BCG BOSTON CONSULTING GROUP

Seizing Brazil's potential for low-emission marine fuels

UNLOCKING OPPORTUNITIES IN BIOFUELS UNDER THE IMO NET ZERO FRAMEWORK

BRAZIL CLIMATE SUMMIT NEW YORK
September 2025

Brazil Climate Summit.

Authors, co-authors and participants

BCG BOSTON CONSULTING GROUP


Arthur Ramos


Ricardo Pierozzi


Lucas Moino


Santino Lacanna


Peter Jamerson


Maurice Jansen


Bruno Vasconcellos


Thiago Cardoso


Thais Esteves


Fernando Thiers


Matheus Munhoz


Luiza Boechat


Rafaela Dalsenter


Pedro Costa

In partnership with

Brazil Climate Summit.


Luciana Ribeiro


Jorge Hargrave


Marina Cançado

About this report

Objective	This report sets out BCG's perspective to help Brazilian and global leaders catalyze action, remove barriers, and unlock Brazil's potential in a transforming shipping sector — accelerating the global economy's transition to Net Zero (2020-2050)
Audience	This report was built for all those willing to drive actions against Climate Change (e.g., investors, board members, executives, entrepreneurs, academia, etc.) focused on leveraging Brazil's green agenda and potential.
Data	This document is a compilation of public information and BCG expertise, carefully selected, to bring numbers and facts to Climate discussions and decision-making. Its analyses are subject to rapidly evolving technologies and business models and should be revisited and updated accordingly.
Special thanks	BCG is thankful to the SB COP Finance Working Group for bringing in the private sector perspective, and to the entire Brazil Climate Summit organizing team for their support. We are especially thankful to all Brazilian students at Columbia University who contributed to accelerating the path to Net-Zero. (www.brazilclimatesummit.com)

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Brazil is a global forerunner towards a low-carbon future – its innate advantages could unlock $2-3T in investments until 2050

A global biofuels leader, the second-largest producer of ethanol and biodiesel worldwide[1]

Protagonist in Wind and Solar: LCOE: $33/MWh and $15B+/yr in investments[2]

Green H_2 Hub positioning to capture 10-15% of global exports +2030

Worldwide hub for low-carbon industrial products

#1 CO_2-offset supplier: mitigate up to 1 Gt CO_2e/yr[5]

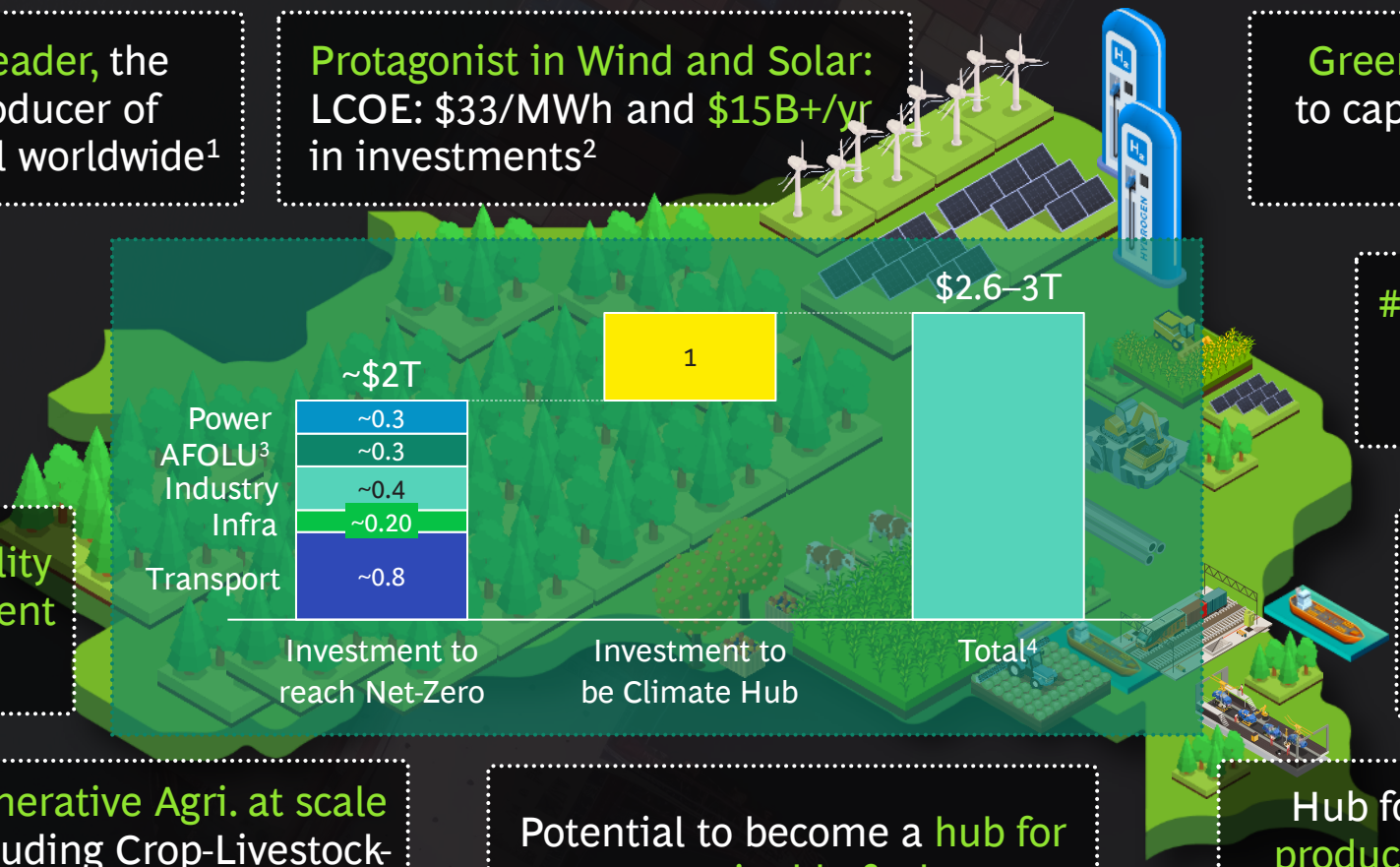
Increased Sustainability in wastewater treatment and water supply[6]

Zero illegal deforestation through command and control[7]

#1 country in Regenerative Agri. at scale (up to 100 Mha including Crop-Livestock-Forest Integration and non-till-farming)

Potential to become a hub for sustainable fuels

Hub for green industrial products and minerals for energy transition



1. Brazil: Biofuels Annual (USDA/FAS), 31 ago 2024; 2. Average Levelized Cost of Energy for wind & Solar plants, considering experts inputs, capacity expansion as disclosed by ONS in 2023, and average renewable energy investments in Brazil between 2015-2022 as reported by UNCTAD in 2023 3. AFOLU: Agriculture, Forestry and Other Land Use; 4. Bloomberg NEF (2025). World Energy Transition Investment; 5. Gibbs, H. K., Rausch, N. F. (2015). Brazil's Soy Moratorium. Science, 347(6220), 377–378; 6. Path toward Sustainability in Wastewater Management in Brazil", International Journal of Environmental Research and Public Health, vol. 20, n.º 16, 2023; 7. Brasil (MMA). PPCDAm – 5ª fase (2023–2027): meta de desmatamento zero até 2030, com foco no combate ao desmatamento ilegal (Portuguese).

BCS Reports highlight the "how to" make opportunities material - today we present the case for sustainable marine fuels

A global biofuels leader, the second-largest producer of ethanol and biodiesel worldwide[1]

BCS NY Sept. 2024

Green H_2 Hub positioning to capture 10-15% of global exports +2030

BCS Sept. 2023

BCS Paris May 2025

Worldwide hub for low-carbon industrial products

BCS EU May 2024

BCS EU May 2024

#1 country in Regenerative Agri. at scale (up to 100 Mha including Crop-Livestock-Forest Integration and non-till-farming)

Today's focus:

Potential to become a hub for sustainable biofuels - marine fuels as a lighthouse

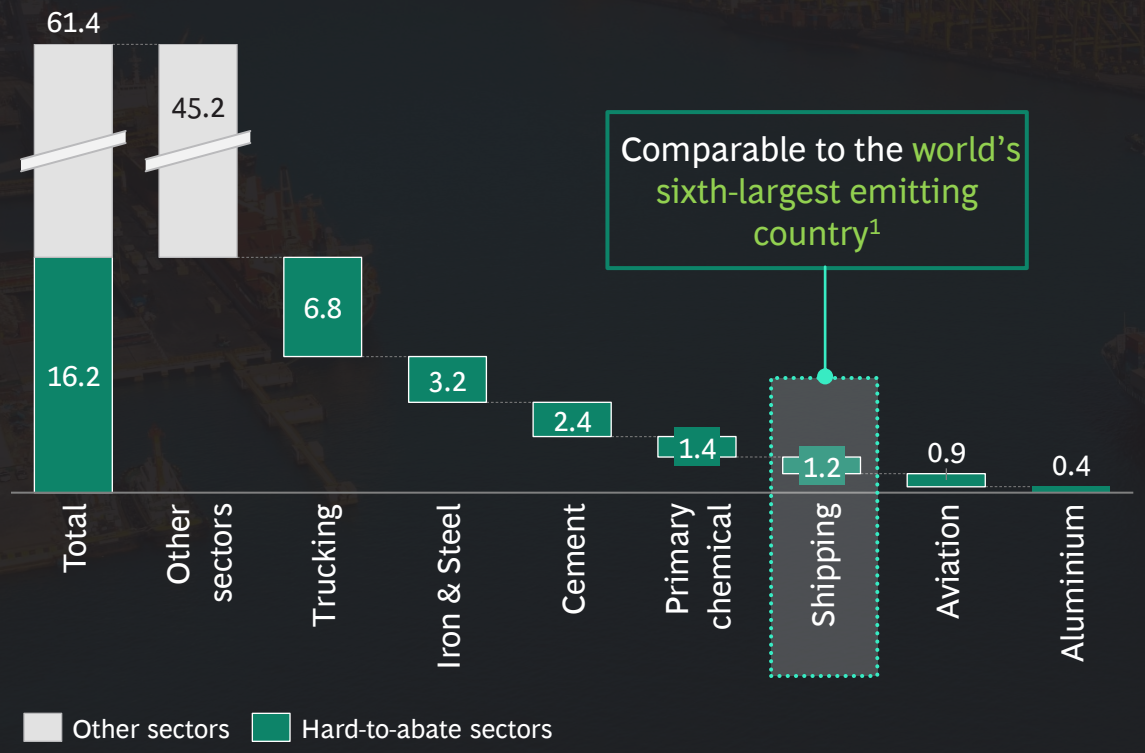
Hub for green industrial products and minerals for energy transition

