



EU REGULATORY FRAMEWORK TOWARDS **DECARBONIZATION**

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23RD MARCH, 2023.



DRIVERS ESG

A
REGULATORY



B
INVESTORS &
CLIENTS



SUSTAINABILITY

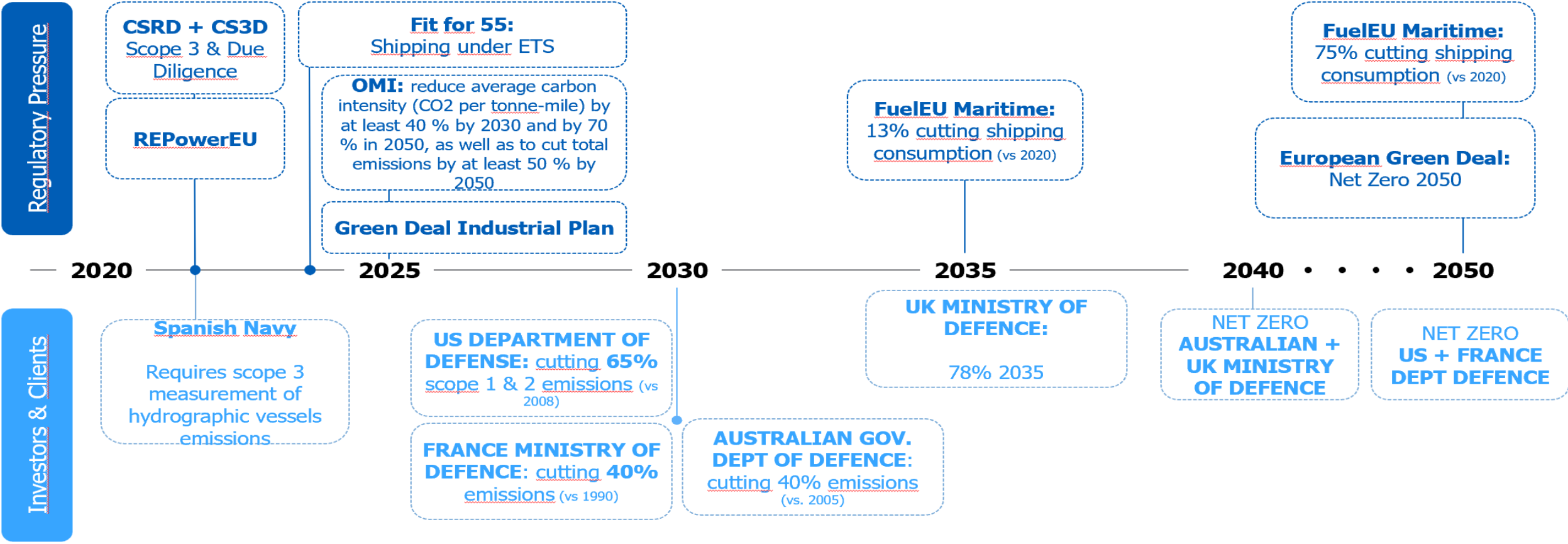
C
EMPLOYEES



D
SOCIETY

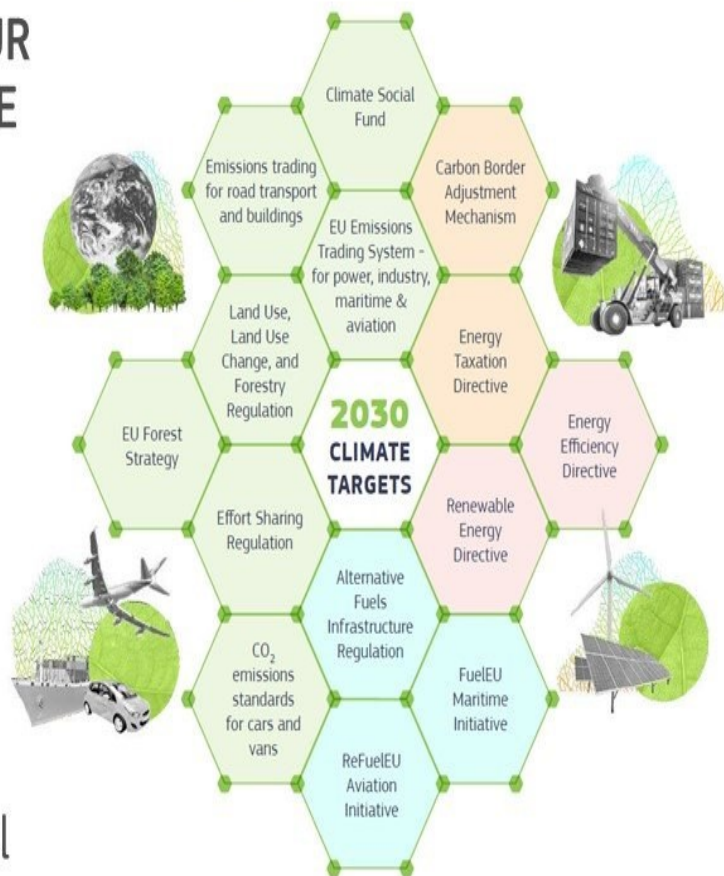


DECARBONIZATION ROADMAP –MARITIME & DEFENCE SECTOR-

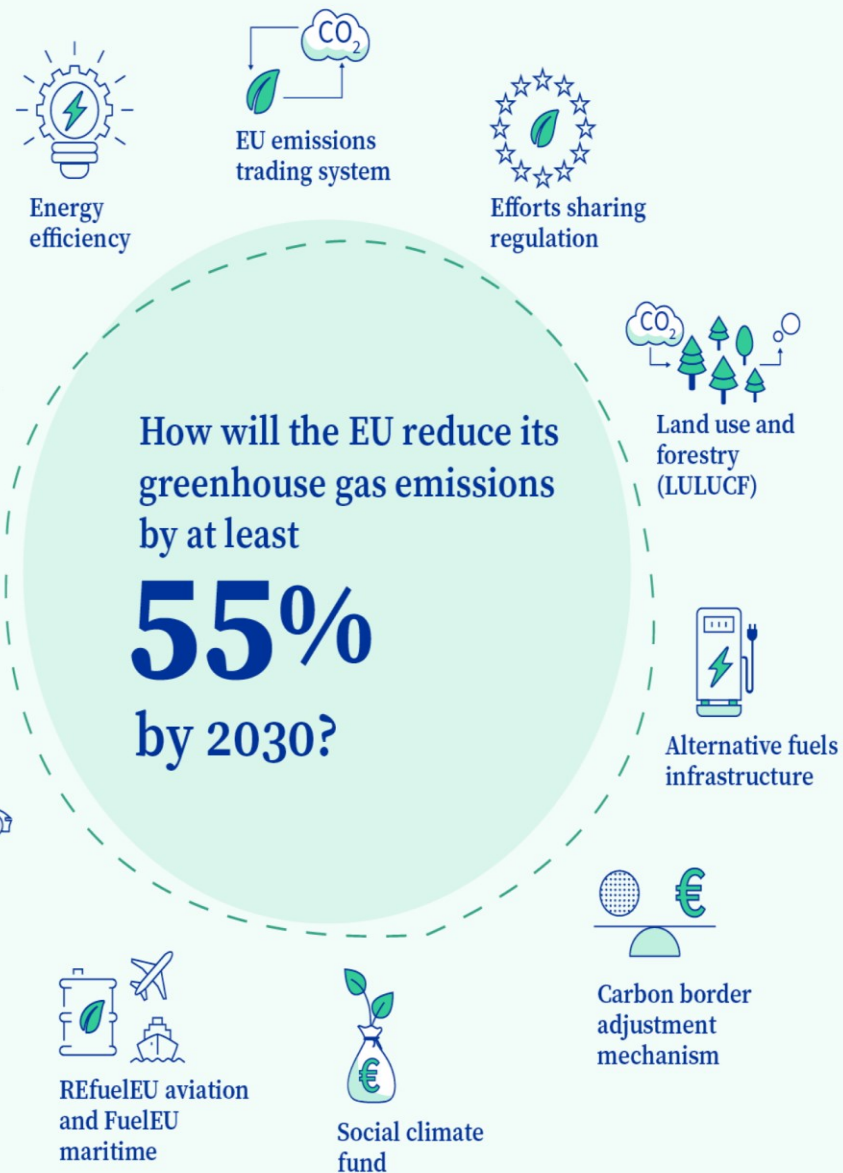


EUROPEAN GREEN DEAL

REACHING OUR 2030 CLIMATE TARGETS



#EUGreenDeal



Energy efficiency



EU emissions trading system



Efforts sharing regulation



Renewable energy



Energy taxation



CO2 emission standards for cars and vans



Land use and forestry (LULUCF)



Alternative fuels infrastructure



REfuelEU aviation and FuelEU maritime



Social climate fund



Carbon border adjustment mechanism

The European Commission launched the "Fit for 55" package.

Consistent and complementary measures to achieve the EU's target of 55% net emission reductions by 2030.

- 1 Review of the EU Emissions Trading Scheme (EU ETS), in particular its extension to maritime transport, the revision of aviation emissions rules and the establishment of a separate emissions trading scheme for road transport and buildings.
- 2 Review of the Effort Sharing Regulation for Member States' reduction targets in sectors not covered by the EU ETS
- 3 Review of the Regulation on the inclusion of greenhouse gas emissions and removals from land use, land-use change and forestry (LULUCF).
- 4 Revision of the Renewable Energy Sources Directive.
- 5 Recast of the Energy Efficiency Directive
- 6 Revision of the Directive on alternative fuels infrastructure
- 7 Amendment of the Regulation laying down CO2 emission standards for passenger cars and vans.
- 8 Revision of the Energy Taxation Directive.
- 9 Carbon border adjustment mechanism (CBAM).
- 10 ReFuelEU Aviation initiative for sustainable aviation fuels
- 11 FuelEU Maritime Initiative for a green European maritime space, aims to increase the use of sustainable alternative fuels in European maritime transport and ports.
- 12 Social Climate Fund

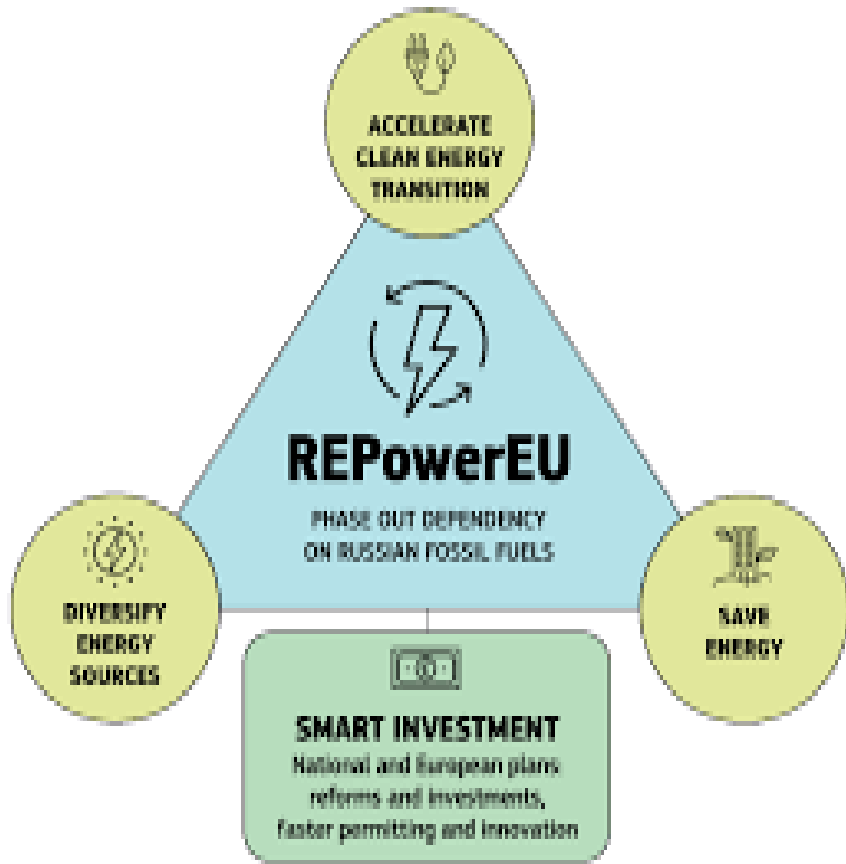
EU MARITIME REGULATION

CURRENT EU LEGISLATION REGULATES THE FOLLOWING ASPECTS RELATED TO SHIPPING FUELS:

