INE contribution to the European climate resilience and risk management initiative

Executive Summary

Inland waterways are essential to Europe's economy, society and environment. They provide transport and logistics for industry, safeguard drinking water, supply water to industry and agriculture, support energy generation, protect biodiversity, and mitigate floods. Yet these multi-functional systems are increasingly exposed to the cascading risks of climate change including droughts, floods, infrastructure damage and ecosystem stress. Adverse effects in inland waterways quickly permeate supply chains, industrial competitiveness, food and energy security, and public health, making them an indispensable part of Europe's resilience.

Despite their strategic importance, inland waterways remain underprepared for the climate risks at hand. Gaps in governance, investment, and coordination continue to hinder effective adaptation. To safeguard critical infrastructure and ensure resilience, the EU must adopt a comprehensive policy framework that:

1. Integrates waterways into resilience strategies and frameworks across sectors and borders by recognising the system-level interdependencies and interconnectedness between infrastructure, economy, livelihoods and the natural environment.

2. Invests in research, innovation, and development to improve monitoring and adaptive capacity

3. Prioritises adaptive planning, allowing for phased, flexible implementation that can effectively respond to evolving risks and knowledge

4. Mobilises financing and flexible instruments to strategically fund programmes and projects in both the near and long term.

An EU-level strategy rooted in better institutional coordination, adaptive planning and flexible financing will allow for effective collaboration among stakeholders across sectors and borders. In the wake of accelerating climate change, prompt policy action is fundamental to Europe's overall competitiveness, security, and resilience.

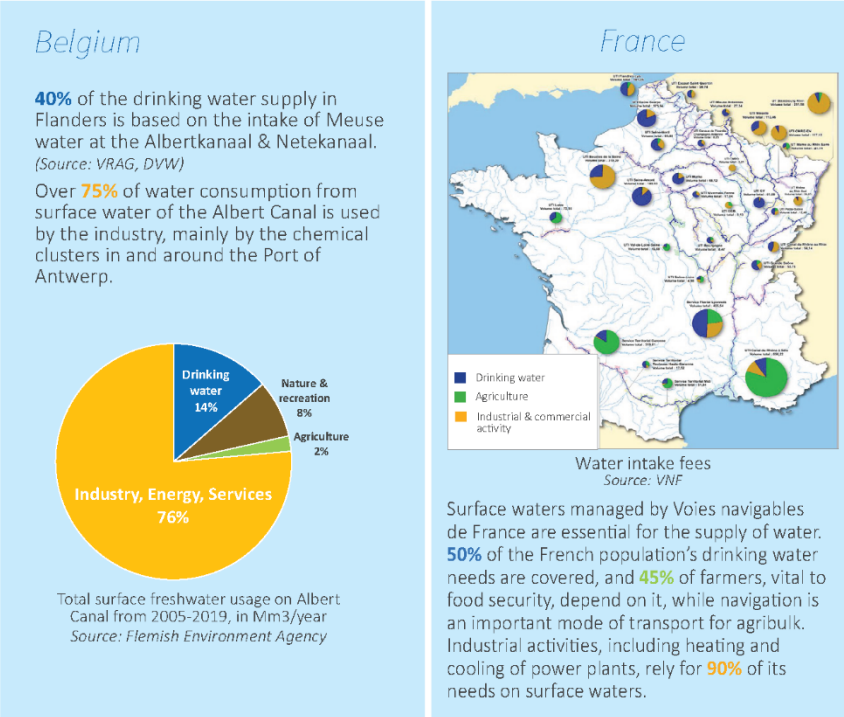
The multi-functional role of waterway authorities

Rivers and canals across the European Union form a vital backbone of society, the economy, and the natural environment. As multi-purpose infrastructure, inland waterways support transport and logistics, water supplies for industry and agriculture, energy generation, drinking water, flood mitigation, and biodiversity. As such, waterways operate within a system of systems. The EEA Climate Risk Assessment identifies 16 out of 36 key risks related to water. The strategic role of inland waterways is increasingly evident in the interdependencies between functions and in the context of climate change, which threatens the availability, safety, and resilience of this critical infrastructure.

Waterway authorities managing navigable rivers and canals are therefore at the frontline of resilience. According to their mandates, their responsibilities extend beyond navigation to integrated management of water resources and infrastructure, regional and transboundary development, and ecosystem services. Given the cross-border nature of many European waterways, effective adaptation cannot be addressed by individual Member States alone. A unified EU-level policy

framework, accompanied by concrete measures and financial instruments, is essential to support waterway authorities to take cost-effective and proactive action on climate resilience.

A sustainable and integrated approach to managing inland waterways is essential for preserving the connectivity of inland navigational routes across Europe, while their surface waters play a critical role in supporting the strategic nexus of drinking water supply, agriculture, and industrial activity.



Climate risks to inland waterways

Climate change is already affecting inland waterways. Attention mainly goes to extreme weather conditions and event such as prolonged water scarcity, droughts, and flooding. But we also have to pay attention to slow-onset and seasonal changes that affect water availability and physico-chemical quality and which are becoming the new normal. This results inter alia in:

1. **Water supply insecurity for navigation and utilities** such as drinking water, agriculture, energy production, heating and cooling. Competing use for scarce water resources during droughts exacerbates conflicts between sectors, and navigation is often compromised.
2. **Disruptions to critical infrastructure and its economic building blocks** that support transport, digital and energy networks as well as tourism and trade.
3. **Harm to biodiversity and the natural environment** that increases the presence of invasive species and algal bloom while affecting ecosystem services and the conservation and restoration of vital water habitats.

