Decarbonising the fisheries sector: current status, identifying and addressing barriers for the energy transition and way forward

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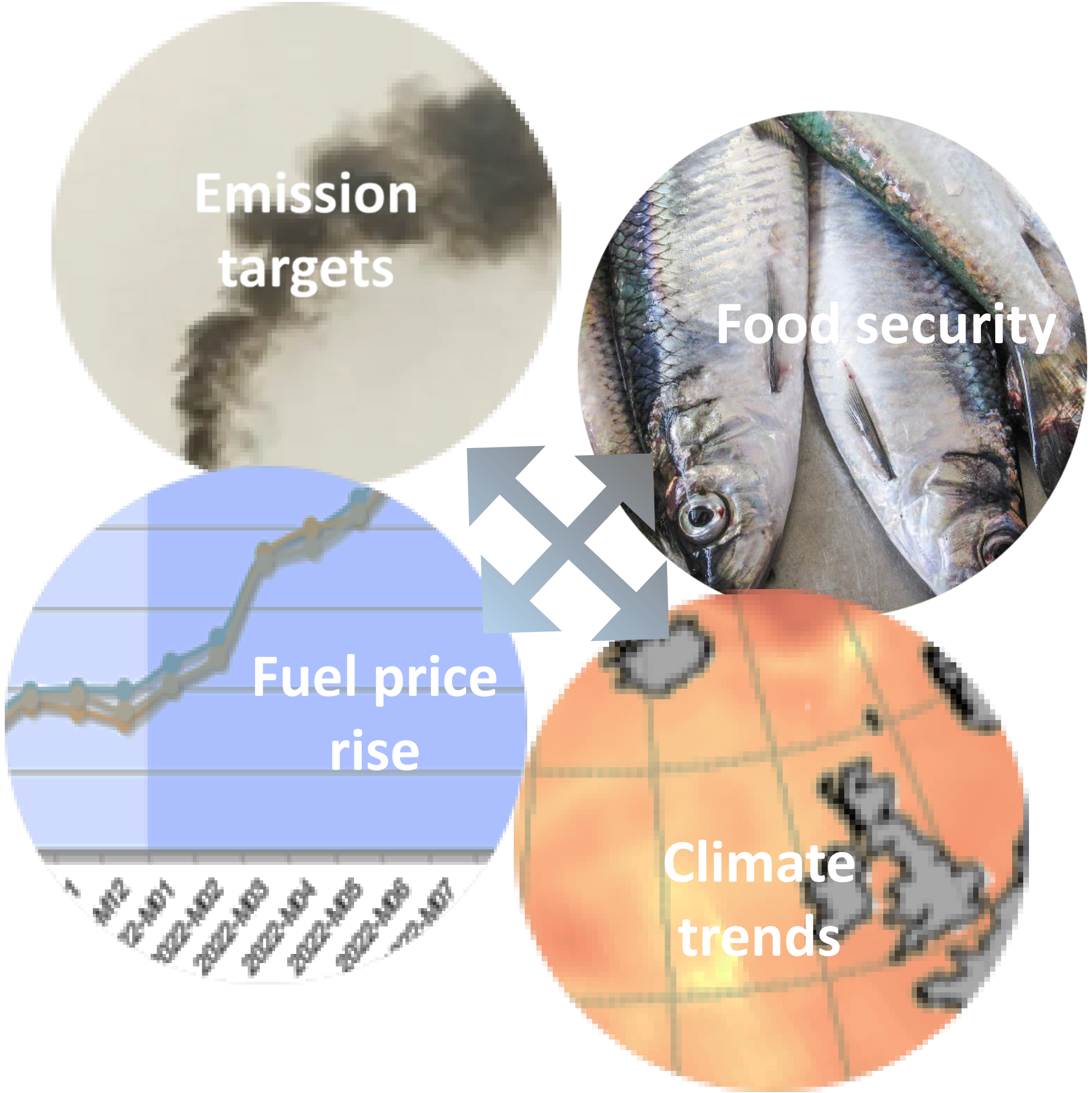
The challenge ahead: energy transition of the EU fisheries

- 30-40% reduction of CO_2 emissions by 2030, a carbon-neutral fishing sector by 2050; EU Fleet (2008-2019) burn ca. 2.6 billion litres annually emitting 6.94 millions tonnes of CO_2eq
- Ensure fisheries' contribution to food and nutrition security
- Reduce fisheries' operating costs, impacts from volatile energy prices, and dependency on foreign and unreliable fossil fuels
- Intertwined challenges: Face climate change and its impacts on ocean productivity and fishing opportunities i.e. changing fish stocks productivity (growth, renewal), spatial distribution and timing (next slide)



Face the unavoidable plurality of objectives: with win-wins!?

Fisheries impacted by external factors

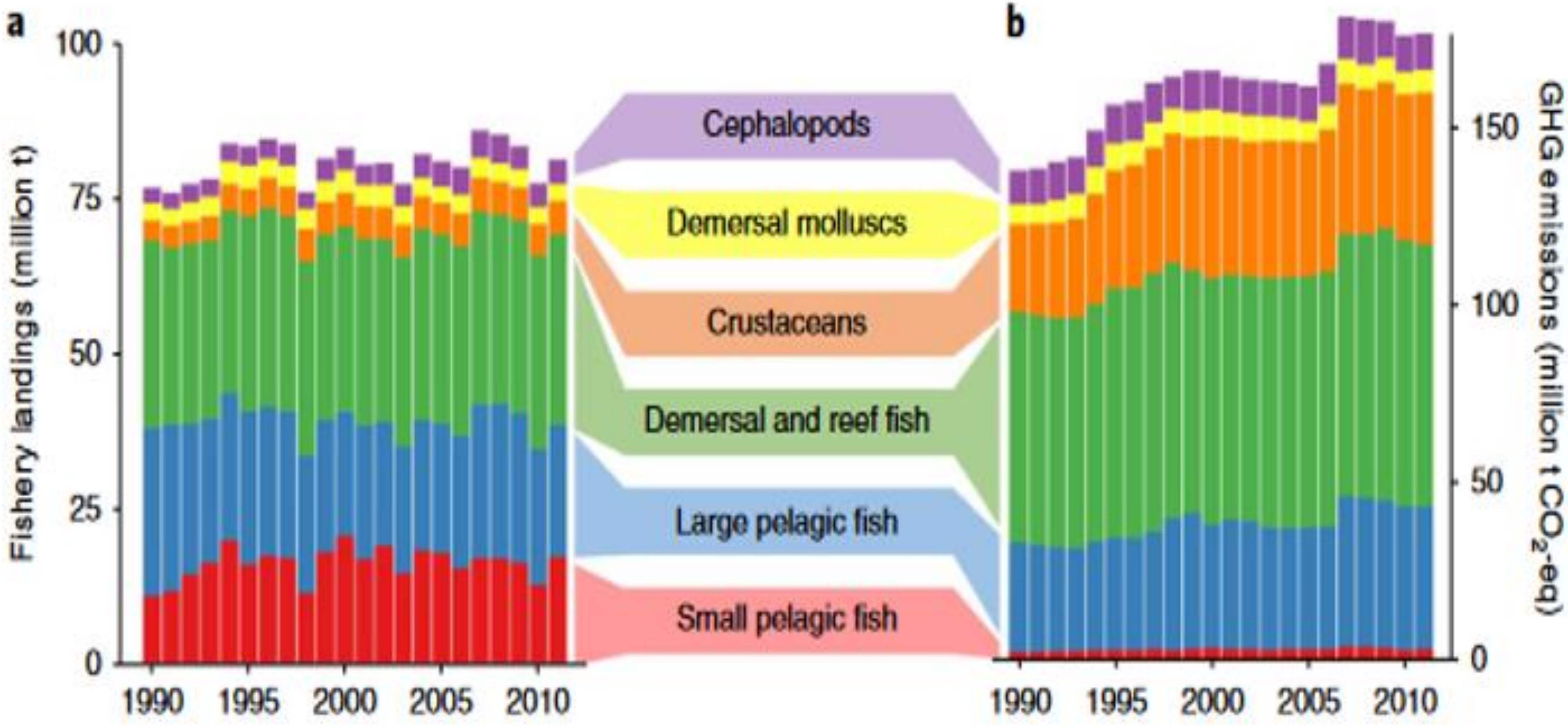
- Fishing has variable and **uncertain** outcomes by nature vs. the fishing businesses want to get stable or improve their incomes

