Policy implementation measures for a new European waterborne transport system

Deliverable D6.3 - Version Final – 2023-06-01

Advanced, Efficient and Green Intermodal Systems

http://aegis.autonomous-ship.org/

This project has received funding from the European Union's Horizon 2020 research and innovation program under Grant Agreement N° 859992.

Document information

Title	Policy implementation measures for a new European waterborne transport system
Classification	Public

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Rev.	Who	Date	Comment
0.1	AAU	2023.05.17	Draft for review
0.2	DFDS	2023.05.23	Comments from consortium reviewer DFDS
0.3	DTU	2023.05.21	Comments from WP partner DTU
0.4	SO	2023.05.29	Comments from WP partner SINTEF Ocean
Final	AAU	2023.06.01	Final version to be submitted to EC

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Executive summary

The European waterborne transport system faces challenges in shifting cargo from road to sea transport, despite the importance of the European maritime transport policy for sustainable growth. The implementation of the AEGIS project provides an opportunity to overcome these challenges and promote a more efficient and sustainable transport system. However, successful implementation and governance of AEGIS require addressing gaps, creating a supportive policy environment, and strengthening coordination and collaboration among stakeholders.

To address implementation failures, policymakers must identify and bridge gaps caused by inadequate resources, limited stakeholder involvement, and insufficient coordination. Comprehensive gap analyses can inform targeted strategies such as securing funding and establishing public-private partnerships to integrate AEGIS technologies into existing infrastructure. Engaging key stakeholders early in the policymaking process fosters collaborative problem-solving and proactive solution development.

Creating a supportive policy environment involves designing policies that offer clear guidance, align with stakeholder interests, and establish monitoring and evaluation mechanisms. This includes accommodating emerging technologies through regulatory frameworks, providing incentives like research grants and tax breaks, and removing legal barriers hindering their adoption. Policies should encourage innovation and support the integration of disruptive technologies, such as autonomous ships and advanced cargo handling systems.

Effective governance requires robust coordination and collaboration among government agencies, industry associations, and civil society organizations. Industry forums, working groups, and public-private partnerships facilitate collaboration, knowledge sharing, and consensus-building. Involving all stakeholders, such as freight forwarders, shipping companies, truck driving companies, insurers, and classification societies, is crucial for addressing concerns and ensuring equitable distribution of benefits.

To govern AEGIS's technological disruption, policymakers should address implementation gaps and technology traps. This involves fostering an environment that encourages innovation, collaboration, and adaptation within the logistics chain. Stakeholder engagement and alignment of interests through dialogue platforms are essential. Incentive structures tailored to stakeholder needs, such as financial support, regulatory exemptions, or preferential infrastructure access, can drive desired behaviours. Balancing incentives with measures like increased taxes and fees on road transport can encourage the shift to sustainable alternatives.

In conclusion, effective governance of the AEGIS project and the European waterborne transport system requires policymakers to bridge implementation gaps, create a supportive policy environment, strengthen coordination and collaboration, and establish tailored incentive structures. By adopting these strategies, policymakers can navigate challenges associated with disruptive technologies, maximize benefits for stakeholders, and successfully integrate AEGIS into the European waterborne transport system.

Definitions and abbreviations

AAWA	Advanced Autonomous Waterborne Applications Initiative
AEGIS	Advanced Efficient and Green Intermodal Systems project
AIS	Automatic Identification System
AIS	Automatic Identification Systems
BIMCO	Baltic and International Maritime Council.
CCNR	Central Commission for Navigation on the Rhine
CEF	Connecting Europe Facility
CEF-T	Connecting Europe Facility for Transport
CEMT	European Conference of Ministers of Transport
CESNI	European Committee for drawing up Standards in the field of Inland Navigation
CLECAT	European Association for Forwarding, Transport, Logistics and Customs Services
CLIA	Cruise Lines International Association.
CMR	Convention on the Contract for the International Carriage of Goods by Road
COLREG	Convention on the International Regulations for Preventing Collisions at Sea
DMA	Danish Maritime Authority
EC	European Commission
ECSA	European Community Shipowners' Associations
EEA	European Express Association
EFIP	European Federation of Inland Ports
EMSWe	European Maritime Single Window environment
ESN	European Short Sea Network
ESPO	European Sea Ports Organisation
ESR	Effort Sharing Regulation
ETC	European Transport Corridors
ETD	Energy Transition Directive
ETS	Emissions Trading Scheme
EU	European Union
EUDA	European Dredging Association
FAL	Facilitation of International Maritime Traffic Convention
FEPORT	Federation of European Private Port Companies and Terminals
GHG	Greenhouse Gas
GNS	Good Navigation Status
GSIS	Global Integrated Shipping Information System
HFO	Heavy Fuel Oil
IALA	International Association of Marine Aids to Navigation and Lighthouse Authorities
ICS	International Chamber of Shipping
ICT	Information And Communications Technology
IMO	International Maritime Organization
IPSCA	International Port Security Contractors Association
ISO	International Organization for Standardization
ISPS	International Ship and Port Facility Security

ITF	International Transport Forum
IWT	Inland Waterway Transport
LNG	Liquefied Natural Gas
LPG	Liquified Petroleum Gas
M2M	Machine-to-Machine
MARPOL	International Convention for the Prevention of Pollution from Ships
MASS	Maritime Autonomous Surface Ships
MOS	Motorways of the Seas
MRV	Monitoring, Reporting, and Verification:
MSW	Maritime Single Window
MUNIN	Maritime Unmanned Navigation through Intelligence in Networks project
NAIADES	Navigation and Inland Waterway Action and Development in Europe.
NEXUS	Next Generation Support Vessels Providing Safe And More Efficient Offshore Wind Farm Services project
NGO	Non-Governmental Organization
NOx	Nitric Oxides
OPS	Onshore Power Supply
PIANC	World Association for Waterborne Transport Infrastructure
RFNBO	Renewable fuels of non-biological origin
ROPAX	“Roll-On/Roll-Off” passenger
RORO	“Roll-On/Roll-Off” vessels
SOLAS	International Convention for the Safety of Life at Sea
SOx	Sulphur Oxides
SPC	Short-Sea Promotion Centres
SSS	Short Sea Shipping
STCW	International Convention on Standards of Training, Certification and Watchkeeping for Seafarers
TEN-T	Trans-European Transport Network
UNCLOS	United Nations Convention on the Law of the Sea
UPEI	Union of the European Independent Fuel Suppliers

1 Introduction

This report concludes a series of three reports fulfilling the task of providing policy support to the introduction of an advanced, efficient, and green intermodal system. The main objective of the AEGIS project is to develop a new waterborne transport system for Europe that leverages the benefits of ships and barges while overcoming conventional problems like dependence on terminals, high transhipment costs, low speed and frequency and low automation in information processing. AEGIS uses new innovations from the area of connected and automated transport, including smaller and more flexible vessel types, automated cargo handling, autonomous ships, new cargo units and new digital technologies to regain the position that waterborne traditionally had in cargo transport.

