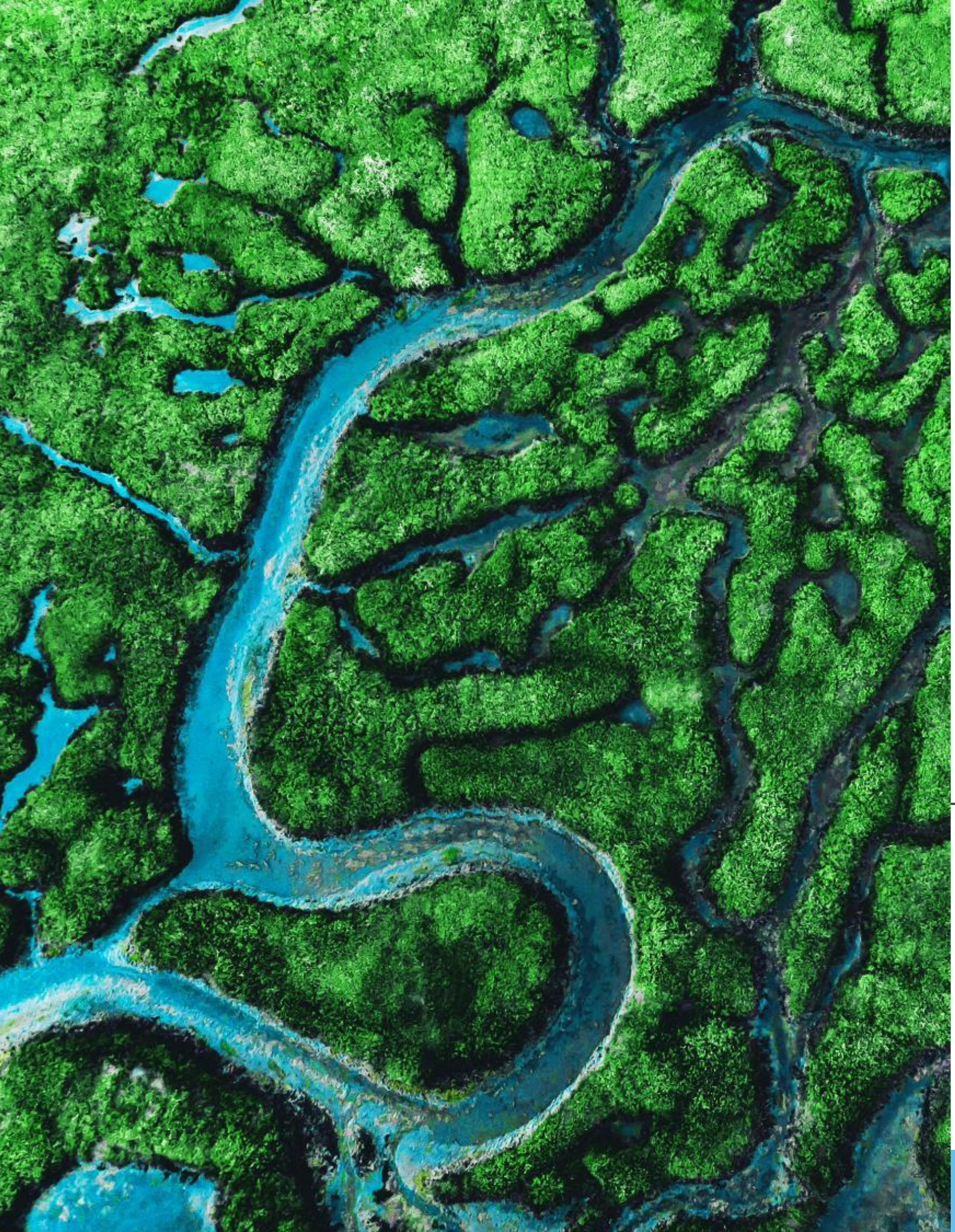


Association of the leading European River Cruise Companies

DANUBE PORT DAYS

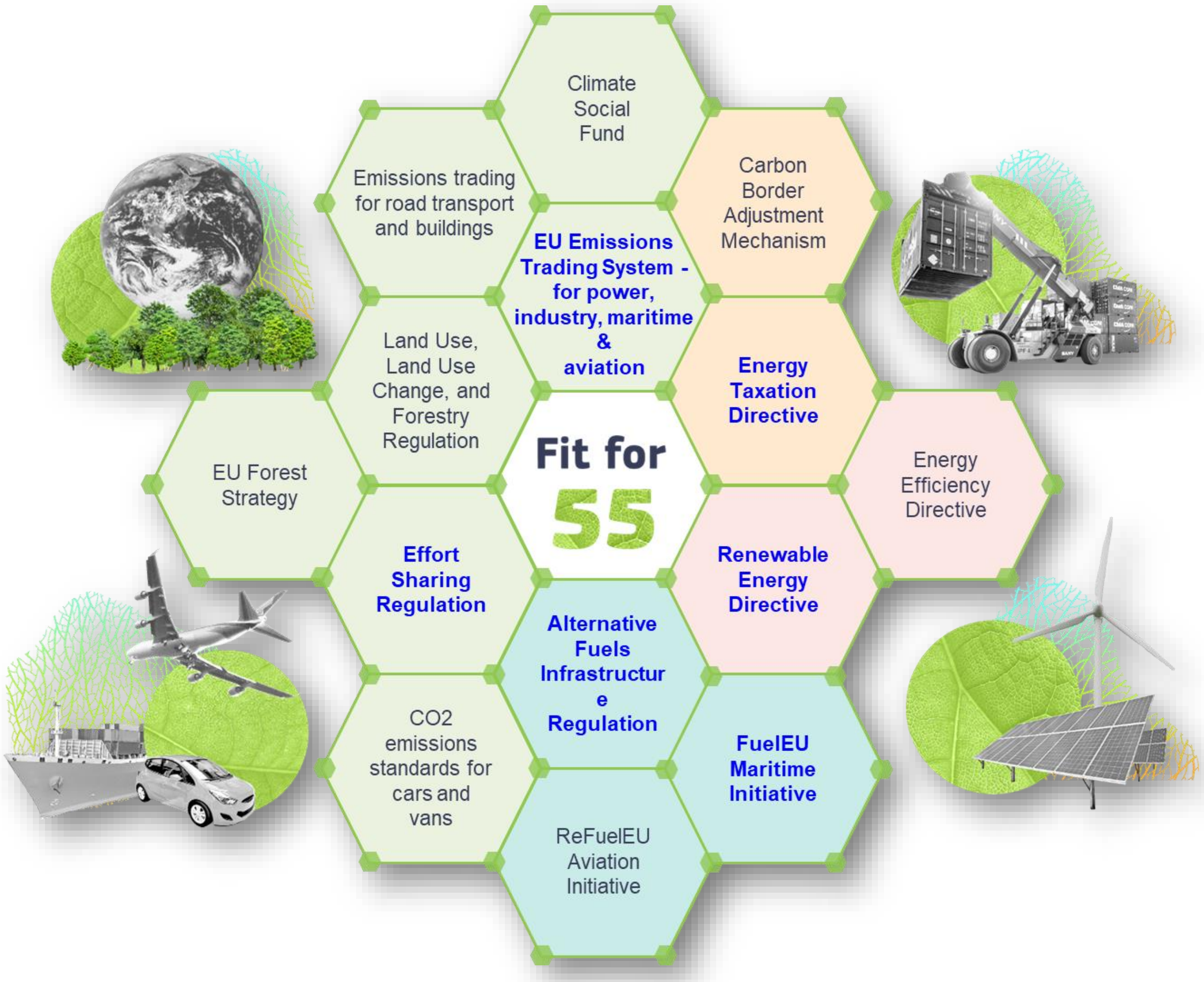
The Challenge

We need a proof of concept

The Legislative Framework

The European Green Deal has an evolving legislation. Each sector has a ***basket of measures*** to drive it to reach its decarbonisation goals.

The basket of measures can be compared to a “stick and carrot” approach, where tax and GHG limits become the “stick”, and ETS and Funding become the “carrot”

