AN OVERVIEW OF PORT DECARBONIZATION

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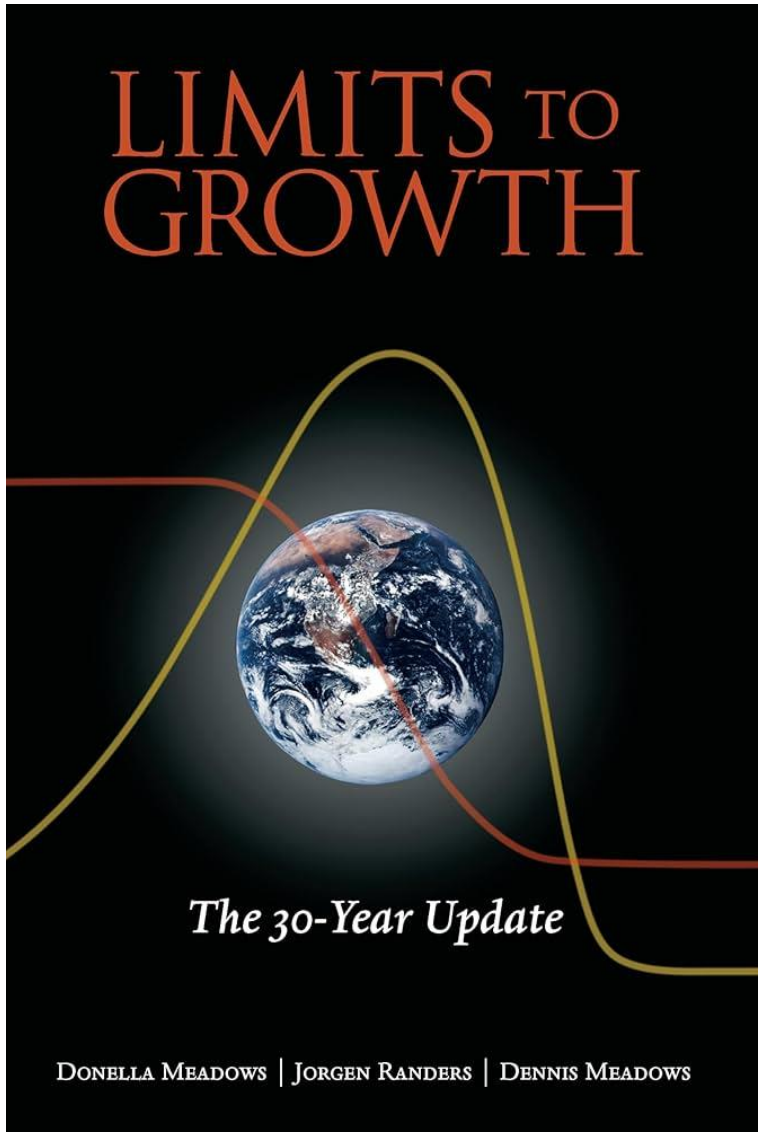
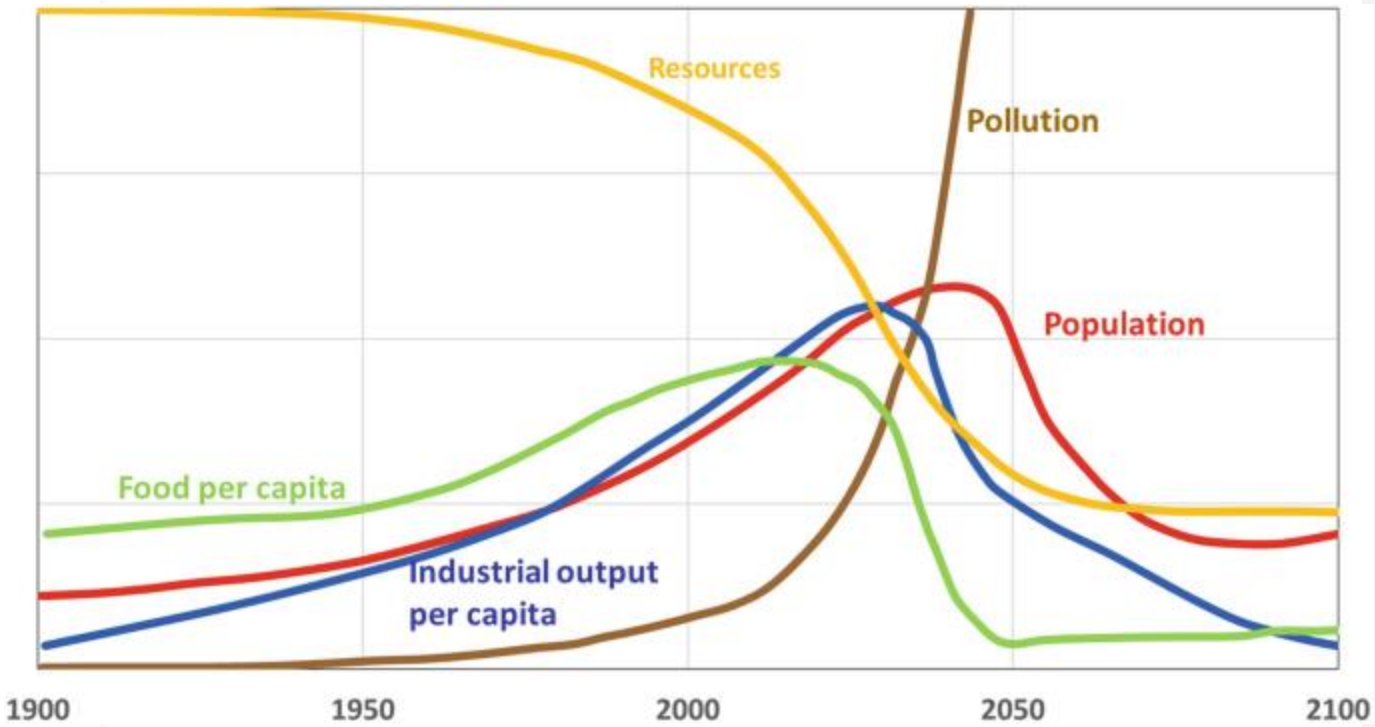
TAL TECH





Higgs, K. (2022). A Brief History of The Limits to Growth Debate. In: Williams, S.J., Taylor, R. (eds) Sustainability and the New Economics. Springer, Cham. https://doi.org/10.1007/978-3-030-78795-0_8

- https://www.ined.fr/en/everything_about_population/population-games/tomorrow-population
  https://studyofprogress.org/models/limits/