The angle of this report is on *policy implementation,* more specifically on designing *measures* to apply the public policy recommendations as presented in AEGIS D6.1, all the while dovetailing legal and regulatory challenges identified in AEGIS D6.2 [1]. This report is thus both a synthesis of two previous project deliverables and an analysis of how their conclusions can be transformed into actionable decisions by policymakers at all levels.

This report examines factors that contribute to the realization or nonrealization of policy objectives for the European transport sector, namely from the perspective of the waterborne segment. It begins by defining 'implementation', the often-overlooked part of the public policymaking process. Subsequently, after considering the general objectives of EU transport policy, the report focuses on identifying implementation failures, i.e., reasons as to why policy targets associated with modal shift were not attained. This diagnosis highlights the existence of an *implementation gap* between targets and reality, and the risk of an *implementation trap*, meaning that the policy may keep failing to deliver intended results if such gaps are not addressed. It is proposed that policy makers may be stuck in a technological trap too, meaning that the status quo is overly reliant on a particular technology or set of technologies, to the point where it inhibits innovation and progress, something that is reinforced by existing policy arrangements. The report then finalizes with two sets of reflections: one on how to design measures to overcome the implementation trap, and a second one, more general, on how to govern disruption altogether.

The core message of this report is that implementing a Europe-wide shift in logistics requires good governance and a systematic approach to the transport sector rather than sectoral targets based on environmental compliance. Governing disruption is an essential part of policy implementation in a context of great technological change, and designing measures to support concepts such as the one proposed by AEGIS require considering stakeholders whose livelihoods or business models will be affected, for they may act as barriers to change and prevent objectives from being fulfilled.

2 Methodology

This report is based on academic scholarship about 'implementing public policy', supplemented by the data collected from publicly available policy documents from the European Union.

Further data was collected while the AEGIS project was ongoing, from June 2019 to May 2023, with recourse to semi-structured key informant interviews from industry and civil service directly or indirectly involved in the AEGIS project use-cases. (see Annex A.).

In a nutshell, the use-cases evaluate the introduction of the proposed system in three contexts:

- the creation of short sea shipping routes linking terminals in the Trøndelag region (Norway) to large European ports
- the setting of inland waterway RORO connections from the port of Rotterdam or the port of Ghent to terminals along the Scheldt, all the way to Paris
- the revitalization of small and medium enterprise city centre terminals of Aalborg and Vordingborg in Denmark [2].

These three cases serve as the basis for generalizing conclusions that would support the introduction of a new waterborne transport system for Europe, and thus implementation measures are proposed on a broader context than the cases themselves.

3 Defining "implementation" as policy

The technological developments brought along by AEGIS require a change in public policies for waterborne transport [1]. Change refers to incremental shifts in existing political structures, or new and innovative policies [3]. Policy change goes hand in hand with *policy implementation*, which can be defined as carrying out of a basic policy decision, usually incorporated in a statute, but which can also take the form of executive orders or court decisions[1]. Also defined as the process of "translating policy into action" [4], implementation is an evolutionary process in which policy programs are constantly reshaped and redefined [5].

There have been three generations of implementation research paradigms [6]. The first generation, in the 1970s, discovered implementation as the missing link in the study of the policy process. A seminal study opened the black box of the policy process by focusing on the intervening process between policy objectives and program outputs and outcomes: the implementation part of the policy process [7]. The first-generation implementation research conceptualized implementation as "a complex and dynamic process that involved multiple participants with a wide range of interests and interpretations regarding authoritative decisions" [8]. For them, there is a clear separation of policy formation from policy implementation[2]. In the 1980s the top-down models of implementation were criticised, and alternative bottom-up approaches were suggested, focusing on bargaining and negotiation processes within networks of multiple formal and informal implementers. The second generation was criticised for its lack of theoretical backing, which led to a third generation characterized by a more rigorous research design. On the one hand, this generation emphasized the conceptual and measurement problems related to variables identified as important for policy implementation, and on the other hand it considered the way hypotheses were formulated and tested. In this third generation, policy implementation is defined "as the set of processes after the programming phase that are aimed at the concrete realisation of the objectives of public policy" [9].

More recently, in 2022, the journal *Governance* published a special issue article on the polity of implementation [10]. The aim of this special issue was (1) to allow a more nuanced conceptualization of implementation arrangements, (2) to discuss the ways implementation arrangements influence and are influenced by additional aspects of the policy sector, and (3) developing a comprehensive approach to implementation research. According to one study published therein, policy implementation is a formative stage of the policy process that determines a policy's form and effect, while also lying at the intersection of politics (the solution of societal problems), policy (the substantive content of the identified solution) and the public [10]. The authors emphasize that policy implementation takes place within a given institutional setting and requires a specific organizational structure. This is what they call the "implementation arrangement". Institutions and organizational structure allocate decision

[1] Mazmanian, D. A., & Sabatier, P. A. (1983). Implementation and public policy. Scott Foresman. "Implementation is the carrying out of a basic policy decision, usually incorporated in a statute but which can also take the form of important executive orders or court decisions. Ideally, that decision identifies the problem(s) to be addressed, stipulates the objective(s) to be pursued, and in a variety of ways, 'structures' the implementation process."

[2] Sabatier and Mazmanian (1979, 1980, see also Mazmanian and Sabatier 1983) are among the core authors of the top-down approach. Like Van Meter and Van Horn (1975), Sabatier and Mazmanian started their analysis with a policy decision that was made by governmental representatives. Mazmanian, D. A., & Sabatier, P. A. (1980). A multivariate model of public policy-making. American journal of political science, 439-468. Mazmanian, D. A., & Sabatier, P. A. (1983). Implementation and public policy. Scott Foresman. Van Meter, D. S., & Van Horn, C. E. (1975). The policy implementation process: A conceptual framework. Administration & society, 6(4), 445-488.

power and they mint specific roles in the implementation process [10]. The authors develop this approach to counter the dominance of politics and agency in implementation studies that overshadow the institutional and organization aspects of policy implementation.

