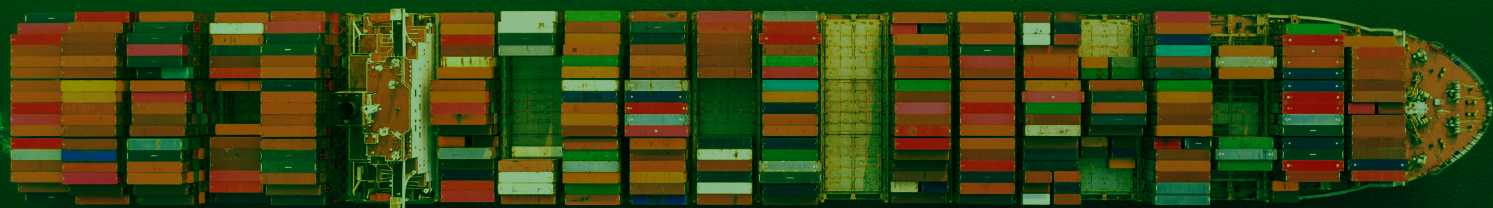


## MAIN CONCLUSIONS



## NAVIGATION



# TRANSPORT COALITION

HOW TO MAKE THE TRANSPORT SECTOR AN ACTIVE  
CONTRIBUTOR TO THE REDUCTION OF BRAZILIAN EMISSIONS



## CONTEXT AND MOTIVATION

- Brazil's New National Determined Contribution (NDC) and Climate Plan **represent opportunities to position the country as a global decarbonization leader**, especially as it is the host of COP 30 in 2025.
- The transport sector is critical, accounting for **~11% of national gross emissions (260 Mton in 2023, well-to-wheel vision<sup>1</sup>)**; **~1,6% of transport emissions come from the rail mode**.
- Given the expected growth for the country, in an inaction scenario, the emissions of the rail mode can **reach 5,5 Mton CO<sub>2</sub>e in 2050**.



## THE COALITION

- The magnitude of the challenge **requires widespread engagement and debate** by the transport sector.
- **Led by Motiva, CEBDS, CNT and Insper's Mobility Observatory**, the Coalition mobilized **+50 entities of 6 groups**: urban mobility, road, rail, coastal & inland navigation, airway and infrastructure/cross-sectionality.



## INITIAL OBJECTIVES

- The effort, started in Nov/2024, developed from the **active contribution of coalition entities and primary data** available until Feb/2025, materialized important deliveries, such as:
  1. Measurement of the emissions baseline in 2050<sup>2</sup>;
  2. Mapping of 90 decarbonization levers;
  3. Quantification of impacts for decarbonization path.

The conclusions of this study are the result of a collective effort in favor of sustainable decarbonization of the transport sector, based in the technologies and information currently available, and may evolve with new future advances.

1. Emissions from the transport sector calculated based on sources external to SEEG; 2. Baseline 2050 is a projection based on estimates of passenger and cargo growth and inertial vision of the fuel consumption matrix

# COASTAL & INLAND NAVIGATION – MEMBER ENTITIES

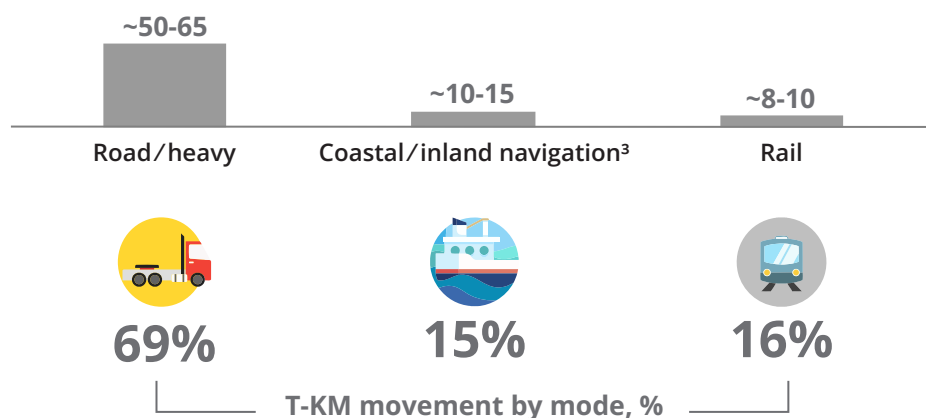
This document was supported by the following entities of the coastal & inland navigation transport mode.



## COMPARISON OF THE EMISSION LEVEL BY FREIGHT MODE IN 2022<sup>1</sup>

(CO<sub>2</sub>/T-KM)

The coastal & inland navigation mode has a less polluting nature compared to road mode (emits about 5x less CO<sub>2</sub>e per T-KM). Currently, it **represents ~15% of the national cargo movements and emits ~1,8%<sup>2</sup> of the CO<sub>2</sub>e volume of transport sector**, which reinforces its emission efficiency.



