ReNEW

White Paper

ReNEW Solutions – Survey Report

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Acronyms and Abbreviations	Meaning
ALICE	Alliance for Logistics Innovations through Collaboration
DT	Digital Twins
FMP	Floating Modular Platforms
IWT	Inland Water Transport
ReNEW	Resilience-centric smart, green, Networked EU Inland Waterways
RIS	River information services

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1 Introduction

1.1 Overview project

The resilience of the Inland water transport (IWT) system depends on the reliability of the infrastructure and the IWT fleet. Furthermore, due to the increasing dynamics, heterogeneity, and complexity of inland waterway systems, it is becoming increasingly difficult for the system to cope with serious predictable and, in particular, unexpected events.

The European Commission views the digitalisation of the transport sector as a key enabler for smart solutions that can support the resilience and sustainability of inland water transport (IWT) and deliver economic, environmental, and societal benefits. Industrial data spaces, simulation and digital twins (DTs) have gained importance in recent years in various fields (e.g. Industry 4.0, smart manufacturing, intelligent transport and smart cities). Simulation and DTs are used to predict outcomes and evaluate what-if scenarios. This leads to better real-time optimisation of processes and operations. Thus, DTs can serve as a decision support system for industry to achieve resilience and system decarbonization based on cross-domain modelling standards and innovative architectures.

Furthermore, it is essential to have the right infrastructure that can flexibly handle unexpected events and provide a link between IWT and other transport modes, allowing proposed solutions resulting from simulations and DT to be effectively implemented.

The ReNEW (Resilience-centric smart, green, Networked EU Inland Waterways) project aims to study and demonstrate how this digitalisation of the IWT sector and the current or new infrastructure (including vessels) could go hand in hand. The aim is to make the sector a smarter, greener, more sustainable and climate-resilient sector.

After studying and demonstrating various innovations, the question arises as to how the sector will implement these innovations. This brings us to the purpose and scope of this deliverable: capacity building and policy recommendations.

2 Survey

2.1 Introduction

The Horizon Europe project ReNEW represents a multidisciplinary group of 24 participants from 11 EU countries working to change inland water transport (IWT) into a smart, green, sustainable and climate-resilient sector.

IWT system resilience is essentially co-dependent on infrastructure and barge/fleet reliability, maintainability, and fault tolerance. It encompasses the sector's key priorities: sustainable infrastructure adjustments, environmental friendliness, competitiveness of the vessel fleet, digitalisation, integration of IWT into multimodal transport chains, and securing the availability of skilled workers.

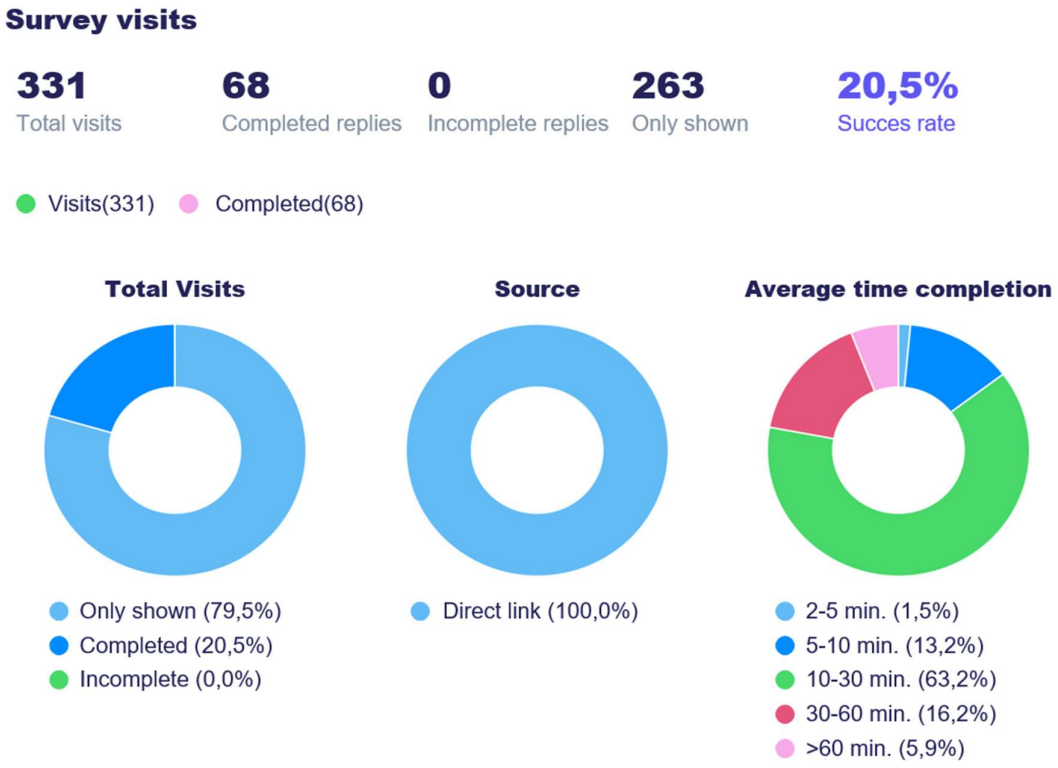
The project builds on previous results and current initiatives to deliver real-world solutions to achieve its objective. The solutions developed in ReNEW are:

- Modular pontoons for resilient logistics hubs
- Waterway infrastructure resilience management
- Digital transport planning tool
- Resilience-promoting autonomous barges

This survey will assess the relevance and acceptance of the developed solutions, identify barriers to adoption, explore the drivers that promote their development, and examine the impacts of implementing these solutions.

Based on the findings, necessary actions will be outlined. This analysis will serve as the foundation for tailored recommendations, supporting EU policies that aim to promote inland waterway transport as a sustainable and resilient option in today's increasingly disrupted environment.