The three generations of implementation research presented earlier can be subdivided into three distinct theoretical approaches to the study of implementation:

1. *Top-down models* put their main emphasis on the ability of decision makers to produce unequivocal policy objectives and on controlling the implementation stage
2. *Bottom-up critiques* view local bureaucrats as the main actors in policy delivery and conceive of implementation as negotiation processes within networks of implementers
3. *Hybrid theories* try to overcome the divide between the other two approaches by incorporating elements of top-down, bottom-up and other theoretical models.

In the case of the AEGIS project, the policy decision leading to the design of the concept was driven by a top-down process. Governmental actors played a crucial role in formulating the policy objectives that are expected to drive change at various levels. These decision makers likely worked to produce clear and unambiguous policy goals for the new waterborne transport system in Europe [11].

To comprehend the objectives behind the AEGIS project and understand why the proposed change is seen as a response to a failure in implementation, it is important to examine the policy objectives set by these governmental actors. This information will shed light on the specific goals that the AEGIS project aims to achieve and how it addresses any previous shortcomings in implementing these objectives.

4 Overview of EU public policy objectives

In 2001, the European Commission analysed the challenges and issues facing European transport policy, especially considering the then upcoming eastern enlargement of the EU [12]. The analysis anticipated a substantial increase in traffic volume, leading to problems such as traffic congestion, gridlock (particularly in road and air transport), and escalating health and environmental costs. To address these concerns, the Commission proposed a comprehensive set of measures aimed at decoupling economic growth from traffic growth and addressing the imbalanced development of different transport modes. The primary objective of the proposed measures was to stabilize the market share of rail transport, inland navigation, and short sea shipping at the levels observed in 1998 [12]. In 2006, the Commission conducted a mid-term evaluation of the implementation of such measures and concluded that they were inadequate [13]. Therefore, the Commission introduced new instruments, including action plans for intelligent transport systems in Europe, urban mobility, and goods transport logistics. Additionally, an integrated European action program was established to enhance inland waterway transport, and strategic goals and recommendations were put forth for the EU's maritime transport policy [13]. Further to this, the 'Greening Transport' Package was presented by the Commission having as primary focus to devise a strategy for internalizing the external costs of transport [14]. The Commission also presented the outcomes of the debate concerning the long-term future of transport, considering a timeline of 20 to 40 years ahead [15].

In 2011, the Commission released its vision for the future of transport until 2050 [16]. The Commission proposed the establishment of a Single European Transport Area. The aim is to eliminate all remaining barriers between different modes of transport and national systems, with the goal of promoting integration and facilitating the growth of multinational and multimodal operators [17]. In that same year, the Commission also outlined proposals to speed up decarbonizing transportation in Europe [18]. The primary objective of this strategy is to achieve complete elimination of emissions in order to effectively support the attainment of the goals set out in the COP 21 Paris Agreement.

More recently, the Commission introduced *The Sustainable and Smart Mobility Strategy* [19]. The strategy outlines a roadmap to ensure that European transport moves towards a sustainable and intelligent future. By implementing the proposed policy measures, the strategy demonstrates that a 90% reduction in transport emissions can be achieved by 2050. To illustrate the path towards sustainable, smart, and resilient mobility, several milestones are established, highlighting the level of ambition required for future EU policies. The Commission also proposed in 2021 a revision of the Emissions Trading Scheme (ETS), which encompasses maritime transport, as well as the establishment of standards for CO2 emission performance and alternative fuel infrastructure.

The objectives of EU transport policy today can be summarized as follows:

1. Breaking the link between economic growth and traffic increase.
2. Promoting the revival of rail, sea, and inland waterway transport.
3. Eliminating cross-border bottlenecks and improving infrastructure.
4. Advancing technological innovation and automation.
5. Internalizing external costs and promoting sustainable mobility.
6. Establishing a Single European Transport Area and facilitating integration.
7. Decarbonizing European transport and contributing to climate goals.
8. Achieving sustainable, smart, and resilient mobility.

These policies are described in depth in AEGIS Deliverable 6.1 [1]. In this report, the focus will instead be on how these policies can be implemented. Instead of policy recommendations, the goal is to discuss how measures to translate objectives into action have an impact on the success of policy. From the standpoint of AEGIS, certain failures have been diagnosed.

5 Diagnosing EU policy implementation failure

The proposed designs introduced by the AEGIS project introduce changes in the logistics chain. Stakeholders interviewed for the purpose of this report mention that important market players (e.g., the cargo owners or the freight forwarders) who make the decisions regarding the mode of transport are not considered in the policy design, leading to implementation failure. Furthermore, national governments have given priority to road transport and extending the road network in relation to initiatives supporting cargo rail or short-sea shipping, which is running counter to the EU policy objectives mentioned above. Road pricing for trucks has seldomly been thoroughly adopted to force a modality change. This may help explain the trend depicted in the figures below, showing that despite having set clear targets, namely that by 2030, 30% of road freight over 300 km should shift to other modes such as rail or waterborne transport, and more than 50% by 2050, the shift from road to sea has not been achieved so far.

