefrieda, STC Ab Initio, Interrijn, Mercurius, Koninklijke Smals, Nohl Barging, NPRC (barge owners cooperation), Scheepvaartbedrijf ficut maris bv, Scheepvaartbedrijf Terra bv, Thyssenkrup Veerhaven, Vof van Weelden, Verenigde Tankrederij, ZULU associates.

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SYNERGETICS Workshop at the Dutch IWT Trade Fair Maritime Industry in Gorinchem

von Cristian Chirita | Jun 4, 2024 | SYNERGETICS Events, SYNERGETICS Presentations

Figure 2 SPB Director Khalid Tachi introducing SYNERGETICS at the co-hosted workshop in Gorinchem in May 2024 (snapshot from the blogpost on the project website).

4.1.2 Budapest: Danube Port Days SYNERGETICS informal workshop

On the 29th and the 30th of October 2024, the Danube Port days were held in Budapest, Hungary. For the SYNERGETICS project this proved an ideal meeting ground to interact with other projects, pilots and operators with a view on the Danube River area.

SYNERGETICS partners (MARIN, DST, TTS) were active with presentations in plenary sessions to discuss specific topics. The workshop, where SYNERGETICS partner SPB was also present, focussed more on interactions with the public and was continued after the plenary sessions during the coffee break. Representatives of the SYNERGETICS project, Mr. Benjamin Friedhoff and Mr. Immanuel Czege, were present to answer questions, providing insights into various Synergetics pilots and addressing general inquiries about the project. This open, accessible setup encouraged meaningful interactions, as participants explored innovative solutions and learned about the project's impact on emission targets for the Danube region.

The SYNERGETICS workshop at Danube Ports Days 2024 in Budapest provided an engaging platform for stakeholders to discuss project goals and innovations. The session featured a free-flowing, informal format where attendees could easily join the conversation. Notable stakeholders at the event included the MULTIRELOAD project, the GREEN INLAND PORTS project, the FOREMAST project, the MULTIRELOAD project, Pro Danube, the Danube Commission and the Danube Ports network.

This dynamic session highlighted the value of SYNERGETICS' collaborative approach and fostered valuable connections with vessel operators and stakeholders interested in sustainable

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logistics advancements. For the workshop, a special poster was developed by the SYNERGET-ICS team (see below).

Notable connections: due to the informal setting of the workshop, there was not a clear list of participants. However, multiple operators were participating in addition to the stakeholders mentioned above.

Figure 3 SYNERGETICS partners and attendees at the informal Danube Port Days workshop

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Figure 4 Poster for the SYNERGETICS informal Danube Port Days workshop

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4.1.3 Brussels: SYNERGETICS Mid-Term

In November 2024, SYNERGETICS held its midterm conference in Brussels. The conference was held the day before the PLATINA4Action Stage Event in the same venue to persuade both audiences to opt for a combined trip and join both events. For similar reasons, the NAIADES Expert Group meeting did take place at the same venue one day after the PLATINA4Action Stage Event. Given the number of participants external to the project, this was a reasonable success.

During the midterm conference, Work Package 2 had the opportunity to take the floor to present the work package. Instead of presenting the work done so far, WP leadership opted to turn this session into another workshop. This was achieved by inviting four parties involved in decarbonising the inland- and/or coastal fleets to speak about their experiences and approach.

The chosen speakers were:

- ZES, SYNERGETICS partner focussing on offering decarbonisation solutions through their network of swapping points for battery containers;
- Wattlab, a front-of-the-bunch innovator and start-up providing barge operators with solar panel systems covering the hatches of dry bulk freighters;
- Vaar Systems, a developer of high-performance battery systems for the maritime sector;
- Torqueedo, a provider of electrical drivetrain solutions for vessels in recreational and passenger transport sectors.

The presenters highlighted their lessons learned in their journey so-far and their outlook for the future. During this session, some important observations were made regarding the hurdles innovators have to overcome and the (multiple) reasons why many vessel owners prefer not to make the first move but await results of others that are doing so. The result is of course that innovations move slower than hoped. The Q&A was held based on four areas of interest that were at that moment identified by the work package. This allowed the work package to get some feedback on these areas which was later used to complete D2.2.