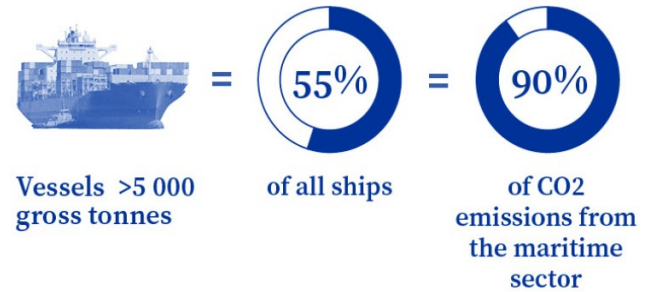
- The **Alternative Fuels Infrastructure Directive** ('AFID', 2014/94/EU). Minimum requirements related to shipping: * LNG for ships; * Shore-side electricity supply for inland waterway vessels and seagoing ships in maritime and inland ports.
- Regulation on the **monitoring, reporting and verification of CO2 emissions from maritime transport** ('EU MRV', Regulation 2015/757/EU). The two monitoring systems are not aligned yet; this results in overlaps and extra paperwork for shipping operators.
- Directive on a **reduction in the sulphur content of certain liquid fuels** (2016/802/EU)
- The recast **Renewable Energy Directive** ('RED', 2018/2001/EU)

MARTIME SECTOR UNDER THE FIT FOR 55

- Revised **EU emissions trading system directive** (EU-ETS, COM(2021) 551) aims to involve shipping in EU carbon trading ('well-to-wake').
- A revised **directive on alternative fuels infrastructure** (AFID, now proposed as a regulation, COM(2021) 559) seeks to raise the availability of LNG by 2025 and shore-side electricity supply in main EU ports by 2030.
- A revised **directive on energy taxation** (COM(2021) 563) aims to end the tax exemptions for conventional marine fuels and incentivise the uptake of alternatives.
- A revised **renewable energy directive** (RED II, COM(2021) 557) sets up the new EU economy-wide target of an at least 40 % share of energy from renewable sources in 2030 and the new renewables target of GHG intensity reduction of at least 13 % by 2030 in the transport sector.

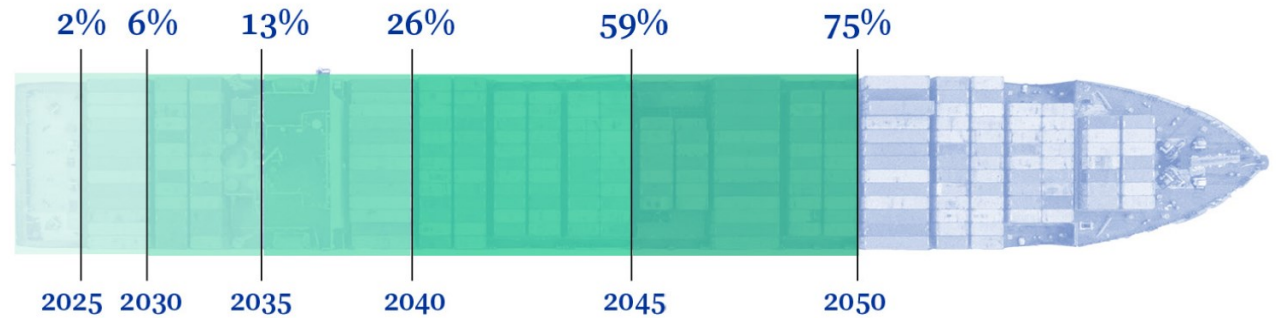


The FuelEU maritime regulation will oblige vessels above 5 000 gross tonnes calling at European ports (with exceptions such as fishing ships):

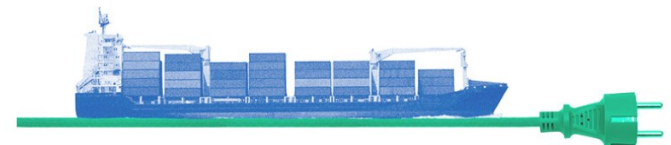


→ to reduce the greenhouse gas intensity of the energy used on board as follows

Annual average carbon intensity reduction compared to the average in 2020



→ from 2030, to connect to **onshore power supply** for their electrical power needs while moored at the quayside, unless they use another zero-emission technology





THE GREEN DEAL INDUSTRIAL PLAN

Speeding up the contribution of Europe's innovative clean tech industries to net-zero

February 2023

With the **Green Deal Industrial Plan**, the Commission will promote the creation of a more supportive environment for deploying the clean tech manufacturing capacity required to meet Europe's ambitious green targets.

The Green Deal Industrial Plan

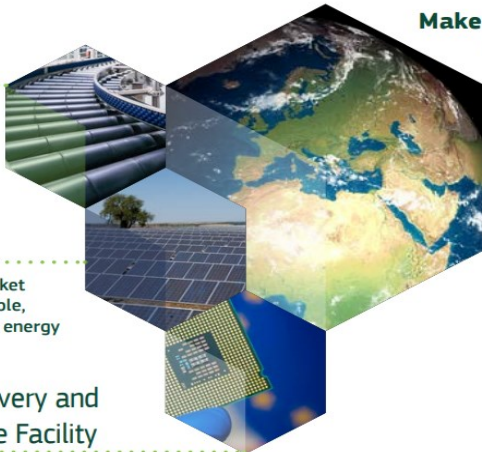
Build the industrial capacity for the clean technologies that make up the Green Deal

REPowerEU

Respond to energy market disruption with affordable, secure and sustainable energy for Europe

The Recovery and Resilience Facility

Recover from the pandemic better prepared for the green and digital transitions



The Green Deal
Make Europe the first climate-neutral continent by 2050

THE PLAN IS BASED ON FOUR COMPLEMENTARY PILLARS



A predictable and simplified regulatory environment

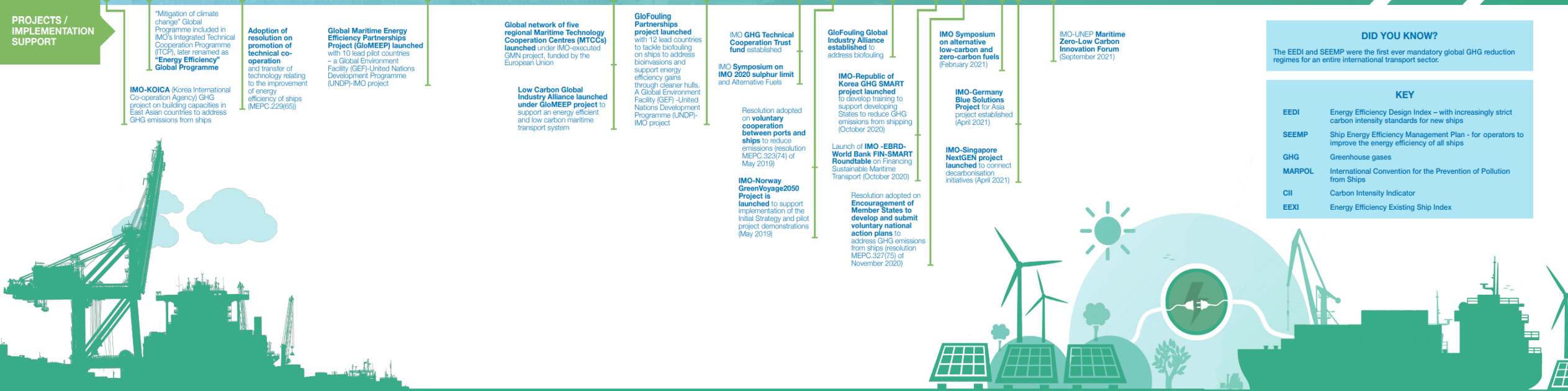
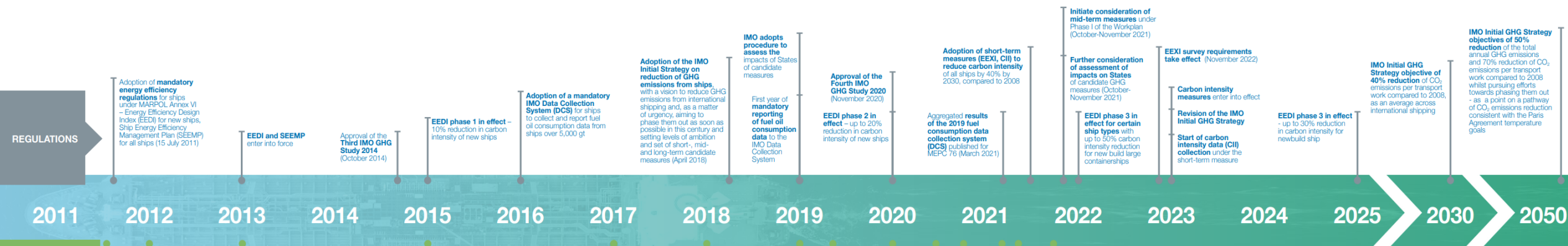
Faster access to funding

Enhanced skills

Open trade for resilient supply chains

Addressing climate change

A decade of action to cut GHG emissions from shipping



DID YOU KNOW?

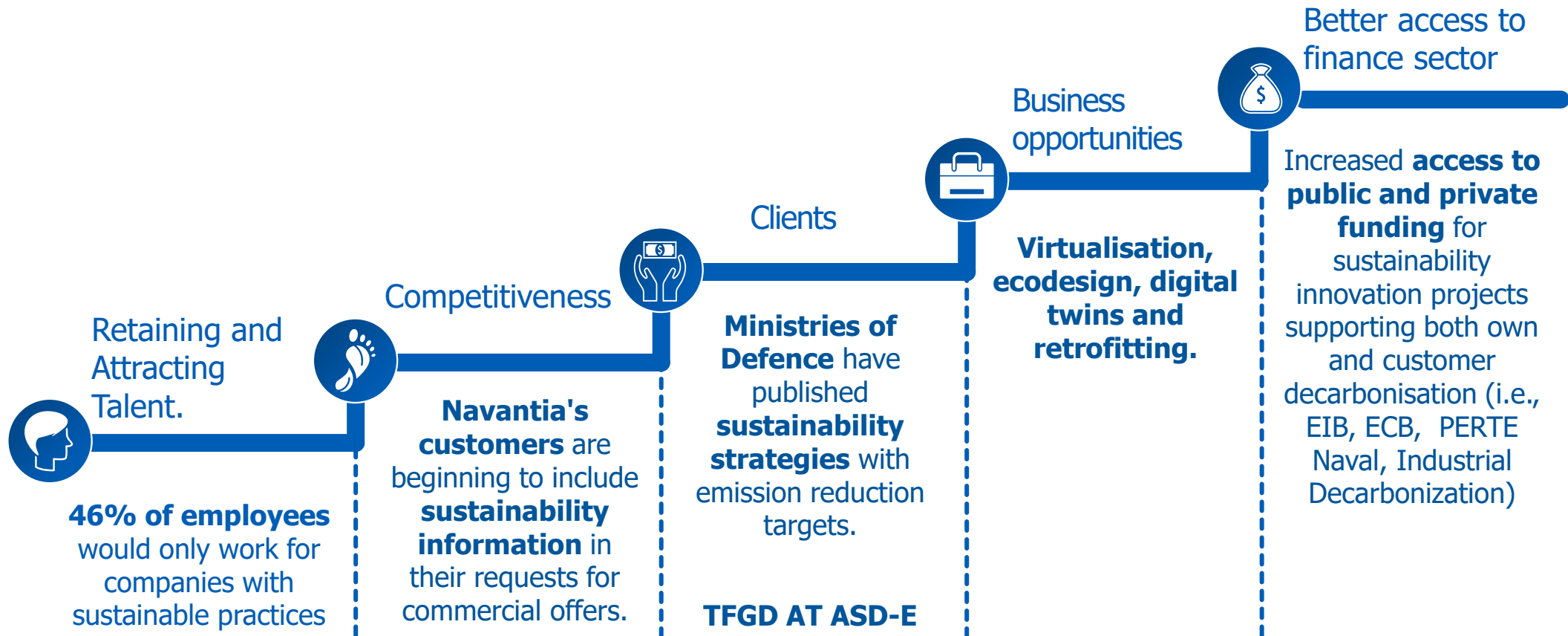
The EEDI and SEEMP were the first ever mandatory global GHG reduction regimes for an entire international transport sector.