- **Climate change on top. Factors independent to fisheries** affect marine ecosystems and oceans: productivity, timing, spatial distributions, trophic interactions, and sometimes badly interacts with unfit management

- Some hints to face the problem: society (including fishers) needs to follow a **precautionary approach**: this translates into saving some fish as insurance against short-term shocks and long-term productivity change, and uncertain science or compliance. In an EU context, we'd rather fish in the lower range of the FMSY range of MAPs, if any…

Difference among fishing techniques regarding CO_2 emissions

GHG emissions are much larger for some of the segments when comparing kg landed per GHG….

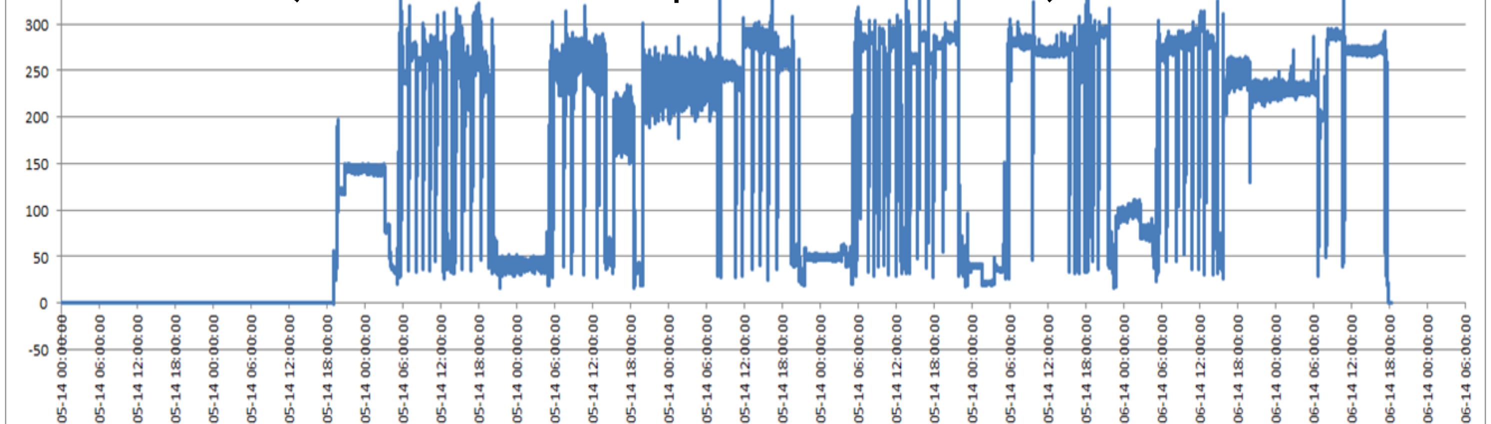


Source: Parker, R.W. et al. 2018

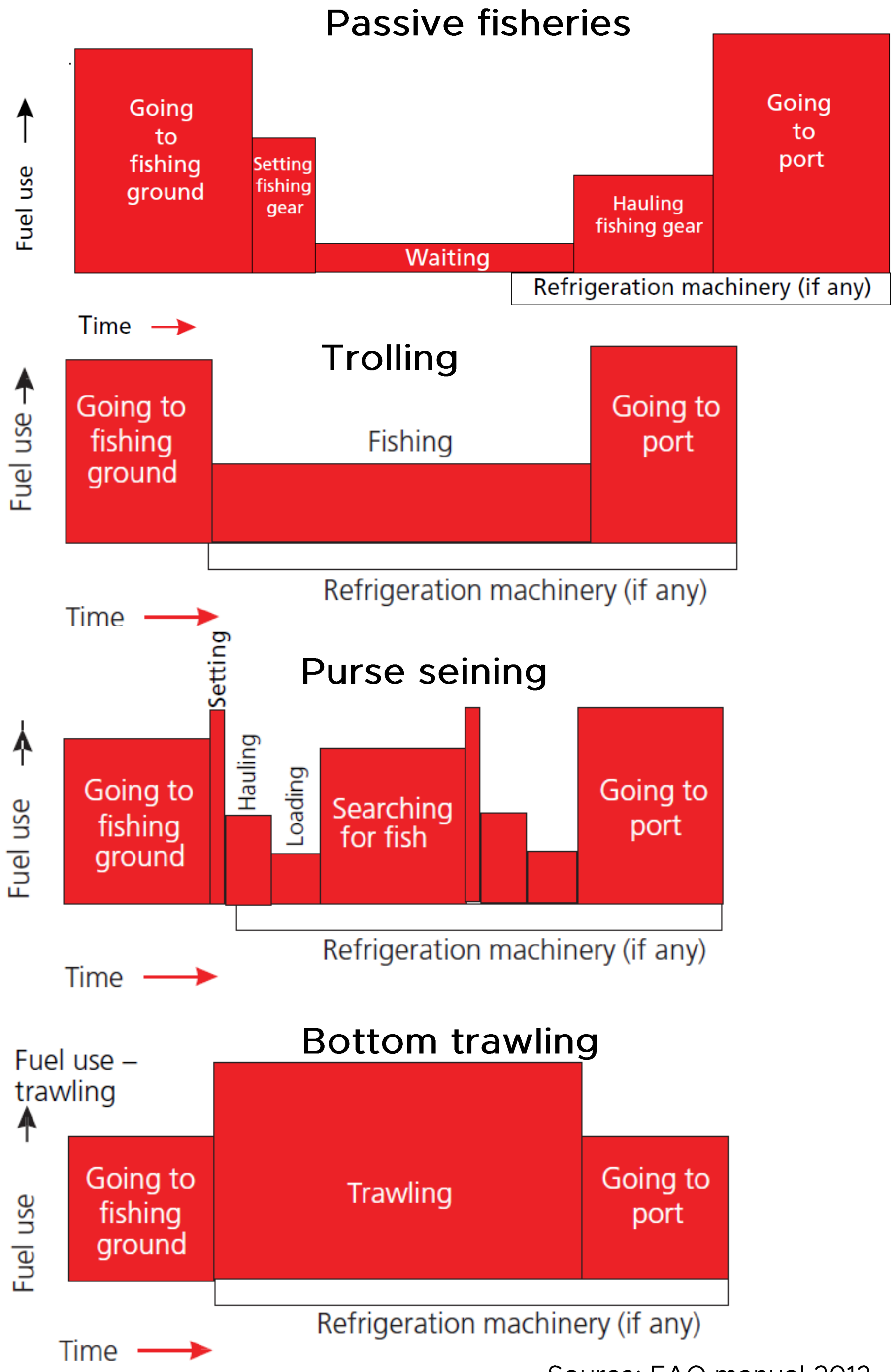
Collecting fuel use data explains why…

Needed: a robust **data collection** to collate accurate and standardized data on fuel consumption at the fishing vessel level (carbon auditing)