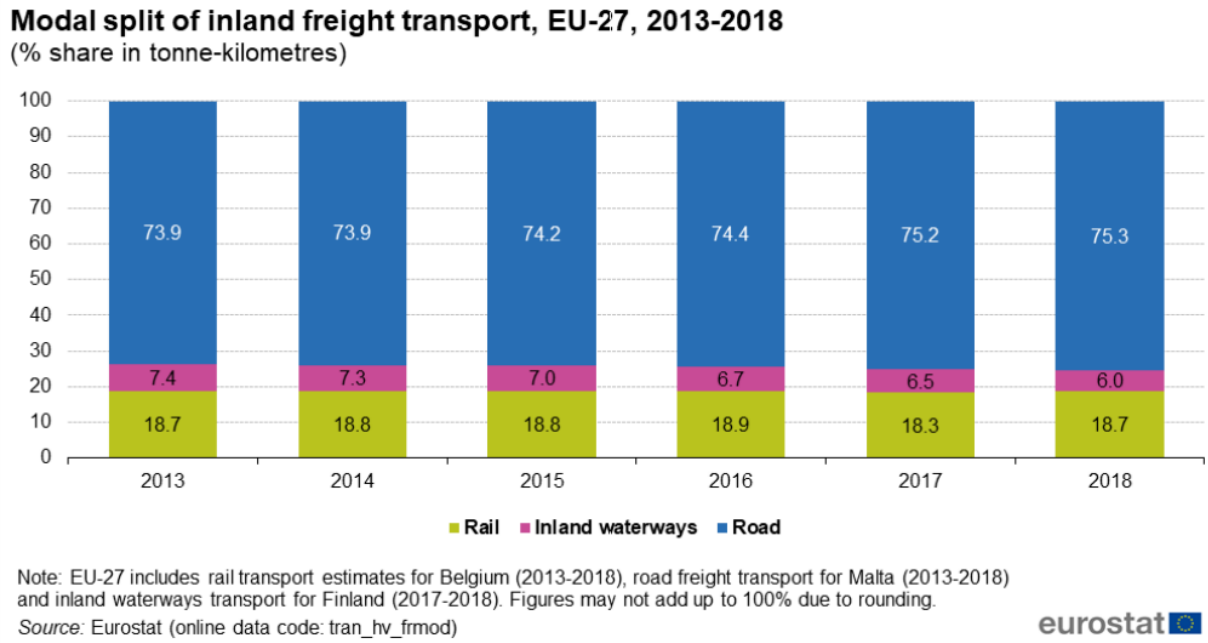

Figure 1: Modal split of inland freight transport, EU27, 2013-2018 (% share in tonne-kilometres). Source: Eurostat, (tran_hv_frmod)

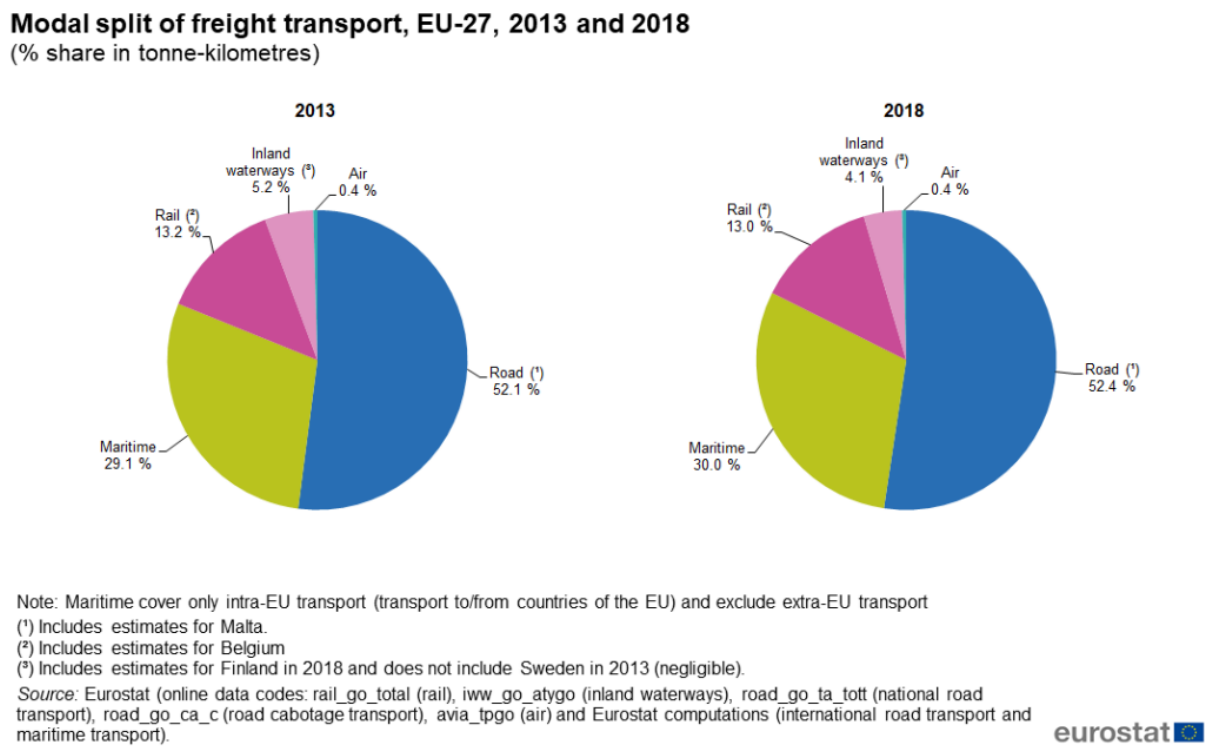

Figure 2: Modal split of freight transport, EU-27, 2013 and 2018 (% share in tonne-kilometres). Source: Eurostat and Eurostat computations

5.1 Gaps and traps in general

To discuss failure in policy implementation, this report considers the existence of an implementation *gap* and of an implementation *trap*. They are two related concepts that describe challenges that can arise during the policy implementation process described above.

The *implementation gap* refers to the difference between what a policy or law is intended to achieve and what is achieved in practice [20]. Implementation gaps can arise due to a variety of factors:

- **Inadequate resource allocation:** Insufficient provision of necessary resources, including funding, personnel, and infrastructure, can impede the effective implementation of policies, leading to a gap between intended objectives and actual outcomes.
- **Bureaucratic inefficiencies:** Administrative bottlenecks, complex procedures, and slow decision-making within the implementation process can result in delays, inconsistencies, and a misalignment between policy intentions and on-the-ground results.
- **Lack of political will:** When policymakers lack the determination, commitment, or prioritization needed to introduce and enforce necessary regulations, it creates a gap between policy goals and the actions taken, hindering effective implementation.
- **Ambiguous or poorly defined rules:** Policies that lack clarity, specificity, or coherent guidelines can make it challenging for implementers to understand, interpret, and execute them accurately, leading to gaps between policy intent and practical implementation.
- **Discretionary powers and interpretation:** Granting wide discretionary powers to bureaucrats, coupled with ambiguous guidelines for their interpretation, can result in inconsistent decision-

making, varying enforcement approaches, and gaps between policy objectives and actual implementation outcomes.