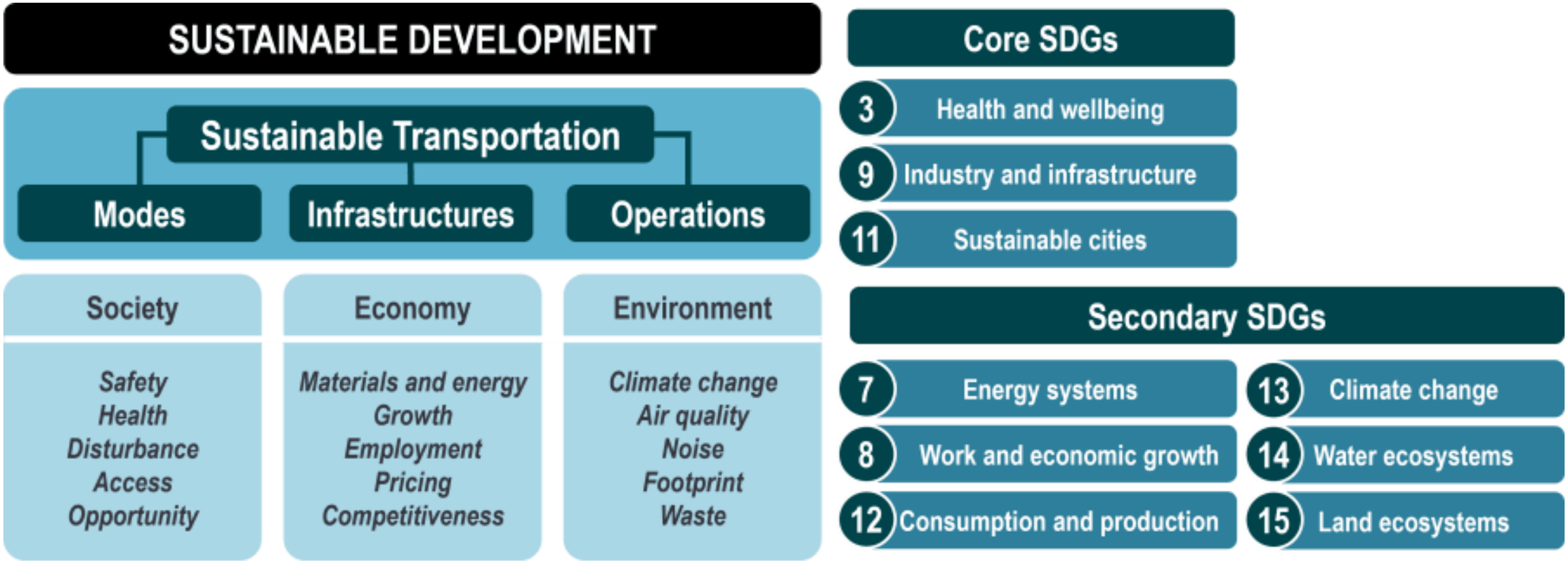
What does sustainable development stand for?

How we must live today if we want a better tomorrow, by meeting present needs without compromising the chances of future generations to meet their needs.


PEOPLE
Social variables dealing with community, education, equity, social resources, health, well-bring, and quality of life
BEARABLE
EQUITABLE
SUSTAINABLE
PLANET