2.2 General survey information



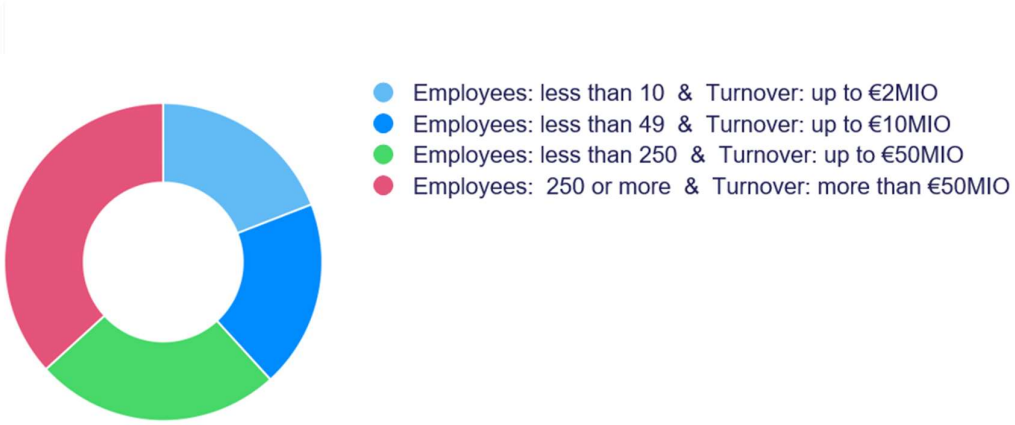
Stakeholder profile

REPLY	REPLIES	RATIO
Equipment manufacturer (ship construction, engine manufacturer...)	1	1,5%
IT-products (operational hard- & software, sensors, ...)	5	7,4%
Barge company	4	5,9%
Infrastructure manager (waterway, river, ...)	3	4,4%
Port, terminal, stevedoring company	1	1,5%
Authority, policymaker, regulator, municipality	16	23,5%
Shipper (producer, industry, ...)	6	8,8%
Logistics Service Provider (integrator, 3/4 PL, freight forwarder, ...)	11	16,2%
Other, kindly specify	21	30,9%

All relevant stakeholder categories within the inland waterway ecosystem are represented among the respondents. This comprehensive representation is essential for effectively identifying the gap between the state-of-the-art developed in the ReNEW project and the perceptions held by the broader inland waterway community. The significant engagement from authorities and policymakers underscores a genuine interest in further promoting inland waterways as a resilient alternative mode of transport.

The survey gathered responses from all identified categories, ensuring widespread representation across Europe. In the "others" category, the respondents predominantly comprise individuals from research institutions, academic settings, and consultancy firms.

Type of organization



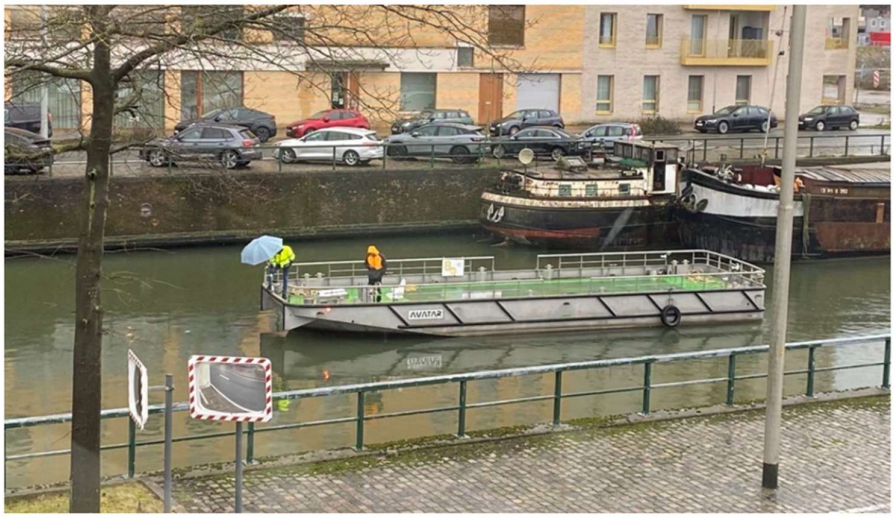
REPLY	REPLIES	RATIO
Employees: less than 10 & Turnover: up to €2MIO	13	19,1%
Employees: less than 49 & Turnover: up to €10MIO	13	19,1%
Employees: less than 250 & Turnover: up to €50MIO	17	25,0%
Employees: 250 or more & Turnover: more than €50MIO	25	36,8%

A clear and balanced representation of organizations and companies of varying sizes.

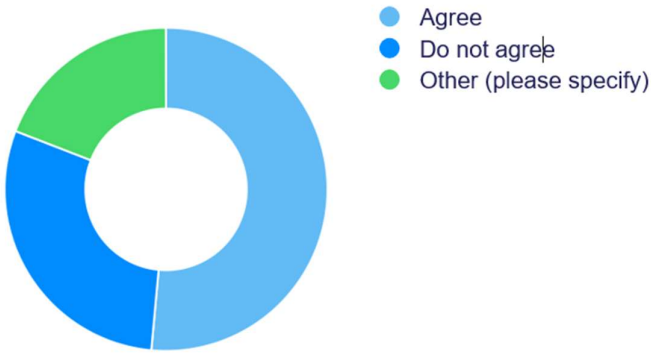
2.3 Modular Pontoons for resilient logistics hubs

The modular pontoon design for a resilient logistics hub focuses on creating a "resilient smart terminal" that integrates water, road, and rail transport systems, allowing for automated mooring and cargo handling. This terminal will facilitate the deployment of modular pontoons. The development and testing of this solution will incorporate automated navigation systems and environmental sensors to enhance both sustainability and resilience. It aims to operate flexibly during extreme events while minimising emissions, allowing for a multimodal response.

Additionally, the solution will feature a remote command center, supported by Shore Control Centers located in Antwerp and Rotterdam, which will efficiently operate and manage these vessels through remote control. A digital twin solution will utilize data collected from the pontoons, the shore, and the control center to provide data-driven predictions and model various scenarios.



2.3.1 Big ships harm the flexibility of inland shipping, making them less suitable for really versatile inland water transport.

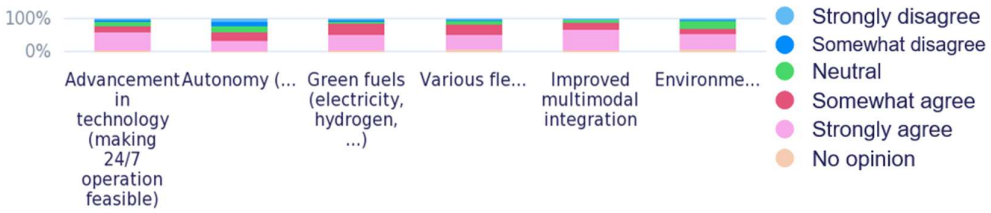


REPLY	REPLIES	RATIO
Agree	35	51,5%
Do not agree	20	29,4%
Other (please specify)	13	19,1%

Although just over half of the respondents fully agree, most believe there are significant possibilities for these modular pontoons.

The "other" responses indicate a balanced perspective, with some suggesting that both options are complementary and that the deployment of vessels primarily depends on waterway routes navigated and the type of cargo. Additionally, one respondent noted that these pontoons are better suited for shorter connections, such as those in or near urban areas.