KEY

- EEDI** Energy Efficiency Design Index – with increasingly strict carbon intensity standards for new ships
- SEEMP** Ship Energy Efficiency Management Plan – for operators to improve the energy efficiency of all ships
- GHG** Greenhouse gases
- MARPOL** International Convention for the Prevention of Pollution from Ships
- CII** Carbon Intensity Indicator
- EEEXI** Energy Efficiency Existing Ship Index

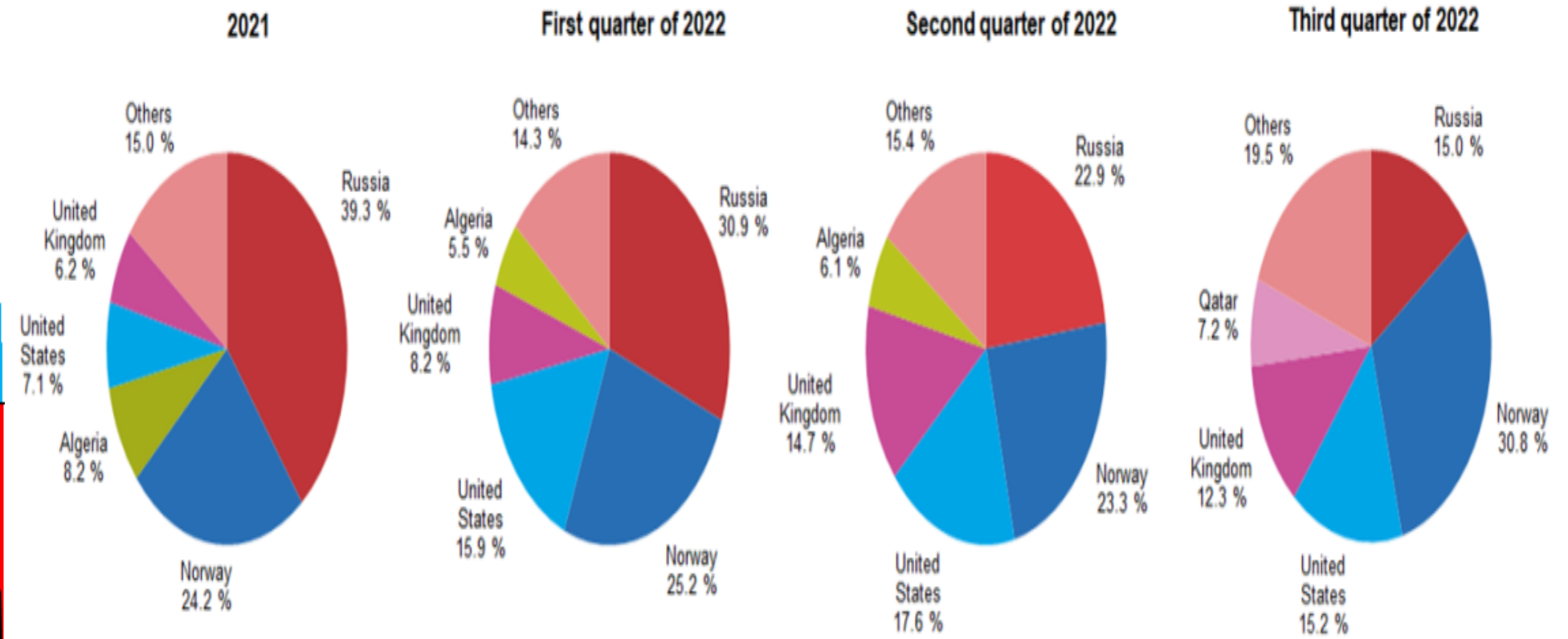
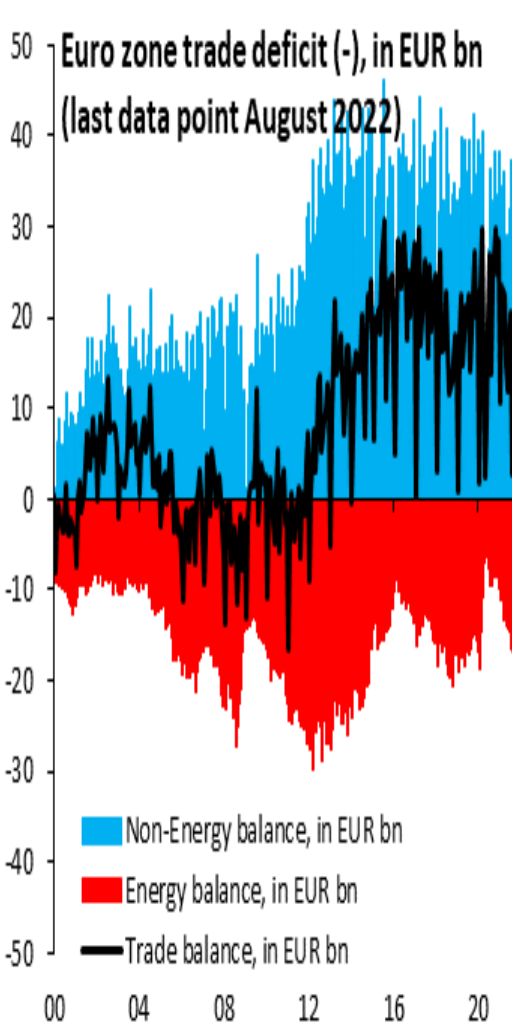


Sustainability/Decarbonization is becoming a source of **COMPETITIVE ADVANTAGE**, attracting better talent, more customers and better financing.



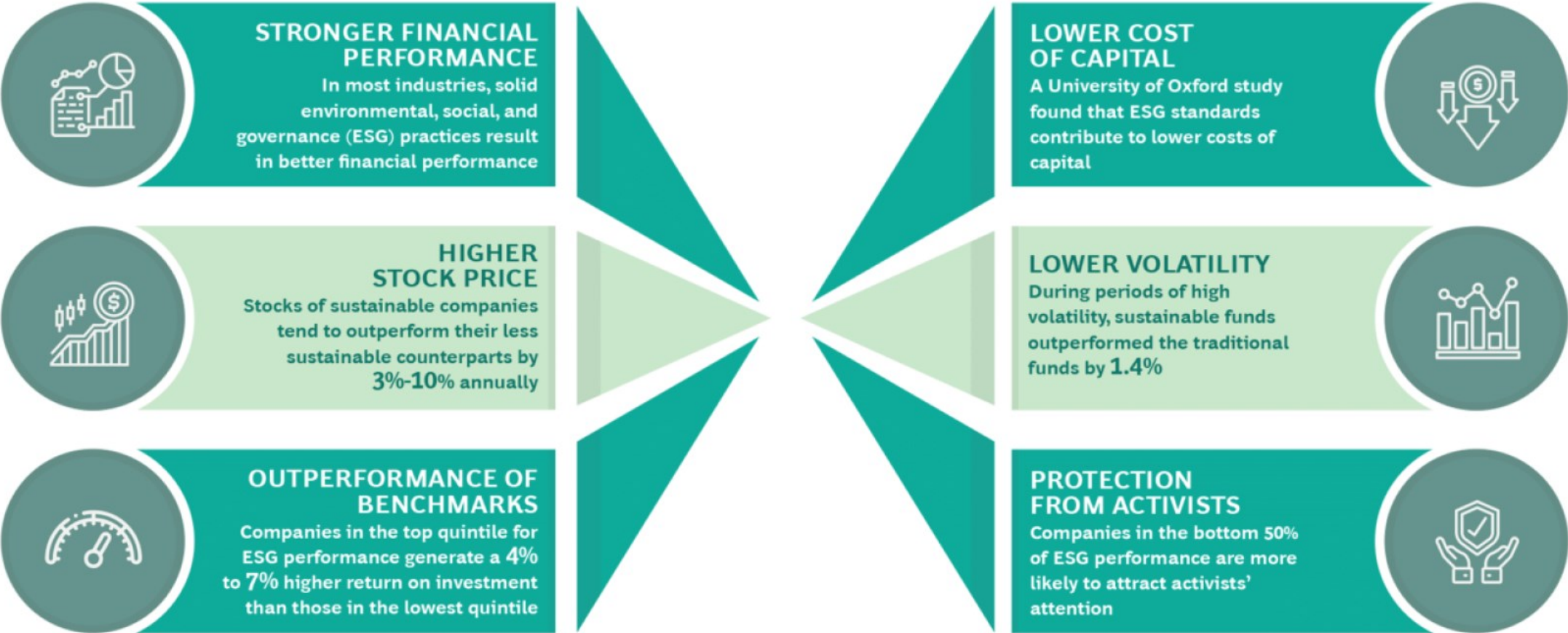
Extra-EU imports of natural gas by partner

(share (%) of trade in value)



Source: Eurostat database (Comext) and Eurostat estimates

Exhibit 1 - High Sustainability Ratings Correlate with Better Financial Performance



Sources: University of Oxford; Arabesque Asset Management; A&M Activist Alert; Harvard Business School; Journal of Sustainable Finance & Investment; Morgan Stanley, BCG analysis.

MARITIME SECTOR & NAVY

Both Spanish and European regulations require companies to report GHG emissions resulting from their operational activities (generally understood as **Scope 1 & 2**). Through the new European CSRD regulation, it is expected to be mandatory to report **Scope 3** emissions from 2025 onwards.

Through the **Fit for 55 plan**, and specifically the **FuelEU Maritime initiative**, the incorporation of the commercial maritime industry into the ETS carbon credit market by 2023 is envisaged, and the industry's lifecycle emissions reduction is set to 75% by 2050. Although not applicable to the defence sector, it indicates the **regulatory trend**.

In addition, the **IMO** requires up to 30% emission reductions for newly built merchant ships from 2025 onwards, compared to 2014, through the EEDI index. Some defence customers are already using this index to assess the efficiency of ships when awarding contracts.

MARCH 2022
#EUDefence
#StrategicCompass



THE EU'S CLIMATE CHANGE AND DEFENCE ROADMAP

ADDRESSING THE IMPLICATIONS OF CLIMATE CHANGE FOR SECURITY AND DEFENCE


Ministry
of Defence

Ministry of Defence Climate Change and Sustainability Strategic Approach



Department of Defense Climate Adaptation Plan

September 1, 2021



The Secretary General's Report

Climate Change & Security Impact Assessment

2022

Climate Change and Impact Assessment

NATO aims to become the leading international organization in understanding and adapting to the impact of climate change on security.

- There is no clear indication of procedures in place to achieve each of these measures nor a clear timeline for their implementation.

CLIMATE IMPACTS

- Structural damage to critical infrastructure at military bases and training areas resulting in disrupted site access, operations, and mobility
- Technical failure of infrastructure and equipment
- Increased demand on utilities (particularly energy and water) to cope with harsher operating environments
- Budget pressures due to increased maintenance and repair regimes
- Increased occupational health and safety risks
- Decrease in the number of available training days
- Altered operating environment
- Increased supply chain vulnerabilities
- Climate change related political instability and proliferation of conflict
- Changes in mission profiles

The Secretary General's Report

Climate Change & Security Impact Assessment

2022

Climate Change and Defence Roadmap



The report's stated aim is to ensure that climate policy implications become integral to the EU's thinking and action.

- The roadmap provides a more detailed look into efforts the EU is already undertaking to address identified threats to peace and security.