Fuel-monitoring tools onboard vessels, monitoring programs, pilot studies and subsequent evaluation of fuel use (ca. 2000 EUR per instrument)

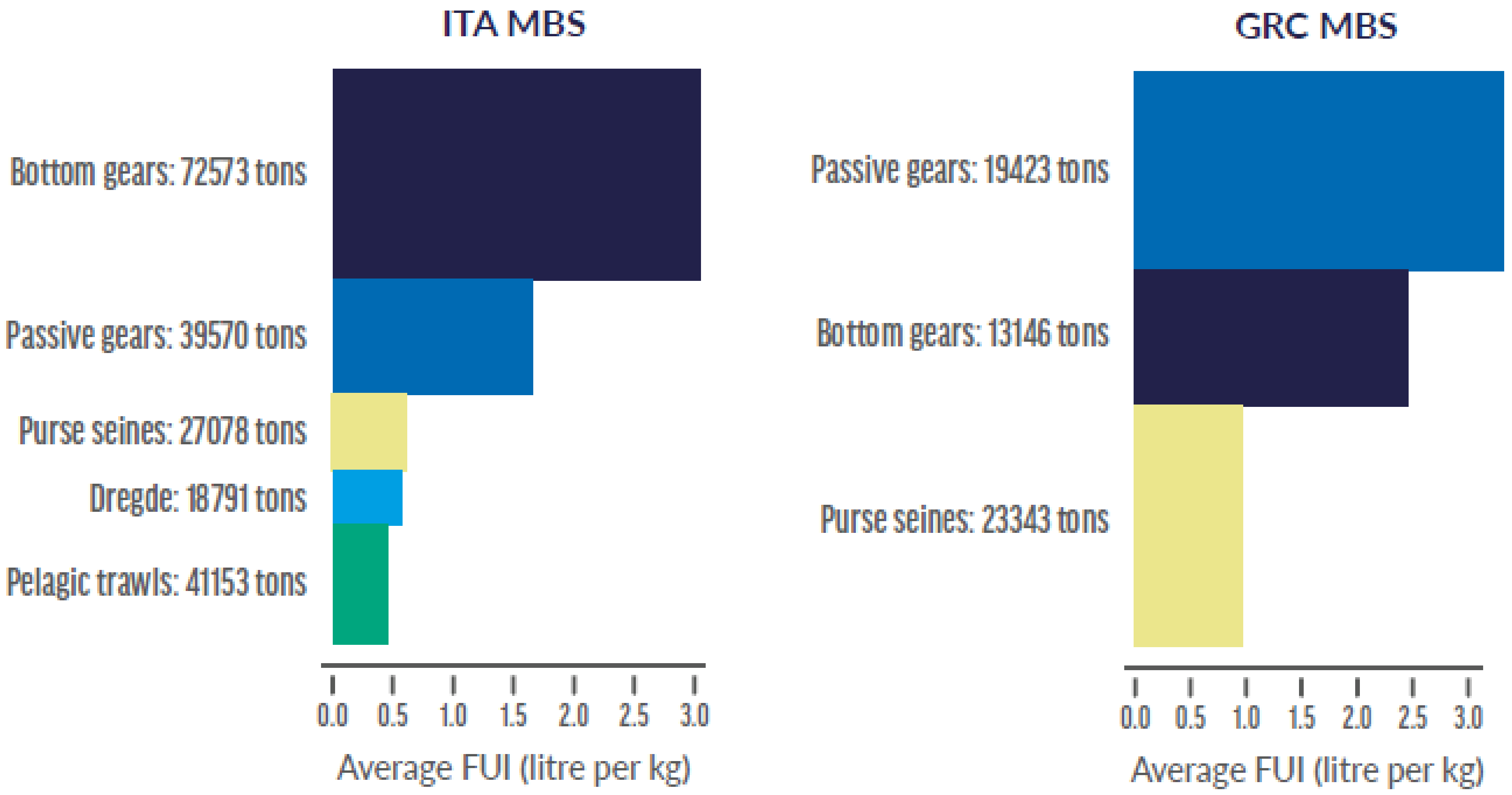


North Sea Sandeel trawler speed profile of a trip



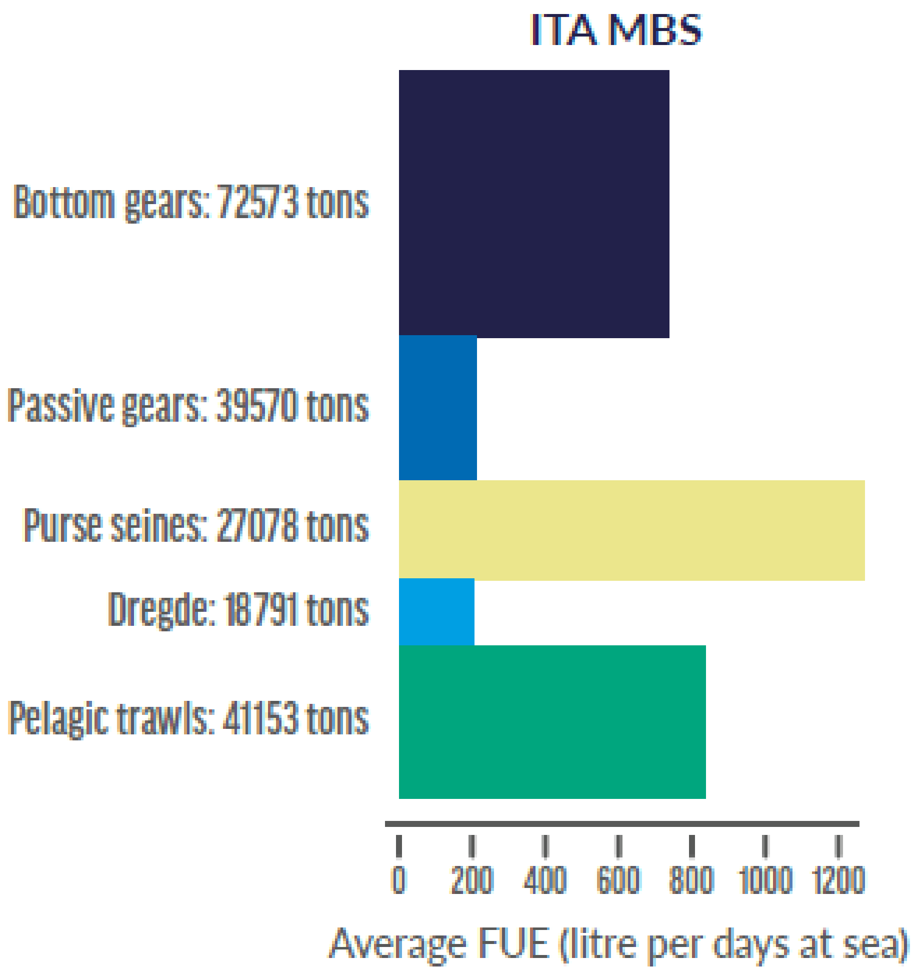
Source: FAO manual 2012

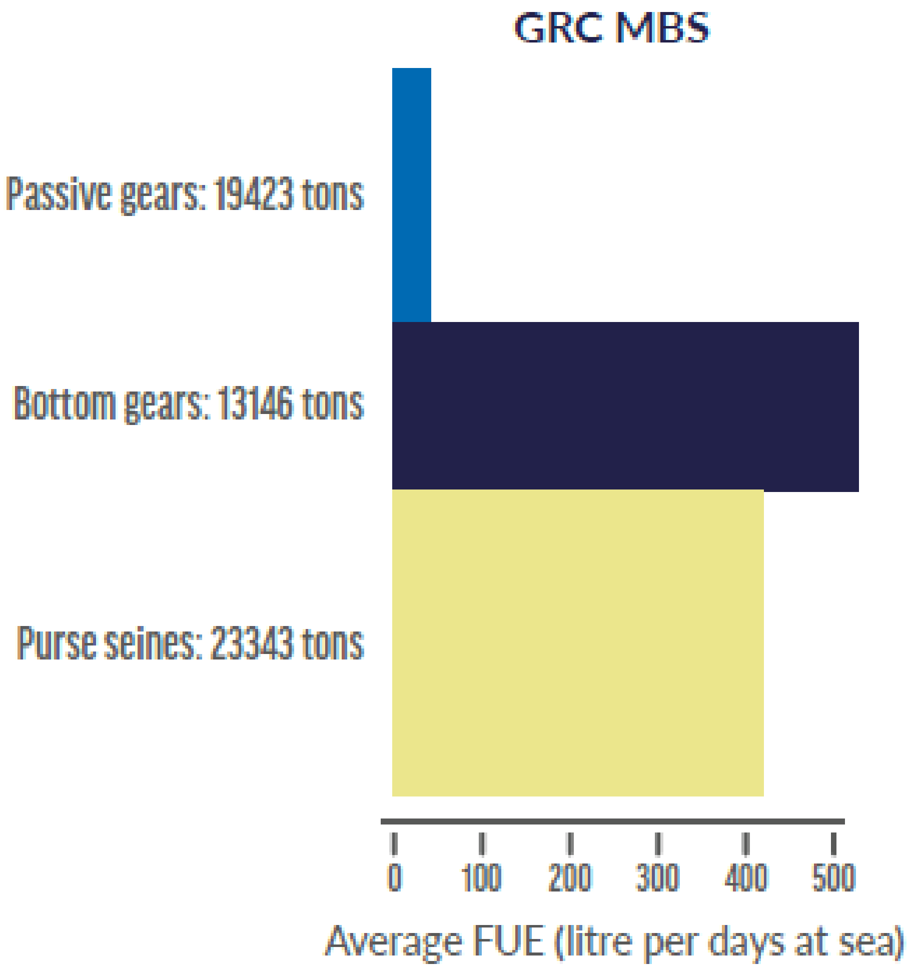
Fuel Use Intensity (litre/kg landed) of some MED EU fleets



Source: calculated from STECF AER 2020, fuel use during the at-sea operation. Only in FAO area 37. (see Alma Maris 2023 https://doi.org/10.5281/zenodo.7757175)

Fuel Use Efficiency (litre/day) of some MED EU fleets

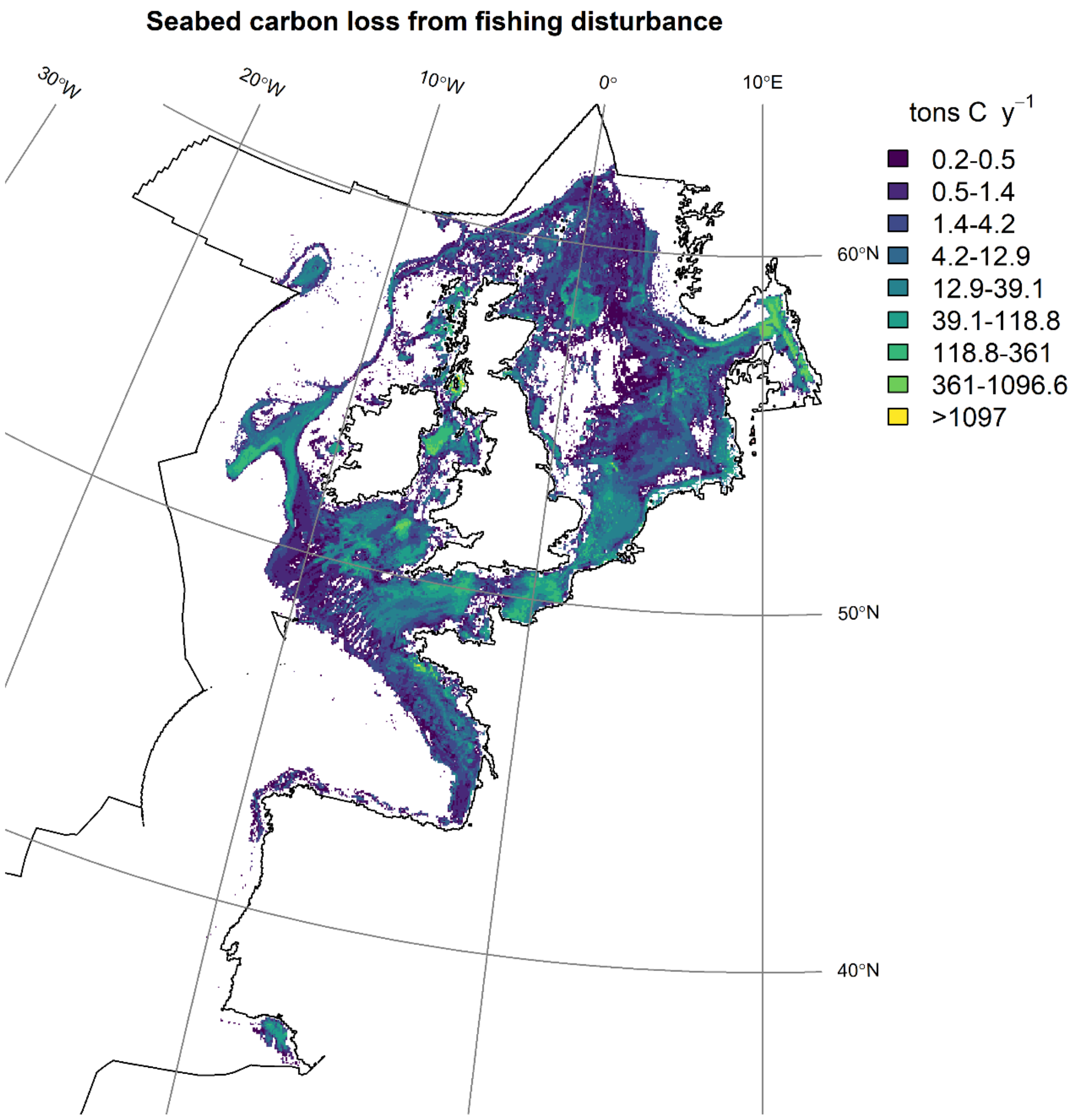




Source: calculated from STECF AER 2020, fuel use during the at-sea operation. Only in FAO area 37. (see Alma Maris 2023 https://doi.org/10.5281/zenodo.7757175)

Phasing out the more energy-hungry fishing techniques…

- Bottom trawling impacts the seafloor integrity and contributes to a bad environmental status
- The elephant in the room: Bottom trawling may release large amounts of blue-carbon **(~ up to 10-15-fold the direct emissions)**
- Necessary to take action and implement area-based management plans in sensitive and vulnerable and blue carbon marine habitats. i.e. in existing (Natura 2000) and new dedicated areas