This session also attracted much attention from the conference participants which led to a lengthy Q&A session. In the end is was concluded that electrification efforts are very important to decarbonise inland and coastal shipping. The different fields of the presenters also garnered mutual interest to keep in contact with each other and explore possibilities for cooperation.

Notable stakeholders attending: DG MOVE (EC), CCNR, Antwerp Maritime Academy, PLATINA4Action, Bureau Veritas, CEA, De Vlaamse Waterweg, DNV, European Investment Bank, Belgian Government (MOW), TNO, University of Gent, Lloyds Register, CINEA.

Notable operators/innovators attending and/or participating: ZES, Wattlab, Vaar Systems, Torqueedo, Siemens Gamesa Renewable Energy, SNCF Voyageurs (rolling stock operator), ABB Marine, HB-Hunte.

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Figure 5 Snapshot of the panel discussion during the SYNERGETICS Mid-Term Conference

Figure 6 Opening sheet of the WP2 workshop during the Mid-Term Conference

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4.1.4 Antwerp: Co-Hosted workshop with PLATINA4Action

On the 4th of December 2024 SYNERGETICS cooperated again with PLATINA4Action to organise a second joint workshop. This workshop focused on reaching barge owners and operators in and around Belgium. The event was translated live to the participants who had the option to listen to live transcriptions on their personal devices. Similarly, the agenda was distributed in multiple languages. Languages available were English, German, Dutch and French. For the organisers it was the first time working with live translation and thus a multi-language workshop, but the results were interesting. It allowed operators, who are usually more versed in either Dutch, German and/or French than English, to understand the event and join the discussions in their native language. Some policymakers also chose to present and discuss in their own language. All in all, probably more operators joined than would have been the case in a one-language-only event.

In the morning part of the workshop, policymakers from the Belgian regions Flanders and Wallonia and from France informed the participants about their visions on sustainable and futureproof inland shipping in their respective areas of responsibility. This included policy outlines and some subsidy possibilities. This session was ended with a Q&A moment that proved valuable ground for discussions.

The afternoon part highlighted several technological options to decarbonise the inland waterway fleet by opening the floor to operators of these technologies. SYNERGETICS partner ZES led a presentation and discussion on propulsion on swappable battery containers and updated the audience on the possibilities they could offer. Another project partner, Future Proof Shipping (FPS), then gave the participants insight in the technicalities of operating a vessel on hydrogen fuel cells. Especially the gaps in the business case of this solution were highlighted along with the fact that there are too few customers willing to pay for the so-called green premium.

This was followed by a discussion on the practicalities of HVO. Presenters were representers of De Wit Bunkering, a Belgian fuel provider to the inland shipping sector that can deliver HVO in several blends. Another presenter was the barge operator of the MS Were Di, discussing their experience with HVO. The next presenter discussed HVO experiences of the ELV, a Dutch cooperation for small inland vessels with extensive HVO experience. This session gave rise to long discussions with the audience, which included operators of whom one also had experience with HVO. It was concluded that HVO offers quite significant reductions of greenhouse gas emissions without much operational downsides.

Notable stakeholders attending: PLATINA4ActionUniversity of Antwerp, ESO, Flemish Government, Wallonian Government, French Government, Dutch Government (Ministry of IenW), ESO, KBN, De Vlaamse Waterweg, PLATINA4Action.

Notable operators attending and/or participating: MS Were Di barge operator, ELV cooperative of barge operators, ZES, FPS, Gefo Shipping Group, MS La Coruna barge operator, Citbo cooperative of barge operators.

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Figure 7 During the break of the Antwerp co-hosted workshop the audience mingles

Figure 8 Much interaction took place during the presentations by operators on decarbonisation options. Antwerp co-hosted workshop

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4.1.5 Duisburg: joint event with BinSmart & PLATINA4Action

On the 26th and 27th of May 2025 SYNERGETICS organised a workshop in collaboration with PLATINA4Action and the German funded BinSmart II project. The workshop was held in Haus Rhein in Duisburg and organised by SYNERGETICS coordinator DST.

Over two days, participants were presented an overview of technological solutions and insights in several pilot projects. Insights into policy developments were also presented. The workshop had a regional, German, focus so the event was held in the German language. As in earlier workshops, this led to a significant participation of vessel owner/operators.