2.3.2 In the trade-off between larger, less flexible barges and smaller, more adaptable ones, the following characteristics of modular pontoon solutions should be considered:



	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEUTRAL	SOMEWHAT AGREE	STRONGLY AGREE	NO OPINION
Advancement in technology (making 24/7 operation feasible)	2	3	9	12	39	3
Autonomy (reduced to zero crew, no accommodation)	5	9	12	19	21	2
Green fuels (electricity, hydrogen, ...)	1	4	4	23	33	3
Various fleet configurations (impact on terminal operations, demand responsiveness ...)	2	2	7	22	30	5
Improved multimodal integration	1	1	5	14	43	4
Environmental advantages (less disturbance of riverbeds, less generation of wave propagation,...)	1	2	16	12	32	5

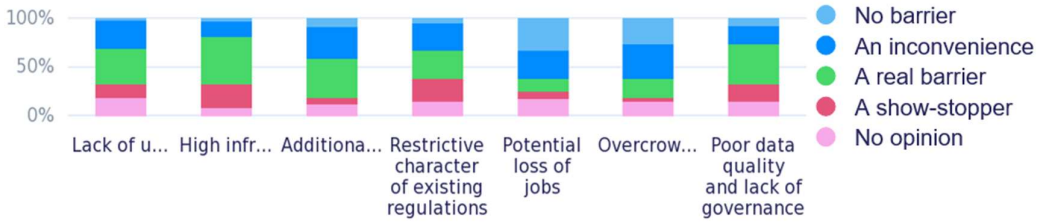
Approximately 80% of respondents recognise the ecological benefits of modular pontoons, strongly agreeing that they positively affect riverbeds, reduce wave generation, and protect both natural and infrastructural surroundings. The same 80% (with 63% strongly agreeing) are even more convinced about the enhanced multimodal integration enabled by these modular pontoons, viewing them as a valuable addition to existing fleets. This improvement increases the overall responsiveness of inland

waterway capabilities and expands the available options within the fleet. Consequently, this will enhance demand responsiveness and help keep inland waterways operational during times of disruption.

Additionally, around 75% of respondents, almost 60% strongly, believe that technological advancements will further support 24/7 operations, emphasising the flexibility of these systems.

About 60% of respondents agree with the aspect of autonomous operations, albeit with less enthusiasm than for other points raised.

2.3.3 BARRIERS



	NO BARRIER	AN INCONVENIENCE	A REAL BARRIER	A SHOW-STOPPER	NO OPINION
Lack of understanding the impact of the solution	1	20	25	9	13
High infrastructure investment needs	2	11	33	16	6
Additional technical infrastructure requirements for remote control	6	22	27	5	8
Restrictive character of existing regulations	3	19	20	16	10
Potential loss of jobs	22	20	9	5	12
Overcrowding of small waterways by multiple users	18	24	13	3	10
Poor data quality and lack of governance	5	13	28	12	10

In examining the challenges associated with deploying modular pontoons to support resilient logistics hubs, 88% of respondents identify high investment needs for modifying existing infrastructure as the primary issue. Additionally, 78% express concerns about the poor quality of available data, which impacts the efficient management and operation of the solution. There is also a lack of governance regarding this inadequate data.

Almost 80% of respondents indicate that a better understanding of the impact of the solution is essential. This concern is echoed by nearly 20% of participants who stated they have no opinion, suggesting a lack of comprehension regarding the potential effects of modular pontoons. Many respondents are unsure of what is feasible.

Comments also highlight worries about how increased traffic at deep-sea terminals might interconnect with the pontoons. Some people view the navigation of pontoons in docks or terminals

as potentially disruptive. However, overcrowding or congestion on small waterways is not seen as a major hindrance, with over 60% rating it as a minor issue.

A general belief exists that the technology required to meet the necessary infrastructural requirements is a barrier, with over 70% of respondents agreeing. However, only about 7% consider this a dealbreaker. Concerns have been raised regarding the overall costs required to make the solution fully operational.

The issue of restrictive existing regulations is somewhat inconclusive, with a majority of 57% viewing it as an inconvenience and a significant barrier rather than a dealbreaker (23%).

Respondents generally do not consider the potential loss of jobs a major concern, as the solution is seen as addressing industry needs. While over 60% categorise it as at worst an inconvenience, some comments express the importance of the human component.

2.3.4 DRIVERS

	NO DRIVER	NICE-TO-HAVE	A REAL SUPPORT	A GAME CHANGER	NO OPINION
Staff shortage solution	3	8	26	19	12
More flexible use of IWT thanks to vessel size and modularity	1	7	33	21	6
Improved responsiveness/flexibility to disruptive events	3	13	26	16	10
Reduction of operational costs	3	10	25	23	7
Improved responsibility regarding environmental concerns	3	20	27	10	8

Due to their vessel size and modularity, the drivers for deploying these pontoons indicate that their flexible use in inland waterway transport (IWT) is viewed positively by over 75% of respondents, with 30% considering it a game changer. More than 70% believe these pontoons will significantly help reduce overall operational costs. This perception includes the belief that the solution can help address the staff shortage, which 66% of participants acknowledge.

On the other hand, the response regarding the potential of this solution to improve responsiveness or flexibility in the face of disruptive events is less enthusiastic. The views range from "nice to have" to "game changer," with nearly 40% still seeing it as a meaningful support. However, enhancing responsiveness remains a key objective of the project. While the contribution of the pontoons to improved environmental responsibility is recognised—only 16% of respondents expressed no opinion or disagreement (with just 4% disagreeing)—this driver ranks the lowest among the various factors.

One particularly noteworthy suggestion emerged in the comments section: “the pontoons could enable a reliable and consistent barging scheme with accurate ETAs, making them a valuable addition to a more comprehensive approach to last-mile distribution”.

It’s important to note one dissenting opinion. This individual consistently emphasizes that the challenges faced by both large and small barges remain the same, as do the technological opportunities available.

2.4 Waterway infrastructure resilience management

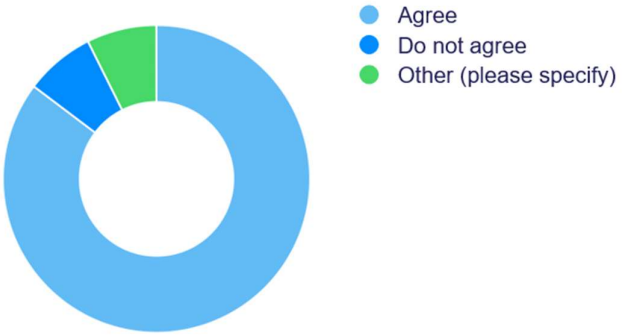
This solution involves creating a digital twin to model the hydrological behaviour of the Douro River.

This digital twin will serve as a tool to support decision-making during extreme weather events such as floods and droughts.

The focus will be on improving prediction accuracy, adapting responses to various scenarios and considering critical factors such as existing rail <<connections, particularly their role in emergencies like evacuating passengers and goods.