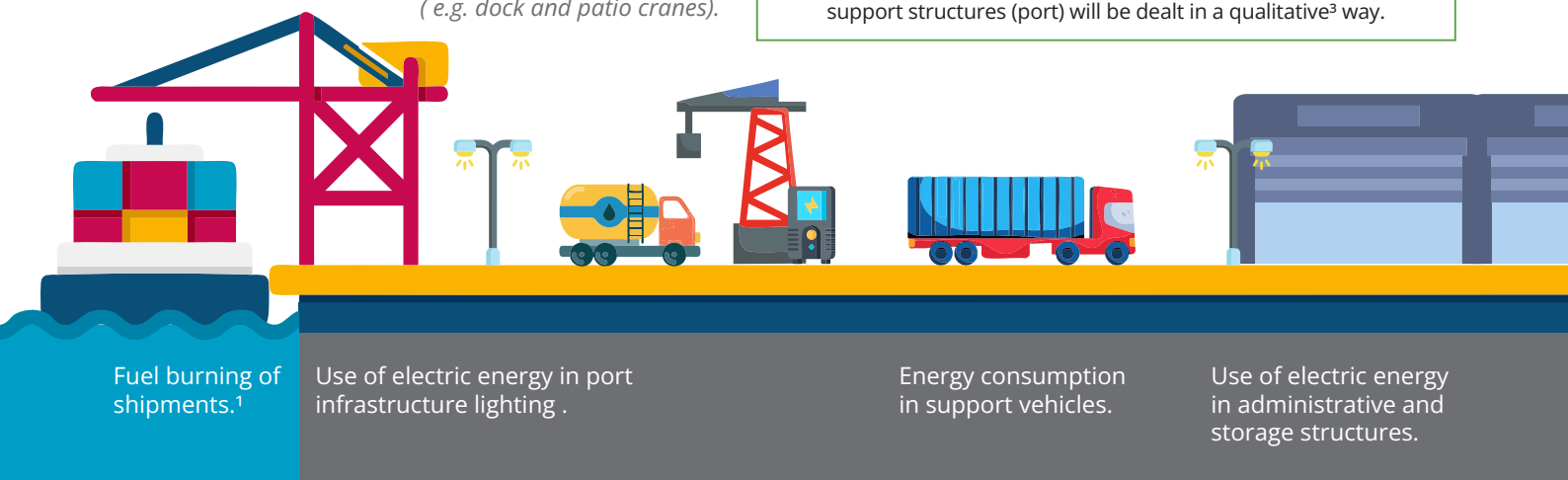
**More efficient and more rebalanced transport matrix**, which exploits the potential of each mode in an integrated way, is essential for the country's socioeconomic development

1. Calculated based on data from ANTF and SEEG 2022; 2. Considers well-to-wheel adjustments (WTW), even for values performed (2023); 3. Coastal, Interior Interstate and State; Source: PNL 2035, ANTF, ANTT, SEEG

## THE NAVIGATION EMISSIONS COME FROM TRANSPORT, WITH LESS IMPACT FROM INFRASTRUCTURE

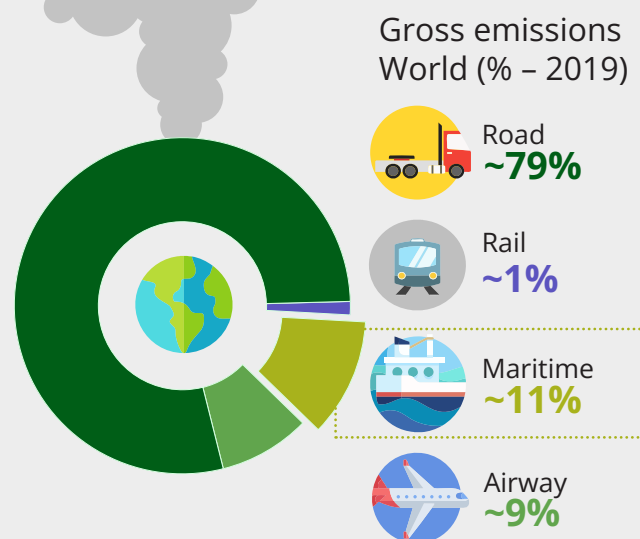
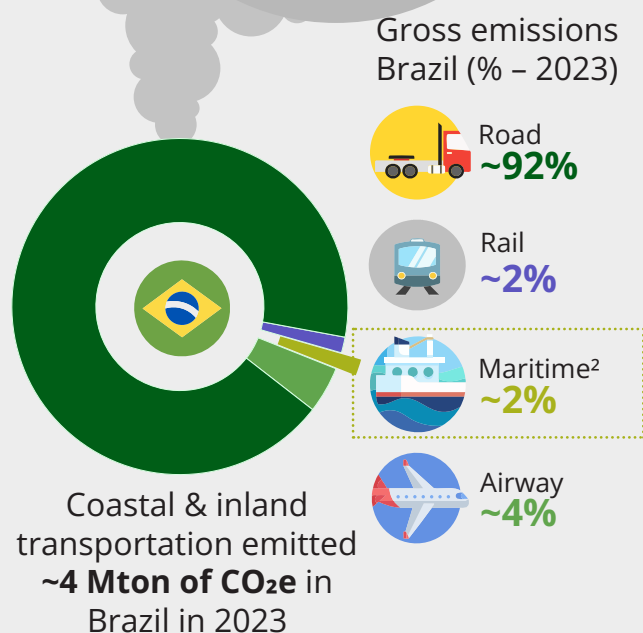
Energy consumption in support machinery (e.g. dock and patio cranes).

**Most of the emissions from the coastal & inland navigation sector come from the burning of fuel by the vessels.** Therefore, quantitative<sup>2</sup> study will focus on this category, and emissions of support structures (port) will be dealt in a qualitative<sup>3</sup> way.