Environmental variables relating to natural resources, water & air quality, energy conservation & land use
VIABLE
PROFIT
Ecomonic variables dealing with the bottom line & cash flow

How does sustainable development reflected in transport industry

- Rodrigue, (2025). The Geography of Transport Systems



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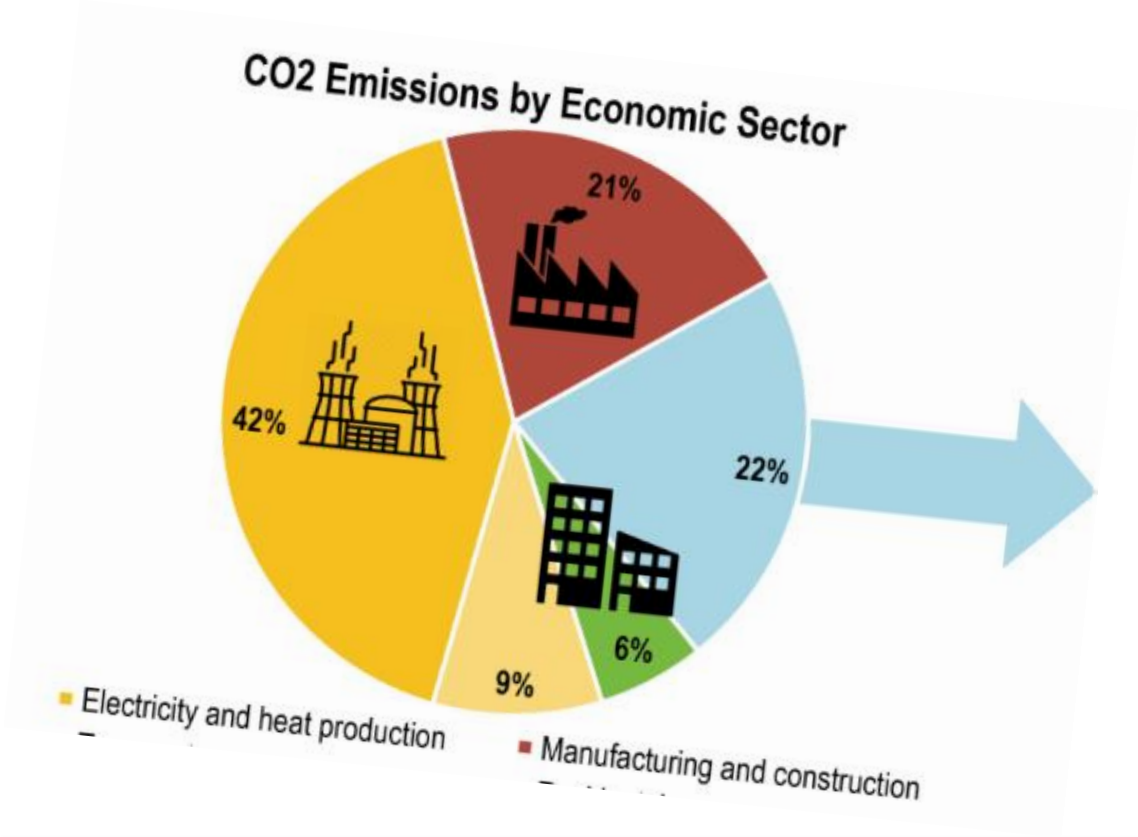
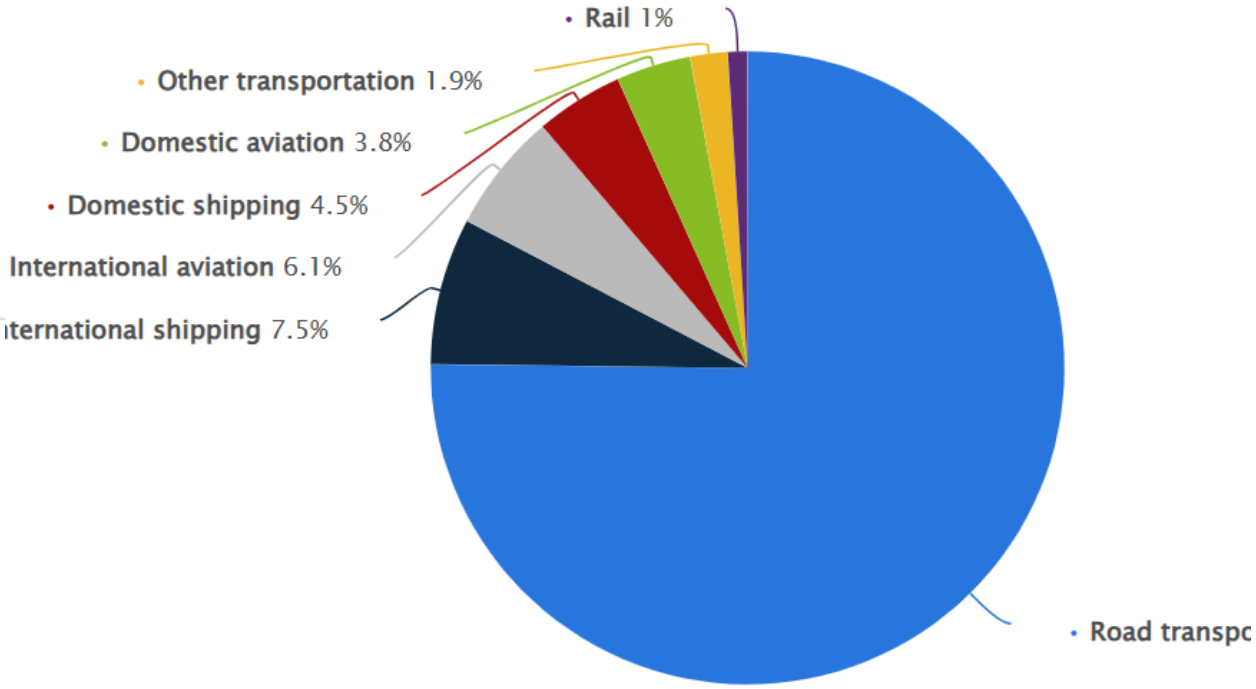
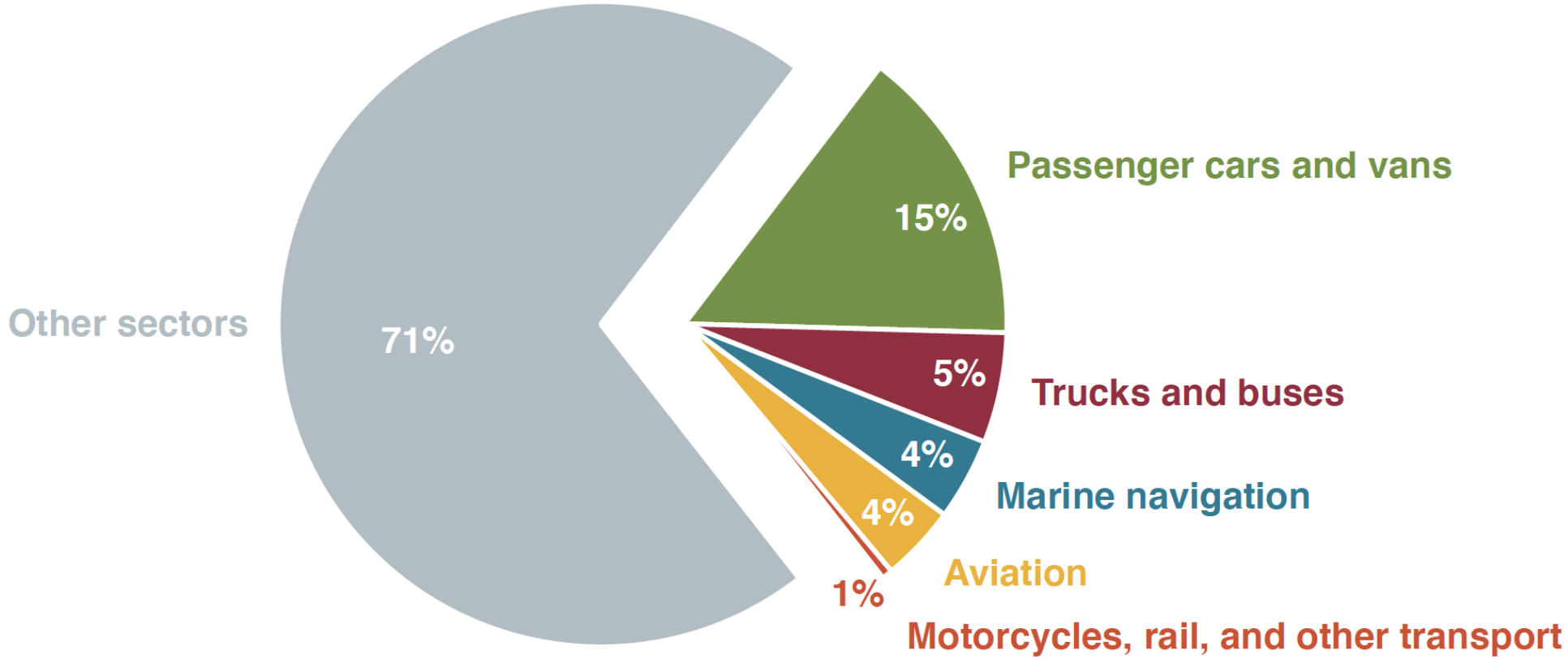