Additionally, this tool, supported by digital ship improvements, will facilitate operators on and along the river in environmentally responsible behaviour and river management, while promoting sustainable shipping practices and overall river use.

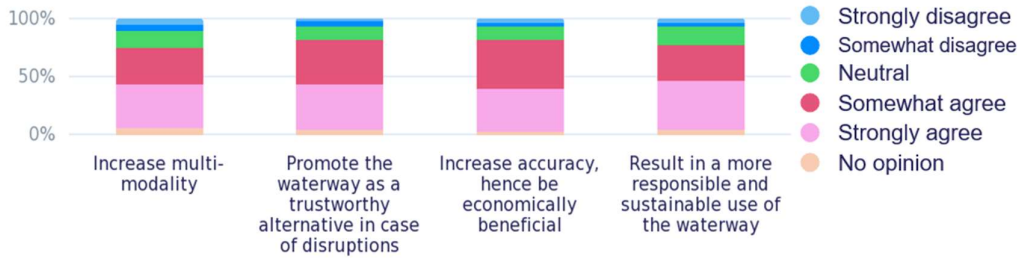
2.4.1 The implementation of responses and scenarios produced by the digital twin solution is a key step towards achieving a responsible, sustainable, and intelligent use of the waterway by its users.



REPLY	REPLIES	RATIO
Agree	58	85,3%
Do not agree	5	7,4%
Other (please specify)	5	7,4%

A significant 85% of respondents affirm that implementing the responses and scenarios generated by the digital twin solution serves as an effective mechanism to promote a more responsible, sustainable, and intelligent utilization of the waterway.

2.4.2 Implementing the solutions and scenarios from the digital twin will:



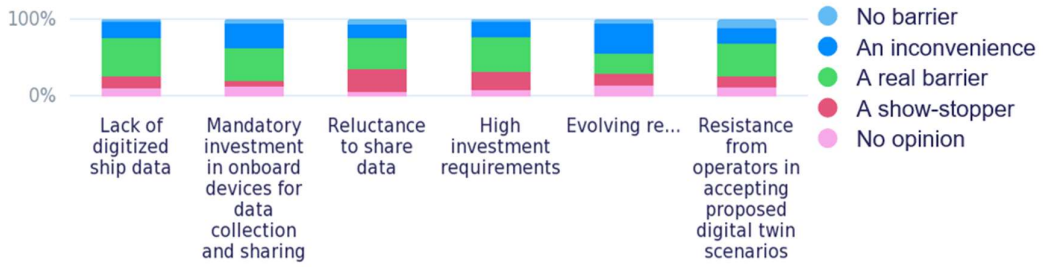
	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEUTRAL	SOMEWHAT AGREE	STRONGLY AGREE	NO OPINION
Increase multi-modality	3	4	10	21	26	4
Promote the waterway as a trustworthy alternative in case of disruptions	1	3	8	26	27	3
Increase accuracy, hence be economically beneficial	2	2	8	29	25	2
Result in a more responsible and sustainable use of the waterway	2	2	11	21	29	3

The survey participants strongly agree that implementing a digital twin will promote a more responsible and sustainable use of the waterway, with 42.6% in agreement. Additionally, nearly 40% firmly believe that the digital twin will enhance the waterway's reputation as a trustworthy and economically viable alternative during disruptions, thereby increasing multimodality.

This optimistic view is further supported by the fact that approximately three-quarters of the responses reflect a positive reaction to implementing a digital twin.

Among the remaining participants who did not share this optimistic view, two-thirds expressed a neutral rather than a negative stance.

2.4.3 BARRIERS



	NO BARRIER	AN INCONVENIENCE	A REAL BARRIER	A SHOW-STOPPER	NO OPINION
Lack of digitized ship data	2	14	34	11	7
Mandatory investment in onboard devices for data collection and sharing	3	22	29	5	9
Reluctance to share data	4	12	28	20	4
High investment requirements	2	13	31	16	6
Evolving requirements and roles in accountability and governance	3	27	18	10	10
Resistance from operators in accepting proposed digital twin scenarios	7	14	29	10	8

When assessing the obstacles to implementing a high quality digital twin solution, survey respondents expressed various concerns regarding the challenges involved.

A total of 83.2% indicated that some form of action or solution would be required. Specifically, 25% of participants identified only minor hurdles, while 30% felt no significant challenges were ahead. In contrast, 41.4% recognized that substantial barriers existed but believed solutions could be found, whereas 17.7% thought these barriers were insurmountable.

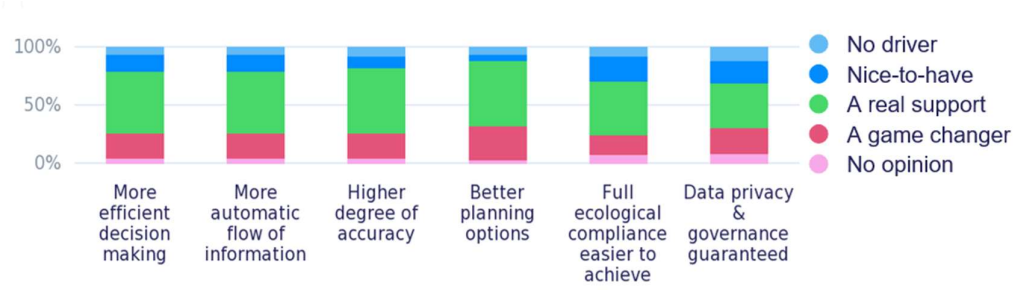
Between 42.5% and 50% of participants considered all barriers real challenges, although they believed they could be overcome.

The most prominent obstacles identified were the reluctance to share data and the necessary investments. Overall, respondents viewed these barriers as particularly difficult to address, with approximately 70% suggesting they were hard or impossible to overcome.

Additionally, the lack of digitised data and operators' resistance to proposed digital twin scenarios were noted as significant obstacles. However, most responses expressed the belief that these issues could be resolved. One pertinent comment suggested that integrating too many data sources leads to increased complexity, ultimately harming trust, which further exacerbates the main obstacle: the reluctance to share data.

Accountability and governance were also recognised as challenges, but respondents felt these could be addressed later.

2.4.4 DRIVERS



	NO DRIVER	NICE-TO-HAVE	A REAL SUPPORT	A GAME CHANGER	NO OPINION
More efficient decision making	4	10	36	15	3
More automatic flow of information	4	10	36	15	3
Higher degree of accuracy	5	7	38	15	3
Better planning options	4	4	38	20	2
Full ecological compliance easier to achieve	5	15	31	12	5
Data privacy & governance guaranteed	8	13	26	15	6

Considering all responses from the participants, 87.25% believe that the drivers effectively stimulate the implementation of the digital twin solution. Only a small minority, 7.35%, expressed reservations by labelling them “no driver.”