1. Port and maritime transport and support vessels; 2. The application of the levers considered the diversity of the sector, covering different types of vessels and companies, taking into account their different realities in terms of size, resources and absorption capacity of the levers identified; 3. Overall, port emissions represent < 5% of total emissions from the coastal/interior navigation and maritime sectors. Source: PNL 2035, ANTF, ANTT, SEEG, OECD

# EMISSIONS<sup>1</sup> OF COASTAL & INLAND NAVIGATION ARE ~1.8% OF THE TOTAL FROM TRANSPORT IN BRAZIL

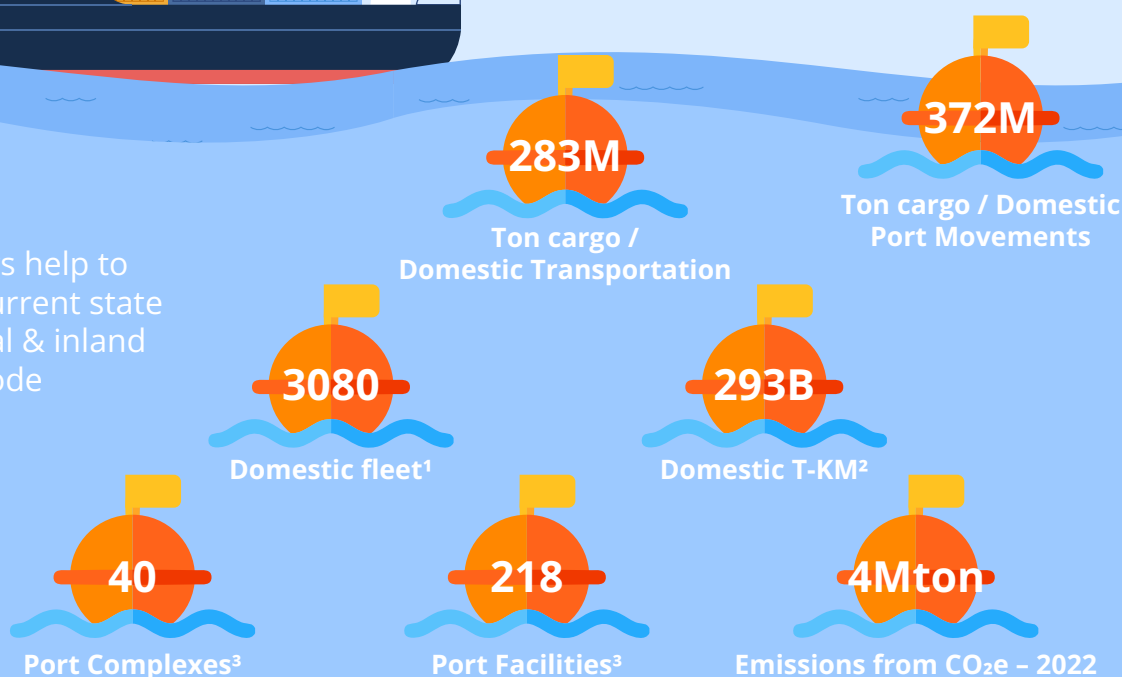


1. Transport emissions reported by SEEG are restricted to burning fuels; 2. Considers coastal and inland navigation, without long haul; 3. Global value excluding Brazil; Source: Anfavea; SEEG; CAIT; CLIMATE TRACE

## CURRENT OVERVIEW

Relevant indicators help to understand the current state of the 2023 coastal & inland transportation mode

2023

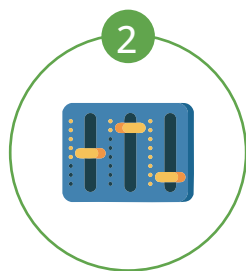


1. It does not consider support ferries, barges and passenger vessels ; 2.Coastal, Interior Interstate and State; 3. Indicated in the ANTAQ coastal & inland navigation Statistics with unique ID

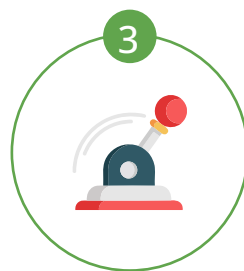
# APPROACH | FOUR STEPS FOR DECARBONIZATION OF THE COASTAL & INLAND NAVIGATION MODE



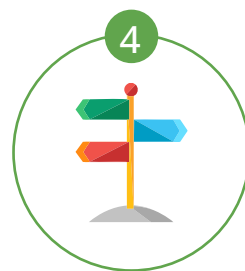
Definition of projections for the total emissions of the sector, **WITHOUT** changes in the participation of different modes in the transport matrix;



Definition of projections for the total emissions of the sector, **WITH** changes in the participation of the different modes in the transport matrix;



Mapping levers for **reducing emissions applicable to transport mode;**



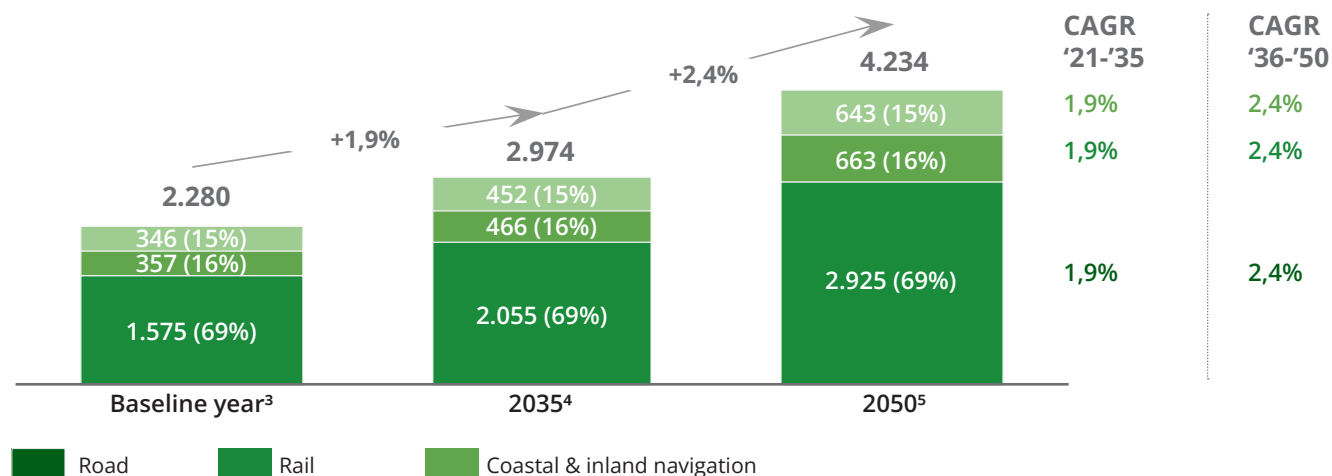
Proposition of **possible sensitivities based on mapped levers.**