CO2 contirbution of Industries

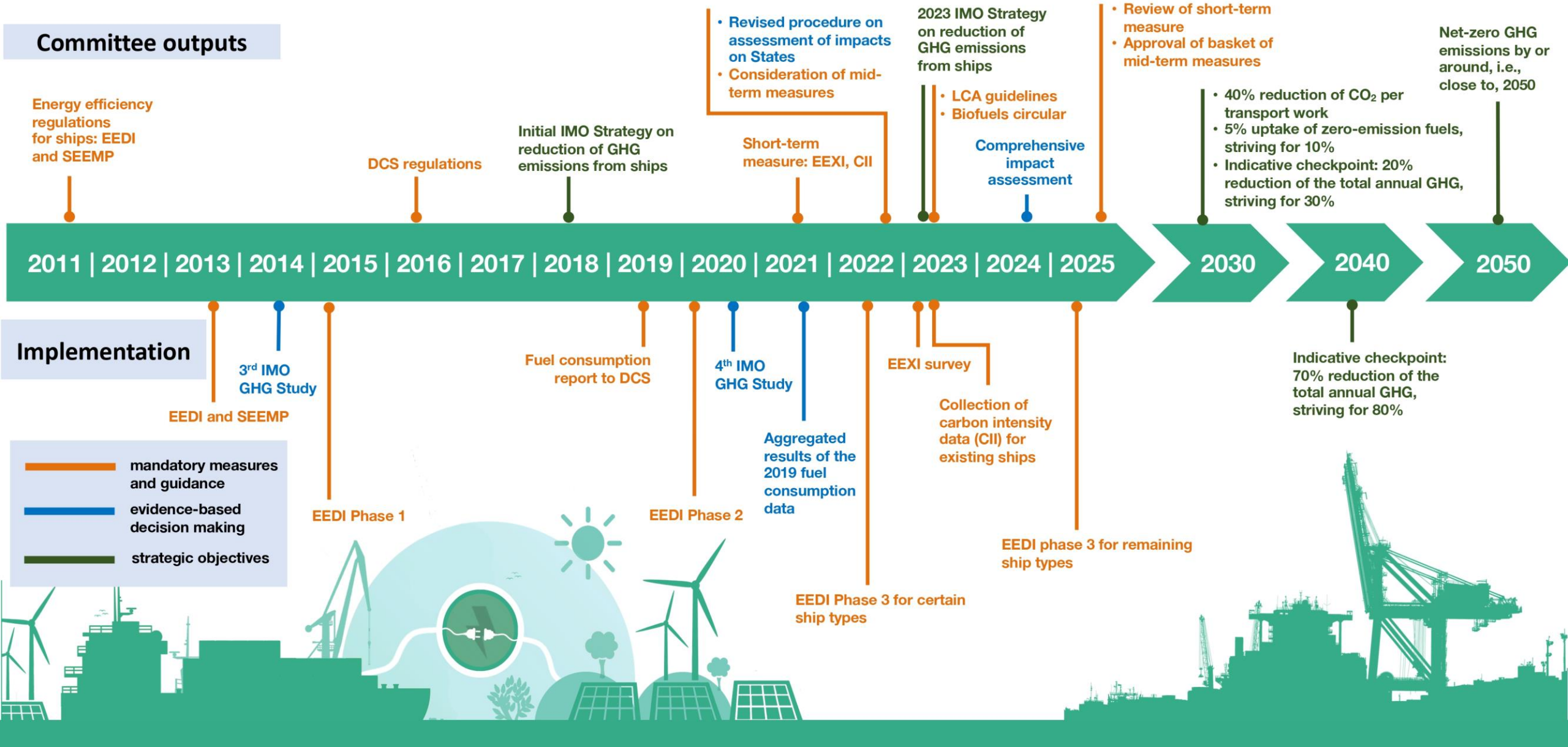
Greenhouse gas emissions in the EU

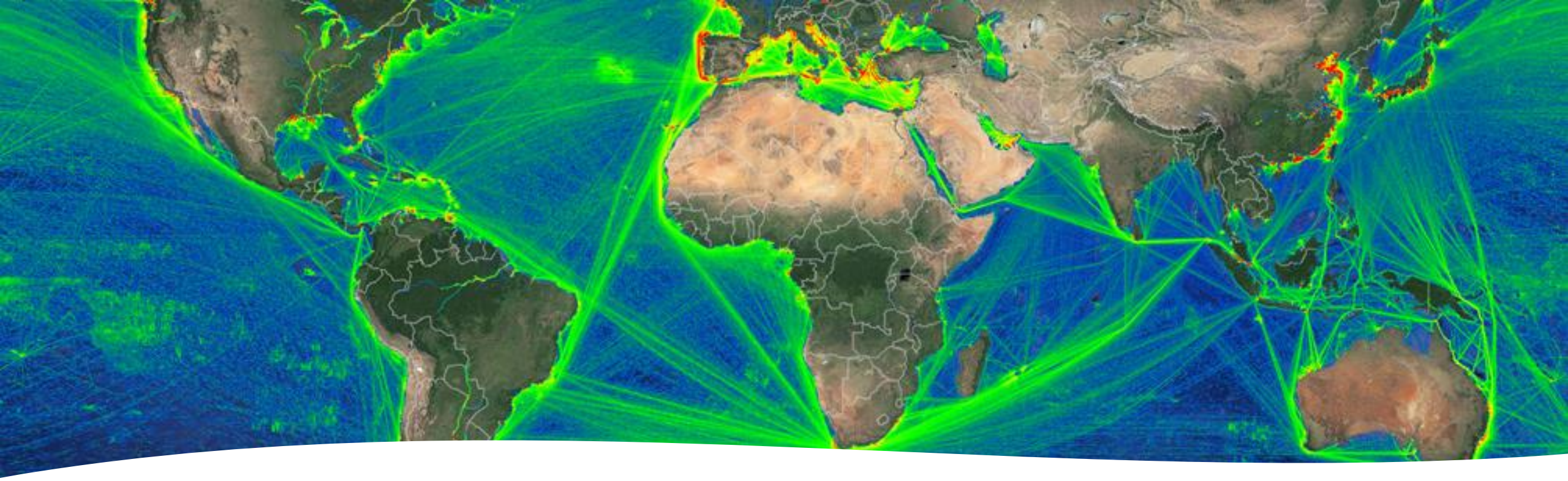
2018 total: 3.8 Gt CO_2e



Addressing climate change

Over a decade of **regulatory action** to cut GHG emissions from shipping





Why we are here?

Port as a critical nodes for climate action

marinetraffic.com (12.05.2025)

POTENTIAL CLIMATE CHANGE EVENTS AND IMPACTS

EXAMPLES OF EVENTS THAT CAN AFFECT PORTS:

1. sea level rise
2. storm surge
3. saltwater intrusion
4. strong winds
5. heavy rains
6. electrical storms
7. river flooding
8. extreme temperatures
9. sedimentation
10. drought
11. reduced river flows
12. coastal erosion

Such events can damage, deteriorate or destroy port infrastructure including, but not limited to, buildings.

These types of events can also hamper port access or cause accidents or disruptions that could limit port operations or result in higher costs.

The physical environment in the area around the port can also be altered by climate-related events.

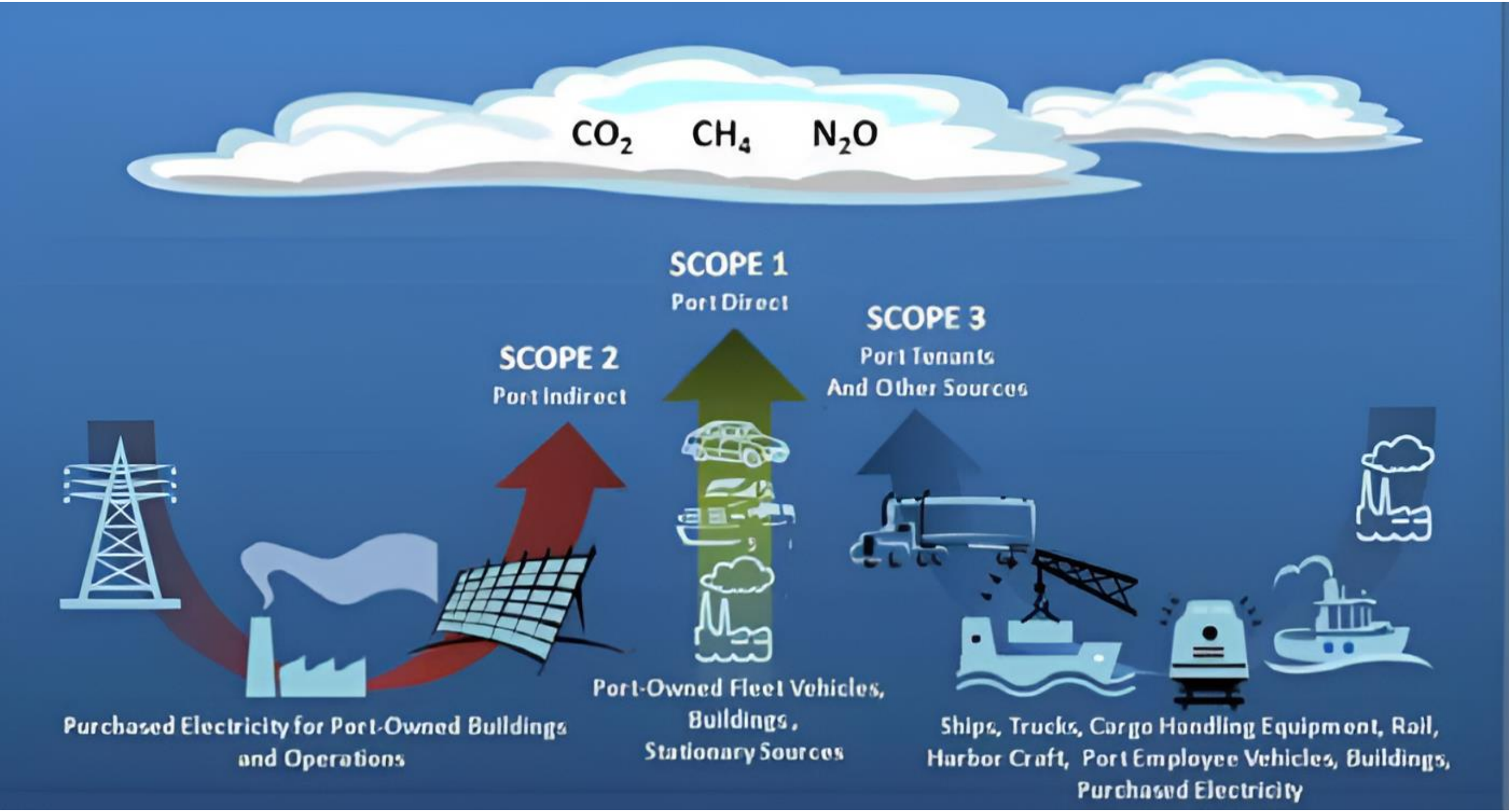
Socioeconomic impacts may include displacement of local populations or disruption of livelihoods.