The digital twin is primarily recognised for providing better planning options, with over 85% of respondents viewing this aspect as a significant support or a game changer.

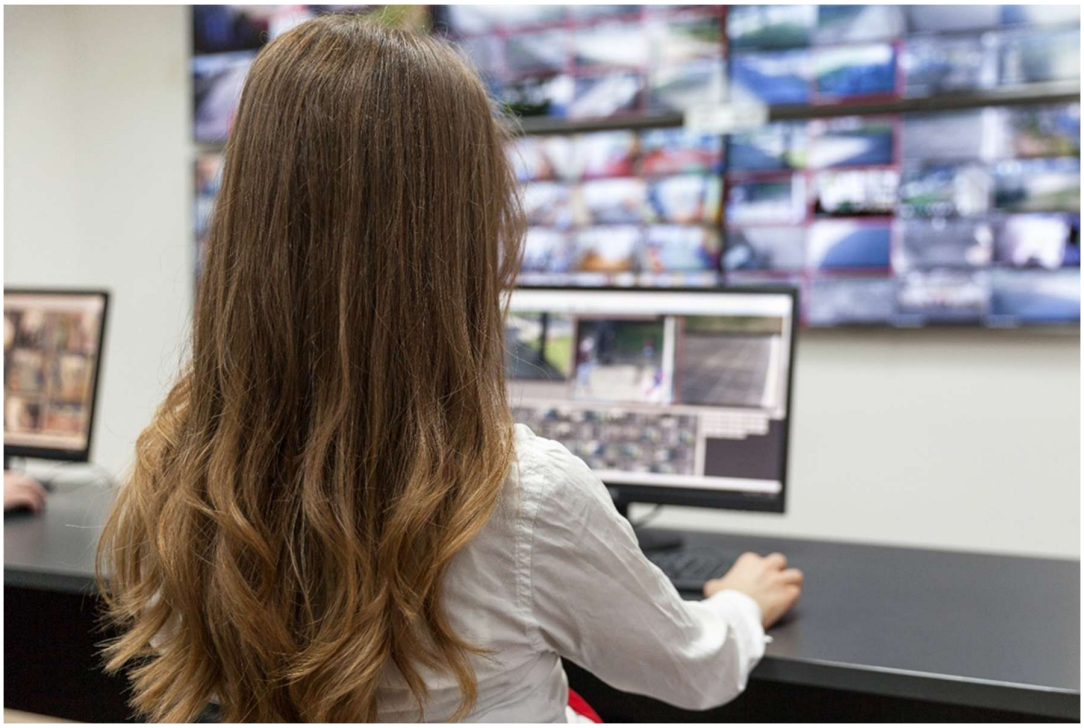
Additionally, a large majority of survey respondents (76%) virtually assigned equal importance to the digital twin for enhancing accuracy, improving decision-making efficiency, and increasing the automation of information flow.

While its contribution to ecological compliance was acknowledged as a beneficial factor, it was not considered a primary driver.

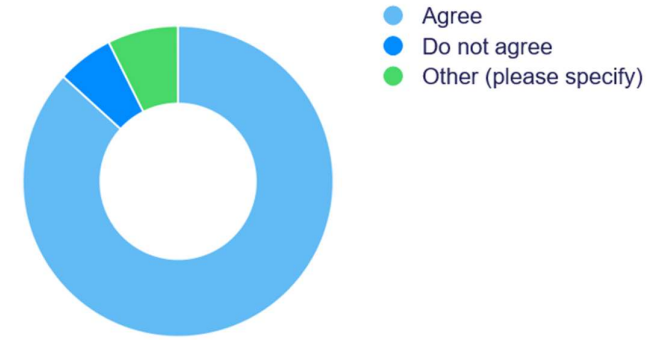
2.5 Digital transport planning tool

This solution is designed to increase the capacity of resilient infrastructures during disruptive events. The digital twin app gathers information from various partners in the inland waterway logistics chain, including skippers, terminal operators, forwarders, and shippers.

It provides user-friendly, real-time insights into the status and progress of transport. The app seamlessly integrates information about current water levels and forecasts, obstacles, and traffic conditions at locks and bridges to assist in planning proactively.



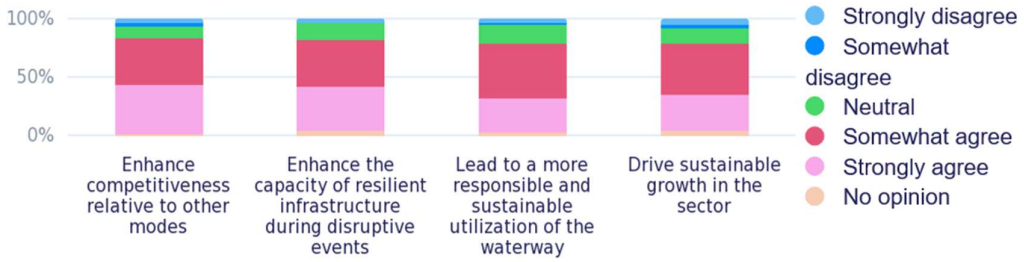
2.5.1 Improving the reliability of inland shipping is crucial for enabling the desired modal shift and unlocking its full potential. A planning tool that integrates all key decision factors in real-time will be instrumental in enhancing the efficiency, reliability, and resilience of inland shipping operations.



REPLY	REPLIES	RATIO
Agree	59	86,8%
Do not agree	4	5,9%
Other (please specify)	5	7,4%

For an overwhelming 86.8% of survey respondents, it is clear that a planning tool that integrates all key decision factors in real-time is instrumental in enhancing the efficiency, reliability, and resilience of inland shipping operations.

2.5.2 The widespread adoption of this planning tool in inland shipping logistics will:

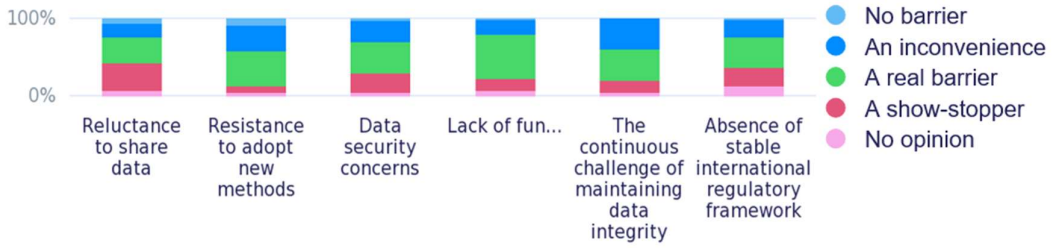


	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEUTRAL	SOMEWHAT AGREE	STRONGLY AGREE	NO OPINION
Enhance competitiveness relative to other modes	2	2	7	27	29	1
Enhance the capacity of resilient infrastructure during disruptive events	2	0	10	27	26	3
Lead to a more responsible and sustainable utilization of the waterway	2	1	11	32	20	2
Drive sustainable growth in the sector	3	2	9	30	21	3

Overall, the participants agree that the widespread adoption of the planning tool will have beneficial effects. It will enhance the competitiveness of inland waterway transport compared to other modes, with 82.35% supporting this view, and 42.65% strongly agreeing. A similar sentiment is expressed regarding its impact on infrastructure capacity during disruptive events, with 79% agreeing it will be beneficial and 38% strongly agreeing.