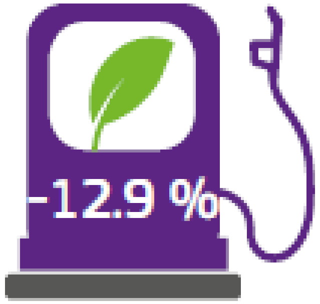
Reduction targets are feasible as there are existing solutions…

1. Implement technological solutions on the market or close-to-market innovative energy-efficient technologies (fishing gear modifications)

2. Implement more extensive changes in the long term (retrofitting vessels, shift towards **"best available fishing techniques"**, develop alternative fuels and propulsion)

3. plus stop the indirect emissions from degrading "blue carbon" habitats

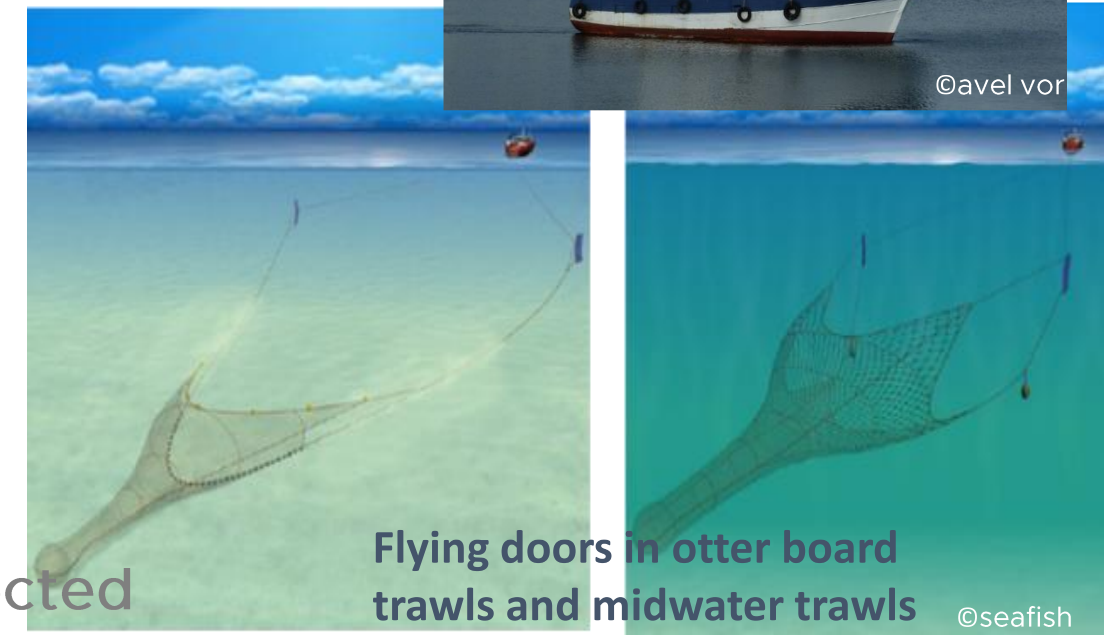
4. Common Fisheries Policy (CFP) and environmental governance to incentivise a shift towards sustainable and responsible fisheries (e.g. eco-certification, funding, workforce upskilling) and unlock barriers



2009 to 2019

Existing and new technical solutions for cleaner production…

- **Gear modifications** to reduce the drag and impact ("flying doors", innovative trawl design etc.)
- **Retrofitting** for optimizing vessel hull shape, inverted bow, anti-fouling, etc.
- Alternative, **greener fuels** (**for large vessels** LNG, catalysis hydrogen, bio-methanol, ammoniac)
- **Alternative propulsion** (electrification **for small vessels**, hybrid engine, wind-powered vessels, etc.)
- **Slow steaming**, route optimization, feedback underwater sensors ("precision fishing") for improved catch rates etc.



Flying doors in otter board trawls and midwater trawls

Up to 40-100% reduction in CO_2 emission expected

A large panel of technologies to reduce fuel use in fisheries already exist and are workable solutions, but also innovative solutions

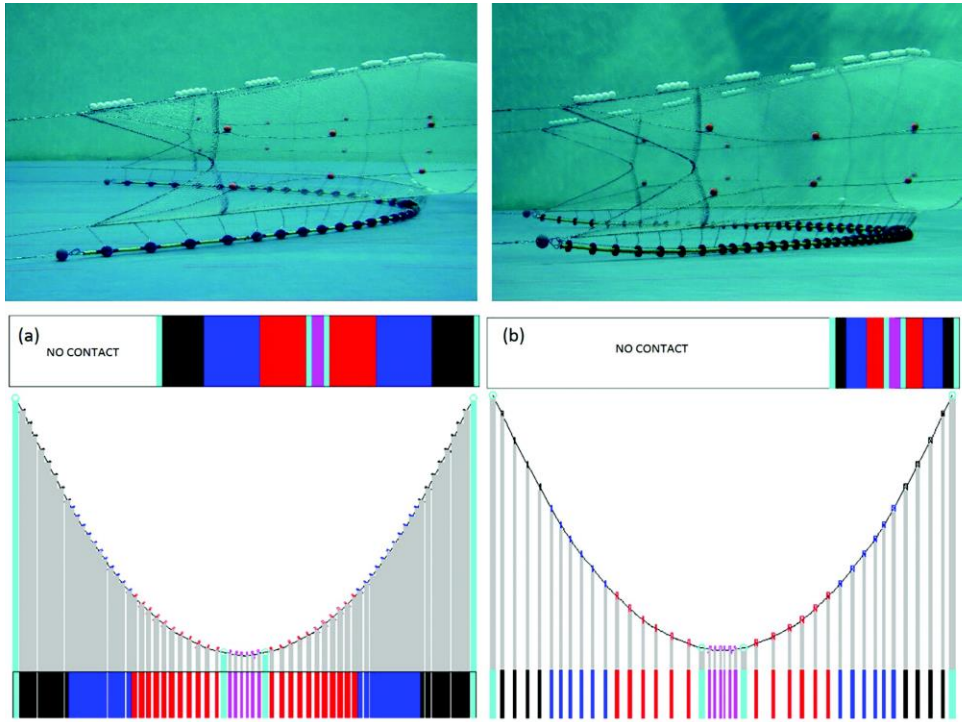
- ”Precision fishing” to influence catch composition (e.g. real-time cameras/sensors), for example reduce unnecessary CO_2 emissions (e.g. by stopping fishing when catch rates are low), adjust the gear during trawling, etc.