- **Stakeholder resistance and divergent interests:** Opposition, resistance, or conflicting interests from various stakeholders, such as industry groups, affected communities, or interest organizations, can impede the implementation of policies, resulting in gaps between intended goals and actual progress.
- **Lack of monitoring and evaluation mechanisms:** Insufficient monitoring and evaluation systems to assess policy compliance, progress, and outcomes can lead to gaps in understanding the effectiveness of implemented policies, impeding necessary adjustments and improvements.
- **Resource constraints and capacity limitations:** Even when policies are well-defined and well-intentioned, a lack of adequate resources, both financial and human, can hinder implementation efforts, resulting in gaps between policy ambitions and practical realization.
- **Unintended consequences and trade-offs:** Policies may unintentionally create unintended consequences or trade-offs that work against their intended objectives. For instance, policies designed to reduce carbon emissions may inadvertently incentivize companies to shift production to countries with weaker environmental regulations, leading to an implementation gap between emission reduction targets and the actual environmental impact.
- **Noncompliance and weak enforcement:** Policies that are not effectively enforced or lack mechanisms to ensure compliance can lead to a significant gap between policy intentions and realized outcomes. Noncompliance can be due to a lack of penalties, inadequate enforcement capacity, or low awareness and understanding among the target audience.

The *implementation trap* occurs when policies fail to be implemented due to a cycle of failure or path dependency, resulting from a lack of learning and adaptation [21][22]. In other words, a trap exists when a gap is left unaddressed in the policymaking process. This can happen when policymakers continue to implement ineffective policies or use inappropriate agencies for implementation. The categories of implementation traps include incomplete specification of aims or objectives, conflicting objectives within or between policies, incentive failures, conflicting directives from agencies or senior officials, limited competence of agencies or those tasked with implementation, inadequate administrative resources, and failure to communicate with the affected community.

While the implementation gap reflects the difference between policy intentions and actual outcomes, the implementation trap is a specific situation where policies fail to be implemented due to a cycle of failure or a lack of learning and adaptation. Both the implementation gap and the implementation trap can lead to delays, incomplete implementation, bureaucratic opposition, confusion, inefficiencies, and other problems in the policymaking process. Alternatively, the implementation gap can also be seen as a mismatch between 'those who create policy' and 'those who have to act on that policy'. This mismatch does not necessarily indicate a failure or lack of learning and adaptation but rather highlights the disparity between the two parties involved. Addressing these issues is crucial to bridge the gap between policy intentions and actual outcomes and to ensure effective implementation of policies. It is essential to acknowledge and address the mismatch between policy creators and implementers, fostering better communication, collaboration, and understanding between the two. By recognizing this mismatch, policymakers can actively work towards aligning policy objectives with the realities

faced by those responsible for implementation, thus increasing the likelihood of successful policy execution and desired outcomes.

The implementation trap can be accompanied by another phenomenon known as the *technology trap* [23]. This occurs when policymakers become excessively fixated on a specific technology or solution within the context of a policy, disregarding the wider implications and potential alternatives. For instance, let's consider a new European waterborne transport policy. If policymakers solely concentrate on electric propulsion as the exclusive means of reducing emissions, without considering other possibilities like alternative fuels or improved vessel design, they may overlook opportunities for achieving the intended objectives in a more effective or efficient manner. By narrowing their focus to a single technology, policymakers risk missing out on potentially superior or complementary solutions. Alternative fuels or improved vessel design, for example, might offer advantages that electric propulsion alone cannot provide. Neglecting these alternatives may result in suboptimal outcomes and limit the overall progress and innovation within the sector. As the AEGIS project itself well exemplifies, It is important to explore and incentivize a range of technologies and solutions to ensure a comprehensive approach that maximizes the potential for success in achieving policy objectives.

5.2 Implementation gaps in the transport sector

Implementing a new waterborne transport system that utilizes innovations from the connected and automated transport sector requires addressing implementation gaps, avoiding implementation traps, and navigating technological traps. The successful implementation of such a system necessitates careful consideration of the following implementation gaps:

- **Infrastructure Investment**

To introduce a new waterborne transport system, substantial investment in infrastructure is required. This includes the development of appropriate port infrastructure, waterways, and other physical infrastructure to support the implementation of new vessel types, cargo handling systems, and digital technologies. Policymakers should prioritize infrastructure development by leveraging funding programs like the TEN-T and the CEF [1]. These programs can provide financial support for projects aimed at enhancing waterborne transport infrastructure.

- **Regulatory Framework**

The introduction of new technologies in waterborne transport requires a harmonized regulatory framework that ensures their safe and efficient operation, albeit at the global level it is possible to govern with a uniform interpretation of existing treaties [24][2]. Currently, there is a lack of standardized regulations at the EU level governing the use of connected and automated technologies in this sector. Policymakers must prioritize the development of harmonized regulations that cover vessel design, data sharing, and communication protocols between stakeholders in the transport chain. By establishing clear standards and guidelines, policymakers can create an enabling environment for the widespread adoption of connected and automated technologies.

- **Digitalization and Data Sharing**

The successful implementation of connected and automated technologies relies on digitalization and seamless data sharing across the transport chain. However, the lack of interoperability between digital systems and data silos poses a challenge. To address this, EU transport policy should emphasize the development of a common digital platform that facilitates the sharing of data among stakeholders. This includes establishing standardized data protocols, data sharing agreements, and promoting digitalization throughout the waterborne transport sector.

5.3 Implementation traps in the transport sector

Implementing new policies or systems in the waterborne transport sector can be a complex endeavor fraught with various challenges. These implementation traps pose significant obstacles to policymakers, hindering the successful adoption and execution of transformative initiatives. It is crucial for policymakers in the waterborne transport sector to be aware of these traps and devise effective strategies to overcome them. This section explores the implementation traps specific to the waterborne transport sector, shedding light on the critical issues that policymakers must address to ensure the smooth implementation of innovative solutions. By navigating these challenges adeptly, policymakers can lay the foundation for a robust and sustainable waterborne transport system, unlocking its full potential for economic growth and environmental stewardship.

- **Resistance to Change**

Stakeholder resistance from the waterborne transport industry can hinder the adoption of new technologies and business models. Policymakers should prioritize stakeholder engagement, fostering dialogue, and building consensus on the benefits of the new waterborne transport system. By addressing concerns and incorporating stakeholder input, policymakers can design policies and initiatives that respond to industry needs.

- **Lack of Financing**

Introducing a new waterborne transport system requires substantial investment, which can be challenging to secure. Policymakers should explore various financing mechanisms, such as public-private partnerships and incentives for private investment. Leveraging existing funding programs, such as the European Investment Bank, and creating new funding mechanisms can help overcome financial barriers.