However, opinions were more moderate when assessing the tool's potential for promoting more responsible and sustainable utilization of waterways. Here, 76.5% of participants supported the statement, but 47% were only "somewhat agreeing." Similarly, expectations that the planning tool will drive sustainable growth in the sector received support from 75% of respondents, with 44% "somewhat agreeing." The respondents have a less pronounced opinion on these last two statements.

2.5.3 BARRIERS



	NO BARRIER	AN INCONVENIENCE	A REAL BARRIER	A SHOW-STOPPER	NO OPINION
Reluctance to share data	4	12	23	24	5
Resistance to adopting new methods	6	22	31	6	3
Data security concerns	2	18	28	17	3
Lack of funding to secure data accessibility across the infrastructure network	1	13	39	10	5
The continuous challenge of maintaining data integrity	0	27	27	11	3
Absence of a stable international regulatory framework	1	15	27	16	9

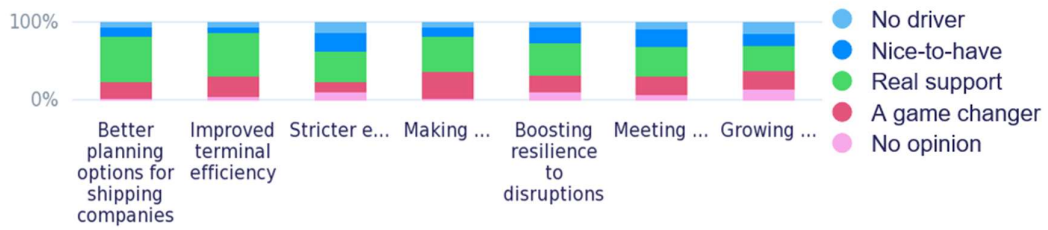
The reluctance to share data presents a significant obstacle to progress within the industry and the adoption of more collaborative tools. According to survey results, 69% of participants view this reluctance as a serious barrier or a showstopper, while 86.8% consider it a challenge of some kind. Concerns about data security are a significant contributing factor to this perception, with 92.6% of respondents identifying security issues as a barrier.

Another noteworthy finding from the survey is the lack of funding necessary to ensure data accessibility across the infrastructure network. An overwhelming 91.2% of participants see this as a hurdle, with 72.1% characterizing it as a real barrier or showstopper. Additionally, the absence of a stable international regulatory framework hampers rapid implementation, as 85.3% of respondents reported.

Maintaining data integrity is viewed as an ongoing challenge. This does not necessarily directly relate to this specific transport planning tool, as nearly 40% of respondents see it as a general inconvenience, another 40% as a real barrier, and another 16% as a showstopper.

An additional remark worth mentioning was the need to pursue a more holistic approach by aiming to interact with other modes of transport.

2.5.4 DRIVERS



	NO DRIVER	NICE-TO-HAVE	REAL SUPPORT	A GAME CHANGER	NO OPINION
Better planning options for shipping companies	4	8	40	14	2
Improved terminal efficiency	4	5	38	18	3
Stricter environmental regulations	9	16	27	9	7
Making multi-modal connectivity simpler and more efficient	4	8	31	23	2
Boosting resilience to disruptions	4	14	28	15	7
Meeting customer expectations for transparency and data sharing	6	15	26	16	5
Growing congestion on road infrastructure	10	10	22	16	10

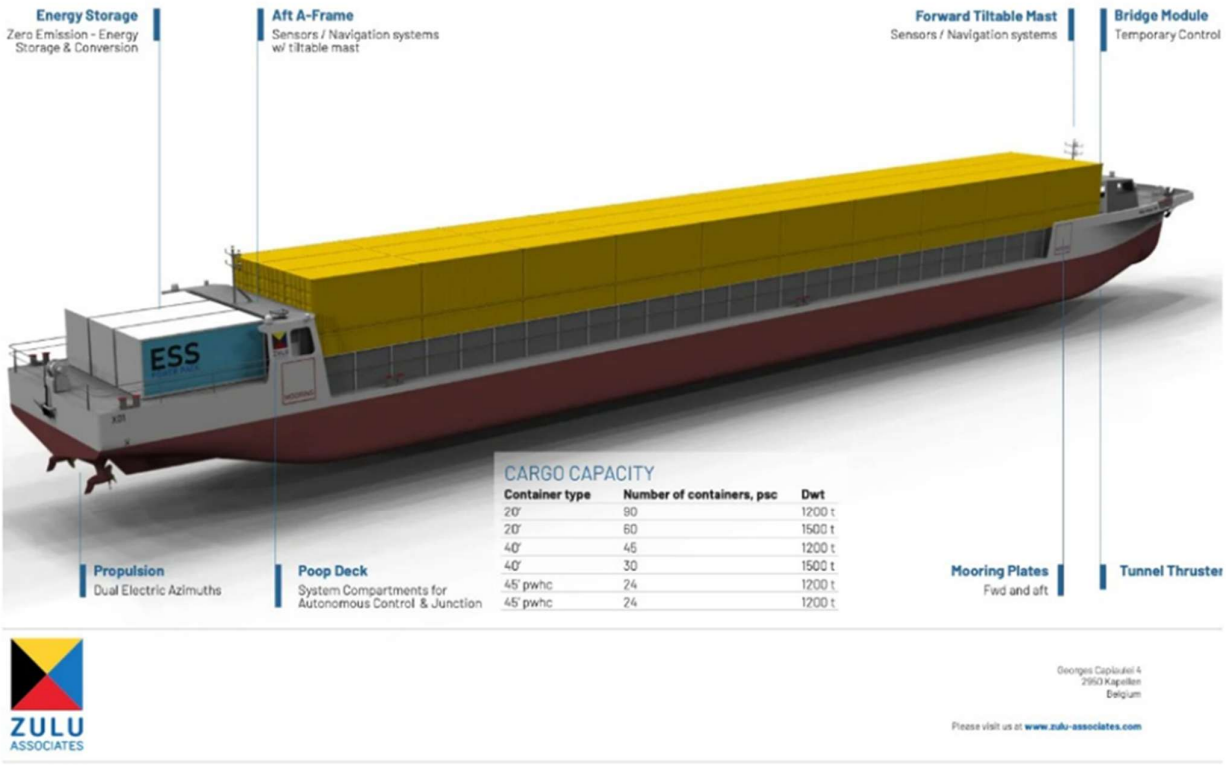
The survey participants recognize that the planning tool significantly improves terminal efficiency (89.7%) and provides better planning options for shipping companies(91.2%). One of the most notable responses indicates that the tool simplifies and enhances multi-connectivity (91.2%), with over a third of the respondents (33.8%) labelling it as “a game changer.”