- Electronic monitoring improves traceability, sustainability claims and market access in the seafood supply chains = a win-win

Source: DTU-Aqua

A win-win: Switching to alternative fishing techniques = preserve seafloor integrity, its biodiversity & saves carbon stored in the seabed & save fuel

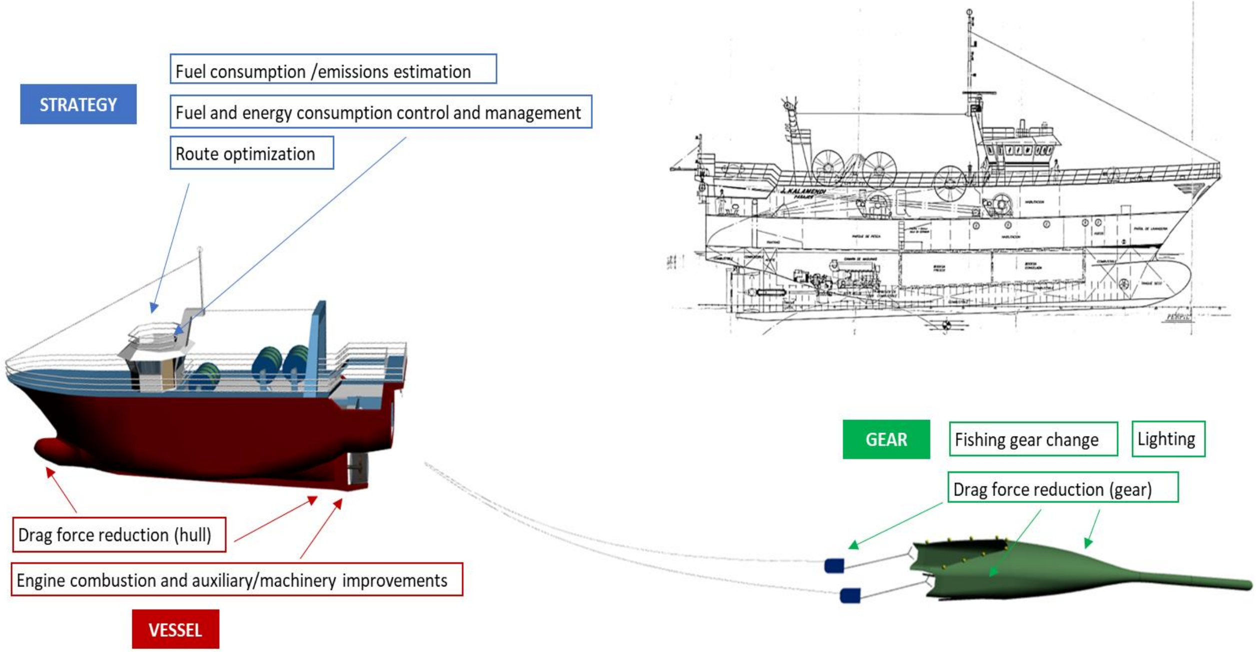
Reductions in the resistance of the gear in water can lead to lower fuel consumption during fishing and less impact on the bottom. Use of adjustable gear… winches sensor system (WSS). These adaptations will also reduce the impact and the re-suspension of sediment.



Source: DTU-Aqua

A large panel of technologies to reduce fuel use in fisheries already exist and are workable solutions

In the EU CINEA report, inventory of technical means of improving energy efficiency and alternatives for a low carbon sector, within overarching categories:



⇒ many solutions already exist… How to arrange upscaling?

Category	Target	Subcategories	Source of info * S	G	CQ	SQ	% Fuel saving potential	Source
Strategy	Route optimization	**Route optimization (based on metocean data)**						
		Route planning systems, route optimisation						Chang *et al.*, 2016; Granado *et al.*, 2021; Groba *et al.*, 2020
		Change of fishing ground						
		Change the fishing ground based on the catch and changing the return day						
	Energy consumption control and management	**Onboard control and monitoring**						
		Energy audits					***	Basurko *et al.*, 2013; Basurko *et al.*, 2022; Sala *et al.*, 2012; Sala *et al.*, 2011; Thomas *et al*, 2010
		Onboard energy monitoring devices and operative advice					3 - 15	Basurko *et al.*, 2013; European Commission, 2006; Latorre, 2001; Notti & Sala, 2014; Sala *et al.*, 2011; Van Marlen, 2009;
Gear	Drag force reduction (gear)	**New netting designs**						
		New or improved designs					17 - 22	Balash *et al.*, 2015a; European Commission, 2006; Hansen *et al.*, 2013; ICES, 2020b; Lee *et al.*, 2018; Notti & Sala, 2014; Parente *et al.*, 2008; Priour, 2009; Sala *et al.*, 2011; Sala *et al.*, 2012; Van Marlen, 2009
		Alternative materials (DyneemaTM)					2 - 40	Balash *et al.*, 2015a; European Commission, 2006; Hansen *et al.*, 2013; ICES, 2020b; Lee *et al.*, 2018; Notti & Sala, 2014; Sala *et al.*, 2012; Van Marlen, 2009
		Different mesh size, type of knots, panel cuttings					25 - 27	European Commission, 2006; Hansen *et al.*, 2013; Khaled *et al.*, 2012; Lee *et al.*, 2018; Parente *et al.*, 2008; Sala *et al.*, 2011; Sala *et al.*, 2012; Van Marlen, 2009
		Operational improvement						
		Electronically controlled gears					>15	ICES, 2020a
		New gear designs						
		Change from demersal to semi pelagic trawling doors					1.6 – 19	Basurko *et al.*, 2013; European Commission, 2006; Guijarro *et al.*, 2017; Hansen *et al.*, 2013; ICES, 2020b; Lee *et al.*, 2018; Notti & Sala, 2014

European Commission, 2022 https://data.europa.eu/doi/10.2926/155626

Barriers to decarbonising the EU Fleet

Feasibility of converting to other fishing practices	• **New equipment** required to use passive gears on former trawlers • **Upfront costs**: e.g. vessels out of water for a few months with possible foregone revenue
Feasibility of converting to alternative propulsion, or greener fuels	• **"Chicken & the egg"**: Necessary port infrastructures: Electric propulsion requires recharging facilities in ports, grid infrastructure, with competition to other energy-demanding sectors • **Need more space onboard** to fit new, larger, heavier engines for alternative fuels (all with less energy per volume) • **Need for qualified crew**, marine engineers and new education schemes
Lack of incentives to change behaviour	• Limited knowledge transfer on the technologies • Mistrust toward innovation • **Financial risks and payback time** changing catch rates, investing in new materials, or retrofitting vessels • Fossil fuel use is currently **subsidied** • Spurious correlations or tradeoffs (e.g. "we will be forced to import seafood with lower standard from foreign countries to ensure food security", "bottom trawling vs. food, income and jobs")
Ecological risk on components of the marine biodiversity induced by shifting toward passive gears	• Not all marketable species and areas are accessible to passive gears • Not all effort can be reallocated to all types of species • A new challenge with biodiversity (e.g. bycatch, ghost nets, etc.)

Barriers to decarbonising the EU Fleet

Seafood market disruption	• Lack of consumers´ demand for fish products with a small carbon footprint • E.g. seiners vs small-scale fishing (seine operated with smaller vessels than trawlers and lower kW engine and large spatial footprint ~1km2/h i.e. better efficiency with lower FUI, quicker at catching the TAC).
Unintended effects in implementing Marine Protected Areas	• Displacement effect can cancel out the beneficial effect when the reallocation occurs in surrounding areas
Misfit legislation & management barriers	• Need for clearer restricts on using bottom-contacting gears • **Imcompatible fishing capacity limits** with the use of alternative fuels • Not eligible for EMFAF funding because of capacity limits (**abnormal, fuel innefficient vessel shapes** induced by capacity limits)
Research needs to document issues with evidence-based and experiential knowledge & develop innovations	• Developing pilot studies and demonstration programs for maritime climate solutions and trial schemes with electricity or new fuels • **Lack of knowledge on success criteria** & a uptake of innovations • Lack of knowledge on blue carbon habitats (seabed mapping, carbon sequestration, habitat restoration, carbon release rates, etc.) • industrialization/scaling of production, distribution and storage of green fuels