The EU has long recognized that climate change acts as a threat multiplier with serious implications for peace and security across the globe. Climate change poses a double challenge for EU's security and defense:

- Climate change increases global instability. This will likely increase the number of crisis situations to which the EU might need to respond while at the same time the armed forces will be asked more frequently to assist civilian authorities in response to flooding or forest fires, both at home and abroad.
- Future capabilities will need to adapt to this changing operational environment (e.g., extreme heat or higher sea levels). At the same time, the armed forces need to invest in greener technologies throughout their capability inventory and infrastructure.

EEAS Climate Change and Defence Roadmap

OPERATIONAL DIMENSION

- Mainstream climate change and environmental aspects into the planning and implementation of CSDP missions and operations.
- All CSDP missions and operations will have environmental advisors as a standard position.
- Launch a mechanism to measure and assess the environmental footprint of CSDP missions and operations to optimize the use and management of energy, water, and waste.
- Foster civil-military cooperation, including preparedness and response to natural and humanitarian disasters.

CAPABILITY DEVELOPMENT

- Develop training modules for national and EU-level curricula.
- Boost technological innovation to make military equipment more efficient and less reliant on fossil fuels.
- Provide concrete solutions for sustainable and circular energy models.
- Explore possible synergies with relevant instruments and directives.
- Assess the feasibility to set up an EU platform run by the EDA to assist the Ministries of Defence to reduce energy consumption and to increase energy efficiency, thereby contributing to climate neutrality by 2050.
- Improve transport infrastructure.
- Gather data on the energy consumption of the armed forces of Member States to help them find joint approaches to enhancing energy efficiency and sustainability.

PARTNERSHIPS

- Work closely with the United Nations on various operational and innovation aspects related to climate and defense.
- Step up dialogue and cooperation with NATO to ensure coherence and mutual reinforcement in different areas.
- Work with bilateral partners such as the United States, Canada, and Norway to identify best practices and areas of further cooperation.

Ministry of Defence Climate Change and Sustainability Strategic Approach



Climate Change and Sustainability Strategic Approach

The government of the United Kingdom acknowledges that defense accounts for 50% of government emissions. It has developed the most comprehensive climate change and sustainability approach of any department of defense. The following points detail a concrete timeline with precise goals and topic-specific goals towards achieving the net zero by 2050 goal the UK government has set.

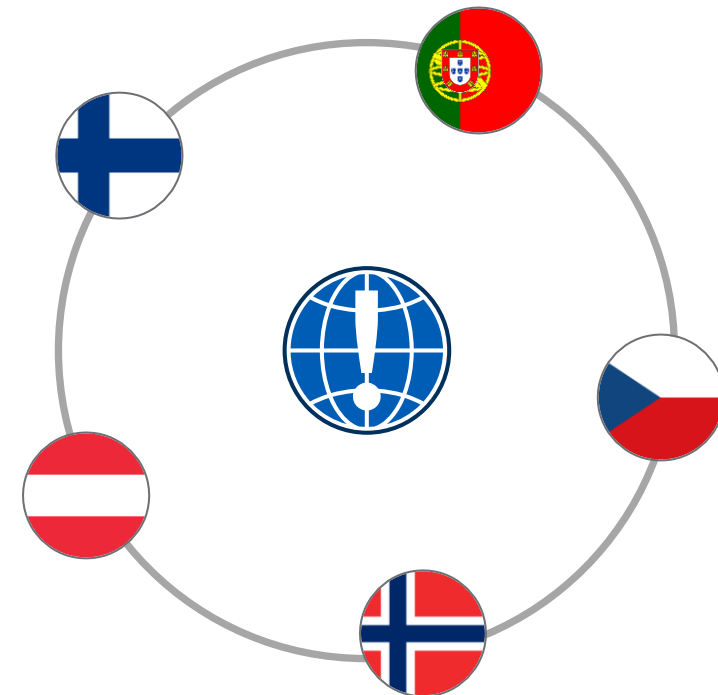
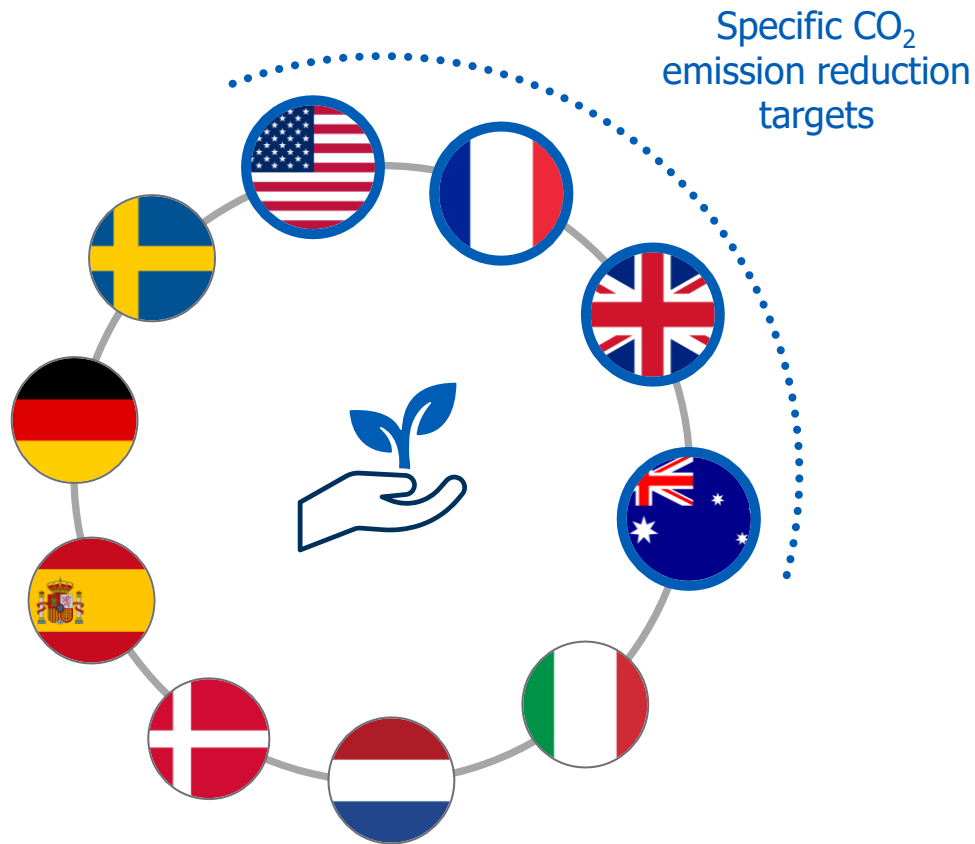
Defence's strategic ambition 2050

1. Defence has **adapted** to be able to fight and win in ever more hostile and unforgiving physical environments.
2. Defence **has reduced its emissions and increased its sustainability** activity and as a department is contributing to the achievement of the UK legal commitment to reach net zero emissions by 2050.
3. Defence **acts and is recognized as a global leader** in response to the emerging geopolitical and conflict-related threats that are exacerbated by climate change.











Some ASD member countries have not yet developed defense sustainability plans; UK, France, Australia and USA lead the way

Some Ministries of Defense have already published their own sustainability commitments...

... but other European countries have only designed plans at the national level











In Europe, the Ministries of Defense of the UK and France have set specific CO2 reduction targets, Italy and Germany have only made commitments

Country	Base year ¹	Target year ²	CO ₂ emission reduction targets					Other sustainability commitments	
			2030	2035	2040	2045	2050		
	2008	2022	① ② 65%	US Navy commitment			100%	<ul style="list-style-type: none"> Energy efficiency objectives and emission reductions from its infrastructures and vehicles; no explicit mention is made of emission reductions from its own vessels 	
	2005	2022	43%	100%				<ul style="list-style-type: none"> Defense Sustainability Plan (2016-2036): improving energy efficiency and reducing the consumption of natural resources 	
	2025	2021		10 years before the national target			100%	<ul style="list-style-type: none"> 10% reduction in the consumption of fossil fuels by 2026 Ministry of Defense Material and Support Sustainability Plan (2025) with GHG reduction targets for 2040. 	
	1990	2022	40%				100%	<ul style="list-style-type: none"> Reduction of 30% in energy consumption and 50% in GHG emissions at the ministry's properties (vs. 2010) 	
ASD Members			No specific targets have been set						<ul style="list-style-type: none"> Energy Strategy Plan (2020): energy efficiency of facilities, substitution of fossil fuels for renewable energies
			No specific targets have been set						<ul style="list-style-type: none"> Sustainability Plan (2020): calculation and commitments of CO₂ emissions reduction from military transport and energy from its facilities
			No specific targets have been set						<ul style="list-style-type: none"> Approval of Directive (1997) and Instruction (2011) on improving energy efficiency, waste management, etc.
			No specific targets have been set						<ul style="list-style-type: none"> Action Plan 2021-2025: improving energy efficiency and reducing waste
			No specific targets have been set						<ul style="list-style-type: none"> 20% reduction in fossil fuel consumption by 2030 and 70% by 2050 (vs. 2010)
			No specific targets have been set						<ul style="list-style-type: none"> Commitment to the non-use of fossil fuels from 2045 onwards

1. Reference year for the reduction target; 2. Year of establishment of the objective; Source: Sustainability reports and national legislation from USA, Australia, UK, France, Italy, Germany, Spain, Denmark, The Netherlands, Sweden

Most countries are aligned with the goal of net zero by 2050, although Germany is committed to 2045 (I/II)

Commitments	ASD Members							
								
National legislation (net-zero emissions in 2050 ¹)	✓	✓	✓	✓	✗ There is no legislation	✓ 2045	✓	✓
Ministry of Defense	✓	✓	✓	✓	≈	≈	≈	≈
Navy	✓	≈	≈	✗	≈	✗	✗	≈
Initiatives	Green Fleet (2009): 50% biofuels use on Navy vessels	Green technologies: hydrogen, battery energy storage and alternative liquid fuels	Construction of greener floats (2022): improved hydrodynamics, route optimization systems, shipyards infrastructure	Investment in fuel cells on vessels, cleaning robots (collaboration with Naval Group)	In 2012 the project "Flotta Verde" was launched to seek alternative fuels for vessels	Use of synthetic fuels and investment in R&D for green vehicles	Use of paints on the hulls of vessels which reduce CO2 emissions	Energy consumption measuring systems, installation of batteries and heat recovery systems on vessels

✓ Commitment to objectives

≈ Commitment without objectives

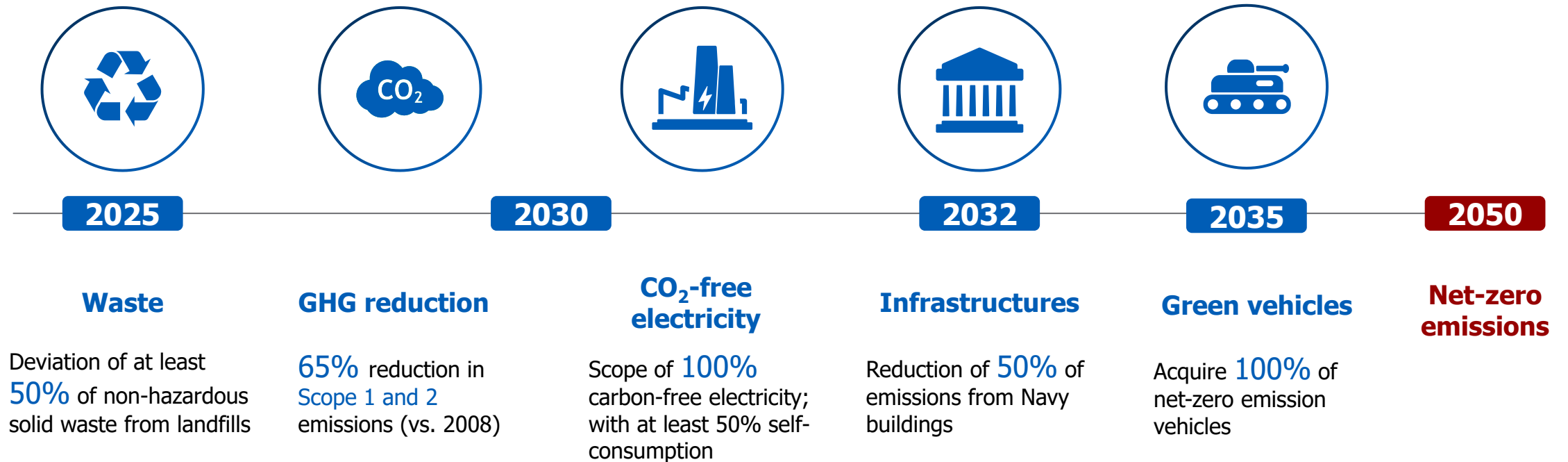
✗ There are no commitments

1. In line with the objective of the Paris Agreement (signed by all listed countries)
Source: Sustainability reports and national legislation of USA, Australia, UK, France, Italy, Germany, Spain, Denmark