In the first part of the workshop, two electrification pilots were presented by their operators. The Frisia E-1 was presented by AG Reederei Norden-Frisia. This passenger catamaran is in operation since April 2025 on the Waddenzee, connecting the shore with the small islands. Although not in operation for very long, first reports are positive. Notable is that the charging infrastructure of the vessel is realised on a floating pontoon, this modular approach boosts flexibility. The vessel's electricity demand is filled by the companies' own solar plant. The E-Spatz Mülheim was presented by its operator as well. This push-barge in operation by the German WSV operates fully electric during works and sailing stretches. Here too, results are notably positive, although the onshore power points used to charge the vessel have sometimes not been up to the challenge and the power management is still complicated.

In the second block of presentations, the Rhenus Mannheim and its hybrid power system were discussed with the participants. This was followed by an overview of Onshore Power Supply (OPS) solutions in and by the port of Duisburg and an overview of technical solutions to reduce carbon emissions by engine service provider August Storm.

The third block, being held on the second workshop day, focussed on policy and funding options for innovative solutions. SYNERGETICS coordinator DST gave specific information about the newest German options to get subsidies for decarbonisation on inland vessels. Further presentations highlighted hydrogen internal combustion engine applications and efficiency gains by CFD optimisation and aftship replacement (a SYNERGETICS innovation).

The event was filled with interactions between presenters and the participants, had two networking breaks and a networking dinner. As such, it was a success from a synchronization point of view. Especially the participation of policy makers, researchers, operators, innovators, industry and other stakeholders was quite strong.

Notable stakeholders attending: PLATINA4Action, BinSmart II project, August Storm, Bundesanstalt für die Wasserbau (BAW), Verein für Binnenschifffahrt und Wasserstrassen (VBW), BG Verkehr, Duisburger Hafen, e-Cap Marine, Planco, Universität Duisburg-Essen, Bundesministerium für Wirtschaft und Energie, Zeppelin Power Systems.

Notable operators attending: AG Reederei Norden-Frisia, B. Dettmer Reederei, WSV, Bingen Rüdesheimer, GEFO Shipping Group, HGK Ship Management, Reederei Deymann, Rhenus Schiffsmanagement, WSV, Zöller GmbH and Gebrüder Mnich.

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Figure 9 The presentation of SYNERGETICS research in the Duisburg workshop

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4.2 Interviews held

Interviews contributed significantly by enhancing the degree of information that was already flowing from the vast amount of desk research and workshops. Interviews were used as an additional instrument to gain specific and extra knowledge. The most interesting conclusions about failures of pilots mostly were obtained by interviews.

More than 20 pilots were evaluated by means of interviews. Some interviews covered multiple pilots at once. Interviews were held under a promise of aggregate disclosure only, except in a few cases. Therefore, the SYNERGETICS consortium cannot disclose the persons interviewed and their specific statements. For use in the reports (both this D2.3 and the D2.2), all lessons learned from interviews could be reported upon in an aggregate manner. This safeguards personal privacy as well as company-sensitive information while still extracting the essential information in a satisfactory manner.

During the work period of the task, the task partners have held interviews with representatives from the pilots held by or on the MS Innogy, Rhenus Duisburg, Eilbeck, Rhenus Mannheim, Kotug, Missunde, Bodenseefähren, CFT, via donau, Future Proof Shipping (FPS), Düsternbrook, Mülheim, ZES, Heisingen and the Large Engine Competence Center of the TU Graz. Furthermore, representatives from several EU funded projects and their pilots were interviewed, such as the HyShip project, the ShipFC project, the RH2IWER project and the FLAGSHIPS project.

4.3 Overview/mapping of evaluated pilots and their synergies

Looking back at SYNERGETICS WP2 efforts to increase synchronization between pilot operators, it can be stated that the goal has been achieved. As described under 4.1, the workshops were successful in stimulating interactions amongst pilot operators, regular operators, innovators and other stakeholders such as policy makers. Below, two visual representations of the work done are presented. The first one has its focus on a landscape of evaluated pilots; it categorises the evaluated pilots in WP2 across the type of innovation tested and across the area of operations of the pilot. The second visual is a summary of reached operators/innovators and stakeholders during the workshops.