Barriers to volunteer actions in mitigating bycatch

Lack of trust in science

- Fishers can fail to see the complete picture and underestimate the effect at the population scale (see e.g. Dean et al. 2022)
- Fishers don´t believe in accurate enough scientific data collection on the matter
- Fishers question the rationale for implementing selective devices if they do not believe in the survivability of fish going through the mitigation devices
- Fishers not offered follow-up studies that would prove the performance
- Innovation that works on paper but is unpractical when it comes to operating the fishing (safety etc.)
- Economic viability studies are lacking·(Suuronen 2022)

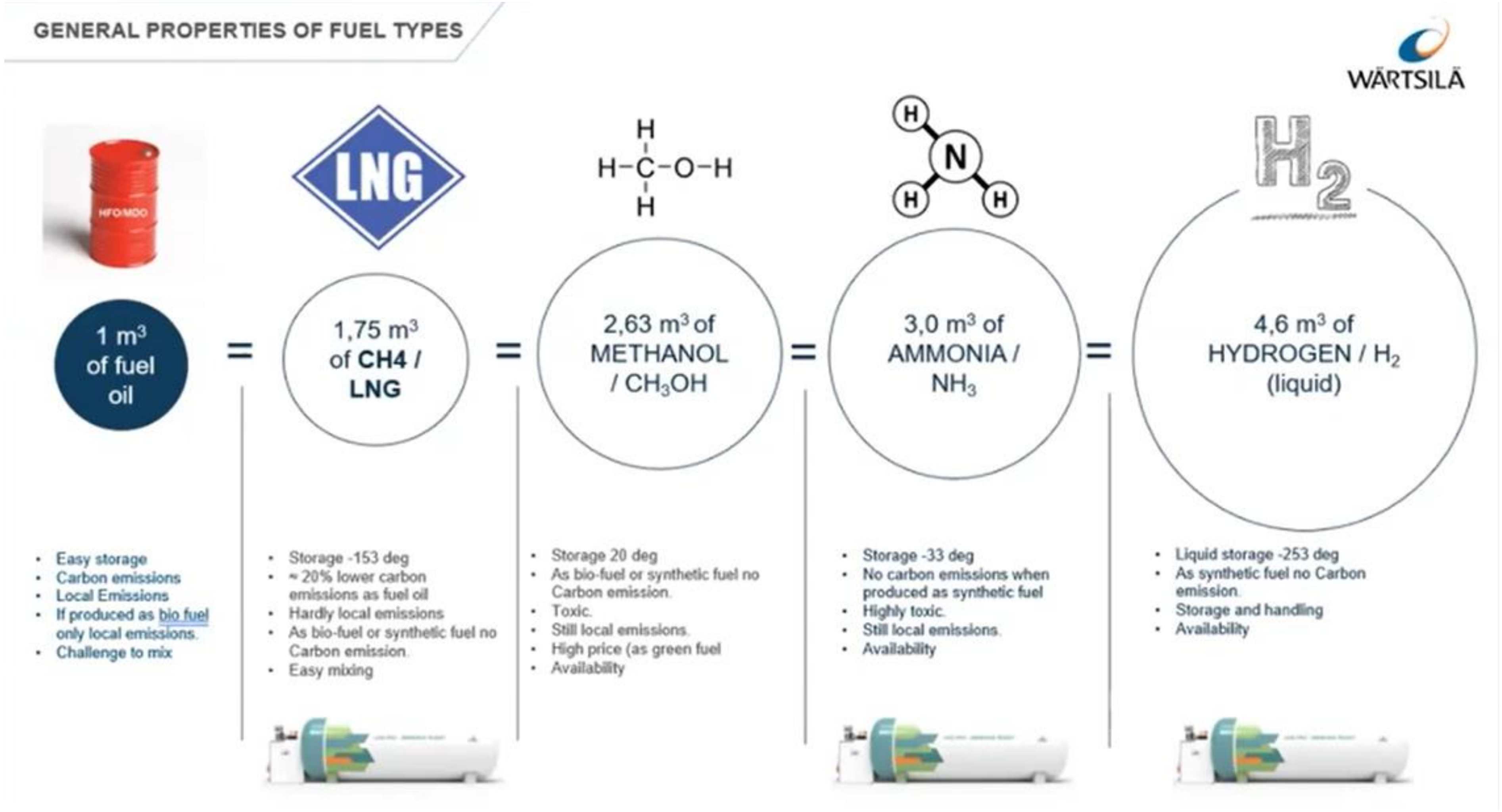
Fear of unecessary economic losses

- Lower income from missed catches (lower catch rates)
- Upfront costs and risky investment in regard to uncertain or non-existent reward
- Some fisheries are already at the edge of profitability and, therefore not eager to take the risk
- Some fishers would feel unfairly constrained if using selective devices compared to others that would not

If mandatory changes

- Need for financial support/compensation
- Low social acceptance. Need enforcement and costly surveillance while non-compliance with TM is possible. Need severe fines to disincentive irresponsible fishing
- Mistrust toward authorities
- Etc.

A strong barrier: Needed space on board vessels



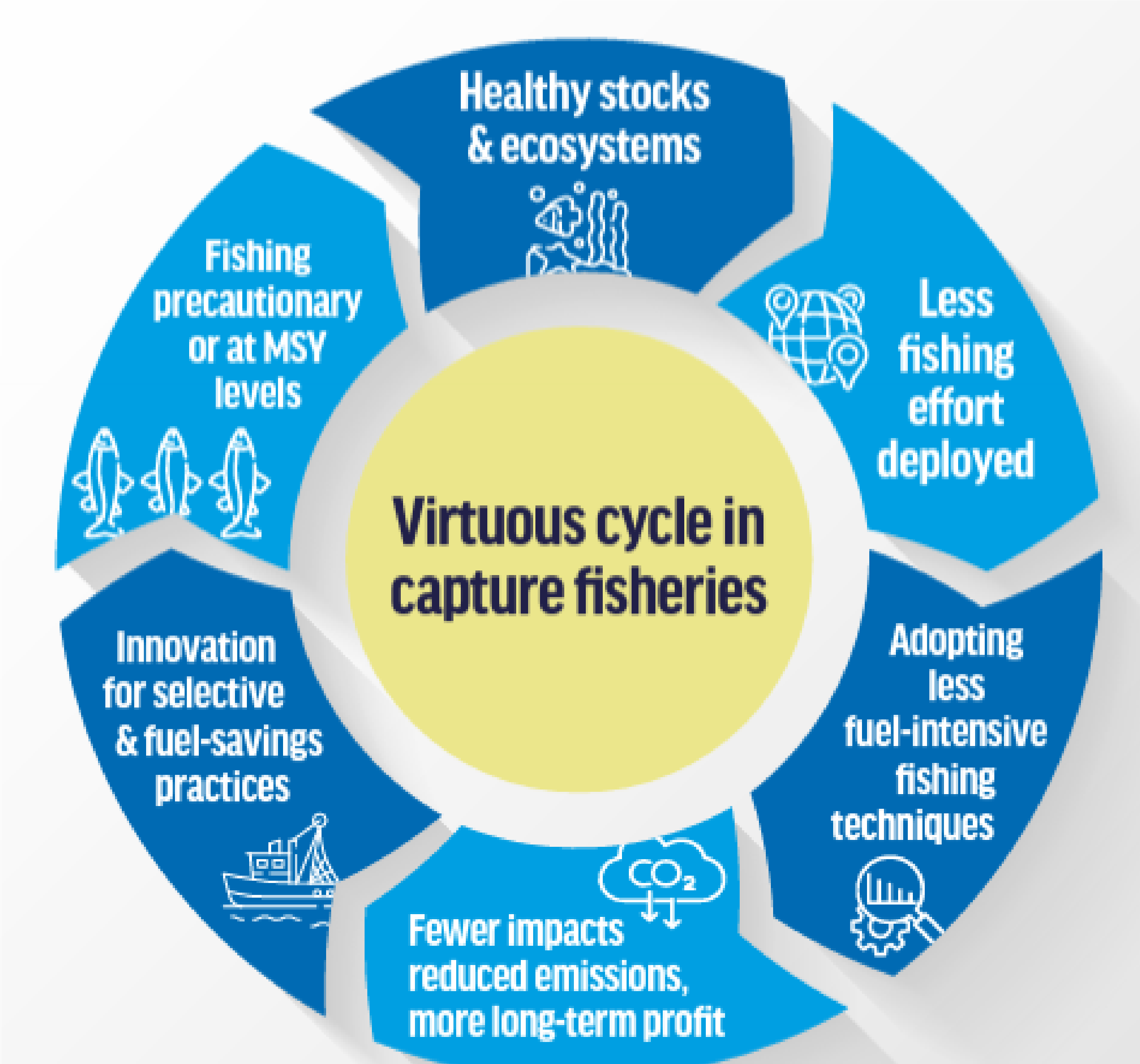
A practical example: A 15-days trip for a 20 m fishing vessel needs 250KWh i.e. 25m^3 of diesel…the same volume of fuel delivers 139KWh with LNG etc.