1. Assume potential of NBS in a price-competitive scenario with carbon price at $70/ton CO2;
Source: BCG Analysis

Shipping represents ~1.2 Gt CO_2e of hard-to-abate emissions – IMO NZ Framework offers a pathway to sector decarbonization

Global GHG emissions

Gt CO_2e, 2024



IMO Net Zero Framework (IMO NZF) key aspects[2]

Presented on 11 April 2025

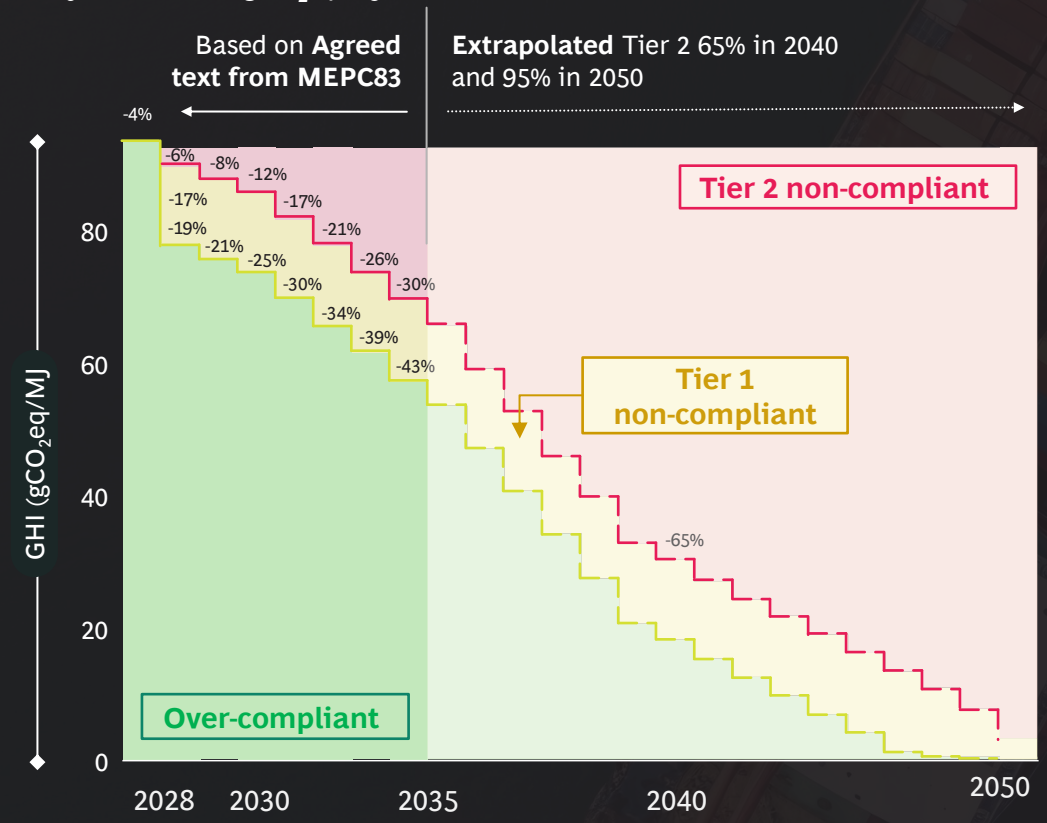
- GHG-intensity decarbonization pathway with defined 2028–35 targets and a sector-wide market mechanism, agreed at Marine Environment Protection Committee 83rd session (MEPC 83)
- Global scope reflecting shipping's international jurisdiction and the large share of emissions governed by the IMO
- Proven track record by the IMO in implementing the 2020 global 0.50% m/m Sulphur cap, with robust enforcement and high compliance[3]
- Next step: Formal adoption at IMO's extraordinary MEPC session, MEPC/ES.2, mid October 2025
- COP30 could serve as a strong platform for advancement on shipping decarbonization, aligned with the Action Agenda (Key Objective #2)

1. Source: B3. Inventário de emissões de gases de efeito estufa 2024: Apresentação de Resultados [Greenhouse Gas Emissions Inventory 2024: Results Presentation]. 2025. (Portuguese) 2. Presented on 11 April 2025, at the close of IMO's MEPC 83 (7–11 Apr, London); 3. Under MARPOL Annex VI Reg. 14, "IMO 2020" lowered the global sulphur limit in marine fuels to 0.50% m/m from 1 Jan 2020 (with 0.10% in ECAs) and introduced a carriage ban for non-compliant fuel from 1 Mar 2020; EU THETIS-EU inspections report >95% compliance. Note: IMO NZF = IMO Net-Zero Framework. Source: EDGAR 7.0; IEA; BCG Analysis

Considering IMO NZF, from 2028, vessels need to reduce emission intensity, face penalties of $100–380/tCO₂e, or acquire surplus units

GHG intensity (GHI) reduction factors and pricing mechanism agreed on MEPC83[1]

Reference: 93.3 gCO₂eq/MJ



Possible actions	Over-compliant	Tier 1 non-compliant	Tier 2 non-compliant
Sell Surplus Units[2] (optional)	✓	-	-
Reduce GHG intensity to reach compliance	-	✓	✓
Pay 100$ /tCO₂e[3] (Tier 1)	-	✓	-
Pay 100$ /tCO₂e (Tier 1) + buy Surplus Units[2]	-	-	✓
Pay 100$ /tCO₂e (Tier 1) +pay 380$ /tCO₂e (Tier 2)	-	-	✓

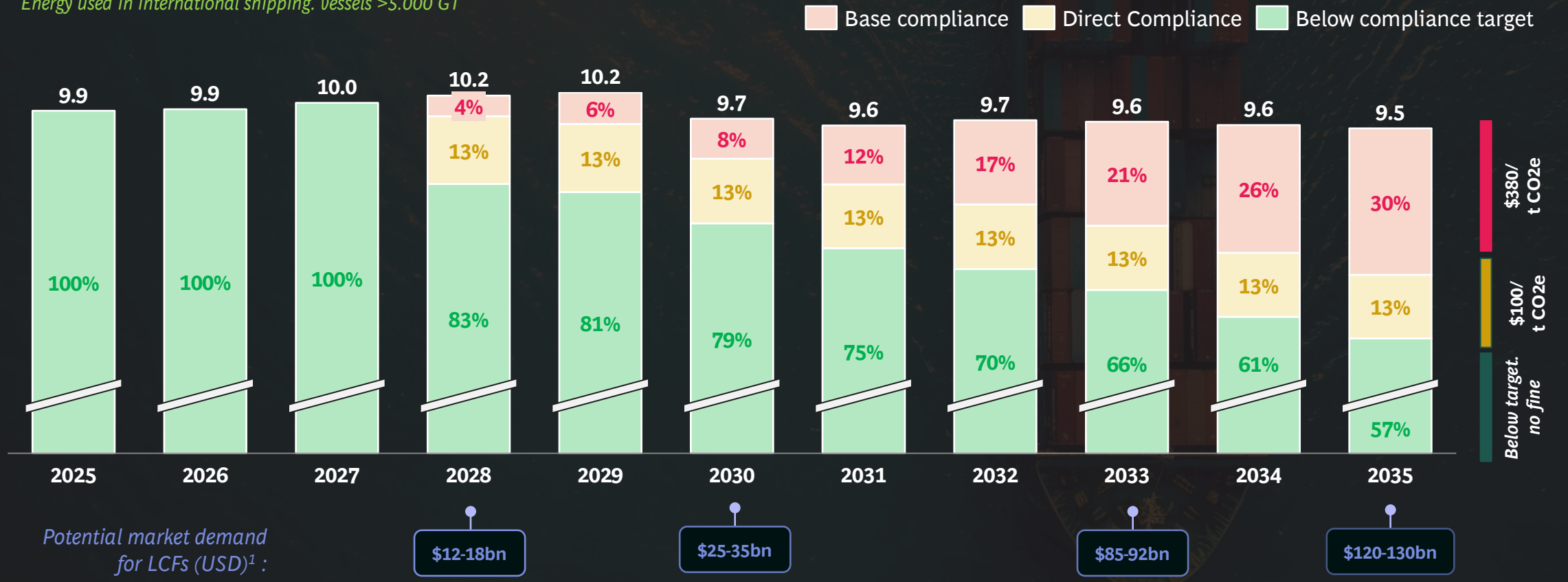
Penallties collected to future **IMO fund**
Rewards for near zero fuels (ZNZ) to be defined
Price of Surplus Units will depend on market development

1. Formal adoption at IMO's extraordinary MEPC session (MEPC/ES.2), 13–17 Oct 2025; 2. SU (Surplus Units) — MEPC 83: If a ship's annual GHG Fuel Intensity is below the Direct Compliance target, it earns SUs, which can be banked for up to two years or transferred once to offset another ship's Tier-2 deficit. 3. At Tier 1, credit purchases are not permitted; the only option is to pay the USD 100/tCO₂e penalty;
Source: Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping; IMO - MEPC 83; GCMD; FuelEU Maritime; Argus; IEA; BCG analysis

IMO Net Zero Framework could unlock up to $120-130B market for sustainable fuels by 2035

Shipping energy demand by compliance target 2025-35 (EJ)

Energy used in international shipping. vessels >5.000 GT



1. SU: Surplus Units; 2. Example for representative 45kt MR conventional tanker - Annual & cumulative costs1 by scenario (MUSD). Note: The fuels shown are not exhaustive; some emerging fuels (e.g.. e-diesel. HTL. pyrolysis oil) have been excluded for clarity.
Source: Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping; IMO - MEPC 83; GCMD; FuelEU Maritime; Argus; IEA; BCG analysis

New regulation can capitalize on positive momentum as key stakeholders are aligning to foster green shipping

Cargo owners

are starting to pay for more sustainable shipping

- 82% of cargo owners were willing to pay a premium for carbon-neutral shipping in 2024
- Commitments to scope 3 reductions drive an increase in WtP[1] - Zemba[2] has completed its 1st tender of 1B TEU-miles of zero-emission shipping
- Biofuel blends are increasingly being adopted on international shipping routes - In 2025, Citrosuco initiated its first long-haul voyage powered by 500 tons of B24[3]

Shipping value chain

is moving to align supply and demand for greener alternatives

- +60 green shipping corridor projects — maritime routes promoting the use of low-emission solutions — are currently underway worldwide
- Leading shippers are securing large offtake contracts – Maersk signed a landmark methanol agreement with Goldwind for 500Kton/year
- Institutions are working to bridge supply and demand gaps - MMMCZCS FDA[4] supports aggregation efforts to enable scaled offtake commitments