As can be seen in the image below, the majority of the evaluated pilots were inland shipping pilots (37), followed by 20 coastal pilots. Two pilots were classified as other, one being held on a full seagoing vessel and one an on-shore demonstrator. The largest pilot type evaluated concerned hydrogen pilots (16 IWT, 9 Coastal and 1 other pilot), followed by electrification pilots (18 IWT and 3 Coastal pilots) and methanol pilots (1 IWT, 6 Coastal, 1 Seagoing). Other alternative fuel pilots evaluated were an IWT HVO pilot and a Coastal Ammonia pilot, while energy efficiency pilots could be evaluated on one inland and one coastal vessel. It is noticeable that the division of evaluated pilots has a clear overlap with the division of total pilots (presented in D2.2). However, the first division is necessarily skewed regarding availability of information and/or willingness to participate in interviews and workshops. Availability of information and contact points for pilots were indeed encountered as issues, but in the end a reasonably wide view of pilot types in both Inland and Coastal shipping could be obtained.

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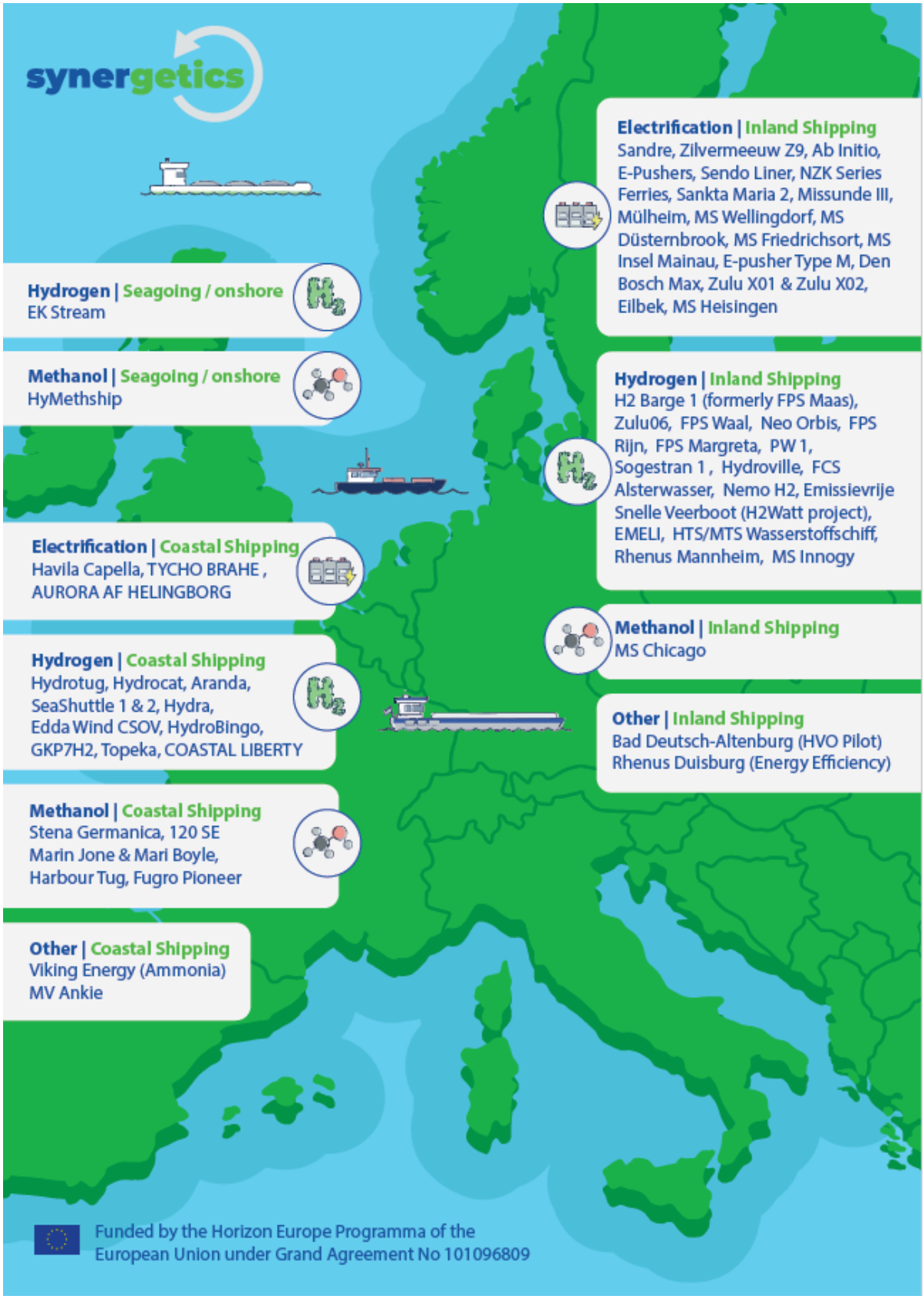