=> shortening trip duration & save energy on other expenses, or fuel-barge at sea?…

What we want: searching for a virtuous circle

Characterizing 'Win-Win' fishing strategies in which fishing effort deployed corresponds to MSY targets AND CFP minimal effects objectives, including less fuel use

= higher catch is obtained, less fuel is spent to attain the catch, and the fishery has a higher resistance and resilience to shock factors to face climate-induced stresses)



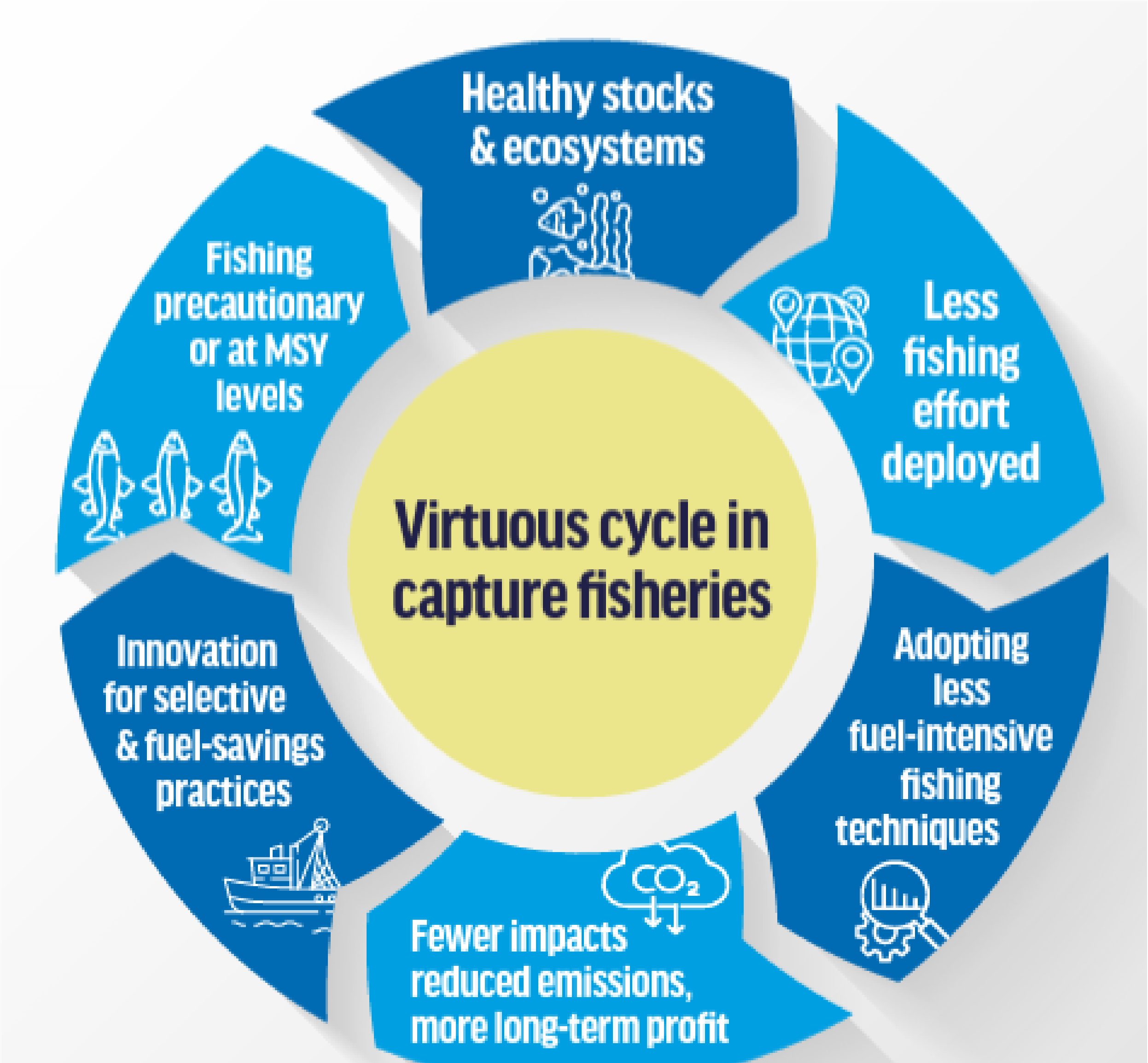
Bastardie et al. 2022

Joint accountability of management and responsible fishing: a win-win

- In EU, accessing funding is not permitted for fisheries not in balance with the fishing opportunities

- Correct implementation of the CFP to protect stocks & preserve habitats is a prerequisite for a resilient sector and successful energy transition

- Limiting the dependency on fossil fuels will increase resilience to possible future crises. Ensured by fishing strategies with precautionary fishing effort targets and CFP minimal effects objectives



Bastardie et al. 2022

Decarbonisation win-wins

- Fishing less = earn more

- Fishing with larger gear meshes = consumes less fuel
- Fishing with existing efficient technological solutions = save fuel, costs & improve catches
- Switching to alternative fishing techniques = preserve seafloor integrity, its biodiversity & saves blue carbon stored in the seabed & save fuel from lower drag
- Switching to alternative low-carbon fishing techniques = higher economic resilience to future crises = not impairing EU food security with non-optimal fishing
- Promoting small-scale fisheries = save fuel, habitats & help the energy transition when downsizing engines (lighter engine, better recharging time, etc.)

Recommendations on long term actions

Full implementation of the CFP for all EU stocks to be fished sustainably (i.e. maintain the 2013 CFP ambition)

Phase out the most energy-inefficient fishing techniques (CFP Art. 17)

Implement a network of MPAs based on blue carbon habitats (CFP Art. 11)

Develop energy-efficient alternative propulsion technologies

Develop ecolabelling based on a carbon footprint scoring system (CFP Art. 17)

Improve the EU political soft power with leadership in international commitments, and promote clean technologies

Reduce imbalanced fleet-segments in EU (CFP Art. 22.2)

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