## 1 DEFINITION OF BAU<sup>1</sup> EMISSIONS WITHOUT CHANGES IN THE TRANSPORT MATRIX

In an inaction scenario, the total transport emissions would reach **~424 Mton CO<sub>2</sub>e in 2050**; in this context, the representativeness of the transport mode in the national transport matrix would remain unchanged (coastal & inland navigation would remain ~15%).

## EVOLUTION OF THE CARGO<sup>1</sup> MATRIX

Inaction scenario (billions of T-KM, %)



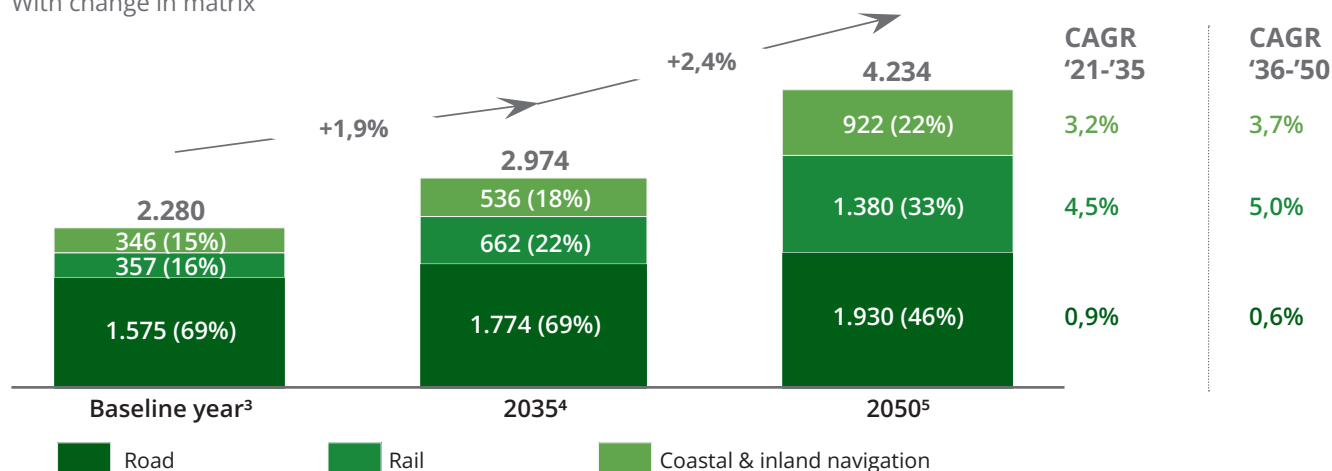
1. Road Transport Sector Plan (PSTR); Rail Transport Sector Plan (PSTF); 2. PNL 2035 – National Logistics Plan; 3. Baseline Year = 2021, with PNL being projected to the respective CAGRs of the Reference Scenario versus 2017; 4. 2035 T-KM values refer to scenario PSR1 of the PSTR and PAX come from the referential scenario of the passenger matrix of PNL 2035; 5. T-KM projected according to GDP with share of scenario PSR3 of the PSTR and PAX projected according to population growth without share changes; 6. The airway mode is not representative in transported versus total cargo; 7. Passengers reported in the PNL only contemplates intermunicipal and interstate routes, and do not consider passengers inside the urban centers. Sources: Infra S.A; Ministry of Transport; Ministry of Infrastructure.

## 2 DEFINITION OF BAU<sup>1</sup> EMISSIONS WITH CHANGES IN THE PARTICIPATION OF MODES OF TRANSPORT

In the second stage, an alternative scenario was explored in which the share of the coastal & inland navigation in the transport matrix could be expanded, which would already be able to generate impacts of emission reduction due to the lower relative emission factor (gCO<sub>2</sub>/T-KM) in this mode vs other more emitters.