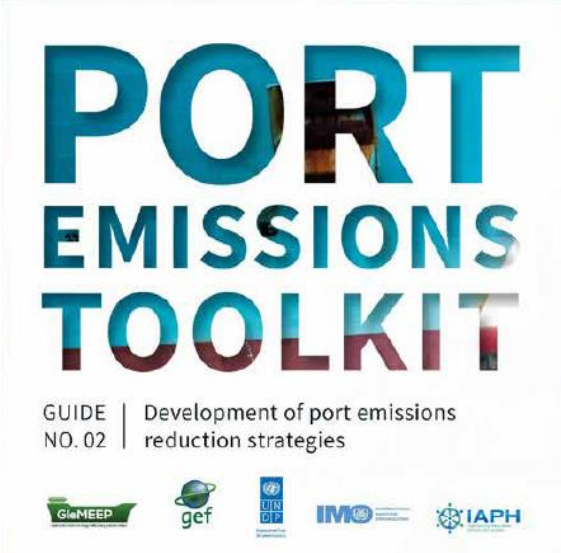
The natural habitat can also be affected, for example by changes in the distribution, growth and reproduction of species

Any and all of these impacts can result in higher costs and further affect other aspects of ports.

ELEMENTS	PORT INFRASTRUCTURE	PORT ACCESS	PORT OPERATIONS	PHYSICAL ENVIRONMENT	SOCIOECONOMIC FACTORS	NATURAL ENVIRONMENT	OTHERS
POTENTIAL AREAS OF IMPACT	• Breakwater • Quay • Yard • Goods storage area • Equipment • Buildings • Electrical infrastructure • Drainage infrastucture	• Roads/pavement • Railways • Inland waterways • Reduced navigation • Dredging requirements • Restrictions to vessel size	• Navigation conditions • Berthing and mooring • Loading and unloading activities • Cargo handling • Energy costs • More difficult working conditions	• Coastline • Estuary area/shoreline • River area/riverbanks	• Population (e.g. displacement) • Marine economic activity • Inland economic activity • Fisheries and related infrastructure	• Habitats • Protected habitats • Species (e.g. fish, birds) • Protected species	• Insurance cost or availability • Port reliability • Port reputation • Increased fire risk

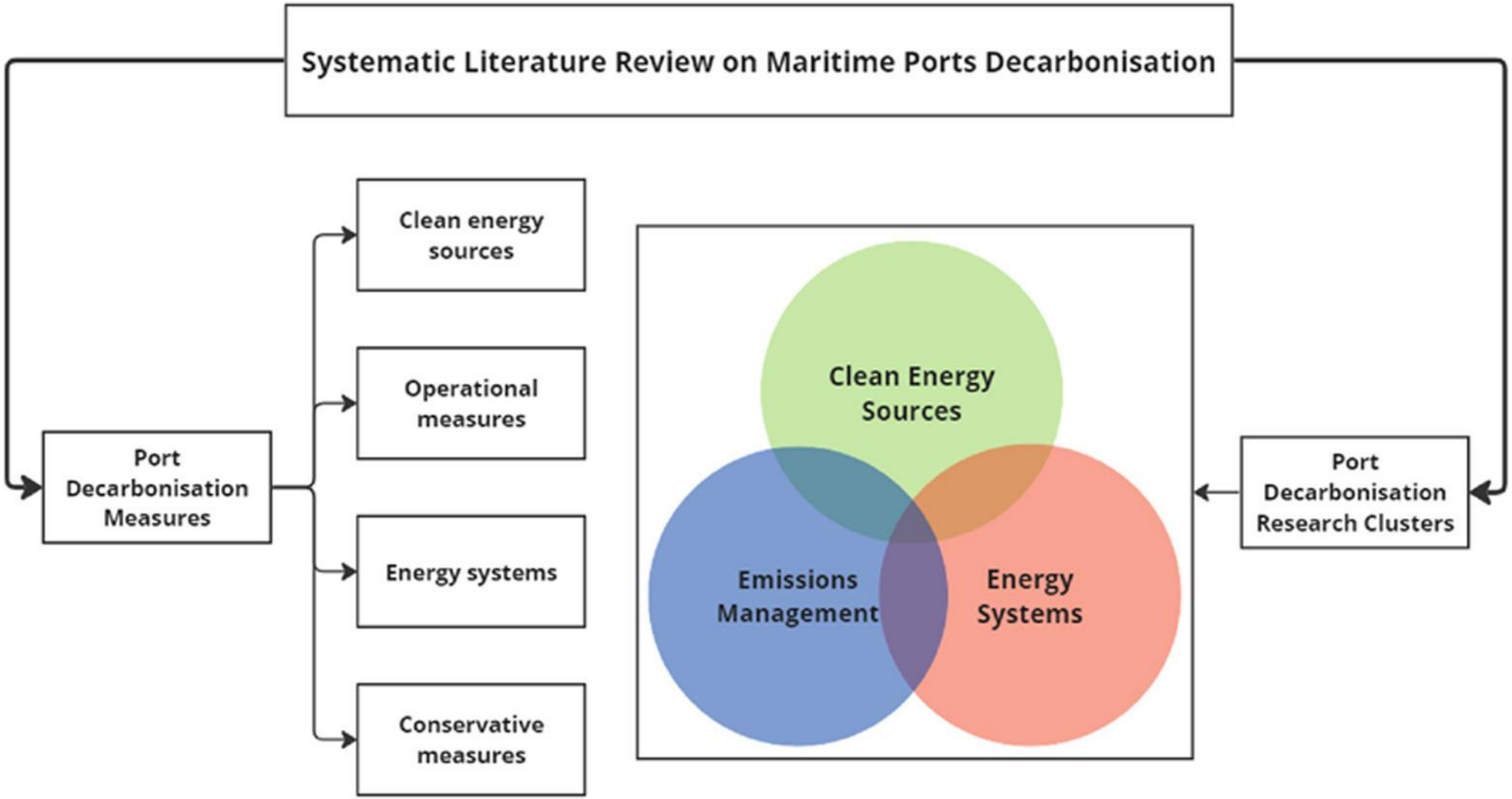
Why decarbonization matters?


CO_2 CH_4 N_2O
SCOPE 1
Port Direct
SCOPE 2
Port Indirect
SCOPE 3
Port Tenants
And Other Sources
Purchased Electricity for Port-Owned Buildings and Operations
Port-Owned Fleet Vehicles, Buildings, Stationary Sources
Ships, Trucks, Cargo Handling Equipment, Rail, Harbor Craft, Port Employee Vehicles, Buildings, Purchased Electricity



- Measures for Port Decarbonization

	Seagoing vessels	Domestic vessels, harbour craft, and inland waterway vessels	Cargo handling equipment	On -road trucks	Locomotives	Landside improvements
Equipment measures	Engine improvements (via)	Engine repower	Equipment replacing		Engine replacement	
	Emissions control technologies (ECTs)					
Energy measures	Cleaner fuels					
	Electrification/onshore power					
Operational measures	Vessel speed reduction (VSR)					Terminal efficiency improvements