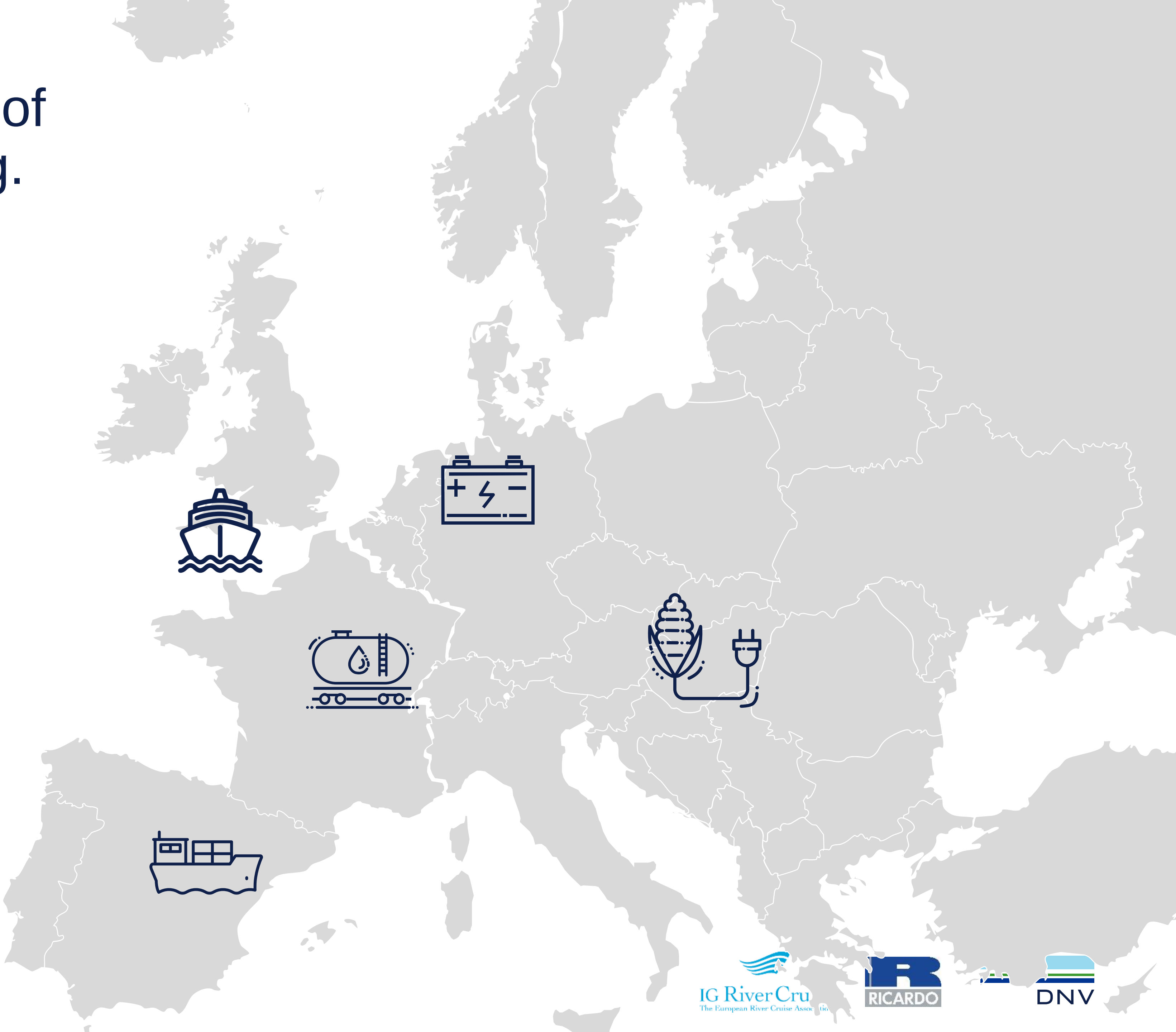


IG River Cruise The European River Cruise Association RICARDO DNV

The sector needs a proof of concept to access funding.

- Type of Molecule or Electron
- River Stretch
- Number of Ships on Stretch
- Bunkering Infrastructure
- Port Infrastructure

= GHG Reduction and Scaling Potential for River



The Findings

There are timely solutions

Key findings

No. of vessels in fleet	Passenger day capacity	Fuel consumption	Total GHG emissions
380 vessels	**13.5 million** PAX-days	**240 000** tonnes MGO	**790 000** tonnes CO_2-eq

Weighted average duration of cruise	Average no. of days in operation	Top 5 embarkation ports	Top 5 docking ports
9.3 days	**232** days	1. Amsterdam 2. Budapest 3. Basel 4. Cologne 5. Passau	1. Budapest 2. Vienna 3. Amsterdam 4. Cologne 5. Passau

Note: all findings are based on operational and technical vessel data for the fleet in 2023

Technology for decarbonisation is generally at a high level of technology or commercial readiness

Current **deployment levels** will inform basis of decarbonisation potential in foresight scenarios

Battery electric
- **Current**: Several vessels equipped for peak shaving; one fully electric vessel
- **Forecast****: low uptake by 2030 and 2050

OPS
- **Current**: Almost all vessels equipped
- **Forecast**: improved landside infrastructure

Hydrogen
- **Current**: No known deployment
- **Forecast****: low uptake 2030, medium 2050