Deep Dive | U.S. Navy has been a pioneer in defining sustainable goals; seeks to achieve net zero emissions by 2050

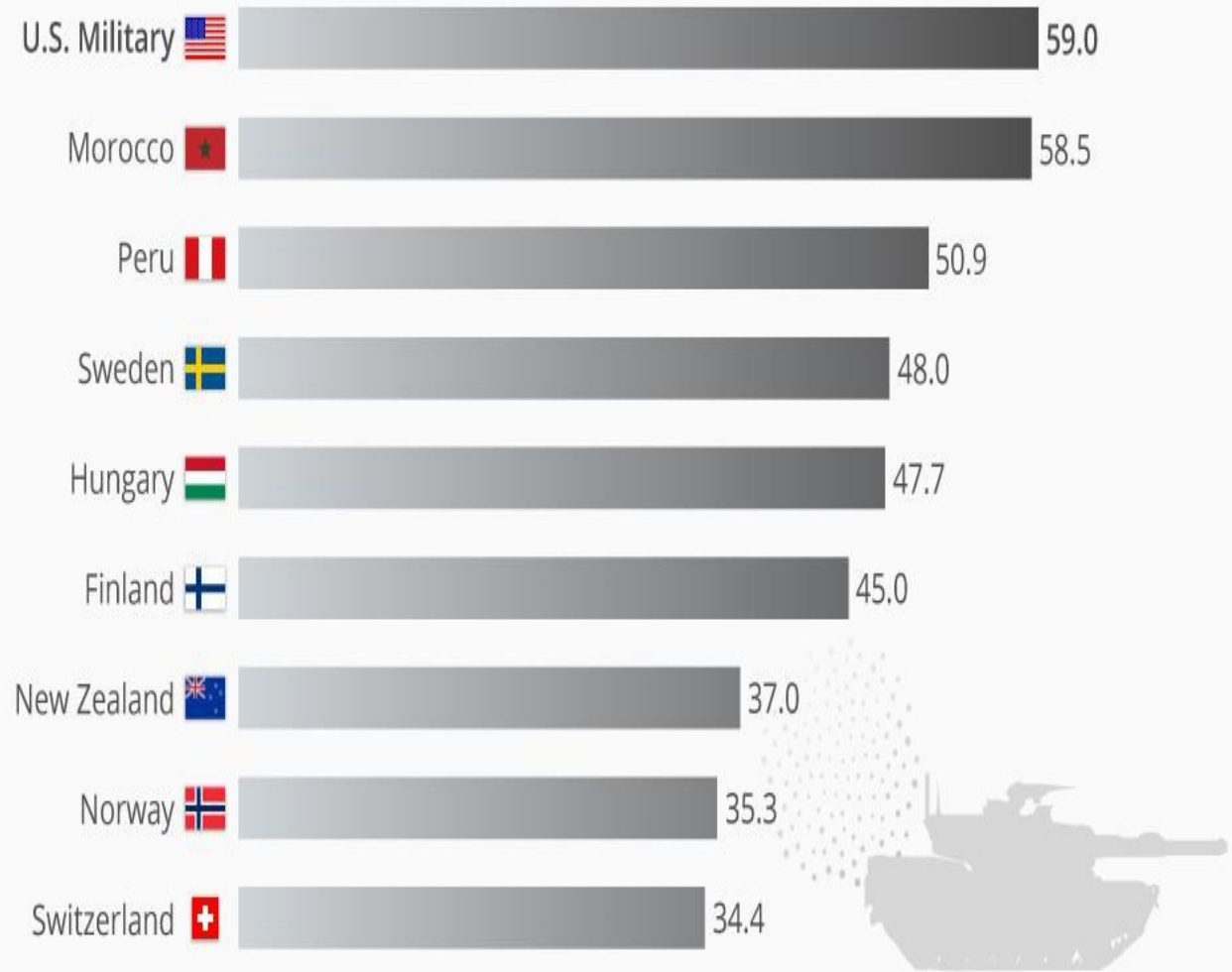


"Climate Action Plan 2030 - U.S. Navy"



The U.S. Military Emits More CO₂ Than Many Nations

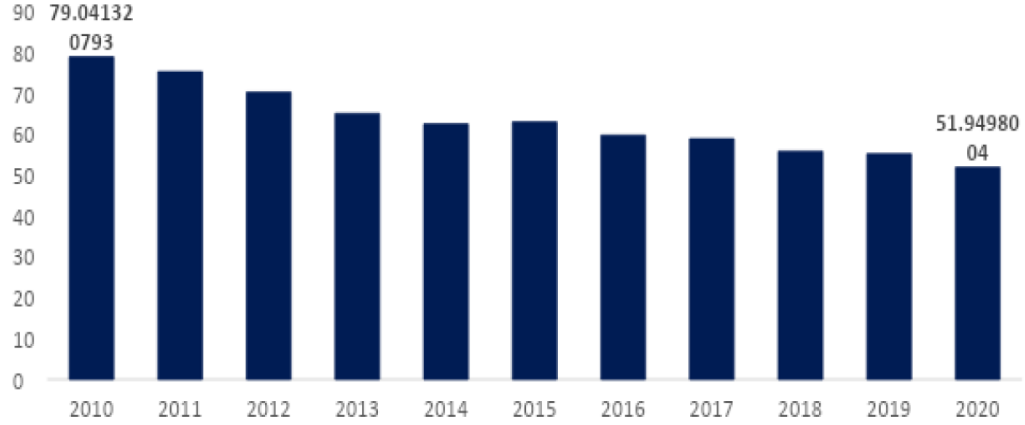
Estimated carbon dioxide emissions in 2017 (million tonnes)



Forbes statista

Evolution of total GHG emissions reported by the U.S. Department of Defense (*)

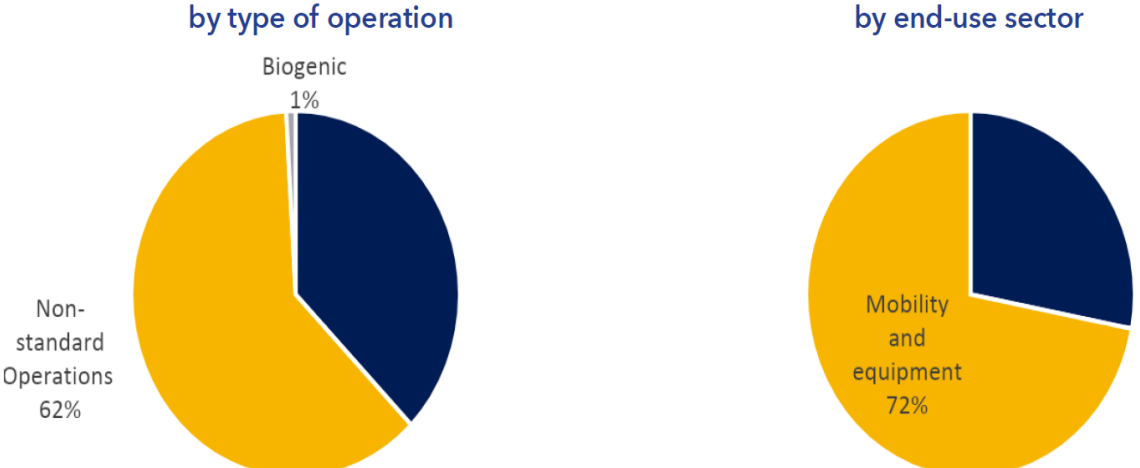
Unit: million tons of CO₂ equivalent



(*) Scope (1) and (2): Emissions directly emitted by the department's buildings and equipment (1) and emissions indirectly emitted by the department via its purchases of energy produced by third parties (2)

Structure of U.S. Department of Defense reported GHG emissions in 2020

Unit: share in % of U.S. Department of Defense volume emissions



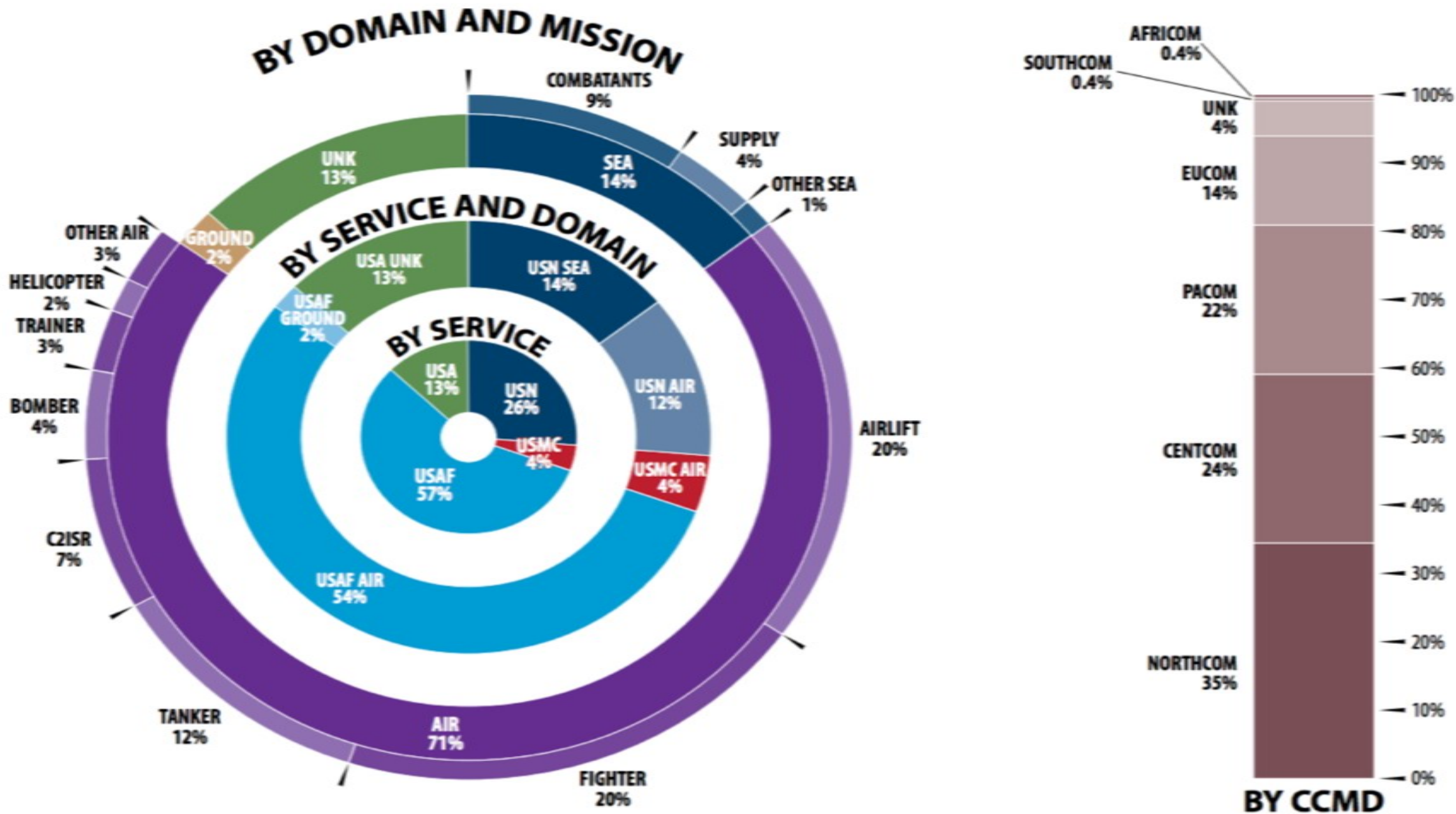


Figure 1: Operational Energy Use, FY 2014



STRATEGY

- National Defense Strategy
- National Military Strategy
- Combatant Command Theater Strategies



PLANNING

- Unified Command Plan
- Contingency Planning Guidance
- Joint Strategic Campaign Plan
- Operation Plans
- Global/Functional Campaign Plans
- Service Planning Guidance
- Combatant Command Campaign Plans



FORCE MANAGEMENT, DEVELOPMENT, & EMPLOYMENT

- Defense Planning Guidance
- Global Force Management Guidance
- Contingency Planning Guidance
- Global Force Posture Recommendations
- Guidance for Employment of the Force
- Joint Warfighting Concept
- Service Warfighting Concepts



BUDGET, ANALYSIS, & ASSESSMENT

- Strategic Portfolio Reviews
- Analysis of Alternatives
- Annual Joint Assessment
- Chairman's Risk Assessment
- Defense Planning Scenarios
- Program Objective Memorandum
- Service and Independent Cost Estimates



PARTNERED ACTIVITIES & ACQUISITION

- Security Cooperation Programs
- Partnership Plans
- Acquisition Strategy
- Major Defense Service and Acquisition Programs
- State Partnership Program
- Joint and Service Capability Development Processes and Oversight

NAVANTIA DECARBONIZATION PLAN



Screening

- Annual reporting and auditing of the carbon footprint, including Scope 1, 2 and 3.
- Automation of the footprint calculation using a carbon footprint tool.