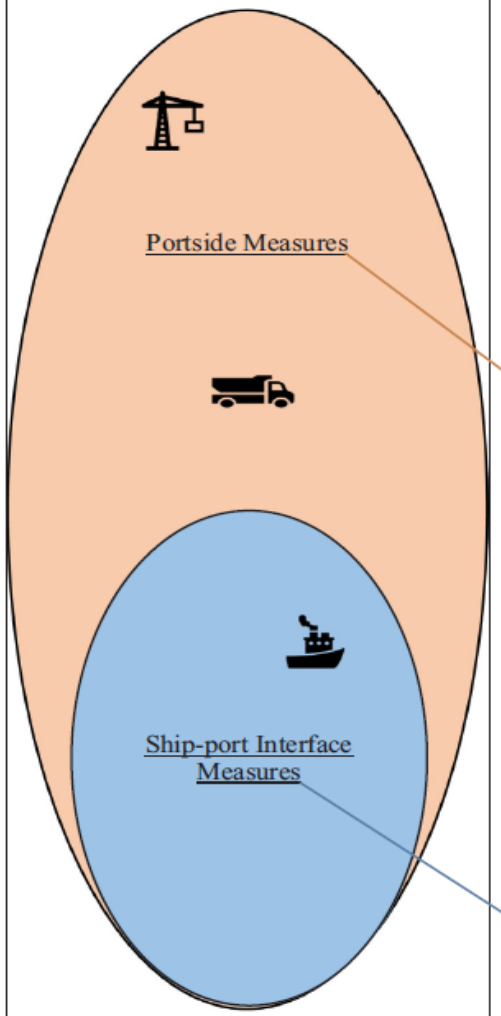


- Fadiga et al. 2024

Port GHG Emissions Reduction Strategy

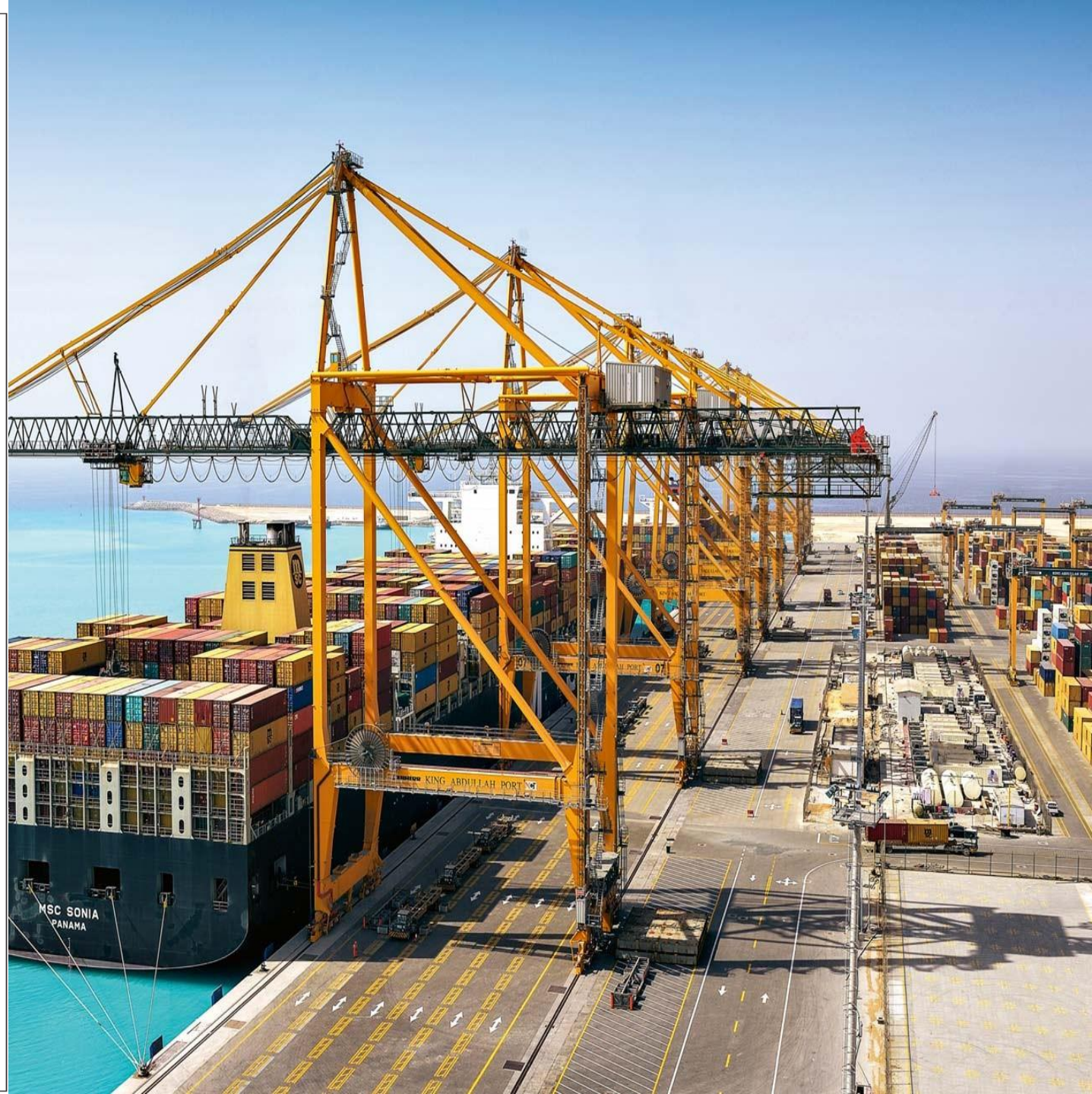
Implementation schemes (regulations, incentives, grants, concession contracts, voluntary agreements, etc.)

Technical and Operational Measures



1. Information Measures
(Inventory, Monitoring, Reporting)
2. Equipment Measures
3. Energy Measures
3.1. Alternative Fuels
3.2. Alternative Power Systems (Electrification, Hybridisation)
3.3. Renewable Energy Utilisation (Solar, Wind, Ocean, Geothermal)
4. Energy Efficiency Measures
4.1. Energy Saving Measures
4.2. Energy Management Systems and Technologies (Energy Management Plans, Energy Storage Systems, Smart Grid & Virtual Power Plants, Microgrids, Smart Load Management)
5. Operation Measures
5.1. Digitalisation
5.2. Container Terminal Automation and Operation System
5.3. Equipment Maintenance
5.4. Port City Integration
5.5. Port Green Policies
6. Land Transport Measures
6.1. Truck Emission Reduction
6.2. Modal Shift/ Split
6.3. Truck Congestion Reduction

7. Ship-port Interface Measures
7.1. Onshore Power Supply (OPS)
7.2. Alternative Fuels Bunkering
7.3. Ship Turnaround Time Reduction (Berth Allocation, Yard Allocation and Scheduling, Automated Mooring Systems, Mid-Stream Operations)
7.4. Virtual Arrival and Just-In-Time Berthing
7.5. Vessel Speed Reduction (VSR)
7.6. Miscellaneous Services