Financial institutions

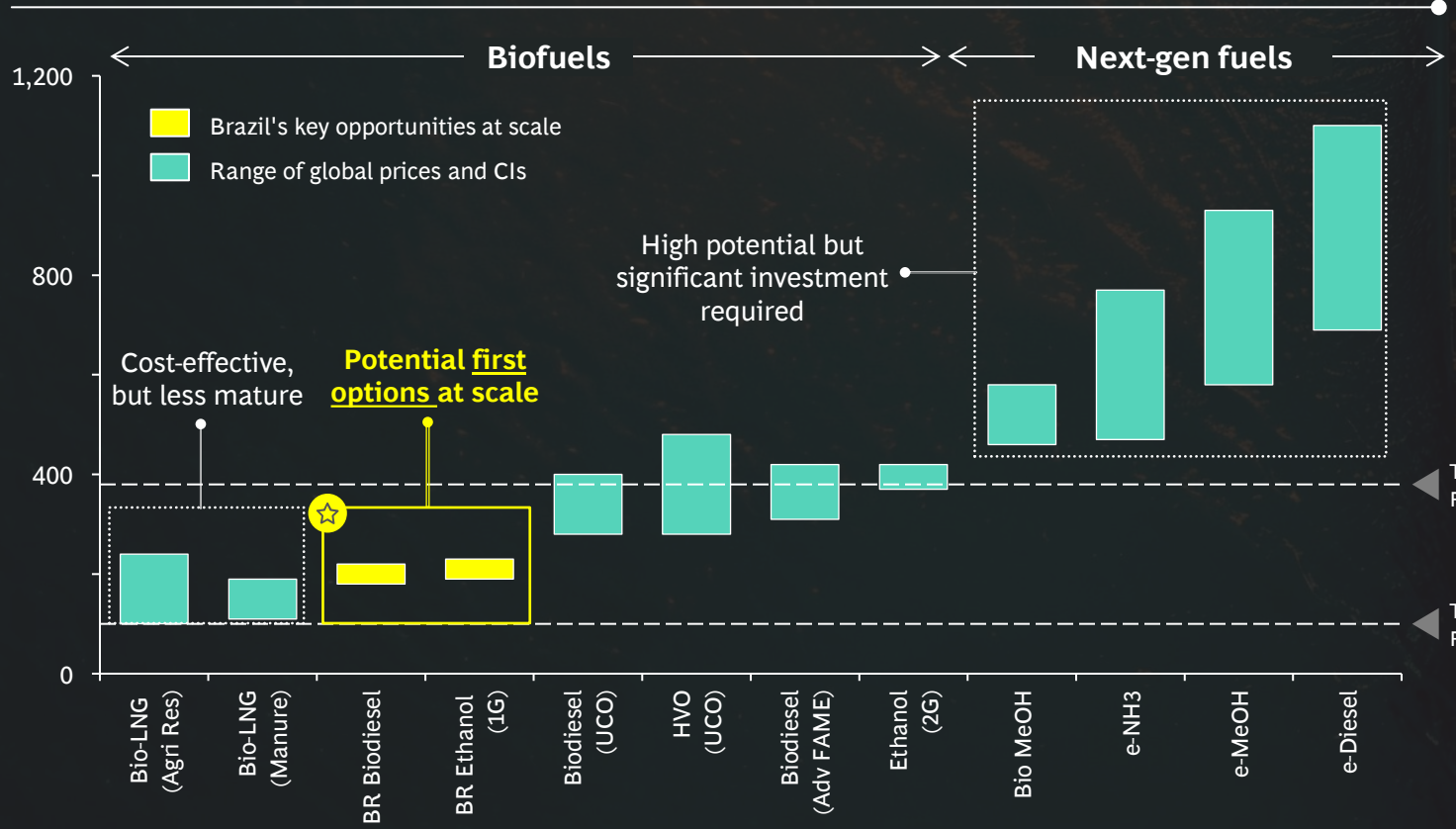
are developing mechanisms to unlock access to climate capital

- Dedicated funds for maritime decarbonization are maturing —Eurazeo has already mobilized $200M to unlock shipping low-emission assets
- Capital alignment frameworks are in place — Poseidon Principles include 35 institutions, covering ~80% of global maritime lending
- Innovative mechanisms are emerging to improve capital access - double auctions accelerate early market formation via demand and supply consolidations

1. Willingness to pay 2. Zero Emission Maritime Buyers Alliance 3. Biodiesel blend, with 24% concentration of biofuel 4. Maersk Mc-Kinney Moller Center for Zero Carbon Shipping – Fuel Demand Aggregator project
Source: Zemba; Uol; MMMCZCS; Global Maritime Forum; Poseidon Principles; Global H2; Eurazeo; Maersk

Brazil can deliver near-term cost-competitive biofuels for marine decarbonization

Fuel Carbon abatement costs 2025 -2030 ($/tCO2)[1,2]



Brazil key opportunities

Short-medium term

Biodiesel and ethanol offer fast turnaround, cost-competitive, scalable alternatives, supported by degraded-land restoration

Deep dive ahead

Medium-long term

Bio-LNG **potential in Brazil is significant**, but will require more materiality of demand and development of distribution and liquefaction infrastructure

Long term

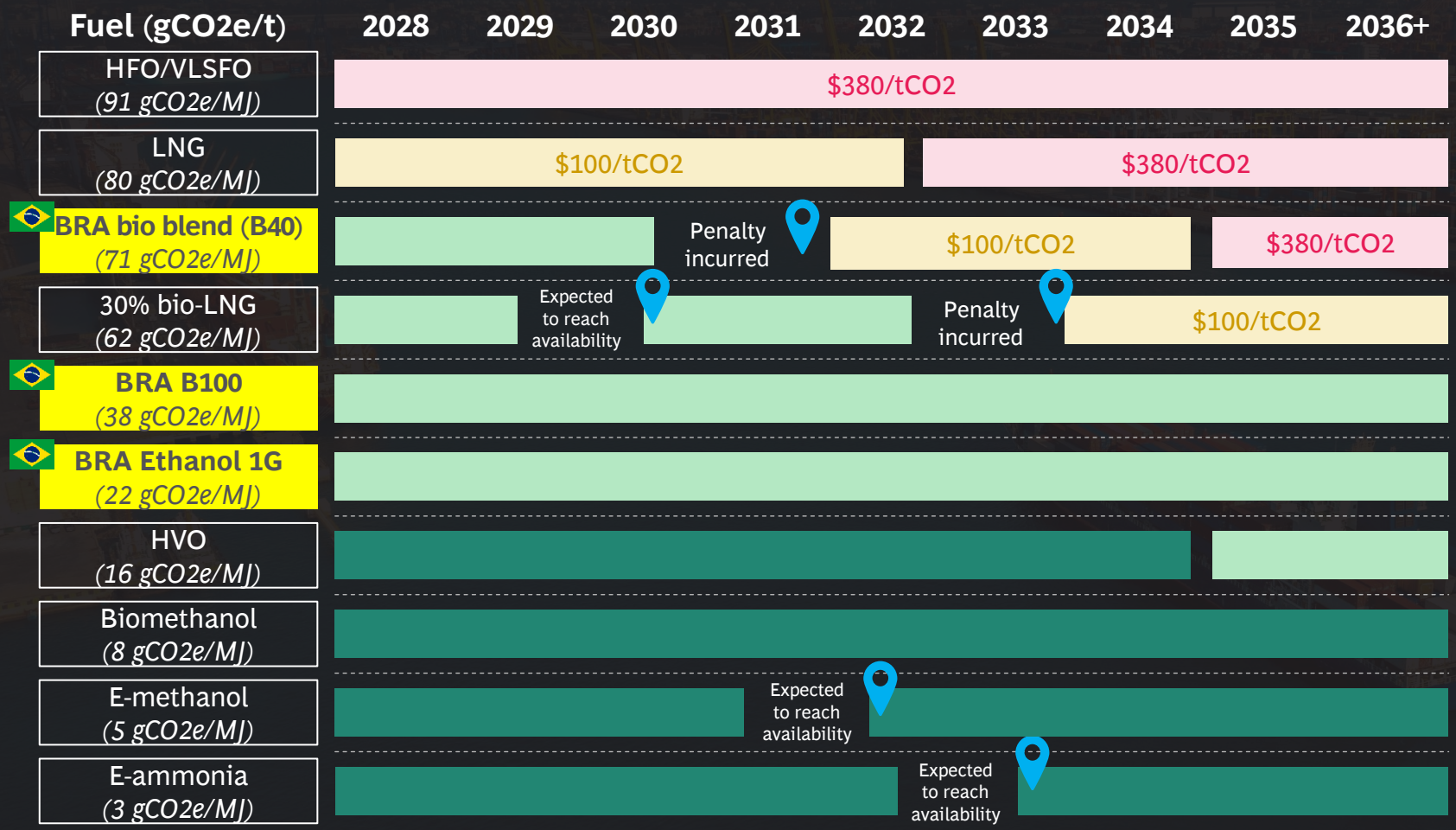
Brazil **has strong next-gen fuel potential** — realization hinges on capital, tech readiness, and engine scaling

1. Carbon abatement cost of fuels; excludes infrastructure. vessel operation. penalties. etc; Note: (a) The fuels shown are not exhaustive - emerging fuels (e.g.. e-LNG. HTL. pyrolysis oil) have been excluded for clarity. (b) Biofuel costs assume minor changes in 2025-2030 period and don't account for potential supply constraints / scarcity due to competition induced by additional demand from IMO policies for shipping. that may lead to volatility / increase of fuel price. (c) In this study only fuel costs were analyzed: most biofuels are drop-in solutions requiring no changes to existing HFO or LNG fueled vessels and infrastructure thereof; next-gen fuels require additional CAPEX. but according to DNV and MMMCZCS, this has negligible impact on TCO compared to next-gen fuel costs. Fuel expenditures represent ~25-40% of TCO today; for next-gen fuels TCO share may rise to 60% during financing period and 80-90% after financing period

Source: Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping; IMO - MEPC 83; GCMD; FuelEU Maritime; Argus; IEA; BCG analysis

The GHG intensity of fuels varies depends on their specific production pathways

By 2028, IMO rules will render HFO and LNG non-compliant; cost-competitive alternatives must be secured to sustain supply



Key insights

- **HFO non-compliant with base in 2028:** At 91 gCO_2e/MJ, HFO exceeds the 2028 Tier 2 target making it an expensive solution in the long-term
- **Blended fuels remain viable through 2034:** B40 is viable through Tier 2 in 2034/35, but future compliance will require increasing blends to lower CI[1] — potentially up to B100
- **Low-carbon fuels offer attractive SUs:** Although low-CI fuels (e.g., ethanol 1G) are currently pricier, they face no penalties at IMO go-live and earn SUs, making their net cost more attractive than other options