### EVOLUTION OF THE CARGAS<sup>1</sup> MATRIX

With change in matrix

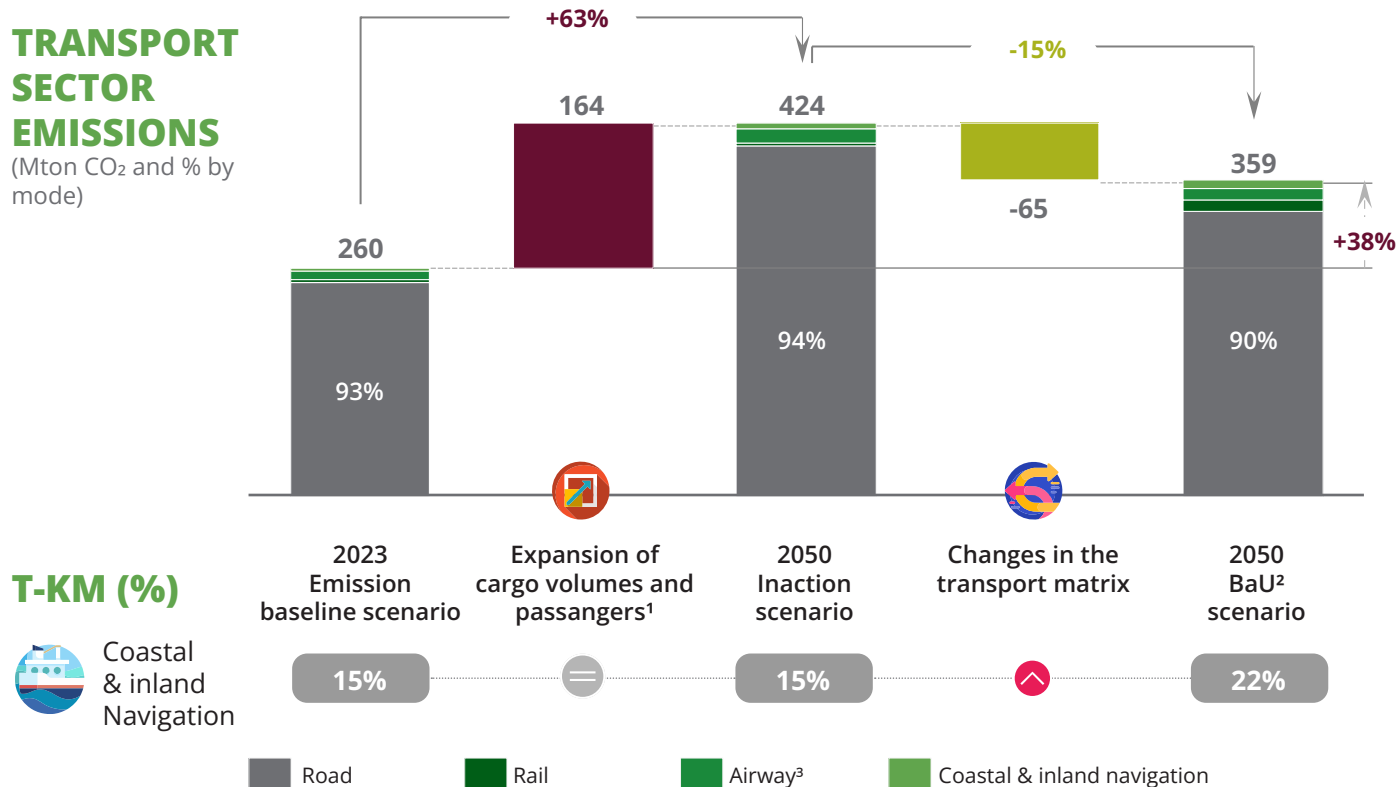


1. Road Transport Sector Plans (PSTR); Rail Transport Sector Plan (PSTF); 2. PNL 2035 – National Logistics Plan; 3. Baseline Year = 2021, with PNL being projected to the respective CAGRs of the Reference Scenario versus 2017; 4. 2035 T-KM values refer to scenario PSR1 of the PSTR and PAX come from the referential scenario of the passenger matrix of PNL 2035; 5. T-KM projected according to GDP with share of scenario PSR3 of the PSTR and PAX projected according to population growth without share changes; 6. The airway mode is not representative in transported versus total cargo; 7. Passengers reported in the PNL only contemplates intermunicipal and interstate routes, and do not consider passengers inside the urban centers. Sources: Infra S.A.; Ministry of Transport; Ministry of Infrastructure.

In summary, the balance in the Brazilian transport matrix would mitigate about 15% (considering the change of matrix foreseen in the rail and coastal & inland navigation modes) of the expected volume of CO<sub>2</sub> emissions by 2050:

### TRANSPORT SECTOR EMISSIONS

(Mton CO<sub>2</sub> and % by mode)



1. Increased emissions due to expected growth in demand for T-KM and passengers by 2050; 2. Business-as-usual; 3. Airway mode emissions are not related to cargo transport, only to passenger transport.

# 3 LEVER MAPPING FOR EMISSION REDUCTION

After the presentation of the transport matrix, levers with potential to reduce emissions in the coastal & inland navigation mode were identified by the working group.

Such levers were mapped into three large blocks as described below. For each of them, a qualitative feasibility analysis<sup>1</sup> was performed and local and global references were presented that illustrate the respective application.

1. The complete details of the viabilities and references can be found in the complete document of the coastal & inland navigation mode, which can be accessed via QR Code at the end of material.

## LEVER BLOCKS FOR REDUCING EMISSIONS

in navigation mode



**EFFICIENCY**



**BIOFUELS**



**ELECTRIFICATION AND POWER-TO-X**



## EFFICIENCY

### Levers – Vessels

- 1 Adoption of **innovative materials and technologies** in the construction and operation of vessels to **improve the design and hydrodynamic performance**.
- 2 **Intelligent route optimization and fleet allocation**, reducing average distance traveled.
- 3 **Reduce and control of the average speed of vessels** to reduce fuel consumption and optimize energy efficiency.
- 4 Use other **technical solutions to support emission reduction**, such as waste heat recovery, liquid cooling system, among others.
- 5 Integrate **electric candle propulsion technologies (WAPs)** to complement traditional motorization.
- 6 **Increase in the size of vessels and/or compositions**, decreasing the number of trips required.
- 7 **Maximize the ability to use journeys** (Stowage Factor), reducing the number of trips and **improving the fleet utilization**.