- **Lack of Skills and Expertise**

The implementation of new technologies requires a skilled and knowledgeable workforce. Policymakers should prioritize the development of training programs and initiatives that upskill and reskill workers in the waterborne transport sector. Collaborating with educational institutions and industry stakeholders can ensure that training programs align with industry needs.

- **Fragmentation of the Market and Multimodality**

The waterborne transport sector faces fragmentation, with various entities involved in different aspects of the supply chain such as ship operators, barge operators, ports, terminals, and trucks. This division of roles creates a challenge in implementing a new waterborne transport system. To address

this, policymakers should prioritize collaborative efforts, standardization, and multimodality. By establishing common standards, promoting data sharing, and harmonizing communication protocols, stakeholders can achieve seamless integration of connected and automated technologies. This will result in a more efficient and cohesive supply chain, benefiting all parties involved.

- **Lack of Investment and Distribution of Benefits**

Inadequate investment in waterborne transport infrastructure and technologies hinders progress. To overcome this, policymakers must consider fair distribution of costs and benefits among stakeholders. Ship owners, commercial operators, and technical operators face dilemmas regarding who should bear expenses for scrubber installations and other advancements. Collaborative discussions, incentive programs, and innovative financing models should be implemented to promote equitable investment, ensuring sustainable development of the maritime industry.

- **Technological Obsolescence**

The rapid pace of technological advancements requires a flexible regulatory framework that keeps pace with innovation. Policymakers should establish review mechanisms to ensure that policies and regulations remain up to date with technological advancements. By fostering an environment that promotes the adoption of new technologies, policymakers can avoid the trap of technological obsolescence.

- **Lack of Standardization**

The absence of standardization in vessel design, data protocols, and communication protocols hinders integration and interoperability. Policymakers should prioritize the development of a harmonized regulatory framework that establishes clear standards and guidelines. This includes encouraging stakeholders to adopt compatible technologies and protocols, fostering collaboration, and developing industry-wide best practices.

- **Cybersecurity Risks**

As the waterborne transport system becomes increasingly connected and automated, the risk of cyberattacks and data breaches rises. Policymakers must prioritize the development of robust cybersecurity frameworks that protect the system from threats. This includes establishing cybersecurity standards, investing in research and development, and creating certification programs for operators.

5.4 Technological traps in the transport sector

As the maritime industry embraces technological advancements, policymakers face the challenge of effectively navigating the potential technological traps that may hinder progress. To effectively navigate around the technological traps, as defined above, policymakers should prioritize the following specific areas:

- **Cybersecurity**

As ships become more automated and interconnected, policymakers need to prioritize the implementation of robust cybersecurity measures. This includes deploying advanced firewalls, intrusion detection systems, and encryption techniques to protect vessels, crew, and cargo from potential cyberattacks. Regular security audits and assessments should also be conducted to identify vulnerabilities and ensure ongoing protection.

- **Interoperability and Standardization**

Policymakers should emphasize the development and adoption of common communication protocols and industry-wide standards. This will enable seamless communication and information exchange between different vessels, port authorities, and logistics partners. Standardized data formats, messaging systems, and interfaces will enhance interoperability and facilitate efficient collaboration across the maritime ecosystem.

- **Cargo Handling and Storage**

With the introduction of smaller and more flexible vessel types, policymakers should focus on adapting cargo handling and storage systems accordingly. Automation technologies should be designed to accommodate various cargo units and enable efficient loading, unloading, and tracking. Additionally, warehouses and terminals should be equipped with the necessary infrastructure and resources to handle smaller volumes effectively and ensure smooth cargo flow.

- **Autonomous Ships**

Policymakers must establish clear regulatory frameworks and technical requirements to govern the operation of autonomous ships. This involves developing comprehensive guidelines for the safe and reliable navigation of autonomous vessels. Additionally, industry-wide collaboration and research efforts should be encouraged to advance the development of robust autonomous navigation systems and enhance their integration with existing maritime infrastructure.

- **Digital Technologies**

Policymakers should address the risks associated with emerging digital technologies such as blockchain and the Internet of Things. This includes implementing stringent data protection measures to safeguard sensitive information, preventing unauthorized access and data breaches. Compliance with relevant privacy regulations should be ensured, and mechanisms for secure data sharing and authentication should be established to leverage the benefits of these technologies while mitigating potential risks.

- **Human Factors and Human-Machine Collaboration**

Policymakers should develop comprehensive policies that address the challenges of integrating human factors and promoting effective collaboration between humans and machines in the maritime industry. This involves designing training programs to enhance human skills and competencies in working with advanced technologies. Clear guidelines should be established to define roles, responsibilities, and decision-making processes in human-machine collaboration scenarios.

Additionally, research initiatives should be supported to optimize user interfaces and systems, ensuring seamless interaction between humans and machines and maximizing their combined capabilities in maritime operations.

By addressing these challenges, policymakers can navigate the implementation gaps, traps, and technological challenges associated with the introduction of a new waterborne transport system. Taking a comprehensive approach that involves infrastructure investment, regulatory development, stakeholder engagement, and the promotion of innovation and standardization will contribute to the successful implementation of connected and automated technologies in the waterborne transport sector.

6 Designing measures to overcome failure

Limited progress in shifting cargo from road to sea transport can be attributed to policy implementation failures, despite the acknowledged significance of the European maritime transport policy in fostering sustainable growth. Therefore, it is crucial to devise effective measures to address these failures. By proactively addressing implementation gaps and cultivating an enabling environment, policymakers can lay the foundation for successful policy implementation and maximize the advantages offered by initiatives such as the AEGIS project. This section discusses the way such measures can be designed.

6.1 Identifying Implementation Gaps

To overcome policy implementation failures, it is essential to identify and address the underlying gaps that impede the realization of intended policy outcomes. These gaps can arise from inadequate resources, limited stakeholder involvement, and insufficient coordination among relevant authorities. Conducting comprehensive gap analyses will provide insights into the root causes of these implementation gaps and enable the development of targeted strategies to bridge them. For example, inadequate resources may hinder the integration of AEGIS technologies into existing infrastructure. By securing funding or establishing public-private partnerships, policymakers can ensure the necessary investment is made in upgrading ports and developing supporting infrastructure. Additionally, engaging key stakeholders, such as freight forwarders, shipping companies, and truck driving companies, early in the policymaking process can help identify potential gaps and develop solutions collaboratively and proactively, anticipating potential incidents.