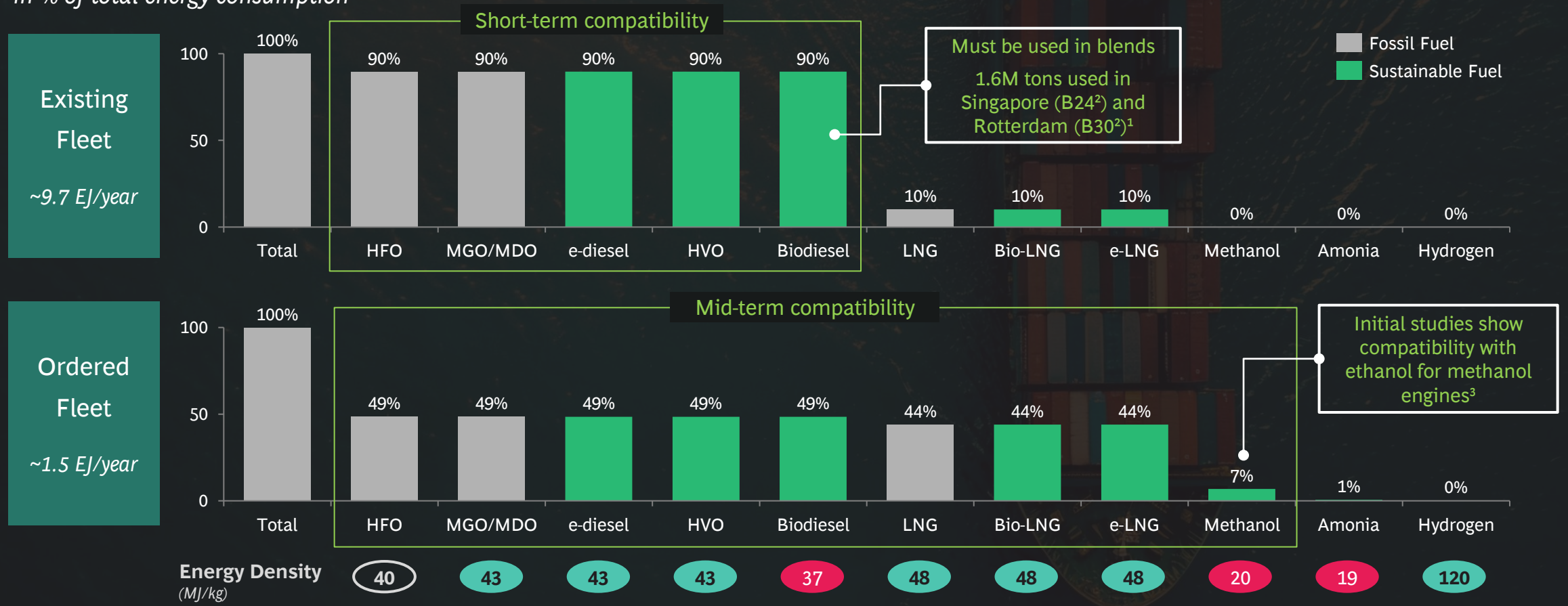
1. CI – Carbon intensity; 2. SU – Surplus Units

Backup

In addition to greener fuels' availability, engine compatibility is key to scaling; biodiesel stands out as a near-term sustainable solution

Compatibility of different fuels for maritime transportation with current and short-term fleet
in % of total energy consumption

World

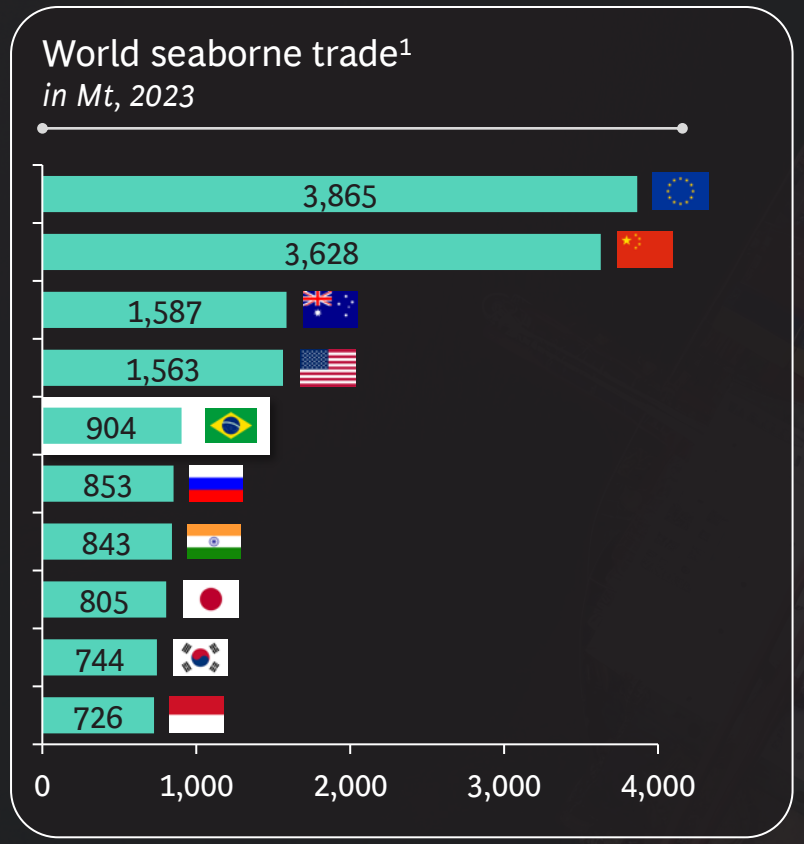


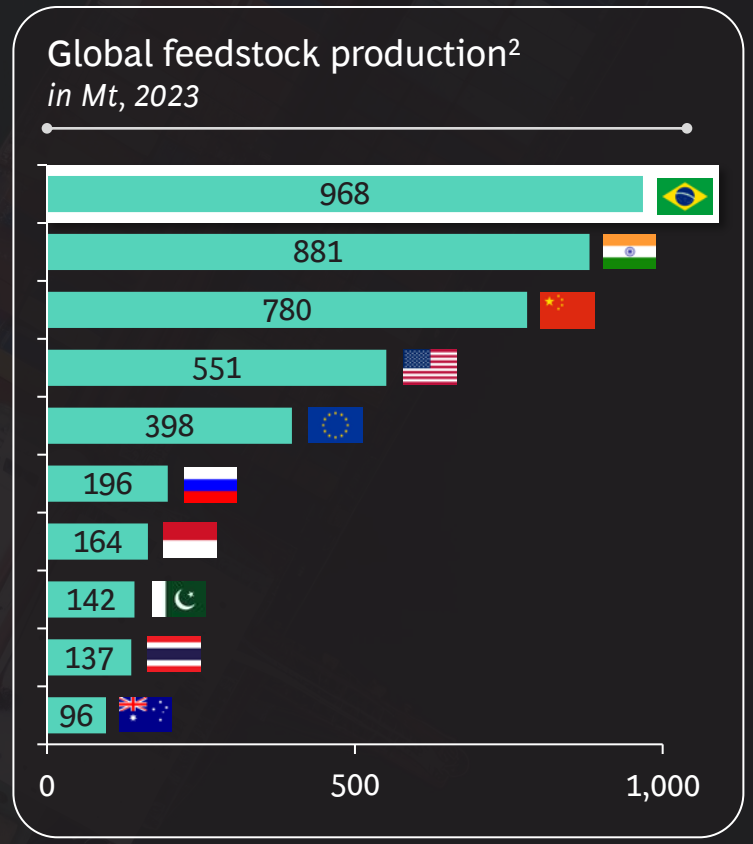
1. DNV - Maximizing the potential of biofuels in shipping; 2. 'BX' designates biodiesel blend levels—B24 contains 24% biodiesel; 3. Raízen press release: Raízen And Wärtsilä Sign Agreement to Accelerate Fleet Sustainability through Ethanol-Based Solutions
Source: IMO – Energy Efficiency of Ships 2024; ClassNK – Alternative Fuel Insights

Brazil's strategic advantages enable biofuel supply at global scale

#5 worldwide in maritime traffic (~3% of global volume)

#1 worldwide producer of feedstock used for biofuels





#Key possibilities to unlock scale

Green corridors
Ongoing initiatives

Proposed Declaration of Intents for Green Shipping Corridor with countries such as France and Norway

Pastureland recovery
Scale potential

Restoring degraded pastureland in Brazil to increase the area available for biofuel production

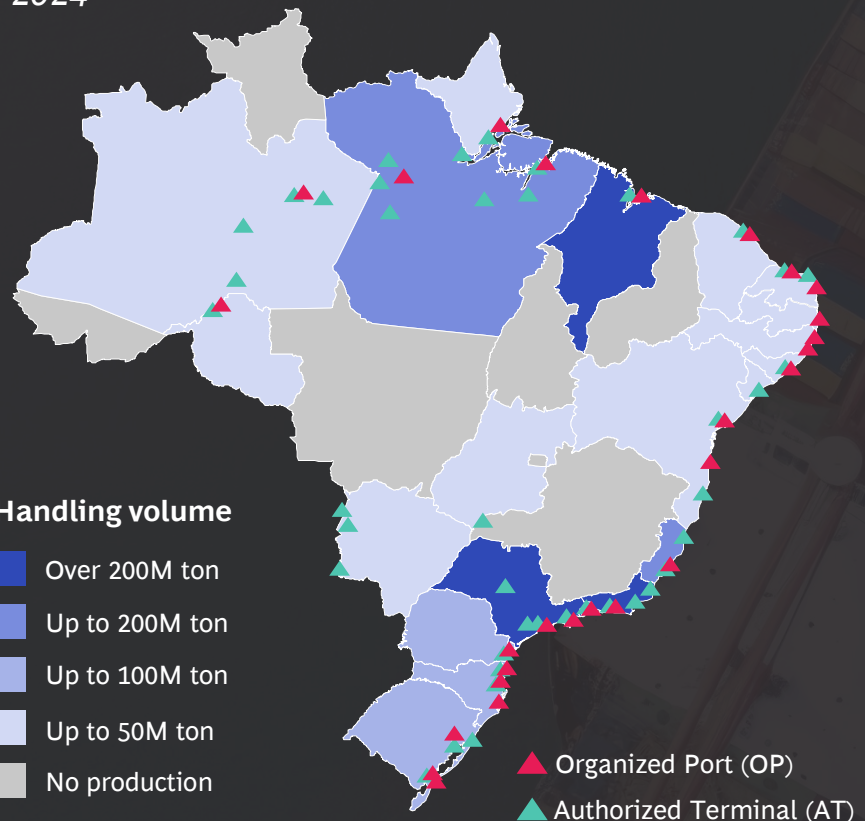
Deep dive ahead

1. Considers both total goods loaded and discharged; 2. Considers cereals, oilcrops, sugar crops, and treenuts;
Source: FAO – Crops and livestock products (QCL) 2023; UNCTADstat - World seaborne trade by type of cargo, annual; Brazil Climate Summit; Brazilian Government