Figure 10 Overview of evaluated pilots

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Figure 11 SYNERGETICS WP2 workshops overview

The figure above shows an impression of the Synergies created by SYNERGETICS WP2 workshops. It gives an overview of key parties attending the relevant workshops hosted by the project and whether these are stakeholders (which is most relevant for WP6) or operators. The latter are most important from a WP2 point of view and it can be seen that the workshops delivered significantly by getting attendance from a group of operators and/or innovators that were allowed the opportunity to inform themselves, but also to synergize with other operators or innovators and key stakeholders attending the same workshops. Amongst the latter often were found policy makers, sector representatives, industry partners or their representatives, relevant EU funded projects and research institutions. The two images combined offer an overview of the work completed in WP2.

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5. | Conclusions

A key part of the Task 2.3 mission was to create synchronization between pilot operators, the project and other stakeholders. With five workshops the task partners have indeed created much synchronization. It is especially to be noted that there was a relatively high number of participating barge owner/operators/innovators present at these workshops. This is of course key to the mission, but also notable because these parties are usually not keen to join events. The barrier to participate to events is rather high, as a part of them only speaks their native language and they have responsibilities to manage and operate their companies. Three workshops (Gorinchem, Antwerp and Duisburg) were held in local languages, close to the business activities of local operators. One of these (Antwerp) even allowed for live translation into other common languages in the region. This proved a significant stimulus in getting practical parties to participate. This strengthened the community in terms of stakeholder engagement.

In total the workshops were able to attract over 30 relevant operators of innovative pilots and/or regular barge operators interested in innovations. Some of the participating operators were small businesses, others large fleet owners and others represented cooperatives of over 150 vessel owners in total. Networking was a key element in the approach, allowing informal bilateral follow-up discussion between participants. It consisted of over 40 represented key stakeholders such as policy makers of the European Commission, River Commissions and several national ministries. Further stakeholders which participated included research institutions, industry partners and representatives from key EU funded projects. Adding to the above the representatives of the twenty pilots that were directly interviewed to evaluate their pilot and its lessons learned gives a broad spectrum of operators, innovators and other stakeholders which the project connected to each other. It therefore seems that the synchronization effort was a success.

The evaluation effort was largely reported upon in D2.2 for reasons explained earlier in this deliverable. The extra pilot evaluations done in the six months since D2.2 was delivered (January – June 2025) did marginally update the status of some of the lessons learned reported upon in D2.2. These new evaluations did also act as a confirmation of the earlier results and conclusions. We can thus conclude that although small steps have been taken, the short period of time since the end of 2024 did not see significant improvement of the key issues that floated to the surface while evaluating pilots as reported in D2.2.

While this deliverable marks the end of the Synchronization Work Package 2, the synchronization efforts do not stop. Under SYNERGETICS Tasks 6.4 and 6.5 the opportunity remains to liaise and network with stakeholders. This enables the project to move forward on a similar foot as in WP2. Multiple relevant events are already in the planning phase and pilot operators will be continued to be invited to participate and to share their findings and experiences. Furthermore, the PEDR process offers a place for ongoing work and workplans to make sure pilot operators are provided with the results from the project.

A final note is reserved for the two research papers that have used the T2.1 Pilot Database. When first envisioned, this database was initiated to be used as a WP2 tool to identify pilots to interact with. However, it turned out to also be a valuable dataset for research purposes. D2.2 already reported partially on the SYNERGETICS paper for the 2024 TRA (now published and available at the download tab of synergetics-project.eu) and currently a second paper by the SYNERGETICS consortium based on the pilot database is nearing publication. Although not a part of the original work package mission, this should be noted as a beneficial outcome of WP partners' efforts as well.

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