Source: EPE; IMO; Trafigura ; Transpetro (RI)

### Levers – Port Infrastructure (1/2)

- 1 **Enabling infrastructure and facilitating access, reducing the average waiting and docking time** given the construction of more terminals/cribs or larger terminals/cribs.
- 2 Implementation of **trade facilitation measures, reducing the time that cargo stay** in ports.
- 3 Construction and supply of **OPS (on-shore power supply) structures to shipments<sup>1</sup>**.
- 4 **Optimization of vessel docking management** through the use of data intelligence tools

1. OPS = Ground power supply that allows the auxiliary engines of the vessels to be switched off while they are docked. Source: Maersk; EPA; Website Ports; ANTAQ; MPor.

## Levers – Port Infrastructure (2/2)

- 5 Implementation of **optimization strategies for support systems**, such as automated lighting and water and waste management.
- 6 **Renewal of the support fleet (vehicles and machinery) by newer and more efficient models** in terms of energy consumption.

Fonte: Maersk; EPA; Website Portos; ANTAQ; MPor



## BIOFUELS

### Levers – Vessels

- 1 **Intensification of the use of biodiesel (FAME)** as an alternative to fossil diesel or bunker or as a mixing component.
- 2 Use of **liquefied natural biogas (Bio-LNG)** as an energy source of vessels.
- 3 **Use of other biofuels – such as ethanol, biomethanol and HVO** – as alternative energy sources to the current matrix.
- 4 **Replacement of HFO bunker use by LFO bunker or ammonia use** (lower carbon footprint versus currently used options) **and LNG** (liquefied natural gas).

Source: EPE; IMO; ANAP; Ministry of Mines and Energy.

## Levers – Port infrastructure

- 1 **Use of clean fuels in the fleet and support** machinery (e.g. LNG-based or biodiesel trucks).
- 2 **Offering options for supplying clean fuels to vessels**, such as cryogenic tanks for LNG, biodiesel supply structures, among others.

Potential intensification of biofuels to reduce the carbon footprint can be applied provided that the technical, mechanical, operational and laboratory viability of the said energy input is verified, as well as respecting the diversity of matrices and regional specificities.

Source: Maersk; EPA; Website Ports; ANTAQ; MPor.



## ELECTRIFICATION & POWER-TO-X

### Levers – Vessels

- 1 **Use of synthetic fuels (PtX: PTL and PtG<sup>1</sup>), such as e-metanol, e-metanol and e-ammonia**, produced from green hydrogen, renewable electricity and captured CO<sub>2</sub>.
- 2 **Use of hybrid (or electric) models for small vessels or low-distance vessels**, replacing fossil fuels with lower CO<sub>2</sub> emissions.
- 3 Direct use of **green hydrogen in fuel** cells offers a zero and efficient carbon alternative.

Levers can be applied since the technical and operational viability of the respective solutions are verified.

1. PtX: Power-to-X, PTL: Power-to-Liquid and PTG: Power-to-Gas. Source: EPE; IMO; CBO; CNN; RMI; Flagships Project.

## Levers – Port infrastructure

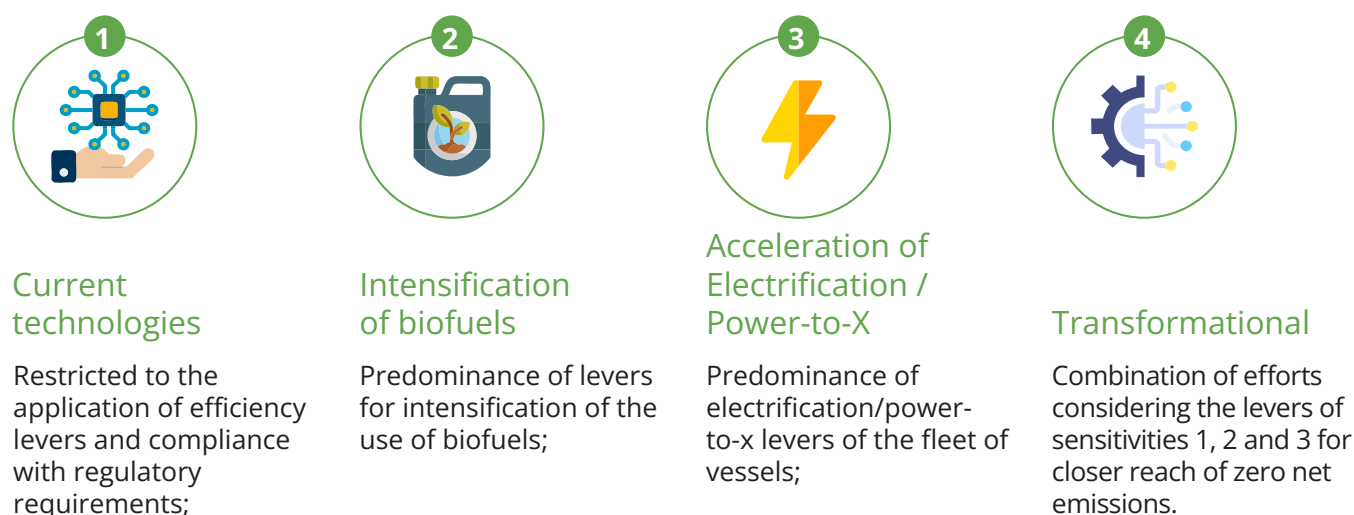
- 1 **Use of renewable energy in port and administrative** operations of groups (e.g. use of solar/wind power in offices, for port lighting, etc.).
- 2 **Hybridization or electrification of the fleet of vehicles and port support machinery** (e.g. 100% electric patio, dock trucks and cranes).

Levers can be applied since the technical and operational viability of the respective solutions are verified.