Port Equipment Measures

- Replacement
- Repowering
- Refitting

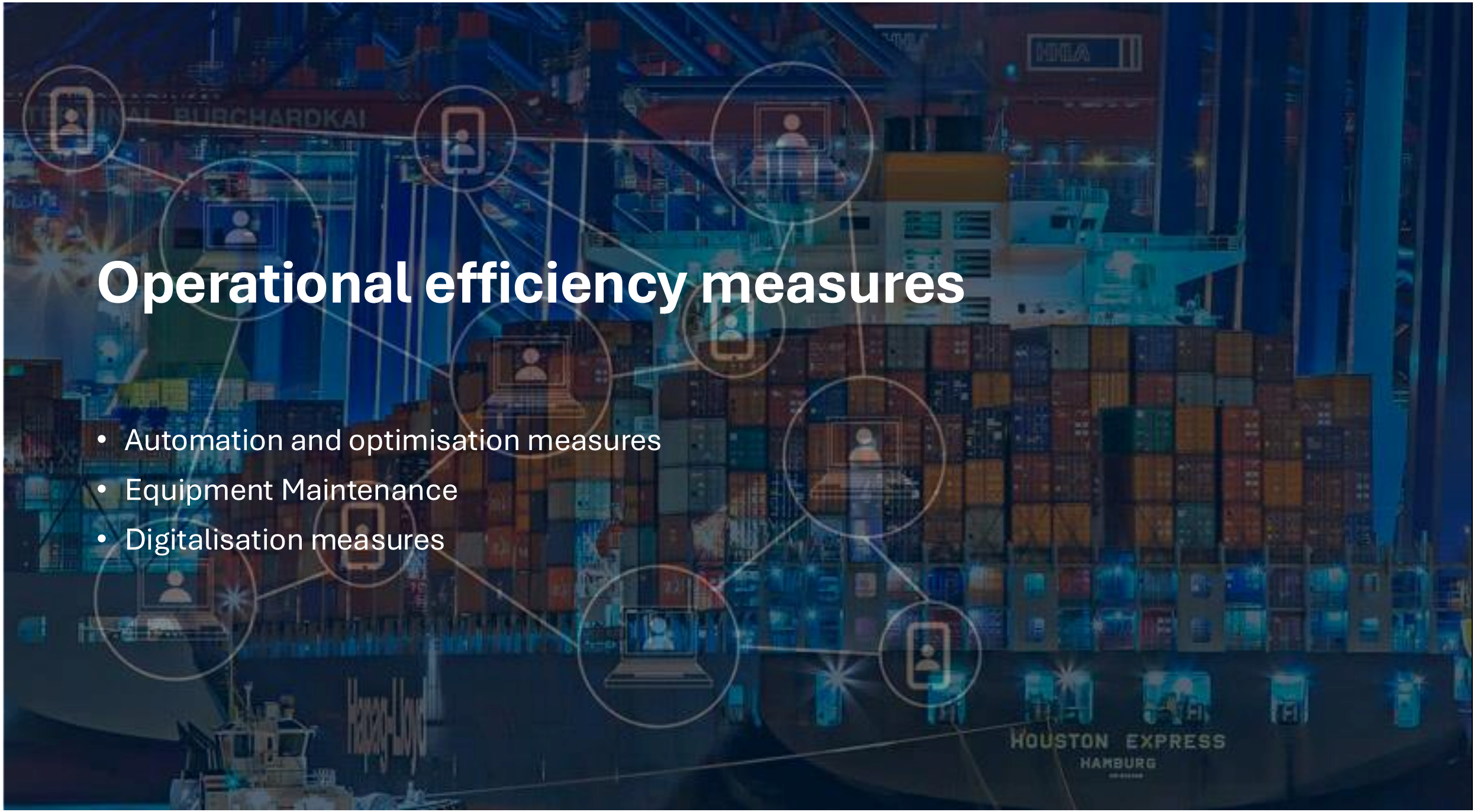
Alamoush et. al. 2024

Energy measures for port emission sources and energy consumers

- Alternative fuels
- Alternative power systems
- Renewable energy

Energy efficiency measures

- Energy saving measures
- Energy Management System and plans
- Energy management technologies

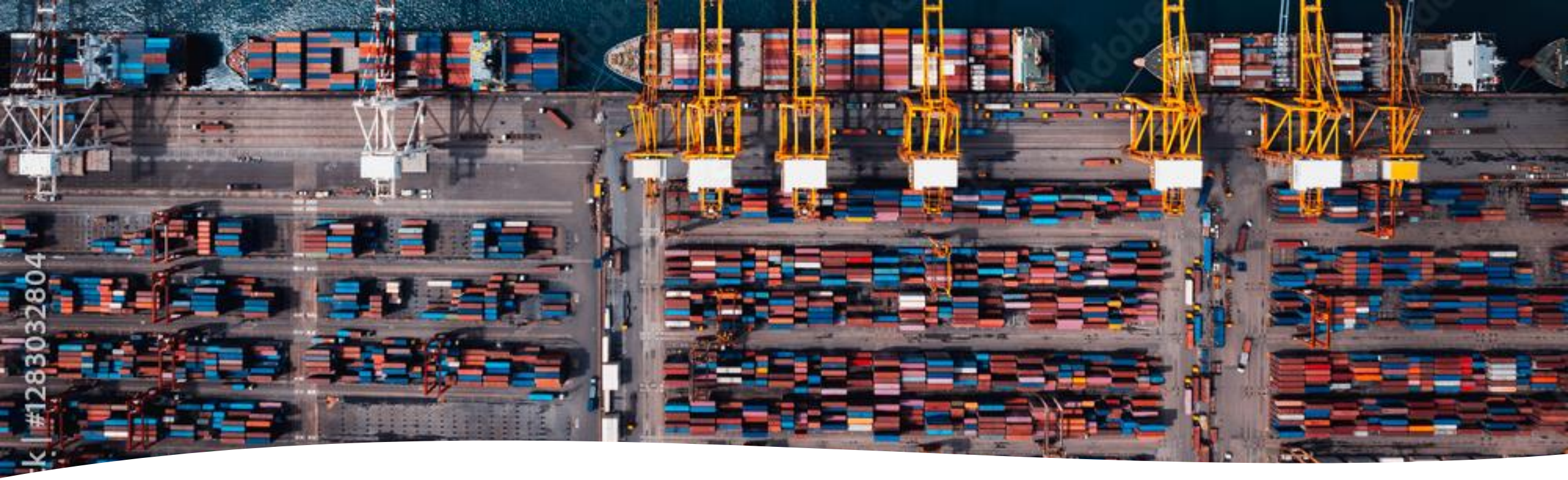


Operational efficiency measures

- Automation and optimisation measures
- Equipment Maintenance
- Digitalisation measures

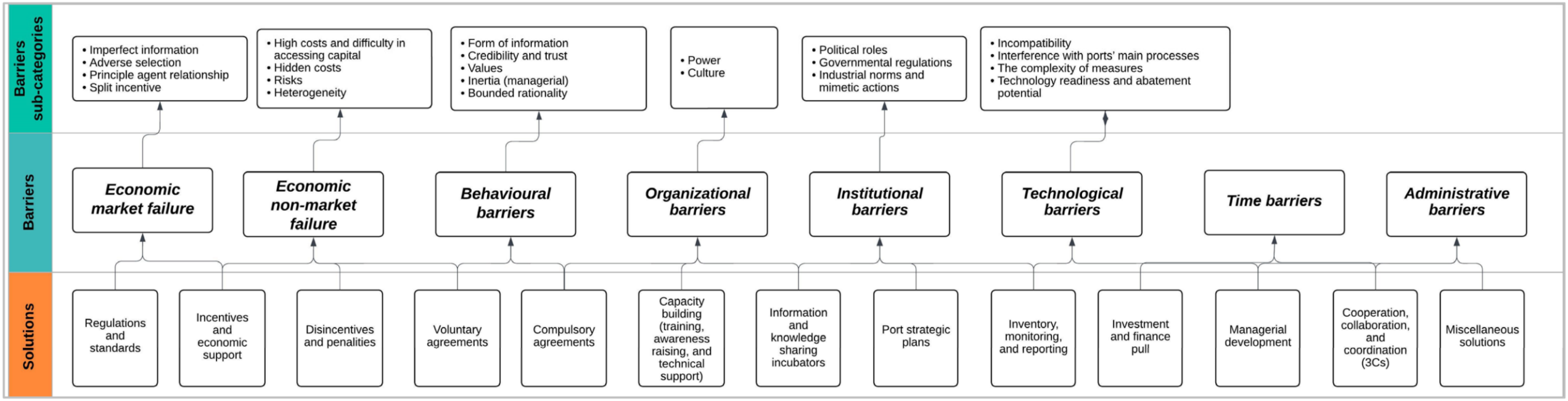
Land transport measures

- Truck emissioon reduction measures
- Modal shift/split measures
- Truck congestion reduction measures