Methanol
- **Current**: No known deployment
- **Forecast**: industry expressed interest

Biofuels
- **Current**: ~90% can operate on biofuels
- **Forecast**: Availability hindering deployment

*** 2022 survey results*

Alternative fuel propulsion power technology is either commercially mature or expected to be **ready** by 2030

Power converter technology	TRL (1-9) / CRL (10-11)				Can it be retrofitted?
	2022	2025	2030	2035	
Methane (LNG) ICE	10	11	11	11	Yes, but limited*
HVO ICE	11	11	11	11	N/A – Fuel is drop-in
Methanol ICE	9	10	11	11	Yes
Hydrogen ICE	7	9	10	11	Yes*
Fuel cell PEM	8	9	10	11	Yes*
Fuel cell – High temperature	7	8	10	10	Yes*

**Retrofit potential dependent on fuel storage volume while maintaining vessel range*

RICARDO DNV

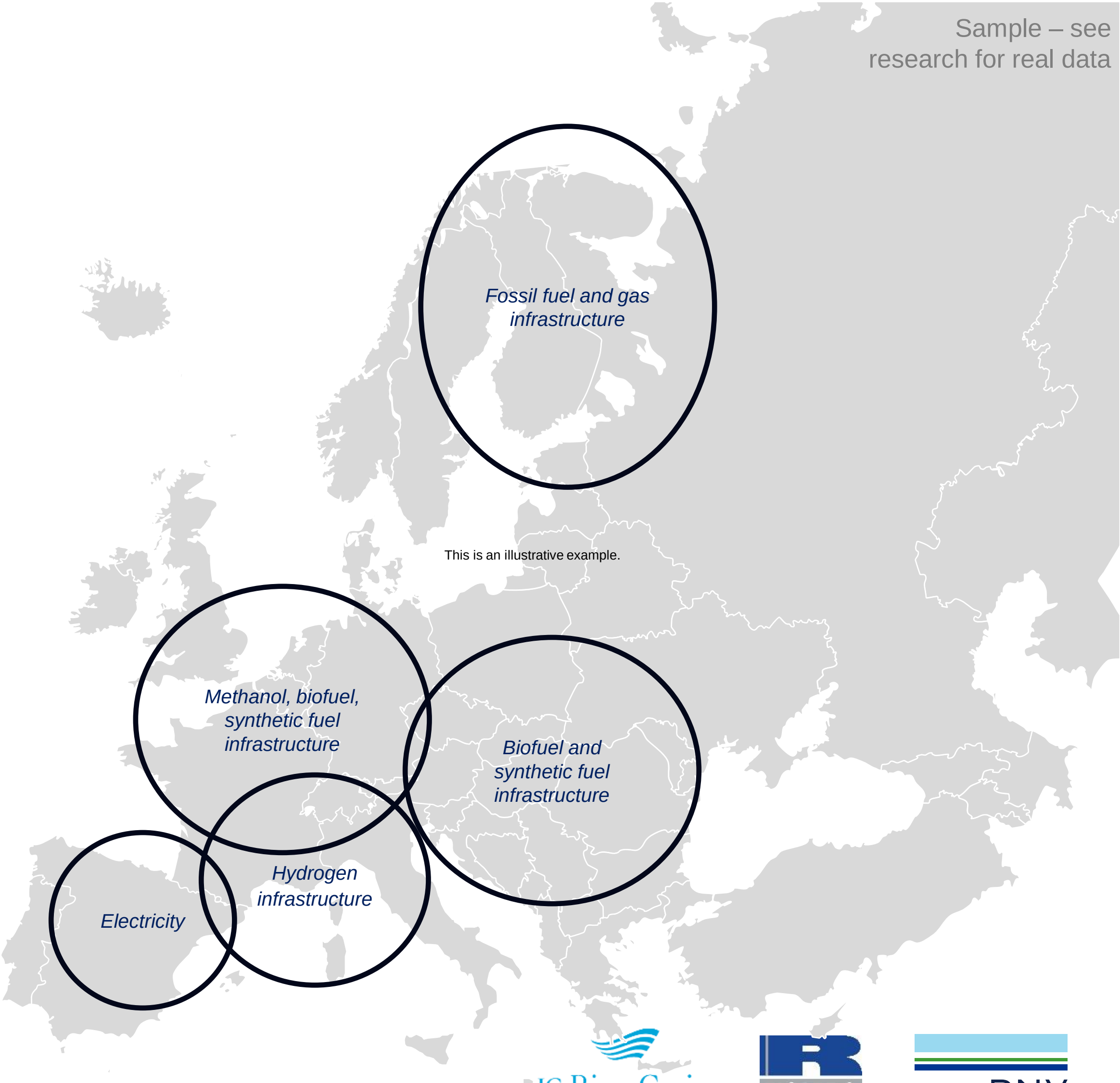
Geographical Difference to Decarbonization

Question to be determined: When mapping the current fleet, versus fuel availability, where would a new-build vessel with zero technology make sense and where we would we place net-zero technologies in retrofitting or new-build?