Renewables

- Promoting the development of second-generation biofuels and synthetic fuels and their use in the defence sector.
- Certification of Navantia ships for the use of biofuels and synthetic fuels.
- Exploration of the adaptation of dual diesel-methanol engines already developed in the merchant sector and their application to defence vessels.



R&D

- Development of digital services that support the decarbonisation of customers (route optimisers in navigation, engine operation, etc.).
- Promotion of eco-design as a lever to reduce the footprint of Navantia ships.



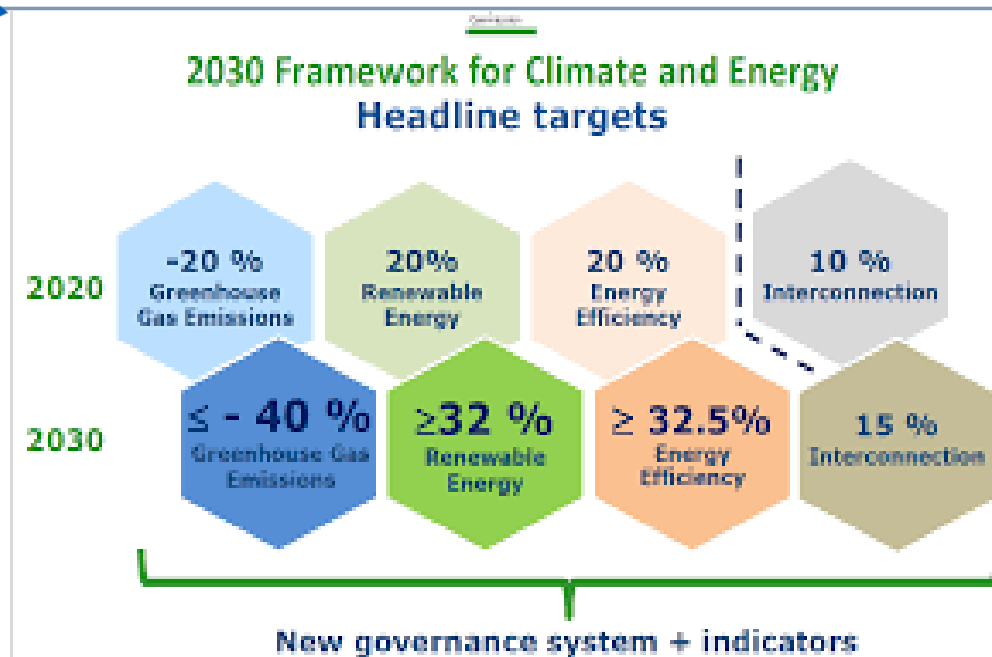
Communication & Advocacy

- Annual publication of the carbon footprint in the non-financial report.
- Achievement of a sustainability score by an internationally recognised body (i.e. CDP).
- Certification of decarbonisation targets by SBTi

European Naval Fleet Decarbonization overview



EU Green Deal targets overview



These targets affect also naval vessels, which progressively must reduce their GHG (Green House Gases) emissions same as other economic sectors. DG DEFIS and EDA are promoting actions in this sense.

Naval Defence sector approach to Green Deal targets

Not all current technological solutions to get zero GHG emissions can be applied on Naval vessels due their **most demanding safety operational requirements**. This means:

- Need to develop **specific fuels for naval vessels**, different of civil ones
 - Civil waterborne solutions aim to Hydrogen as cheapest and more efficient green fuel solution
 - Hydrogen can` t be used on board naval vessels due its high explosivity, and ammonia imply toxicity problems which recommend not use it or to develop specific storage and transfer systems.
- Need to develop **devoted new on-board safety storage and transfer fuel systems**
- Possible **higher fuel cost of** these new fuels

Need to **greening the present UE fleet** minimizing retrofitting works.

Need to **coexist internationally with other fossil-fuels in a transitional period**, with logistic problems to get green fuel out of Europe. Need of dual-fuel propulsion system.

There are several technical solutions what could be developed to greening the EU fleet, and probably every country have different preferences depending on their industrial capabilities. For the EU this means a problem, because aspires to have an EU joint navy operating as a unique fleet.

This EU fleet, when deployed in international waters, will need to be supported by **AOR (Auxiliary Oiler Replenishment) vessels**, what would not be possible without a **common fuel system for all European naval vessels**.

So, after analyzing all possible different solutions, the **European Navies should agree a common solution for all new European naval projects and present fleet retrofitting**.

EPC will be the first EU project where this issue should be agreed between different EU Navies.



First step should be to define and agree a **common green fuel solution for EU naval engines**, covering both scenarios: retrofiting of current fleet and future EU vessels.

Second step should be to define and agree a **common green fuel cell solution for EU naval vessels**, agreeing also a common fuel for this use.

FUTURE MARINE FUELS

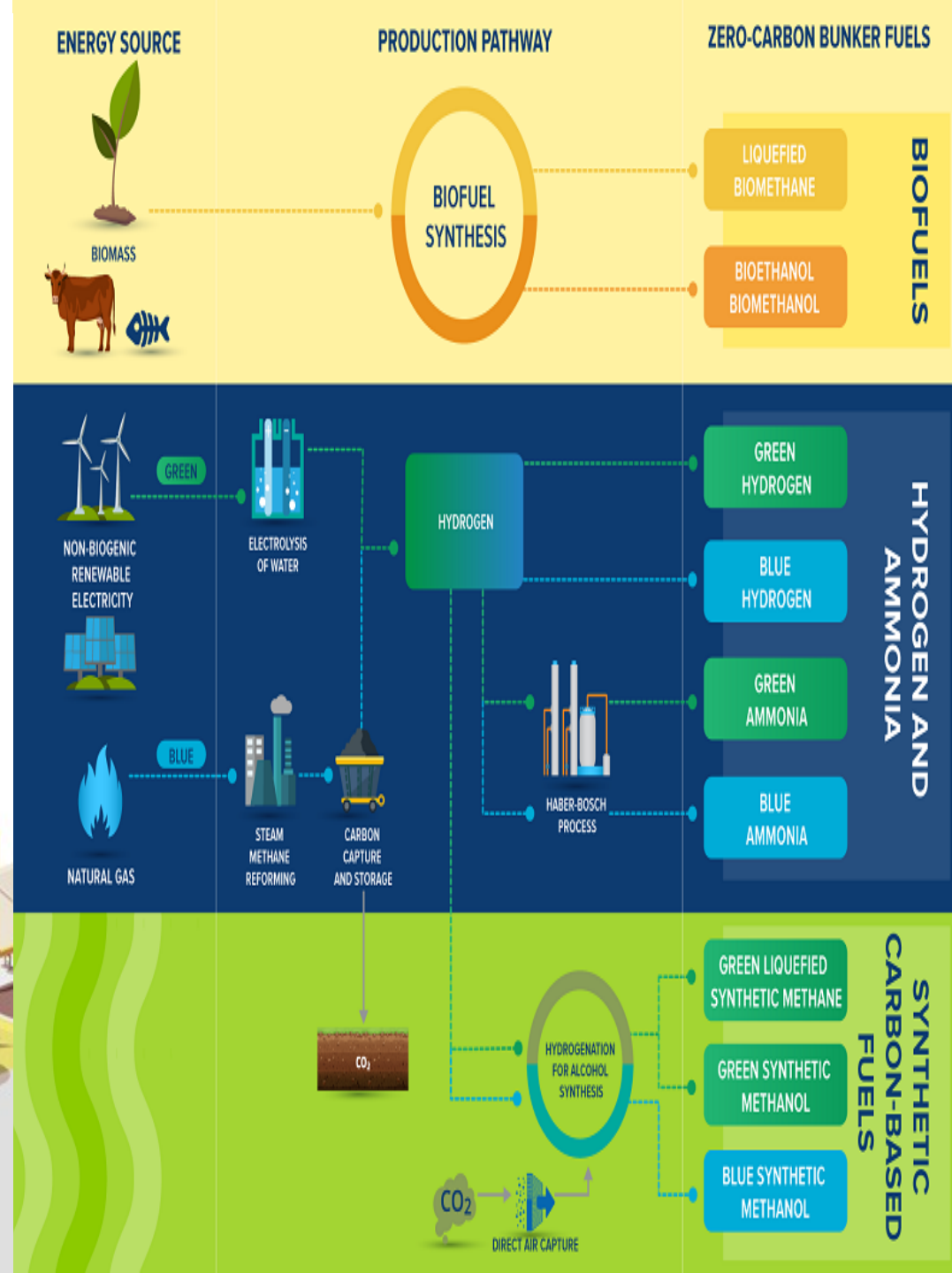
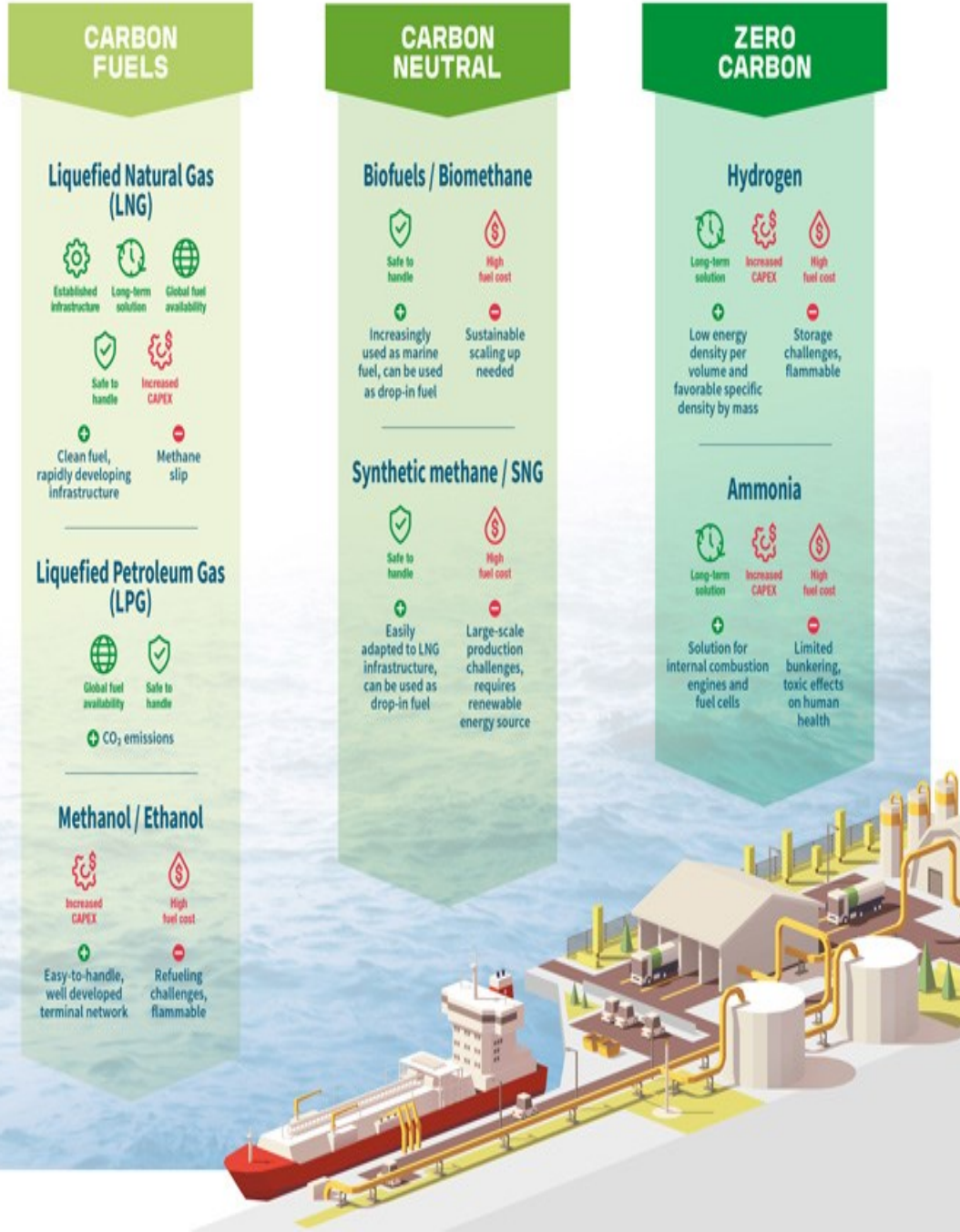
PATHWAYS TO DECARBONIZATION