Source: Maersk; EPA; Website Ports; ANTAQ; MPor

# 4 PROPOSITION OF SENSITIVITIES BASED ON THE MAPPED LEVERS

Finally, sensitivities were proposed to evaluate the impact of different decarbonization paths:



|                                                                                     | <br><b>CURRENT TECHNOLOGIES</b> |                                                                                                                                                  | <br><b>TRANSFORMATIONAL</b>                                                                                                      |
|-------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
|  | Port efficiency                                                                                                    | All efficiency levers applied.                                                                                                                   |                                                                                                                                                                                                                       |
|                                                                                     | Transport efficiency                                                                                               | All efficiency levers applied.                                                                                                                   |                                                                                                                                                                                                                       |
|  | Biodiesel use                                                                                                      | -                                                                                                                                                | <ul style="list-style-type: none"> <li>• Use of B20 in <b>diesel</b> from 2030, <b>reaching B24 in 2040.</b></li> <li>• Use of <b>B24 in bunker from 2030</b></li> <li>• Reaches 7% of the matrix in 2050.</li> </ul> |
|                                                                                     | LNG and bio-LNG use                                                                                                | -                                                                                                                                                | <ul style="list-style-type: none"> <li>• <b>Transition fuel</b> between current and biofuels and PtX.</li> <li>• Represents 4% of the matrix in 2050.</li> </ul>                                                      |
|                                                                                     | HFO replacement by LFO                                                                                             | <ul style="list-style-type: none"> <li>• Equal to baseline – gradual replacement, with LFO <b>reaching 50% of the bunker in 2050.</b></li> </ul> | <ul style="list-style-type: none"> <li>• Faster replacement, with <b>LFO reaching 100% of the bunker in 2050.</b></li> </ul>                                                                                          |
|                                                                                     | Other fuels with lower carbon footprint                                                                            | -                                                                                                                                                | <ul style="list-style-type: none"> <li>• <b>Gradual intake</b> of ammonia (6%), <b>biomethanol</b> (18%), ethanol (15%) in the Matrix.</li> <li>• Ammonia <b>making room for PtX solutions</b> from 2040.</li> </ul>  |

# RESULTS OF SENSITIVITIES ON EMISSION IMPACT



## CURRENT TECHNOLOGIES



## TRANSFORMATIONAL



PtX Solutions -

Use of Battery Solutions (Hybrid) -

- Gradual entry of PtX (E-Ammonia and E-Methanol) solutions.
- It reaches 20% of the energy matrix (MJ) in 2050.
- Focus on support vessels and hybrid pushers.
- 7% of the support and inland fleet should be hybrid in 2050 (214 vessels).

1. Only the levers for which numerical references were found were quantified; 2. Matrix = energy matrix (MJ), does not consider electricity consumption; 3. Potential intensification of biofuels to reduce the carbon footprint can be applied provided that the technical, mechanical, operational and laboratory viability of the said energy input is verified, as well as respecting the diversity of matrices and regional specificities. Sources: EPE; Interviews with sector experts; Clarkson; ANTAQ; DVN; RMI; Mpor.

As a consequence of the implementation of the mapped levers, the industry's absolute emissions **can be reduced to ~3.1 Mton CO<sub>2</sub>e** (-32% vs. 2023) in transformational sensitivity in 2050.

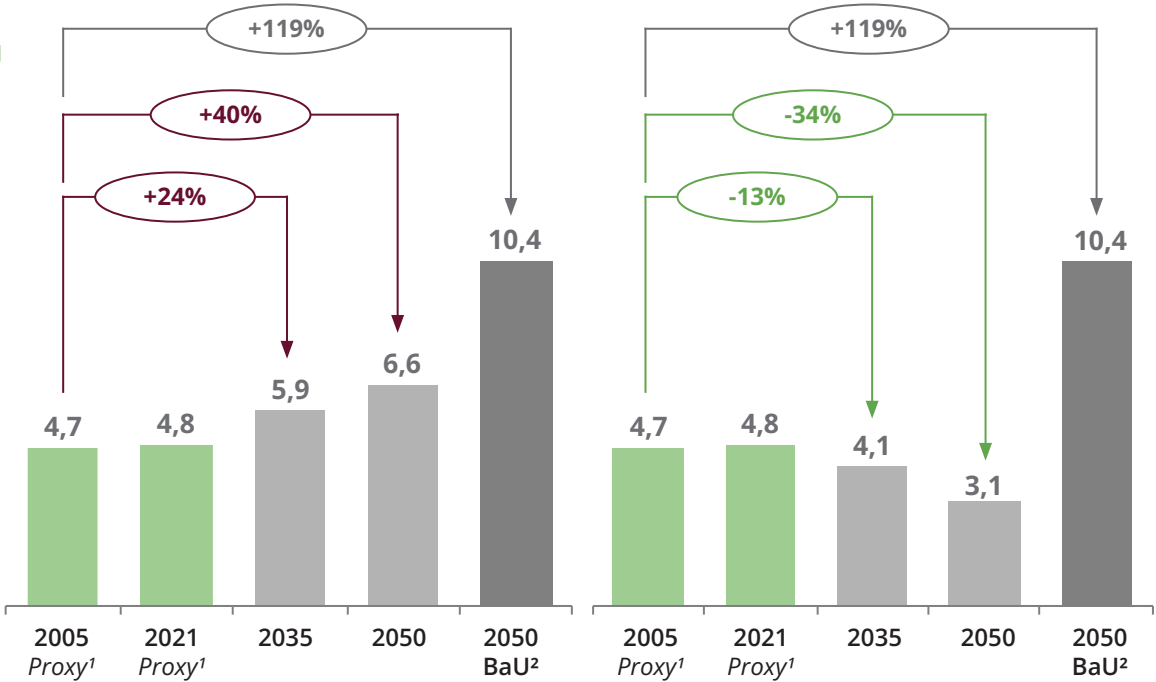


## CURRENT TECHNOLOGIES



## TRANSFORMATIONAL

**ABSOLUTE<sup>1</sup> EMISSIONS**  
(MtCO<sub>2</sub>e)



**T-KM (B)**



1. The SEEG emission was adjusted by a well to tank emission factor (WTT) / tank to wheel emissions (TTW) of the mode, and the values of 2005 and 2021 reflect the numbers reported by SEEG (and not those modeled through the PNL); 2. BaU = Business-as-Usual. Source: EPE; Interviews with sector experts; Clarkson; ANTAQ; DVN; RMI; Mpor.