- “New” fuels are not distributed in the same logistical and geographical manner as traditional fuels are. Therefore, each area will have fuel diagnostic pockets that are unique to one energy carrier. For example, Paris has announced a hydrogen infrastructure on the river, whilst Rotterdam and Amsterdam maybe the key methanol hubs of the future.

- As a result, the fleet of vessels should not all be equipped with the same technology. Instead, zero emission new-build technologies can be deployed in some areas, whilst net-zero technologies may be more favourable in other areas for both new-build and retrofitted vessels.

- Such regional distinction will have a massive impact on operations cost based on fuel infrastructure cost and technology deployment.



The Foresight

We need a consortium and agree

Scenario development – Foresight

Scenario 1: "Liquid drop-in fuels dominate" - MGO with transition into bio- and electro-based fuels

There is a high availability of sustainable biomass as feedstock for producing low-carbon bio-based fuels in the short and medium term. In long term there is a gradual increase of renewable electricity for producing low carbon electro-based fuels. The total volumes of low carbon fuels are sufficient for the cruise fleet to decarbonize, and the prices are affordable. Blend-in of low carbon liquid fuels is therefore the preferred decarbonization option, as new ships can be built with traditional fuel technologies having relatively low CAPEX, and existing ships will not need to undergo any retrofits to comply with the regulations. This preference will lead to a low interest in development of methanol infrastructure and carbon storage for shipping. As a result, these options become expensive and unavailable.

Scenario 2: "Electrons dominate" - Electrons in battery and hybrid solutions

There is a gradual improvement in energy density for batteries that result in an increased uptake of battery and hybrid solutions. At the same time the onshore electricity production and infrastructure promotes use of electricity as an energy efficient solution for de-carbonisation. When the ships need to extend the cruising range, MGO will be gradually replaced by bio-MGO and E-MGO when required to fulfil the emission requirements as most ships will also have options to operate with conventional combustion engines in this scenario.

Scenario 3: "High momentum for methanol" – MGO is replaced by methanol in the long term

A few fully equipped dual fuel methanol ships are already on order in other ship segments. In the first years, methanol is expensive, and in the first periods, we see a combination of alternative fuels for decarbonization. However, as the infrastructure and fuel production of methanol develops, this turns out to be a successful pathway for decarbonization in this scenario. Bio-methanol achieves lower production cost than other bio-based fuels, at the same time these products are highly sought after by other sectors, leading to higher prices.

As a result, the share of methanol ships in the order book increases gradually to become a marked standard towards 2050 in this scenario.

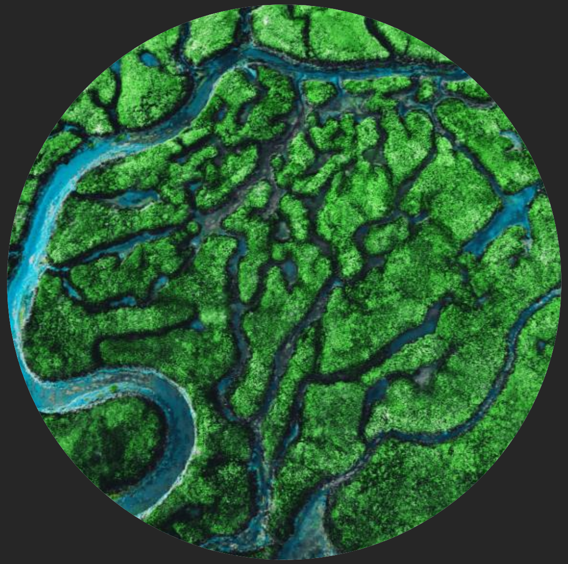
The aim of this consortium is to bundle the competencies and skills to decarbonize river vessels within 10 years based on 2024 EU regulations.

Retrofit

Increase the value of today's vessel by providing funded decarbonization solutions focused on engine replacement.

Replace

Design and Build new vessels for the Rivers of Europe.



Relocate

Relocate vessels based on NET-Zero and Zero GHG geographical criteria as well as mitigation and adaptation rules.