6.2 Creating a Supportive Policy Environment

Policy implementation failures can often be attributed to a lack of supportive policy environments. To overcome this, policymakers must foster an enabling environment that encourages the adoption of innovative solutions and supports the integration of disruptive technologies. This entails designing policies that provide clear guidance, align with stakeholder interests, and establish mechanisms for monitoring and evaluation. For instance, establishing regulatory frameworks that accommodate the unique characteristics of emerging technologies, such as autonomous ships and advanced cargo handling systems, can remove legal barriers and promote their adoption. Furthermore, offering incentives, such as research and development grants or tax breaks, to companies investing in sustainable and efficient transport solutions can incentivize innovation and support the implementation of transformative projects like AEGIS.

6.3 Strengthening Coordination and Collaboration

Successful policy implementation requires robust coordination and collaboration among various stakeholders, including government agencies, industry associations, and civil society organizations. By fostering partnerships and promoting information sharing, policymakers can harness collective knowledge and expertise, facilitating smoother implementation processes and minimizing conflicts of interest. For example, establishing industry forums and working groups that bring together freight forwarders, shipping companies, insurers, and classification societies can foster collaboration, enable the sharing of best practices, and drive consensus-building. Additionally, policymakers can encourage the formation of public-private partnerships to jointly address challenges related to infrastructure development, capacity building, and skills training.

7 Governing technological disruption

The implementation of the AEGIS project represents a significant turning point for the European waterborne transport system. Policymakers are now faced with the challenge of not only recognizing the potential benefits of this disruptive technology but also ensuring effective governance to navigate the changes it may bring. To successfully integrate AEGIS into the existing infrastructure, policymakers need to have a comprehensive understanding of governance theory and carefully consider the interests of all stakeholders involved. This approach will facilitate a smooth transition and maximize the benefits for all parties.

7.1 Addressing Implementation Gaps and Technology Traps

The successful realization of the AEGIS project requires a departure from conventional approaches and the resolution of implementation gaps and technology traps. Effective governance necessitates fostering an environment that encourages innovation, collaboration, and adaptation within the logistics chain. This can be achieved by establishing a regulatory framework that promotes experimentation and knowledge-sharing, ensures compatibility and interoperability among stakeholders, and facilitates the adoption of emerging technologies.

For example, policymakers can incentivize freight forwarders and shipping companies to embrace automation and adopt new cargo units, which can streamline operations and improve efficiency in the logistics chain. Early engagement with insurers and classification societies is crucial to developing relevant safety standards and risk assessment protocols. This ensures the safe integration of autonomous ships and advanced cargo handling technologies, while also addressing concerns related to liability and insurance coverage.

7.2 Stakeholder Engagement and Alignment of Interests

Successful governance of disruptive technologies requires active engagement and alignment of interests among stakeholders in the logistics chain. Policymakers should facilitate open dialogue platforms, such as industry forums and working groups, where stakeholders can voice their concerns, share expertise, and collectively shape the future of waterborne transport. This engagement enhances collaboration and promotes a sense of ownership and shared responsibility.

Involving truck driving companies in the transition process is particularly important to mitigate potential negative impacts on their business models. Policymakers can consider implementing retraining programs or incentivizing their involvement in related areas, such as last-mile logistics, to support their adaptation to the changing landscape. Recognizing and addressing the concerns of different stakeholders fosters inclusivity, ensuring the equitable distribution of AEGIS benefits across the industry.

7.3 Incentive Structures and Overcoming the Status Quo

The lack of suitable incentives often hinders the adoption of disruptive innovations, perpetuating the status quo. Policymakers should design effective mechanisms that encourage the shift from road to sea transport, tailored to the specific needs of stakeholders. Incentives can take various forms, such as financial support, regulatory exemptions, or preferential infrastructure access.

One approach that policymakers can consider is increasing taxes and fees on road transport, creating a financial disincentive to discourage its usage. The revenue generated from these measures can then be directed towards supporting sustainable and efficient transport initiatives. Additionally, offering tax benefits or reduced port fees can incentivize shipping companies to embrace AEGIS technology and demonstrate their commitment to sustainability.

Financial support programs can also assist truck driving companies in transitioning to complementary sectors, mitigating potential negative impacts on their workforce. By aligning incentives with sustainable transport goals, policymakers can promote disruptive change while minimizing resistance to innovation. Striking a balance between encouraging desired behaviours and discouraging unwanted ones is crucial. Higher taxes and fees on road transport can steer the market towards sustainable alternatives while providing support and incentives for sea transport innovation.

In summary, effective governance of technological disruption, such as the implementation of the AEGIS project, requires policymakers to address implementation gaps and technology traps, engage stakeholders, align their interests, and establish incentive structures that promote the desired changes. By adopting these strategies, policymakers can navigate the challenges associated with disruptive technologies, maximize the benefits for all stakeholders involved, and drive the successful integration of AEGIS into the European waterborne transport system.

8 Conclusion

The successful implementation of a new European waterborne transport system necessitates careful consideration of past implementation gaps and challenges. While efforts are being made to address legal and regulatory issues, it is essential to acknowledge the persistent failures in shifting cargo from road to sea transport. The proposed implementation measures outlined in this report serve as meta-recommendations, emphasizing the importance of effective governance rather than immediate deployment of the AEGIS concept.

To effectively govern the disruptive nature of AEGIS, a comprehensive and proactive approach is required. This approach entails fostering collaboration, transparency, accountability, inclusivity, and adaptability within the governance framework. By striking a delicate balance between innovation, regulation, and sustainable development, Europe can regain and advance its position in cargo transport through the new waterborne transport system, while mitigating risks and maximizing benefits for all stakeholders.

Furthermore, the governance of technological disruption in the logistics chain calls for a proactive and comprehensive approach from EU policymakers. Drawing on governance theory principles and considering stakeholder interests, policymakers can navigate the introduction of the AEGIS project and ensure a successful transition from road to sea transport. This can be achieved through dialogue, interest alignment, and the implementation of suitable incentive structures, fostering collaboration and shared responsibility while minimizing adverse effects on existing business models. By practicing prudent governance, Europe can effectively harness the transformative potential of AEGIS, thereby paving the way for a sustainable and prosperous future for the European waterborne transport sector.

Policymakers must recognize the significance of addressing implementation gaps, establishing an enabling policy environment, and enhancing coordination and collaboration to bridge the gap between policy objectives and tangible outcomes. By learning from past failures and embracing innovative approaches, Europe can develop a sustainable and efficient waterborne transport system that aligns with the objectives of the European maritime transport policy. Through proactive governance, Europe can effectively leverage initiatives such as the AEGIS project, ensuring a prosperous future for the European waterborne transport sector.