IMO has developed the ambitious target of a minimum **50% reduction** in greenhouse gas (GHG) emissions **by 2050**.

Shipowners have **alternative fuel options** to help them meet IMO's ambitions, each with its own advantages and challenges.

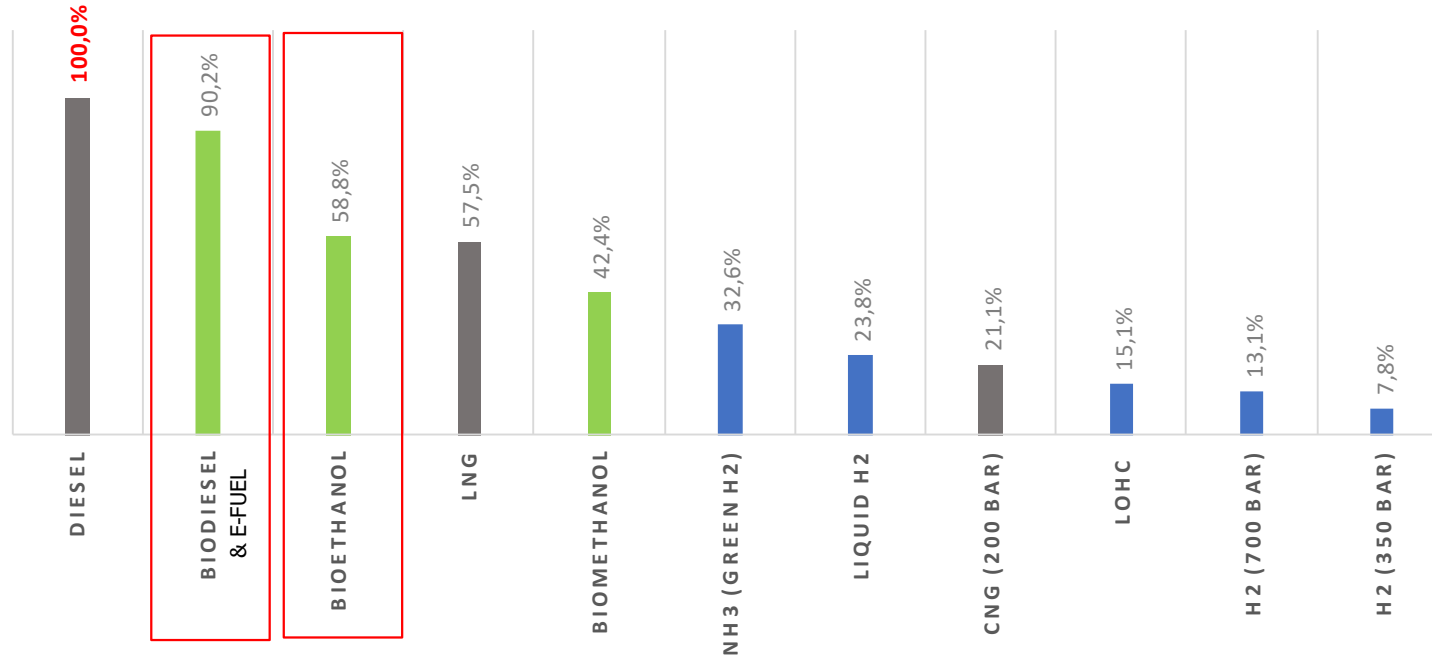
○ Advantages

○ Challenges

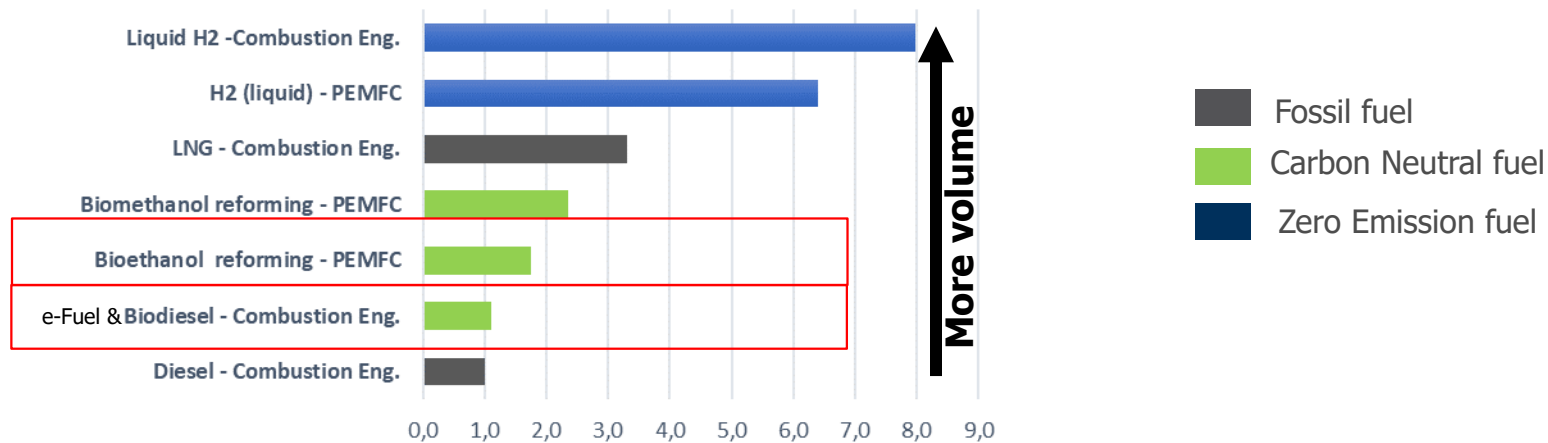


Optimum Naval Green fuel

ENERGY DENSITY REFERRED TO DIESEL



VOLUME RESERVE FOR INTEGRATION RELATED TO DIESEL-COMBUSTION ENGINE SOLUTION



Energy density of biofuel and e-fuel are similar, with values from 5% to 10% of diesel energy density. Regarding this data, increase of storage volume is limited to this value frame and we can conclude this should be best option for naval vessels greening purpose.

Biodiesel is a recycling fuel. So, difficult to be reformed. And e-fuel is under development. Therefore, none e-fuel reforming process could be developed yet.

So, among present existing fuels Bioethanol offers the best characteristics to feed naval fuel cells.

How using renewable fuels does affects vessel logistics?

	FUEL LOGISTICS (MID TERM)			FUEL STORAGE (MID TERM)			
	Availability	Ease of use	Cost	Safety	Complexity	Scaling	Technology Readiness
Diesel	▲	▲	▲	▲	▲	▲	▲
Biodiesel & e-Fuel	▲	▲	▲	▲	▲	▲	▲
Bioethanol	▲	▲	▲	▲	▲	▲	▲
Biomethanol	▼	▲	▼	▲	▲	▲	▲
LOHC	▼	▲	▼	▲	▲	▲	▲
CNG (200 bar)	▲	▲	▲	▬	▲	▬	▲
NH3 (from green H2)	▼	▲	▼	▬	▬	▲	▲
H2 (350 bar)	▬	▬	▬	▬	▲	▬	▬
LNG	▬	▬	▬	▼	▼	▼	▲
H2 (700 bar)	▼	▼	▬	▼	▼	▬	▼
H2 (liquid)	▼	▼	▼	▼	▼	▼	▼

The end user does expect an experience like managing conventional fossil fuels.

e-Fuel plant is simpler and safety than Hydrogen, ammonia, ethanol, methanol or LNG

The e-fuel cost is in the range of the diesel, around 1,2 €/l.

Bioethanol's cost and logistic are quite similar to diesel or e-fuel ones.

User expectative:

- **Fuel supply granted anytime, anywhere.** Quick refueling and easy procedures.
- **Competitive price.**
- **Highest safety standards,** conventional means for hazard prevention and suppression in case of accident.



Alternative fuels: regulation & safety

Based on Repsol and MTU premises, the alternative fuels developed within the collaboration will comply with Europe’s main fuel standards.

	Especificación Navantia	DMX DMA/DFA DMZ/DFZ DMB/DFB	HVO EN15940	E-fuels EN15940	Gasóleo lignocelulósico	Gasóleo lignocelulósico marino
Descripción muestra						
Disponibilidad			2023	2024	2026	2026
	Verano/Invierno		Clase A/Clase B	Clase A/Clase B		

- **Advanced biofuel (HVO)** produced at industrial scale in UE already complies with EN 15940. **GHG savings in more than 80%**
- **E-fuels** will comply with **EN 15940**, but will be made available before 2030.
- **New standards** could be created if required, according with marine regulation and engine necessities. Objective: reduce **retrofitting efforts** between: standards engine to biofuel engines, as well as biofuel engines to e-fuel engines.