Systemic risks to economy and society

Inland waterways demonstrate the interdependence of Europe's systems. Climate change-related changes here cannot be ignored as they cascade across multiple sectors.

Take just **one example of water scarcity and droughts.** When availability of surface water decreases in dry periods, it often leads to more water abstraction for drinking water, agriculture and energy, resulting in even lower water levels. Without investment taking an integrated approach, this leads to cascading systemic risks, highlighted here:

Sector	Cascading effects	Risks
Transport & Logistics	Cargo capacity of shipping decreases, transport costs increase, leads to disruption of supply chains and congestion on saturated land networks	Increasing carbon emissions, Economic losses for industry undermining competitiveness
Industry & Energy	Production capacity of water-dependent industry clusters affected (chemical and energy sectors)	Decreased production capacity Energy security
Agriculture	Water shortages lead to stressors on crop production	Income loss Food security
Public Health	Decrease in reliable drinking water supplies	Health and wellbeing of citizens
Tourism	Water availability affects tourism on and along rivers and canals	Revenue loss for small towns and rural areas depending on income for employment and preservation & promotion of cultural & natural heritage

Water shortage, storms and flooding cause erosion and damage to water-related structures, embankments, dykes, dams, locks, reservoirs and bridges but also surrounding infrastructure such as roads, railways, ports and pipelines, high-capacity data cables, and electricity grids. The interconnectedness and cascading effects of sectors cannot be overstated, as industry, agriculture, and energy production are also impacted by this instability.

These examples demonstrate how any direct climate change impacts within a single infrastructure can precipitate knock-on effects across interdependent systems, resulting in both direct and indirect consequences for other infrastructures, services, and operations. These interdependent systems are collectively vital to the cohesive functioning and security of the EU economy and society.

By addressing these multiplier effects proactively in an integrated approach together with other actors, waterway authorities are able to adapt to the changing climate in the context of both management and operation of waterways. On the contrary, if threats and system-level risks are neglected or ignored, economic and societal consequences of cascading failures can be significant and new problems will develop—and failing to act comes at a higher price than investment in resilience.

Stress factors and barriers for inland waterways

Waterway authorities are already taking action with a diversified toolbox of physical and operational measures. There are also undeniable barriers that must be addressed to forge a successful path toward climate resilience. These barriers include:

1. **Financial:** High cost of inaction when chronic underinvestment, lack of repair or maintenance leads to increased system-level risks to economy and society and higher remediation costs due to unpreparedness.
2. **Institutional:** Conflicting priorities and division between those that use waterways for transport, agriculture, drinking water, industry, and energy at local, national and EU level. Integrated planning is simply not possible in silos.

3. **Regulatory:** Fragmented regulations prevent coherent cross-border resilience measures and inflexibility of grant agreements hinder to apply evolving knowledge.
4. **Knowledge:** Low understanding of multi-functionality of inland waterways and gaps in monitoring, modeling and forecasting capacity.

European climate resilience depends on proactive adaptation and cooperation among stakeholders, citizens and governments. Resilience is defined as the capacity to withstand, absorb, recover, adapt and transform when faced with expected and unexpected changes and disruptions. As such, climate resilient infrastructure calls for a continuous and dynamic process. In the context of inland waterways, fostering this resilience requires risk assessment, research, adaptive planning and flexible financing instruments supported by an institutional framework.

Enabling conditions for EU policy framework:

Raise political awareness and understanding about the multi-purpose role of inland waterways as critical infrastructure, ensuring policy frameworks reflect their interdependencies across numerous sectors. Being fully aware of interconnectedness and leveraging synergies will strengthen our resilience. Breaking silos is key to avoid conflicting use, weak spots and maladaptation.

Promote systemic approaches and policy coherence in governance processes and projects. Enhance collaboration across administrative entities and sectors with EU policies that take into consideration geographic differences. Joint planning objectives integrate the interests of all sectors, enabling a more efficient and sustainable management of resources. In the face of combined challenges such as drought, floods and cyber threats to water related infrastructure, integrated approaches and proactive risk management are essential. We advocate for a strong coordination between the implementation of the Water Resilience Strategy and the forthcoming Climate Resilience Action Plan.

Invest in research, development and innovation to improve forecasting and monitoring of navigable waterways, promote digitalization, and pilot innovation solutions such as smart locks and circular water use systems. INE is looking forward to the research topic on climate change impacts on the European navigable waterway network and the mapping of system-level inter-dependencies to inform smart measures and investment vs the cost of inaction in the EU Mission on Adaptation to Climate Change.

Enable adaptive planning by allowing phased implementation and adjustments based on evolving needs and risks in European funding programmes. Climate adaptation requires working with emerging knowledge, continuous monitoring and evaluation to expand the toolbox with no-regret and adaptive measures according to specific geographic needs. Flexibility can be achieved by carrying out large projects in stages.

Mobilise financing and flexible instruments to strategically fund programmes and integrated projects with the capacity to cover concurring needs. It is imperative to increase capacity and investment in the preparedness and resilience of waterway related infrastructure with nature-based solutions where possible and with other solutions where necessary to deliver the positive gains of climate resilience through risk-reduction in interdependent systems, safeguarding investment and enabling increased productivity and new opportunities.

Inland waterways exemplify how climate change impacts can cascade across Europe's economy, society, and ecosystems. A coordinated and adaptive EU response is indispensable to safeguard this multi-purpose infrastructure and ensure long-term climate resilience.

Inland Navigation Europe (INE) is the European platform of national & regional waterway authorities and organisations promoting waterway transport, established in 2000 with the support of the European Commission, and a neutral platform without commercial interests.