Brazil's port activity is rising - concentrate supply on the highest-traffic regions is key

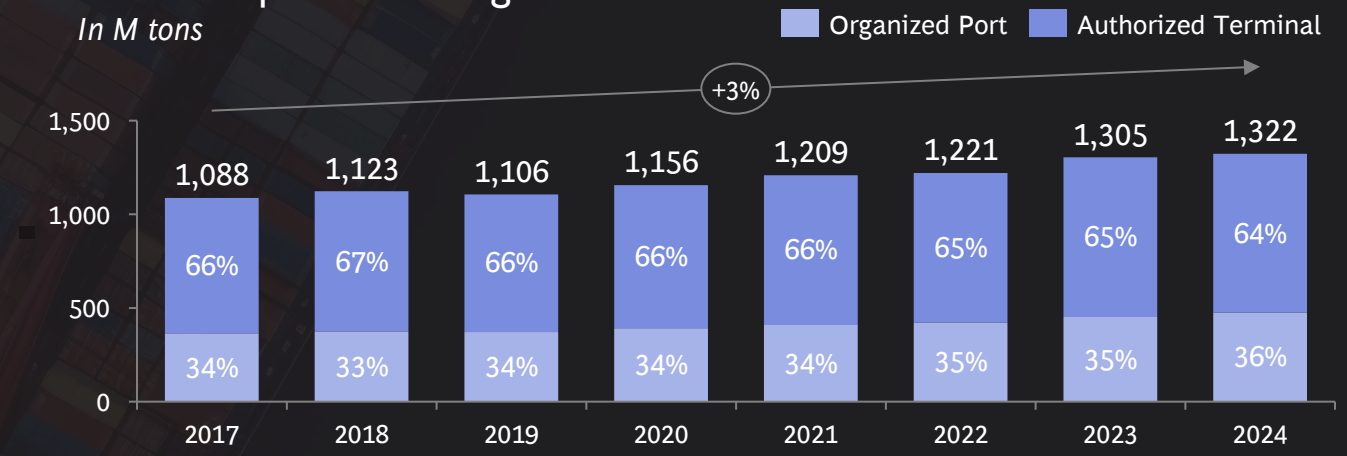
Brazilian port facilities and handling

2024



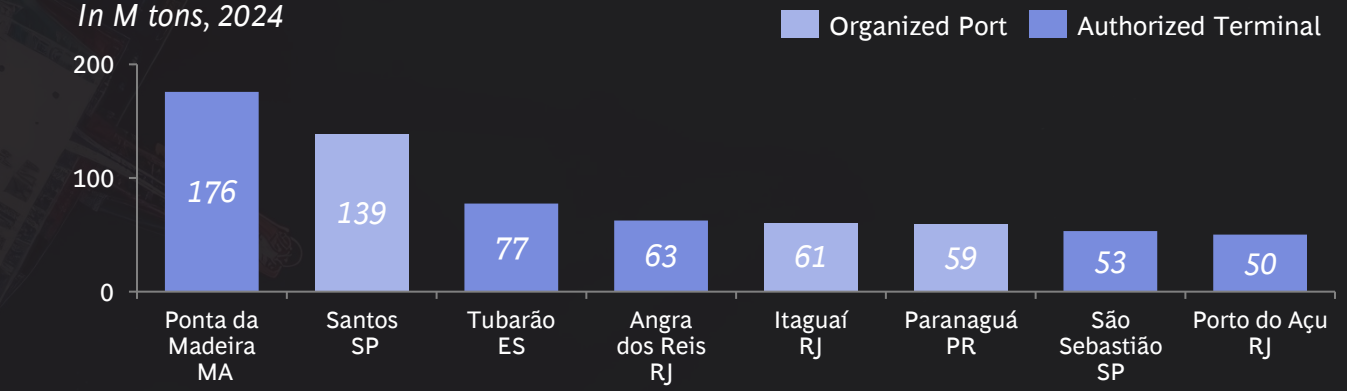
Brazilian port handling volume

In M tons



Key port facilities

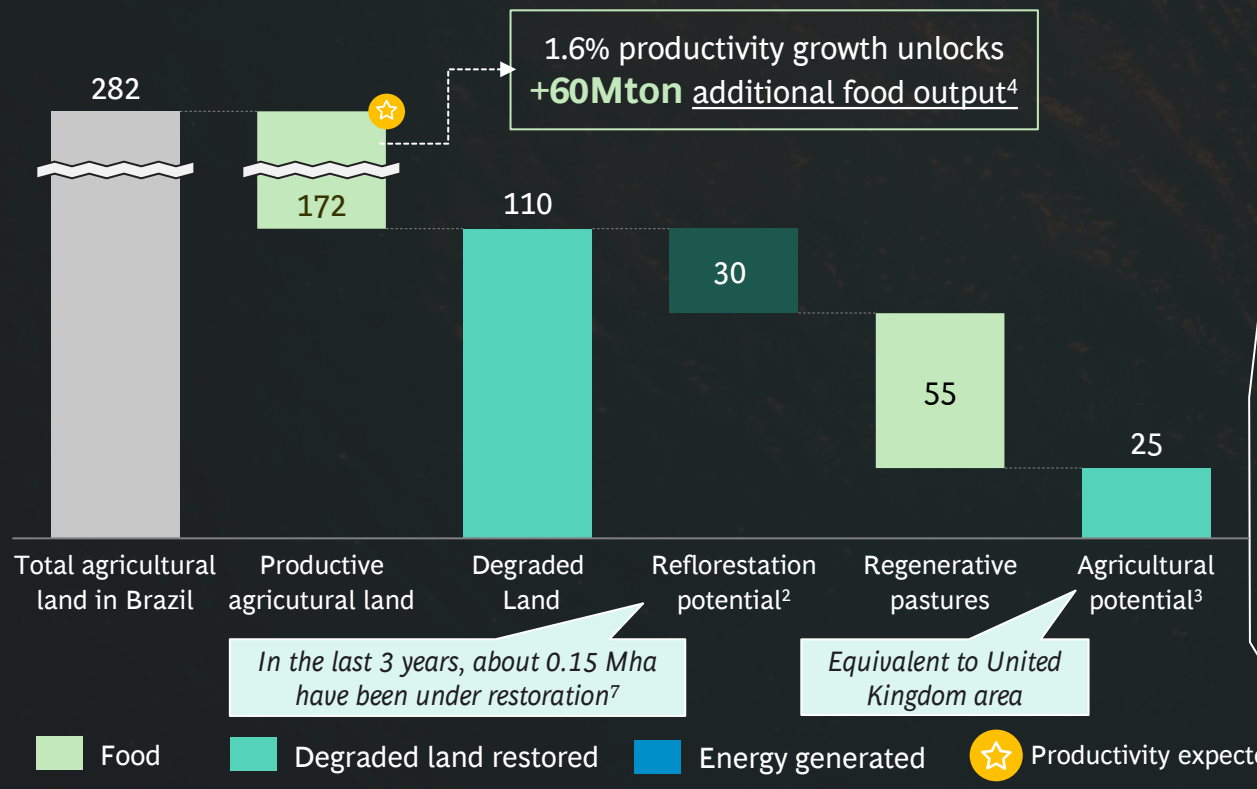
In M tons, 2024



Source: Agência Nacional de Transportes Aquaviários (ANTAQ) – Estatísitco Aquaviário

Biofuel production can restore 25Mha of degraded land, while promoting reforestation and increasing food production

Potential uses for recovered pasturelands *(in Mha)*



Final products generated

Plantation[1]	Biofuels	Food	Other
2 Mha[3] +Food crops	-	-	-
4 Mha Sugarcane	20 BL Ethanol (sugarcane)	-	4.4 GWm Bioelectricity[5] 4.9Mm³/day Biomethane[6]
8 Mha Corn	23 BL Ethanol (corn)	15Mton DDGS	-
20 Mha Soy	16 BL Biodiesel	65 Mton Bran	-

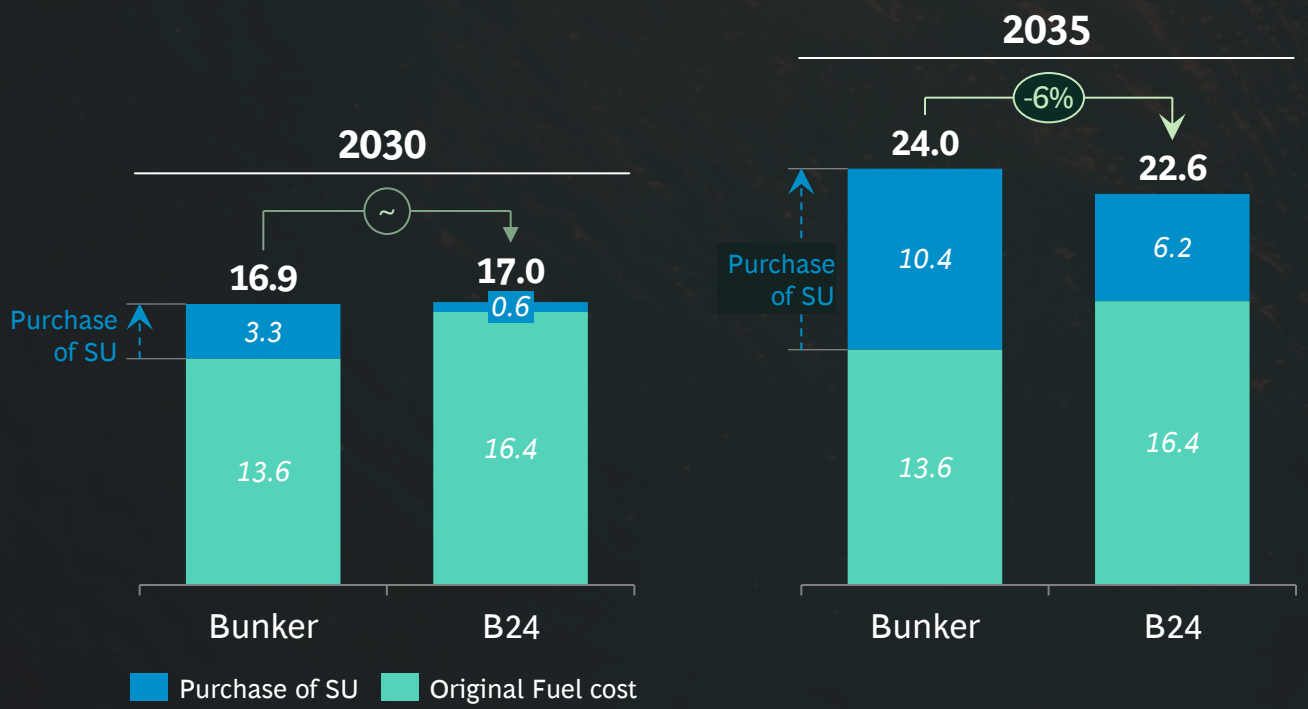
1. There is overlapping planting (use of the same lands) for corn and soybeans; 2. Estimated based on Griscom, 2020 & Roe 2021, according to BCG Forestry NZE 2050 projections in Brazil; 3. The calculation considers only the difference between food-demand growth (1.85% p.a.) and productivity growth (1.6% p.a.); 4: Considering the current supply (only considered grains) of food of 312 Mton - Daniel Rittner, "Brasil virou 'celeiro do mundo' e já lidera exportações mundiais de sete alimentos, diz BTG," CNN Brasil, March 4, 2024; 5. Based on residual bagasse from ethanol production and 25% efficiency in electricity generation; 6. Generated from vinasse, a byproduct of ethanol production; 7. In the last 3 years, about 0.15 Mha have been under restoration
Source: Embrapa; Conab; MapBiomas; Brazil Climate Summit (BCS); BCG analysis