Reactions from survey respondents are more balanced regarding the tool's impact on resilience to disruptions and its ability to meet customer expectations for transparency and data sharing, both of which received scores of 83.8%. In both cases, about 40% of respondents view the tool as valuable support rather than a game changer.

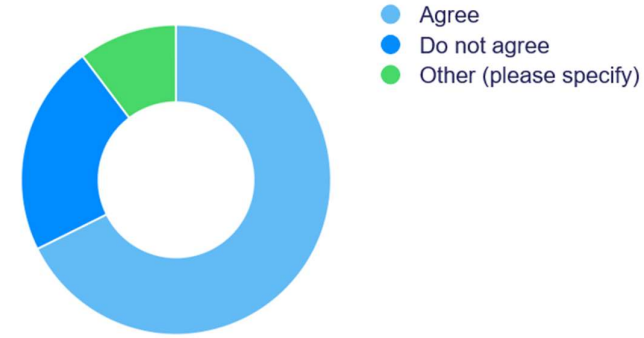
2.6 Resilience-promoting autonomous barges

One of ReNEW's key pillars is that a fleet of smaller and increasingly automated vessels will inherently increase the resilience of the overall infrastructure.

This living lab solution proposes using an autonomous CEMT class 4 barge (the X-barge) to demonstrate and test the improved resilience of the IWT infrastructure. The concept features a disruptive barge design that combines digitisation, alternative propulsion, and autonomy.



2.6.1 Smaller autonomous barges are better positioned to adapt quickly to disruptive events, making them crucial for advancing inland waterway transport (IWT) as a climate-resilient and environmentally sustainable solution.

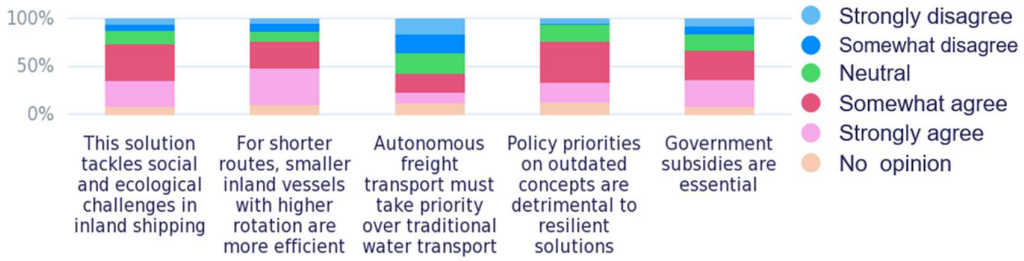


REPLY	REPLIES	RATIO
Agree	46	67,6%
Do not agree	15	22,1%
Other (please specify)	7	10,3%

67.6% of respondents believe that smaller autonomous barges are well-positioned to adapt to disruptive events quickly. This adaptability makes them essential for advancing inland waterway transport as a climate-resilient and environmentally sustainable solution.

However, it is important to note that while two-thirds of the respondents support this statement, this percentage is lower than the approval ratings for all other ReNEW solutions.

2.6.2 Are autonomous barges a disruptive game-changer ?



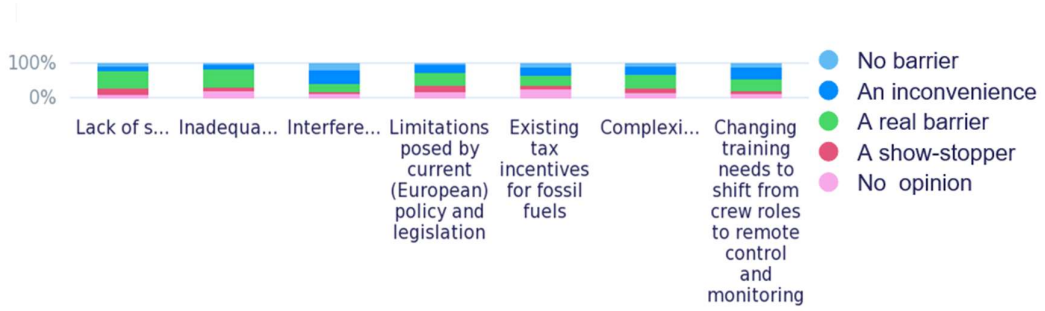
	STRONGLY DISAGREE	SOMEWHAT DISAGREE	NEUTRAL	SOMEWHAT AGREE	STRONGLY AGREE	NO OPINION
This solution tackles social and ecological challenges in inland shipping	4	4	10	26	18	6
For shorter routes, smaller inland vessels with higher rotation are more efficient	3	6	7	19	26	7
Autonomous freight transport must take priority over traditional water transport	11	13	15	13	8	8
Policy priorities on outdated concepts are detrimental to resilient solutions	3	1	12	29	14	9
Government subsidies are essential	5	6	11	21	19	6

When asked if autonomous barges are a disruptive game changer, 56.8% of the surveyed group responded positively, agreeing to varying degrees with the sub-statements presented. In contrast, 16.2% disagreed with the notion. However, it's important to note that the level of positive responses for autonomous barges is significantly lower than the other ReNEW solutions.

Autonomous barges are primarily favoured for shorter routes, as participants believe smaller inland vessels with higher turnover rates are more efficient (66.2%), with 38.2% of respondents strongly agreeing. Furthermore, there is an expectation that autonomous barges will help address the social and ecological challenges associated with inland shipping, with 64.7% agreeing.

Policies focusing on outdated concepts are viewed as obstacles to developing resilient and innovative solutions (63.2%). Although 58.8% of respondents acknowledge the importance of government subsidies, a significant 35.3% believe that autonomous freight transport should not take precedence over traditional water transport, surpassing the 30.9% who argue it should.