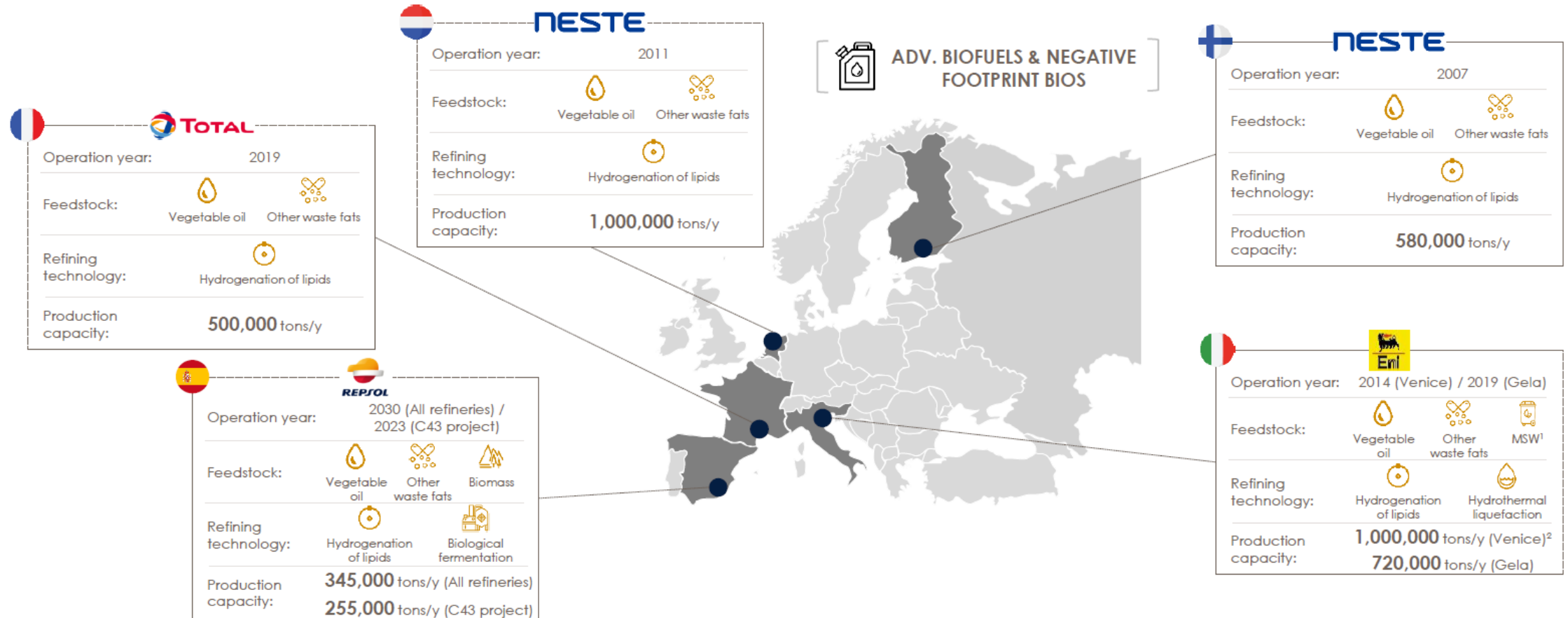
Why Biofuel/e-fuels?

A good tradeoff for innovation and GHG reduction

Biofuel/e-fuels propulsion solutions	H2 propulsion solutions
<ul style="list-style-type: none">✓ Smooth transition to GHG and Green Deal objectives.✓ 100% CO2 neutrality.✓ Well known technology (ICE) and similar propulsion solutions as fossil fuels.✓ RTL 4/5 – enough mature to be ready in 2/3 years.✓ Regulation of biofuels ready in Europe (EN 15940)✓ Same autonomy range than for diesel✓ Logistic and client experience advance and compromised:<ul style="list-style-type: none">▪ 2023 for HVO and Advance biofuels▪ 2025 for e-fuels	<ul style="list-style-type: none">x Technology RTL low for high power solutions and standard operationx Low autonomy in comparison with liquid fuels and biofuels. (x4 to x8 less autonomy or higher volumes)x No regulation for H2 consumption.x Safety and training to handle low flashpoint fuels like H2, cryogenic tanks or NH3 solutions.x Increase risk of production and maintenance. Low knowledge in asset life cycle.x Risk of explosionx No logistics in ports and limited H2 supplies. Bunkering problems.x Solutions not ready for 2026
<ul style="list-style-type: none">x Not zero emission. Neutrality.x Higher fuel production cost.	<ul style="list-style-type: none">✓ Zero emission✓ Highest efficiencies in fuel cells

Advanced biofuels plants in EU: most relevant operating plants

Multiple companies have already created a waste logistics to produce advanced biofuels at scale.



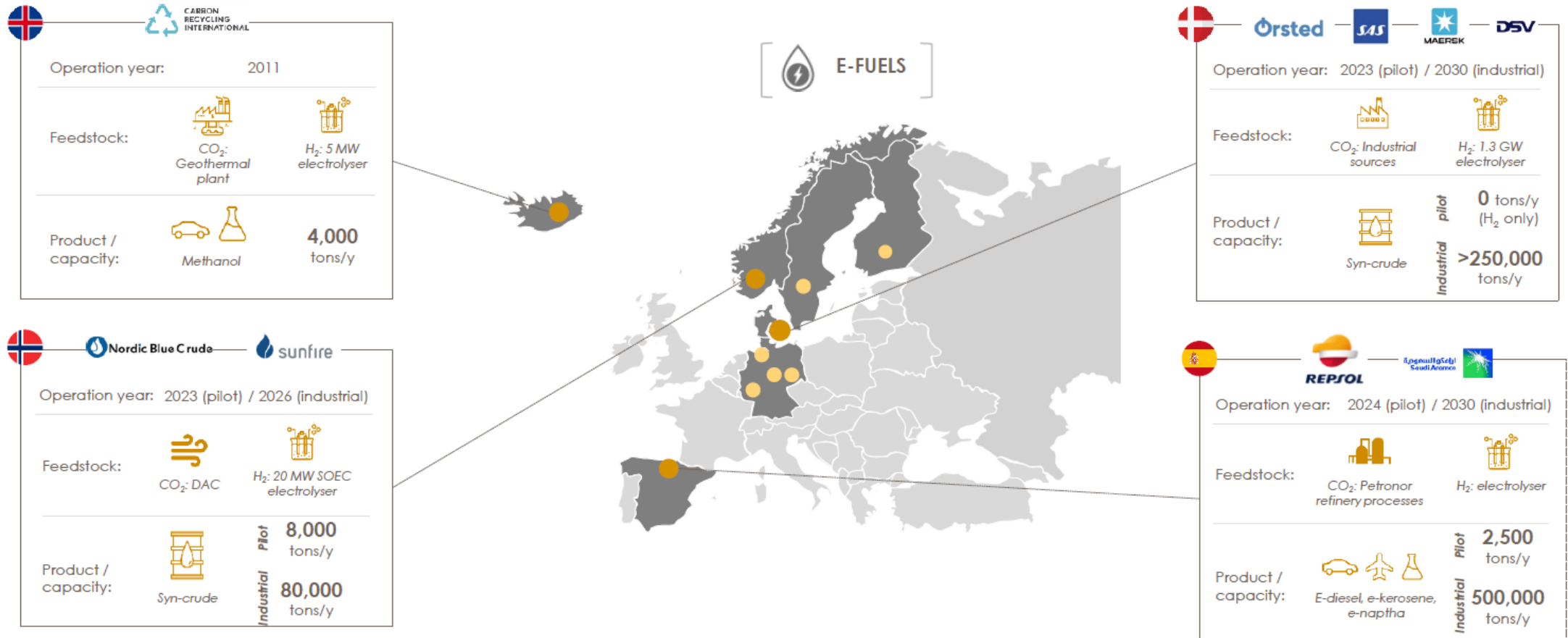
Advanced biofuels are a needed to comply with decarbonization targets in the short term and for the efficient management of waste

¹MSW: Municipal Solid Waste

²~400,000 tons/y in 2020 and 1,000,000 tons/y in 2021.

E-fuels plants in EU: operation and announced projects

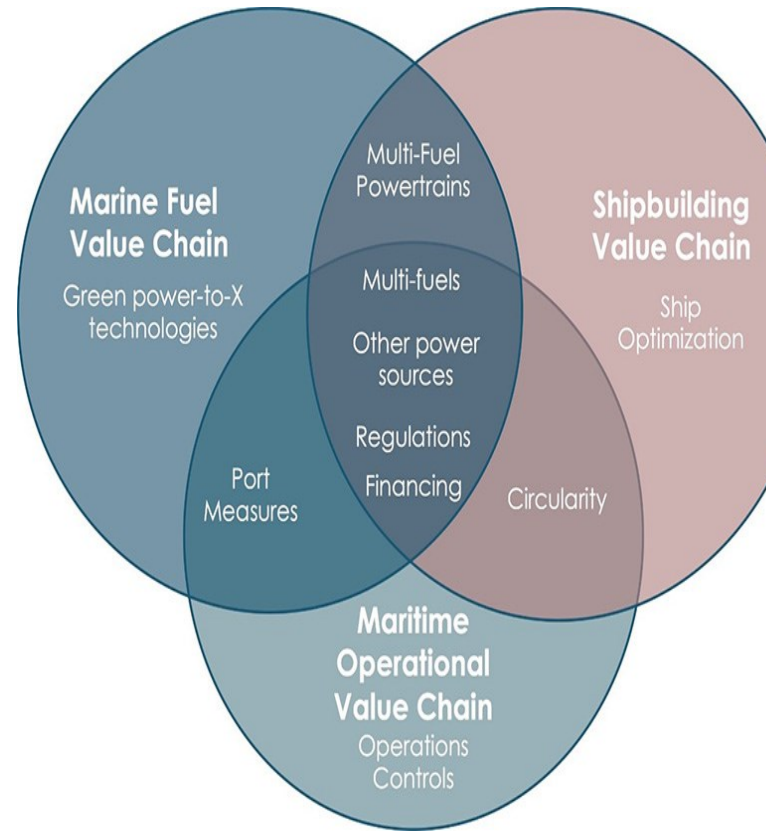
Production of e-fuels is already happening in Europe, including private initiatives as well as EU H2020 funded projects.



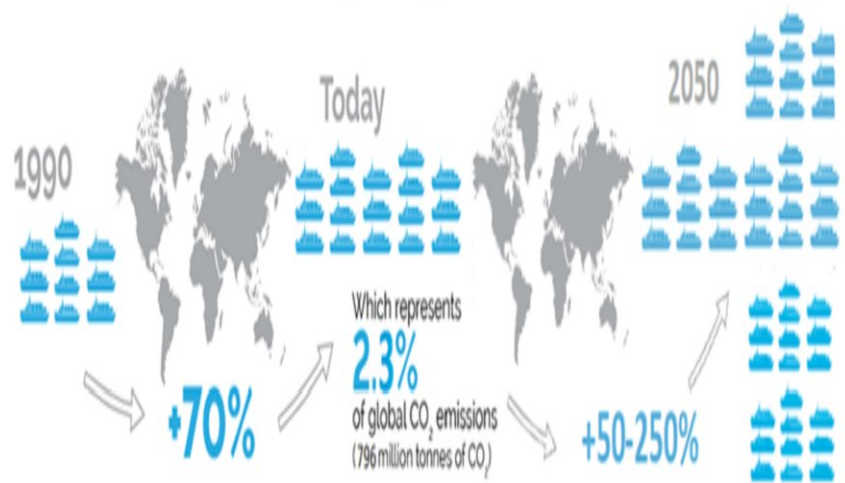
E-fuels promotion will play a relevant role in meeting transport decarbonization objectives

E-fuels plants in EU: operation and announced projects

#	Facility / operator	Year of operation	Country	CO ₂ source	H ₂ production	Product	Plant capacity	Partners
1	George Olah methanol plant	2011		Geothermal plant flue gas	5 MW electrolyser	Methanol	4,000 tons/y	
2	Soletair	2017		Direct Air Capture	PEM electrolyser	Synthetic crude	876 tons/y	SOLETAIR
3	Sunfire	2017		Direct Air Capture	100 kW SOEC electrolyser	Synthetic crude	3 tons in 1500 h	sunfire
4	MefCO ₂ project	2019		Coal power plant	600 kW PEM electrolyser	Methanol	365 tons/y	HYDROGENICS
5	FReSME project	2020		Steel plant	Steel plant + electrolyser	Methanol (marine fuel)	438 tons/y	ECN
6	Sunfire	2020		Direct Air Capture	20 MW SOEC electrolyser	Synthetic crude	8,000 tons/y	
7	Total	2021		Leuna refinery	1 MW SOEC electrolyser	Methanol	200 tons/y	
8	Repsol	2024		Petroror refinery	Electrolyser	E-diesel, e-kerosene and e-naphtha	50 boe/d	
9	ReWest 100 project (Heide refinery)	2020-25		Cement plant	Electrolyser	E-kerosene, hydrogen	-	
10	Greater Copenhagen Area project	2030		Industrial sources	1.3 GW electrolyser	Synthetic crude	250,000 tons/y	



International shipping emissions are the equivalent of Germany's and predicted to increase.



CO₂ comparison (if international shipping was a country):

- | | | |
|----|----|-----|
| 1. | 5. | 8. |
| 2. | 6. | 9. |
| 3. | 7. | 10. |
| 4. | | |



Source: Based on data from the [Third IMO GHG Study](#)

2050 decarbonization (1.5°C aligned) Emissions (million tonnes CO₂)