Biodiesel blends offers a near-term and cost-competitive decarbonization lever

Cost competitiveness of B24[1] compared with bunker[2]

In U$ per GJ, assuming 38 gCO2eq/MJ for B100 and 91.7gCO2e/MJ for bunker

Assuming Surplus Unit price of 350 $ /tCO_2e[3]



Biodiesel blends are **compatible with conventional engines**, covering ~90% of the current fleet[4]

Brazilian B100 differentials

35-38 gCO2e/MJ

Brazilian soybean biodiesel's WtW[5] GHG intensity

220-230 $/tCO2e

Abatement cost at BR ports, smaller than IMO $380/tCO2e

280-300 $/tCO2e

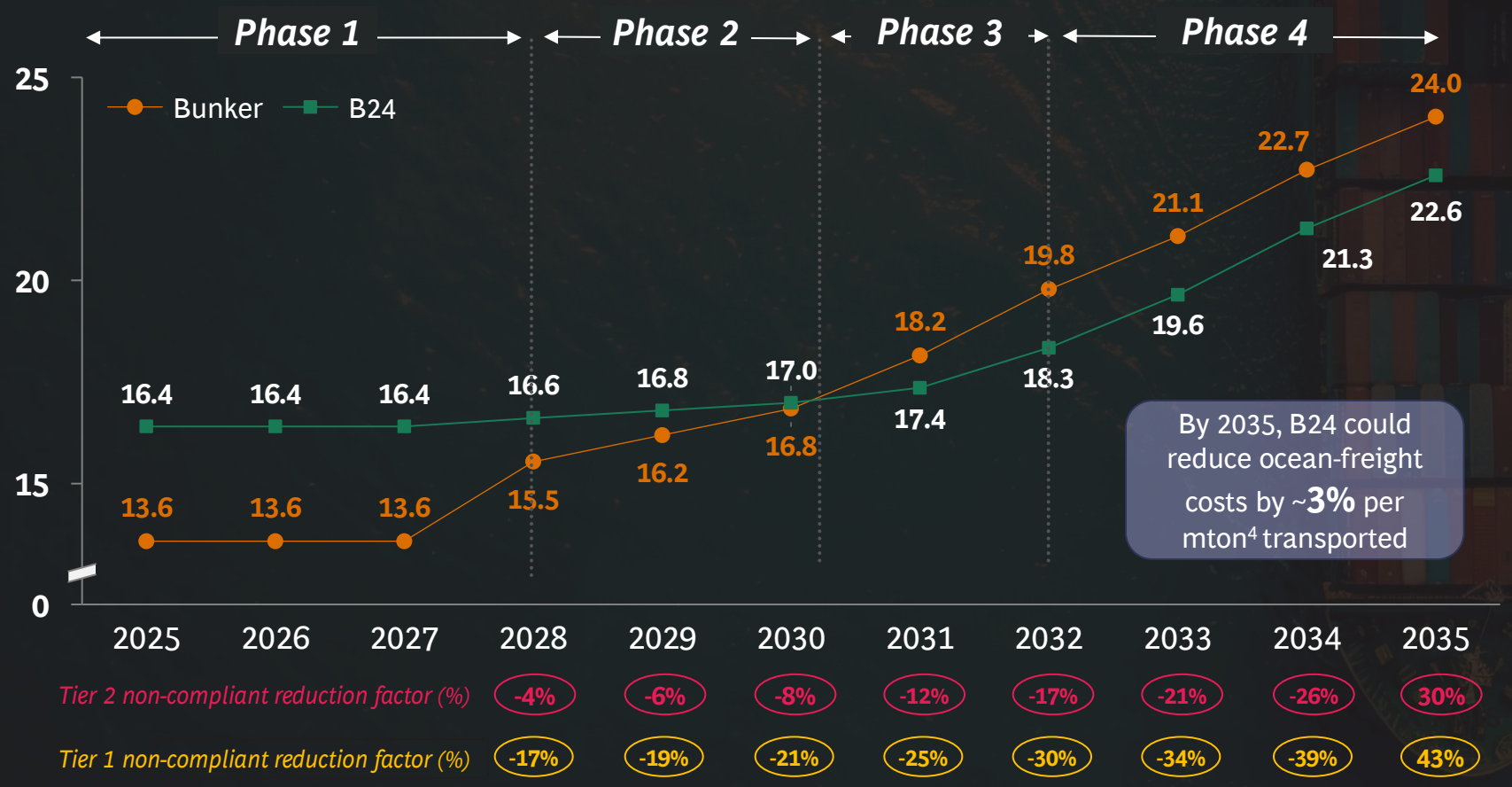
Abatement cost at Rotterdam and Singapore ports, smaller than IMO $380/tCO2e

1.'BX' designates biodiesel blend levels—B24 contains 24% biodiesel 2. Assuming penalties being paid, delivered at BR port; 3. Surplus units value will be defined by the market, consider value slightly lower than IMO carbon penalty 4. B24 blends are already in the market and are blended at the Rio Grande Terminal (TERIG) in Rio Grande, Rio Grande do Sul; 5. Well to Wake
Note: Considering bunker prices at $0.53/L and biodiesel prices at $0.91/L; The number of Surplus Units is determined by the difference between the submitted fuel's GHG intensity and the IMO compliance targets
Source: Agência Nacional do Petróleo; Gás Natural e Biocombustíveis (ANP); IMO; General Index; BCG Analysis

Cost comparison highlights a viable case for biodiesel from Brazil, enabling blends cheaper than bunker around 2030

Cost competitiveness of B24[1] compared with bunker[1] over the years
In U$ per GJ, assuming 79 gCO2eq/MJ for biodiesel and 91.7gCO2e/MJ for bunker

Assuming Surplus Unit price of 350 $ /tCO_2e[2]



By 2035, B24 could reduce ocean-freight costs by ~**3%** per mton[4] transported

Phase 1
No IMO applications yet – price difference remains $2.8 /GJ

Phase 2
Even though bunker fuel is **Tier 2–non-compliant** from IMO Year 1 onward, and B24 becomes **Tier 1–non-compliant**, Bunker is still cheaper than B24 in Phase 2. From this Phase, decrease the share of biodiesel would help cost competitiveness

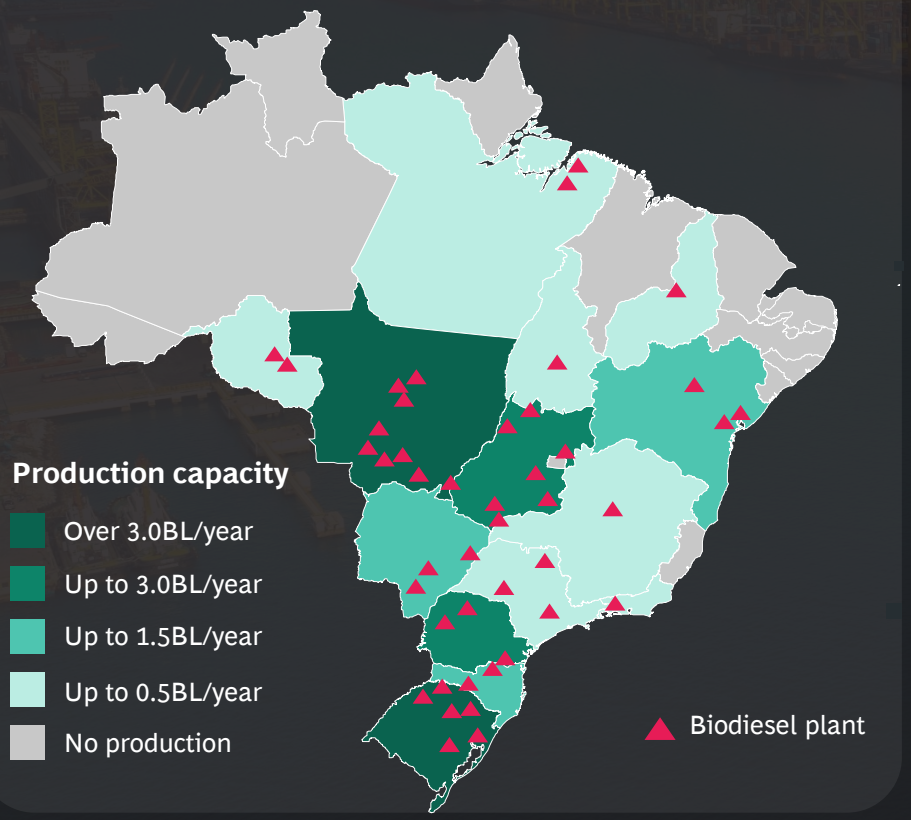
Phase 3
After 2030, B24 becomes cost-competitive, but there is a considerable increase of its price due to its entry into the Tier 2 non-compliant zone, alongside bunker fuel

Phase 4
From 2032 onwards, B24 will remain in Tier 2 non-compliant and the price difference between fuels will remain constant — creating a great opportunity to increase the share of biodiesel in the blend

1. Assuming a Brazil–Europe voyage averages 16 days, with the vessel consuming 80 tonnes of fuel per day; 2.. Assuming that 40% of freight costs are attributable to fuel, and considering a comparison based on the same route and vessel type Source: Agência Nacional do Petróleo; Gás Natural e Biocombustíveis (ANP); IMO; General Index; BCG Analysis

Mobilizing degraded lands could triple current supply and unlock opportunities for new entrants