2.6.3 BARRIERS



	NO BARRIER	AN INCONVENIENCE	A REAL BARRIER	A SHOW-STOPPER	NO OPINION
Lack of suitable waterway infrastructure	6	9	33	13	7
Inadequate reinvestment policies in traditional shipping	1	9	36	8	14
Interference with traditional water transport	12	27	16	4	9
Limitations posed by current (European) policy and legislation	1	17	25	12	13
Existing tax incentives for fossil fuels	7	17	19	7	18
Complexity in reassigning tasks, responsibilities, and liabilities	5	17	27	9	10
Changing training needs to shift from crew roles to remote control and monitoring	8	22	23	6	9

Respondents display slightly less caution than with other Renew solutions when considering the potential obstacles to implementing autonomous barges to enhance inland waterway transport as a climate-resilient and environmentally sustainable solution.

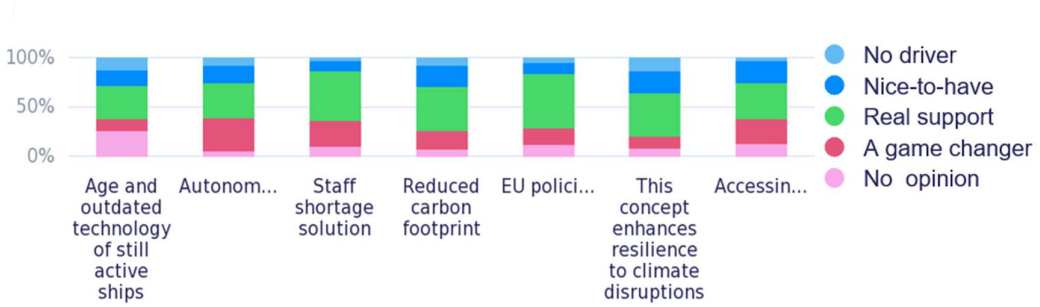
The most significant limitation identified is the lack of suitable waterway infrastructure, with 80.9% of respondents viewing this as a problem and 67.6% considering it a real barrier or showstopper. This concern is further substantiated by evaluating reinvestment policies in traditional shipping, which 77.9% regard as inadequate, while 64.7% see this as a serious issue. Additionally, the limitations of current European policies and legislation concern 69.1% of respondents.

Other barriers, such as the interference of autonomous vessels with traditional vessels, the need to adapt staff training methodologies from traditional roles to more technological ones, and the

complexity of reallocating tasks, responsibilities, and liabilities, are acknowledged. However, a relatively large group considers these challenges resolvable and does not view them as significant impediments, more so than with other ReNEW solutions.

Nevertheless, special attention must be given to the operational aspects of these smaller vessels in a port environment.

2.6.4 DRIVERS



	NO DRIVER	NICE-TO-HAVE	REAL SUPPORT	A GAME CHANGER	NO OPINION
Age and outdated technology of still-active ships	8	11	23	8	18
Autonomous freight transport enables 24/7 operation	5	12	24	23	4
Staff shortage solution	2	7	34	18	7
Reduced carbon footprint	5	15	30	13	5
EU policies focus on new technologies	3	8	37	12	8
This concept enhances resilience to climate disruptions	9	15	30	8	6
Accessing areas unreachable by larger vessels	2	15	25	17	9

Reflecting on the reasons for implementing autonomous barges to enhance inland waterway transport as a climate-resilient and environmentally sustainable solution, respondents express significant enthusiasm about the benefits these vessels offer. A notable 88.2% believe that autonomous vessels can help address the staff shortage, while 86.8% are excited about the potential for 24/7 operations.

Additionally, 83.8% of respondents highlight that these vessels can access unreachable areas by larger vessels. The support from EU policies, particularly in financial backing for new technologies, is also recognised as a key factor enabling the implementation of autonomous vessels.

While a majority (85.2%) acknowledges the potential for a reduced carbon footprint, 22.0% view this benefit as secondary. Many respondents also emphasise that the emission reduction will largely depend on the energy sources utilised.

2.7 The role of authorities in driving solutions for climate-resilient, environmentally sustainable inland waterways

REPLY	REPLIES	RATIO
Authorities should develop strict and binding policies to enforce such solutions (compulsory approach)	23	33,8%
Authorities should develop policies supporting and enabling innovative solutions to this extent (voluntary approach)	43	63,2%
Authorities should refrain from developing any such policies	2	2,9%

A clear 63.2% of respondents expect authorities to create policies that support and promote innovative solutions for climate-resilient and environmentally sustainable inland waterways. Therefore, the results of this survey, along with a detailed analysis of each stakeholder group represented, will serve as the foundation for a focused set of policy recommendations.

3 First categorisation of recommendations

These recommendations, based on the survey findings, aim to address the identified barriers and leverage the drivers to promote the adoption of innovative solutions for climate-resilient and environmentally sustainable inland waterways.

3.1 Modular Pontoons Solutions

- Promote Flexibility: Encourage the use of modular pontoons to enhance the flexibility of inland water transport (IWT), making it more adaptable to various conditions and needs.
- Address Barriers: Tackle high infrastructure investment needs, restrictive regulations, and potential job losses by developing supportive policies and providing financial incentives.
- Leverage Drivers: Utilise the benefits of modular pontoons, such as staff shortage solutions, flexible vessel sizes and environmental advantages, to promote their adoption.

3.2 Waterway Infrastructure Resilience Management

- Implement Digital Twin Solutions: Advocate for the adoption of digital twin solutions to improve the resilience and sustainability of waterway infrastructure.
- Overcome Barriers: Address issues like a lack of digitised ship data, high investment requirements, and reluctance to share data by fostering collaboration and providing funding for necessary technologies.
- Enhance Decision-Making: Use digital twin solutions to enable more efficient decision-making, better planning options, and automatic information flow.

3.3 Digital Transport Planning Tool

- Adopt Planning Tools: Encourage the widespread adoption of digital transport planning tools to enhance the efficiency, reliability, and resilience of inland shipping operations.
- Mitigate Barriers: Overcome data security concerns, resistance to new methods, and lack of funding by ensuring data privacy, providing training, and securing financial support.
- Boost Competitiveness: Use planning tools to enhance the competitiveness of inland shipping relative to other modes, improve terminal efficiency, and drive sustainable growth in the sector.

3.4 Autonomous Barges

- Promote Autonomous Barges: Support the development and deployment of autonomous barges to advance IWT as a climate-resilient and environmentally sustainable solution.
- Address Infrastructure Needs: Ensure suitable waterway infrastructure and reinvestment policies to support the operation of autonomous barges.
- Leverage Technological Advances: Utilise the benefits of autonomous freight transport, such as 24/7 operation, reduced carbon footprint, and enhanced resilience to climate disruptions.

3.5 Role of Authorities

- Develop Supportive Policies: Authorities should develop policies that support and enable innovative solutions for climate-resilient and environmentally sustainable inland waterways.
- Encourage Voluntary Compliance: While some stakeholders favour a compulsory approach, the majority support a voluntary approach to policy development.