## EXAMPLES ILLUSTRATE HOW ENABLERS HELP THE APPLICATION OF DECARBONIZATION LEVERS

### SUSTAINABILITY PERFORMANCE MONITORING

#### IMO

Energy Efficiency Index (EEXI) reporting requirement, which evaluates ship design, and the Carbon Intensity Indicator (IIC), which monitors the operational carbon intensity.

It is strategic to ensure the continuous alignment of Brazil's emission calculation methodology to IMO guidelines to ensure international convergence and consistency.

### PUBLIC INVESTMENT TO ENABLE EXPANSION OF COASTAL & INLAND NAVIGATION MODE

#### New PAC

R\$ 60M for the construction of the Macapa Hydroroad Terminal, with the objective of enhance the transport of cargo and passengers, which itself has a more sustainable nature.

### EXPANSION OF PRIVATE TERMINALS

The increasing number of private terminals, an increase of ~44% in the last 13 years<sup>4</sup>, promotes growth trend in a more sustainable way, contributing to a cleanest transport matrix. 

### INVESTMENTS INCENTIVES IN COASTAL AND INLAND NAVIGATION

#### BR Sea and BR Rivers<sup>1</sup>

By simplifying rules and increasing the possibilities of hiring the coastal and inland navigation mode, it seeks to expand the offer, encourage competitiveness and stimulate investments in operations and infrastructure.

### TANGIBLE MECHANISMS FOR FOSTERING PRIVATE FINANCING

#### Green Shipping Fund

€420M fund that offers loans to operators for replacement or modernization of vessels using green fuels<sup>3</sup>.

### STIMULATION OF PUBLIC INVESTMENTS IN TECHNOLOGICAL DEVELOPMENT

#### Merchant Marine Fund

R\$ 12 billion approved for modernization of the sector, including the first marine support vessel motor conversion project for use of brazilian ethanol.

### CONCRETE FINANCING TOOLS FOR PROMOTION OF R&D<sup>2</sup> BY PRIVATE SECTOR

#### The Mærsk Mc-Kinney Møller Center

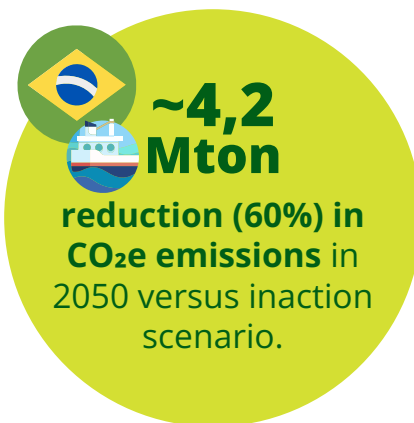
Partnership between Maersk, universities and government for R&D<sup>2</sup> to H<sub>2</sub> green and ammonia.

1. Regulation still in the formulation stage, was not approved; 2. R&D = Research and Development; 3. Such as LNG, methanol, ammonia, green hydrogen or electric vessels; 4. 2023 vs. 2010. Sources: Ministry of Education; Zero Carbon Shipping Initiative; Maersk; Government of Amapá - news page; FINEP; Green Shipping Fund; Petrobras; ANTAQ; Mpor

## WE AIM FOR SUSTAINABLE GROWTH FOR THE COASTAL & INLAND NAVIGATION MODE

Considering the expected growth for the sector, coastal & inland navigation mode should reach **22% of the transported T-KM in 2050 (vs 16% in 2023)** while CO<sub>2</sub>e emissions should represent only ~2% of Brazil's total transport in transformational sensitivity in the same year (vs ~1,8% in the baseline year).

**Conclusions** sought by the work toward the coastal and inland navigation mode in Brazil in 2050:



### CURRENT<sup>1</sup> COASTAL & INLAND NAVIGATION

 **~16% OF THE NATIONAL T-KM** transported by coastal & inland navigation mode (equivalent to ~368B of T-KM).

 **~0 B L OF BIOFUELS** consumed, with the matrix focused on the use of fossil options.

 **<1% OF HYBRID VESSELS** composing the fleet, with few newly implemented exceptions.

 **~0% OF THE FLEET USING PtX<sup>4</sup>** or other low carbon solutions of H<sub>2</sub>.



### FUTURE<sup>2</sup> COASTAL & INLAND NAVIGATION

 **~22% OF THE NATIONAL T-KM** transported by mode (equivalent to ~922B of T-KM).

 **~1,0 B L OF BIOFUELS** consumed among biodiesel, green diesel and ethanol.

 **~6% OF HYBRID VESSELS** composing the fleet, focused on inland navigation and support<sup>3</sup>.

 **15% OF VESSELS** using synthetic fuels (PtX).



1. 2023; 2. Transformational 2050; 3. Maritime and Port Support; 4. Power-to-X. Source: Infra SA 2021; EPE; Interviews with sector experts; Clarkson; ANTAQ; DVN; RMI; Mpor.

## COASTAL AND INLAND NAVIGATION MODE

*Scan the QR Code to access the full document*