Brazilian Biodiesel production facilities



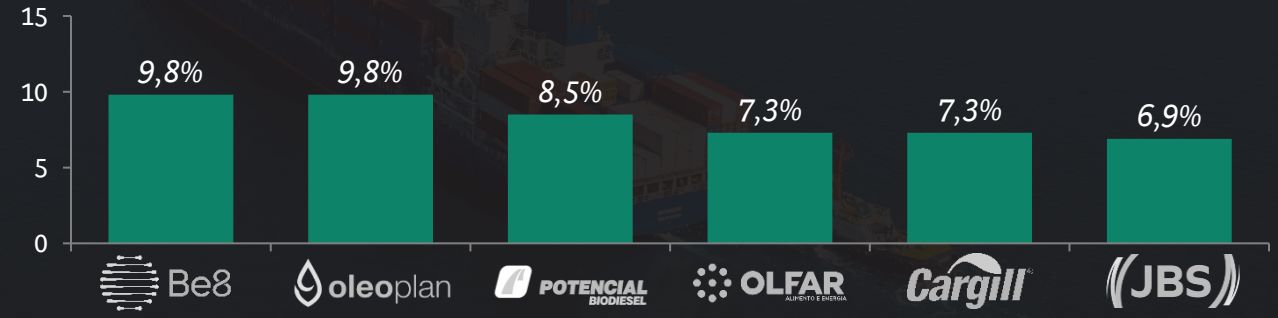
Brazilian Biodiesel production

In billion L

+ 16 BL em 2050

Key producers – Top 6 players

(% of volume sold, 2024)



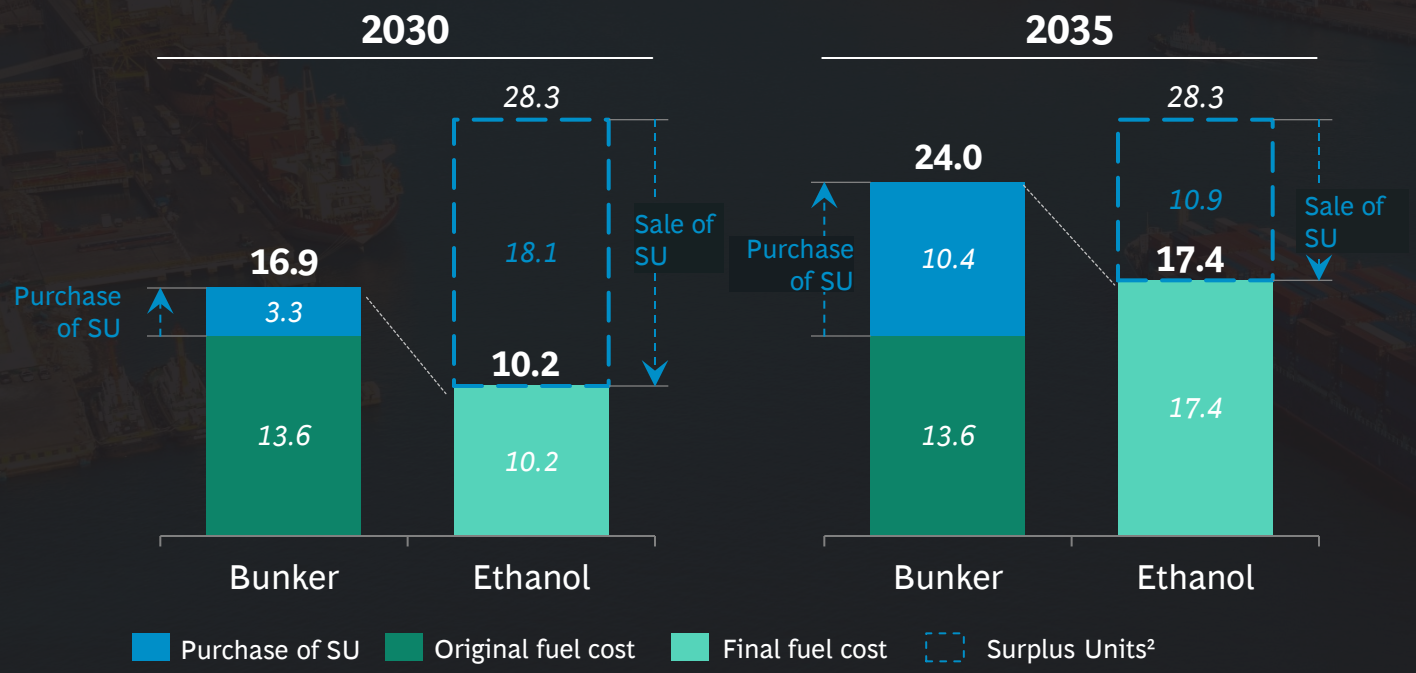
1. Centro Brasileiro de Relações Internacionais (CEBRI) - Alternativas de descarbonização para o setor de transporte marítimo no Brasil; 2. Assumes full B24 penetration across total sector fuel demand to meet equivalent energy needs
Note: Only authorized facilities; capacity considers an estimated 92% production factor
Source: Natural Earth States and Provinces boundaries without large lakes; Agência Nacional do Petróleo. Gás Natural e Biocombustível (ANP)

As engine technology evolves, ethanol offers scalable mid-term growth alternative, with surplus units ensuring cost-effectiveness

Cost competitiveness of ethanol compared with bunker[1]

In U$ per GJ, assuming 22 gCO2e/MJ for ethanol and 91.7gCOe/MJ for bunker

Assuming Surplus Unit price of 350 $ /tCO_2e[3]



Studies show **compatibility of ethanol with methanol engines**

Brazilian ethanol differentials

20-22 gCO2e/MJ

Brazilian ethanol's WtW[3] GHG intensity, corn ethanol with low CI given production in "safrinha"

205-210 $/tCO2e

Abatement cost at BR ports, smaller than IMO $380/tCO2e

265-275 $/tCO2e

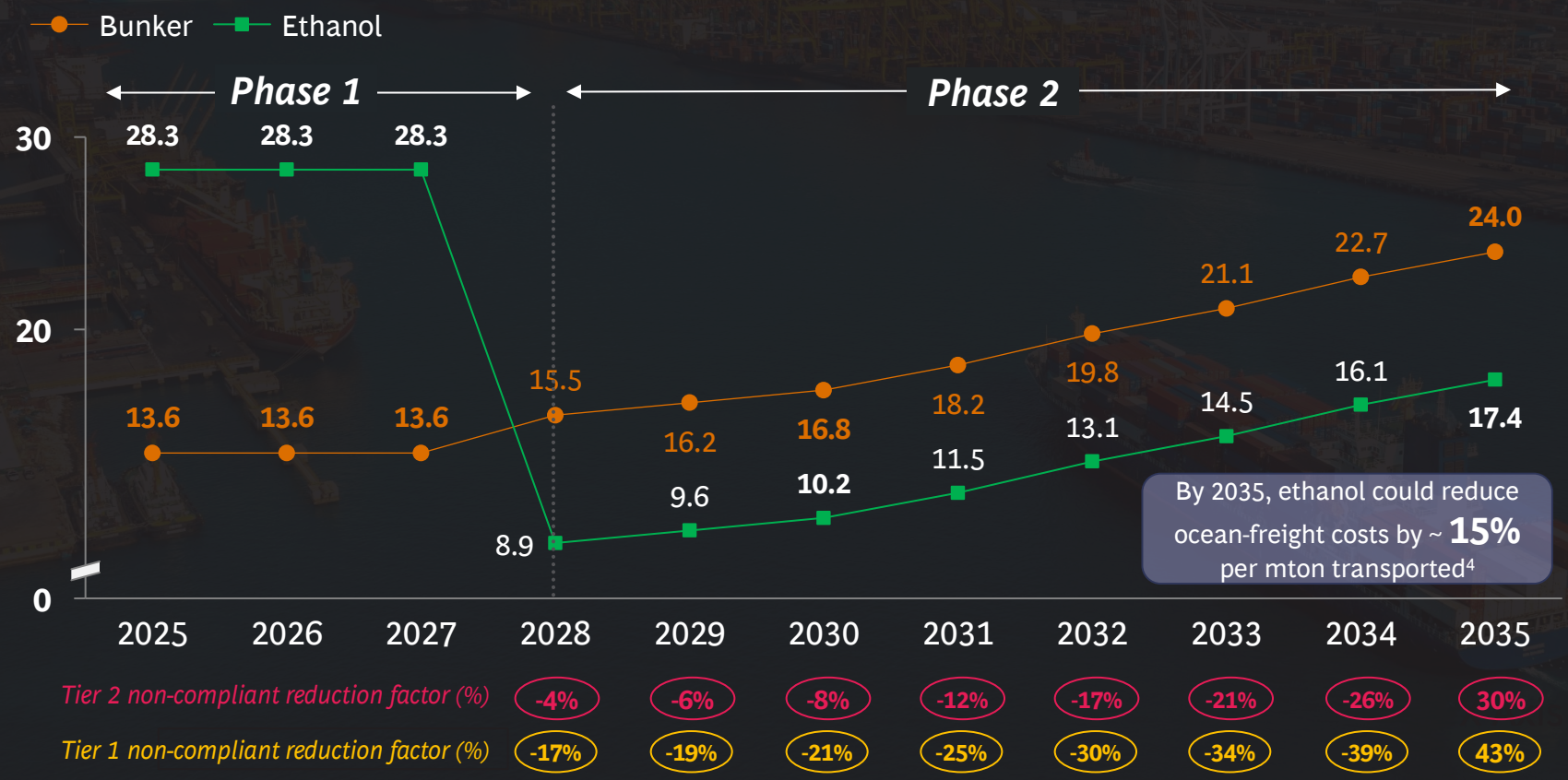
Abatement cost at Rotterdam and Singapore ports, smaller than IMO $380/tCO2e

1.Assuming penalties being paid, delivered at BR port; 2. Surplus units value will be defined by the market, consider value slightly lower than IMO carbon penalty; 3. Well to Wake;
Note: Considering bunker prices at $0.53/L and ethanol prices at $0.62/L; The number of Surplus Units is determined by the difference between the submitted fuel's GHG intensity and the IMO compliance targets
Source: Agência Nacional do Petróleo; Gás Natural e Biocombustíveis (ANP); IMO; General Index ;BCG Analysis

Cost comparison highlights a viable case for ethanol in the beginning of IMO implementation

Cost competitiveness of Ethanol compared with bunker[1] over the years
In U$ per GJ, assuming 22 gCO2eq/MJ for biodiesel and 91.7gCO2e/MJ for bunker

Assuming Surplus Unit price of 350 $ /tCO_2e[2]



Phase 1

No IMO applications yet — price gap remains $14.7/GJ, driven by market differentials and lower energy density (requiring higher ethanol volumes to cover the same route)

Phase 2

From 2028 onward, bunker moves into **Tier-2 non-compliance**. Ethanol stays in the **over-compliant zone** given its lower Carbon intensity and continues to generate SUs