References

[1] AEGIS D6.1 “Public policy recommendations for a new European waterborne transport system”

[2] AEGIS D6.2 “Regulatory challenges for a new European waterborne transport system.”

[3] Bennett, C. J., & Howlett, M. (1992). The lessons of learning: Reconciling theories of policy learning and policy change. *Policy sciences*, *25*(3), 275-294.

[4] Barrett, Susan M. "Implementation studies: time for a revival? Personal reflections on 20 years of implementation studies." Public administration 82, no. 2 (2004): 249-262, p 251.

[5] Majone, G., & Wildavsky, A. (1978). Implementation as Evolution’, in Freeman, H.(ed.), Policy Studies Review Annual. Beverly Hills: Sage.

[6] Sætren, H., & Hupe, P. L. (2018). Policy implementation in an age of governance. *The Palgrave handbook of public administration and management in Europe*, 553-575.

[7] Jeffrey L. Pressman and Aaron B. Wildavsky. Implementation: How Great Expectations in Washington Are Dashed in Oakland. Berkeley: University of California Press, 1973

[8] Sætren, H., & Hupe, P. L. (2018). Policy implementation in an age of governance. *The Palgrave handbook of public administration and management in Europe*, 557.

[9] Knoepfel, Peter, Corinne Larrue, Frederic Varone, and Michael Hill. "Policy implementation." In *Public policy analysis*, pp. 187-220. Policy Press, 2007.

[10] Sager, F., & Gofen, A. (2022). The polity of implementation: Organizational and institutional arrangements in policy implementation. *Governance*, *35*(2), 347-364. 10.1111/gove.12677

[11] Thomas, J. W., & Grindle, M. S. (1990). After the decision: Implementing policy reforms in developing countries. *World development*, *18*(8), 1163-1181.

[12] Commission of The European Communities. (2001). White Paper European transport policy for 2010: time to decide. (COM(2001) 0370 final. 12 September 2001

[13] European Commission. (2006). Communication from the Commission to the Council and the European Parliament - Keep Europe moving - Sustainable mobility for our continent - Mid-term review of the European Commission’s 2001 Transport White paper {SEC (2006) 768 }. COM(2006) 314 final. Brussels, 22.06.2006

[14] European Parliament & Council of the European Union. (1999). Directive 1999/62/EC of the European Parliament and of the Council of 17 June 1999 on the charging of heavy goods vehicles for the use of certain infrastructures. *Official Journal,* L 187. 17 June 1999

[15] European Commission. (2009). Communication from the Commission - A sustainable future for transport : Towards an integrated, technology-led and user friendly system. (COM2009) 0279 final. 17 June 2009

[16] European Commission. (2011). WHITE PAPER Roadmap to a Single European Transport Area – Towards a competitive and resource efficient transport system. (COM(2011) 0144 final. 28 Marts 2011

[17] European Commission. (2017). COMMISSION STAFF WORKING DOCUMENT The implementation of the 2011 White Paper on Transport policy

[18] European Commission. (2016). Communication From The Commission to The European Parliament, The Council, The European Economic and Social Committee and The Committee of The Regions. A European Strategy for Low-Emission Mobility. (SWD2016) 244 final. Brussels, 20 July 2016

[19] European Commission. (2020). Communication from The Commission to The European Parliament, The Council, The European Economic and Social Committee and The Committee of The Regions. Sustainable and Smart Mobility Strategy – putting European transport on track for the future (COM2020) 789 final. Brussels, 9 December 2020

[20] Hudson, B., Hunter, D., & Peckham, S. (2019). Policy failure and the policy-implementation gap: can policy support programs help?. *Policy design and practice*, *2*(1), 1-14.

[21] Schiller, M. (2017). The implementation trap: the local level and diversity policies. International Review of Administrative Sciences, 83(2), 267-282. Howes, Michael, Liana Wortley, Ruth Potts, Aysin Dedekorkut-Howes, Silvia Serrao-Neumann, Julie Davidson, Timothy Smith, and Patrick Nunn. 2017. "Environmental Sustainability: A Case of Policy Implementation Failure?" *Sustainability* 9, no. 2: 165.

[22] Howes M, Wortley L, Potts R, Dedekorkut-Howes A, Serrao-Neumann S, Davidson J, Smith T, Nunn P. Environmental Sustainability: A Case of Policy Implementation Failure? *Sustainability*. 2017; 9(2):165. https://doi.org/10.3390/su9020165

[23] Bolgherini, S. (2007). The technology trap and the role of political and cultural variables: A critical analysis of the e-government policies. *Review of Policy Research*, *24*(3), 259-275.

[24] Ringbom, H. (2019). Regulating autonomous ships—concepts, challenges and precedents. *Ocean Development & International Law*, *50*(2-3), 141-169.

Annex A. List of key informant interviews

Port of Vordingborg	February 2021
Danske Havne (industry organization for Denmark's commercial ports)	March 2021
Port of Aalborg	March 2021
Danish Civil Aviation and Railway Authority (Trafikstyrelsen)	May 2021
Confederation of Danish Industry (DI - Dansk Industri)	June 2021
Danish Maritime Authority	June 2021
Port of Trondheim	September 2021
Port of Aalborg	September 2021
Norwegian Maritime Authority (Sjøfartsdirektoratet)	October 2021
North Sea Container Line (Norway)	December 2021
Short Sea Shipping Network Promotion Centre (Norway)	January 2022
Red Rock (supplier of marine/offshore handling equipment)	January 2022
Norwegian Shipowners' Association (Norges Rederiforbund)	February 2022
Kystrederiene (Norwegian coastal shipowners)	February 2022
Inland Navigation Europe (INE)	June 2022
Port of Rotterdam	June 2022
Zulu Associates (Belgium)	June 2022
Rijkswaterstaat (Netherlands)	July 2022
Lloyds Register	July 2022
Central Commission for Navigation on the Rhine	July 2022
De Vlaamse Waterweg nv (Belgium)	August 2022
Aalborg Municipality	November 2022
Vordingborg Municipality	December 2022
European Shippers Council (ESC)	January 2023
Swedish Transport Agency (Transportstyrelsen)	March 2023
European Federation of Inland Ports (EFIP)	April 2023