Ship-Port Interface measures

- Ship-berth link emission reduction measures
- Alternative fuels bunkering measures
- Ship turnaround time reduction measures



Barriers and Solutions to Implementation of Port Measures

Alamoush et al. 2023

Interreg Co-funded by the European Union
Central Baltic Programme
Sustainable Flow

Sustainable Flow Facts and Figures

- Interreg Central Baltic Programme
  - **Priority 2 - Improved environment and resource use**
  - **Specific objective PO5 - Decreased CO2 emissions**

- Partners
  - Satakunta University of Applied Sciences FI (lead partner)
  - Swedish Maritime Administration SE
  - Åland University of Applied Sciences AX
  - International Transport Development Association LV
  - Tallinn University of Technology EE
  - Fintraffic VTS Ltd FI
  - Swedish Confederation of Transport Enterprises (Ports of Sweden) SE

1.5.2023–31.5.2026

Budget 3,421,725.64
(ERDF 2,737,380.49)

centralbaltic.eu/project/
sustainable-flow/

IN COOPERATION WITH

https://centralbaltic.eu/project/sustainable-flow/

https://centralbaltic.eu/project/sustainable-flow/

Tangible Results to Meet Real-World Needs

- Digital tool for CO2 emission calculations incl. decision-making tool
- Concept for energy savings and production of renewable energy
- Solar panels installed

→ *10% reduction of CO2 emissions*

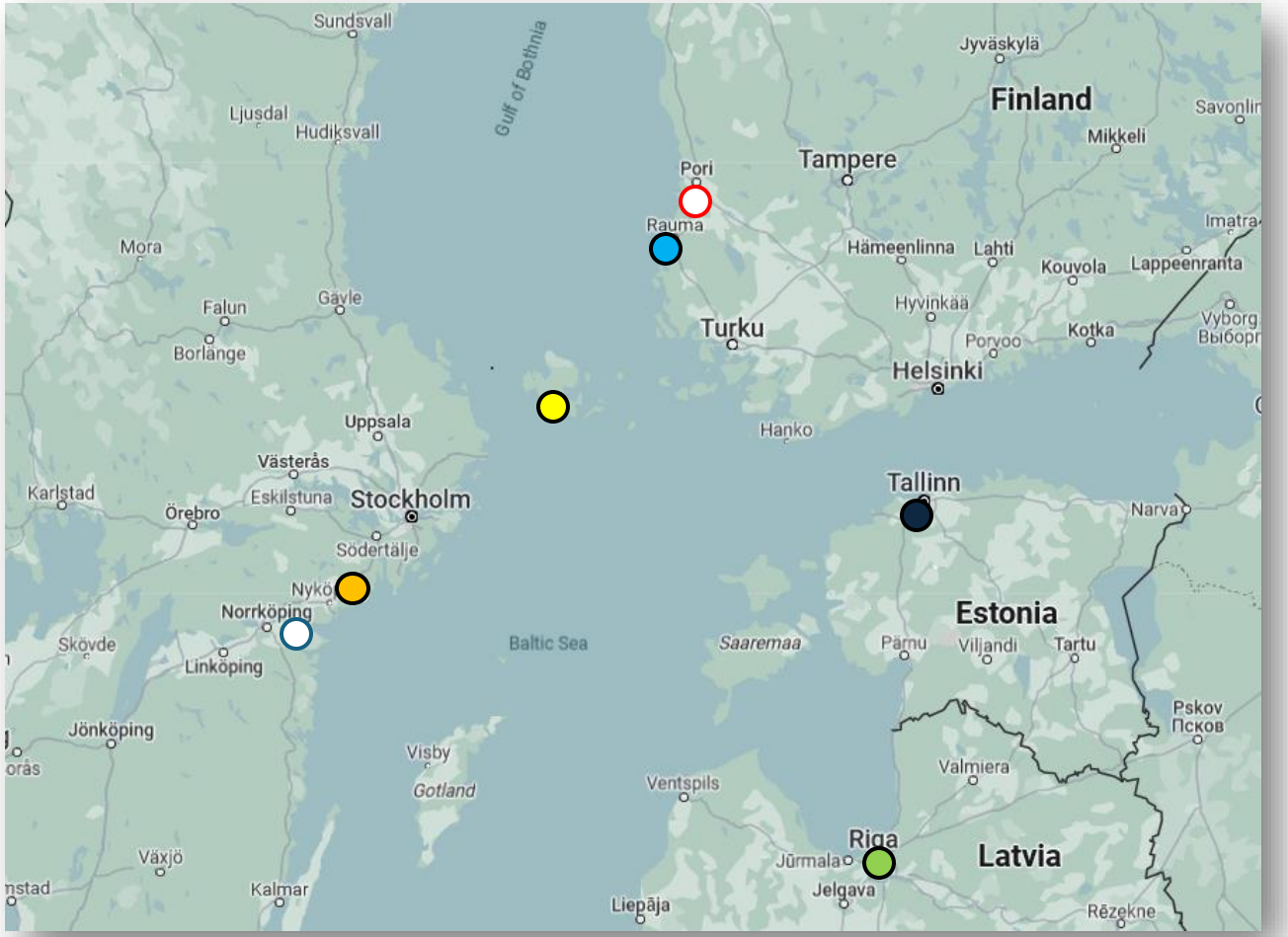
→ *Greener port operations as hubs of multimodal operations*

- Real-time CO_2 emission measurement
- Supports mapping and visualizing CO2 emissions
- High cybersecurity and data protection
- Developed based on port-specific needs
- Third parties (e.g. port operators) can report their emissions
- Supports reporting in accordance with the ESRS E1 in CSRD
- Open source

BY MAY **2026** **-10%** REDUCTION OF CO2 EMISSIONS IN **7** PILOT PORTS

Pilot Ports in Four CB Countries

- Rauma, FI
- Pori, FI
- Mariehamn, AX
- Norrköping, SE
- Oxelösund, SE
- Tallinn, EE
- Riga, LV



The Case of Port of Tallinn

Energy Efficiency and Renewable Energy

Target: 90% of energy consumption from renewables by 2030; climate neutrality by 2050.

73% of total energy consumption came from renewables.

100% renewable electricity purchases for own use since 2021.

Installation of solar panels at **Old City Harbour**, **Muuga Harbour**, and **Paldiski South Harbour**.

Cruise terminal heated/cooled with **seawater system**.

TS Laevad (ferry subsidiary) also shifted to 100% renewable electricity for fleet and offices.

Use of **Blueflow Energy Management System** on ferries to optimize fuel use.

LED lighting

CO_2 and temperature-controlled ventilation system

Automooring

Offshore power (5 quays; In use from 2021; Ships of the Finnish and Swedish route)

Efficient use of the port area

Shorter time spent to load and unload the vehicles to the ship

Efficient use of the vehicle check-in points

Less “useless” time for passenger to spend on the port area

Clear traffic management at the port

Reduced CO2 emission

Tools for the port personnel to run the daily operations

TAL TECH
ESTONIAN MARITIME ACADEMY

THANK YOU!

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