With SUs costing $350/tCO2e[2] versus IMO penalties at $380/tCO2e, SUs are the cheaper compliance route

The price gap holds until ethanol reaches **Tier-1 non-compliance** (beyond 2035)

1. Assuming penalties being paid, delivered at BR port; 2. Surplus units value will be defined by the market, consider value slightly lower than IMO carbon penalty; 3. Well to Wake;
4. Assuming that 40% of freight costs are attributable to fuel, and considering a comparison based on the same route and vessel type; Note: Considering bunker prices at $0.53/L and ethanol prices at $0.62/L;
Source: Agência Nacional do Petróleo; Gás Natural e Biocombustíveis (ANP); IMO; General Index; BCG Analysis

Brazilian biofuels leverage the country's competitive advantages to deliver lower carbon intensity than global alternatives

Agriculture efficiency

- Brazil's crop yields are **3x higher** than the global average
- Intercropping systems ("*safrinha*") optimize land use and fertilizer efficiency
- Extensive use of agricultural byproducts (corn DDGS, soybean bran, sugarcane bagasse)

Technological maturity

- Brazil has been producing biofuels since the 1970s, building decades of expertise
- Strong public policy frameworks since the early 2000s have supported continuous sector growth and innovation

Renewable energy

- Brazil has great access to clean energy, with **+50%** of its energy mix being renewable
- Cane ethanol production enables energy cogeneration from bagasse, reducing fossil energy reliance

CO2 sequestration potential

- Brazil has vast land areas with high CO_2 sequestration capacity, including deep soil layers
- Pastureland restoration for agriculture enhances soil carbon storage

It's critical that the IMO's carbon intensity definitions are based on robust technical analysis on carbon and sustainability levers, enabling a technology neutral approach to accelerate sustainable fuels adoption

Source: EIA Bioenergy; Brazil Climate Summit (BCS); Embrapa; Brazil Federal Government; RenovaBio; GCB Bioenergy

Brazil has a unique position to supply biofuels to reduce shipping emission footprint

Land restoration

~25M hectares

Emission Reduction

~170 Mt CO_2e /year

Investment opportunity[1,2]

~90 USD Billion

Shipping 2050 energy demand

15%

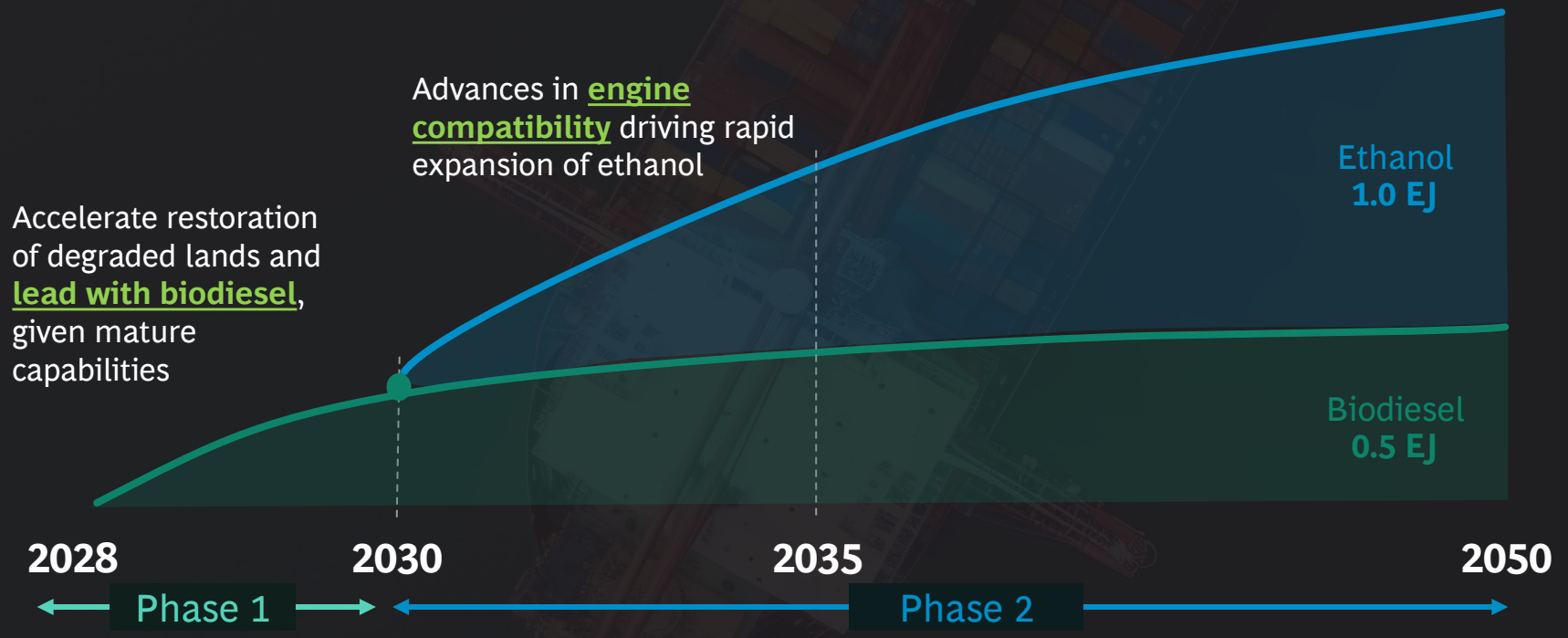
1. Considering $53B investment required to recover degraded pasturelands and $32B investment in CAPEX to scale production;
2. CAPEX estimates reflect only the biofuel production stage, without allocation to distribution or other value chain segments

Source: Agência Nacional do Petróleo, Gás Natural e Biocombustível (ANP); Embrapa; IMO; EPE; Conab; Abiove; Raízen; Única; Unem; BCG Analysis

With key bottlenecks addressed, Brazil is positioned to become a leading global biofuels supplier

Brazilian biofuel production potential [2025-2050]

In EJ (% of potential related to total demand)



Key enablers

Phase 1

- Degraded land restoration strategy
- Decisive move by biofuel producers
- Infrastructure upgrade and export strategies (e.g., green shipping corridor)

Phase 2

- Adapted ports & logistics
- High-end technology to deploy ethanol as a marine fuel (engine compatibility)

Source: EIA Bioenergy; Brazil Climate Summit (BCS); Embrapa; Brazil Federal Government; RenovaBio; GCB Bioenergy

Unlocking the potential of biofuels for shipping requires consolidation of regulatory framework and technology evolution

Regulatory final approval

Final MEPC 83 vote scheduled for the extraordinary session in mid October 2025

Carbon Intensity standards

Carbon accounting under discussion — important evolution towards product level standards

Incentive mechanisms definition

Rewards definition by IMO to be concluded by March 2027

Credibility of compliance

MEPC 83's success requires planning, execution and rigorous enforcement

Short term technology advancements

Methanol-capable engines available at scale to allow ethanol adoption

Source: International Maritime Organization; BCG analysis

Regulatory and infrastructure uncertainties required to be solved in the coming months/years

	2025	2026	2027	2028	2029	2030	2031	2032	2033-2035+
Key risk milestones	**Oct 2025:** Final MEPC83 ratification	**Spring 2026:** Implementation approval	**March 2027:** MEPC83 enforced. targets apply	**2028:** 2027 penalty payments due		**2030:** Penalty price reviewed for potential increase		**2032:** Post-2035 compliance targets set	
Regulatory & policy risks	**Regulatory uncertainty:** Final MEPC83 vote pending		**Credit price volatility:** Unclear where clearing price lands. could be $150 or $350	**Penalty exposure:** Penalty floor of $100 and ceiling of $380 tangible bottom-line threat		**Fuel definitions in flux:** Carbon intensity methodology still evolving; *importance of tech agnostic acceptance of sust. fuels*		**Steep penalty increases:** Potential penalty increases toward 2050 net zero goals	
Asset & infra. risks	**Fleet lock-in:** Most of today's 100k vessels cannot use alternative fuels		**Cutoff for dual-fuel newbuilds:** Secure slots by Q4 2026 for delivery before 2028	**Retrofit pressure:** Yard capacity expected to be bottleneck with retrofit surge		**Orderbook imbalance:** Surge in LNG & methanol/ethanol newbuilds may outpace fuel infra.		**Mismatched fuel & infrastructure:** Limited ammonia & other alt-fuel bunkering	
Fuel supply & market risks	**Race dynamics:** Late movers risk getting locked out of access to viable and accessible fuels		**Price escalation:** Biofuels and methanol expected to spike with rising demand	**Biodiesel contract cutoff:** Secure a more sustainable and cost effective approach though all 2035		**Green fuel shortage:** Supply unlikely to cover demand through 2035; *Brazil potential can reduce/close the gap*		**LNG trap:** Strategic risk to commit only to LNG with no compliant path post-2032	

Source: International Maritime Organization; BCG analysis

There is a good momentum to make announcements on shipping decarbonization in COP 30 – activation group 2 is directly related

Transitioning Energy, Industry and Transport

1. Tripling renewables and doubling energy efficiency
2. **Accelerating zero and low emission technologies in hard-to-abate sectors**
3. Ensuring universal access to energy
4. Transitioning away from fossil fuels in a just, orderly and equitable manner

Stewarding Forests, Oceans and Biodiversity

5. Investments to halt and reverse deforestation and forest degradation
6. Efforts to conserve, protect, and restore nature and ecosystems with solutions for climate. biodiversity and desertification
7. Efforts to preserve and restore oceans and coastal ecosystems

Transforming Agriculture and Food Systems

8. Land restoration and sustainable agriculture
9. More resilient, adaptive, and sustainable food systems
10. Equitable access to adequate food and nutrition for all

Building Resilience for Cities, Infrastructure and Water

11. Multilevel governance
12. Sustainable and resilient constructions and buildings
13. Resilient urban development, mobility and infrastructure
14. Water management
15. Solid waste management

Fostering Human and Social Development

16. Promoting resilient health systems
17. Reducing the effects of climate change on eradicating hunger and poverty
18. Education, capacity-building and job creation to address climate change
19. Culture, cultural heritage protection and climate action

Unleashing Enablers and Accelerators including on Financing, Technology and Capacity Building

20. Climate and sustainable finance, mainstreaming climate in investments and insurance
21. Finance for adaptation
22. Climate integrated public procurement
23. Harmonization of carbon markets and carbon accounting standards
24. Climate and trade
25. Reduction of non-CO_2 gases
26. Governance, state capacities and institutional strengthening for climate action, planning and preparedness
27. Artificial Intelligence, Digital Public Infrastructure and digital technologies
28. Innovation, climate entrepreneurship and small and micro businesses
29. Bioeconomy and biotechnology
30. Information integrity in climate change matters

Source: BCG analysis

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Thank you!

Brazil Climate Summit.