BRAZILIAN CENTER FOR
INTERNATIONAL RELATIONS

INFRASTRUCTURE
AND ENERGY
PROGRAM

RIO DE JANEIRO, JULY 2019

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ENERGY GROUP

Energy transition in the maritime sector

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CEBRI prioritizes themes with the greatest potential to leverage the international insertion of Brazil into the global economy, proposing pragmatic solutions for the formulation of public policies.

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Content: CATAVENTO

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ENERGY GROUP

This Group encourages the discussion on questions related to the energy and Oil & Gas (O&G) sectors and their global trends.

Its focus has been to investigate topics with the potential to enhance the insertion of the Brazilian industry into global chains and influence the formulation of public policies that create a competitive and attractive investment environment, such as technological innovations and their impacts on the sectors' competitiveness; the geopolitical impacts of the increasing relevance of renewable sources in the global energy mix; the identification of anchor sectors for fossil fuel demand in the long term; changes in the sectors' regulations, etc.

TRUSTEE

Jorge Camargo

Former president of the Brazilian Petroleum, Gas and Biofuels Institute (IBP) and senior advisor at McKinsey & Company. Previously, he worked for Statoil, as senior vice-president in Norway and later as president of Statoil in Brazil. He is also a member of the Board of Directors at Ultrapar Group and at Prumo Logistics.

SENIOR FELLOW

Clarissa Lins

Clarissa Lins is founding partner at Catavento, a consultancy on strategy and corporate sustainability. She is Executive Director at Brazilian Petroleum, Gas and Biofuels Institute (IBP) and Member of the Global Future Council on Advanced Energy Technologies at the World Economic Forum (WEF). She was a Member of the Sustainability Committee of Vale's Board of Directors and has also worked for Petrobras and BNDES. She holds a Bachelor and Master's Degree in Economics from PUC-Rio.

EXECUTIVE DIRECTOR

Julia Dias Leite

She is CEBRI´s Executive Director since 2015. Previously, she worked for 10 years at the Brazil-China Business Council, where she occupied the position of Executive Secretary. Recently, she was chosen by the U.S. State Department to participate in the Young World Leaders program.

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PANELISTS

Claudia Sousa

Mrs. Claudia Sousa is currently the General Manager of Petrobras' Downstream Area. She is responsible for domestic sales of fuel oil, petcoke and asphalt, and for bunker trading both in the Brazilian and international markets.

Mrs. Sousa joined Petrobras in 1990 and spent almost 15 years at Petrobras' Downstream Area in the oil trading business having assumed several managing positions. Subsequently, she moved to the Gas & Energy Area, where she served for 11 years, mainly as the General Manager for natural gas procurement and LNG trading.

She received her B.S. in chemical engineering from Federal University of Rio de Janeiro (UFRJ) in 1985. She has two MBA's from COPPEAD-UFRJ (1996) and IBMEC, Rio de Janeiro (2001).

Jonas Mattos

Mr. Jonas Mattos is Business Development Manager South America at DNV GL - the world's leading provider of risk management and quality assurance services to the maritime, oil and gas, power and renewables industries - since 2012.

Prior to DNV GL, he was Sales Director at Xerox do Brasil. He has an extensive experience in B2B segments, in which he already occupied senior positions in the chemical, naval and IT industries. In addition to the engineering background, Mr. Mattos has experience with project management, services, sales, marketing, IT and strategy.

He holds a naval engineering bachelor degree at the Federal University of Rio de Janeiro (UFRJ) and a Master of Business Administration from COPPEAD-UFRJ.

Letícia Villa-Forte

Ms. Letícia Villa-Forte joined Prumo Logística in 2014 as business development and strategic planning manager. In 2018, she assumed the position of CEO, responding for the joint venture formed by BP and Prumo focused on import and sale of marine fuels to supply vessels in the influence area of Port of Açu.

Before joining Prumo, she had over 10 years of experience in the financial market, working in investment banks such as Rothschild and Lehman Brothers.

She has a degree in Production Engineering from the Federal University of Rio de Janeiro (UFRJ) and a master's degree from École Centrale de Paris.

Ricardo Cesar Fernandes

Mr. Ricardo Cesar Fernandes is the Executive Director of the Norwegian Shipowners´ Association Brazil (ABRAN), since it was established in 2012. He is also a member of the Committee of Maritime and Port Law of the Brazilian Bar Association – RJ, since 2017.

He is a seasoned executive with expertise in activities related to the maritime industry, acquired during more than 35 years working for the private sector and in the Brazilian Navy.

Mr. Fernandes is a Commander (ret.) and he holds a Master of Science Degree in Business Administration from FGV/EBAPE and Nautical Science from the Brazilian Naval War College. He also holds an MBA from COPPEAD-UFRJ and has a bachelor's degree in Nautical Science from the Brazilian Naval Academy.

Ricardo Mendes

Mr. Ricardo Mendes is a senior executive with a solid experience in the energy sector and has served, since 2011, as Head of Energy at Vale, one of the largest mining companies in the world, where he has been leading the area through a cycle of robust investment in power generation and energy management.

He has 21 years of experience at Vale, in different leadership positions in the energy area from trading, operations to business development and new ventures.

He has a bachelor's degree in electrical engineering from the Federal University of Minas Gerais (UFMG), as well as several extension courses in Brazil and abroad on energy, sustainability and business.

Erik Ianssen

Mr. Erik Ianssen is the CEO of Selfa Arctic AS, a Norwegian company founded in 1872 in Trondheim, that is leading a revolution in the maritime transport and services towards zero-emission.

He has been a boat builder since 1972, with more than 2,000 vessels built and 800 fishing vessels delivered in 15 countries. In 2015, he delivered the world's first electric fishing boat, MK Karoline. Also, he has a solid role in the closing of the Norway World Heritage Fjords to polluter ships until 2026.

He is part of the present electric revolution taking place in Norway, and aims to spread these sustainability ideas with peers around the globe.

EXECUTIVE SUMMARY

The maritime sector plays a key role in social and economic development. Seaborne trade accounts for 80% of physical global trade[1], transporting goods and commodities from different corners of the world in a more energy and CO_2 efficient way than other modes, such as road and air[2]. On the other hand, the sector has a stake in the climate challenge as seaborne trade accounts for 5% of global oil demand[3], 2% of CO_2 emissions and 13% of sulfur emissions.[4] Therefore, the maritime industry is responding to new societal expectations and demands, mainly through the International Maritime Organization's (IMO) commitments.

The energy-related short-term response from the maritime sector is based on the IMO regulation that limits the sulfur content in marine fuels to 0.5% as of 2020[5] ("IMO 2020"). The new rule has implications for the maritime and energy industries. In the short term, shipping companies have two options to comply with IMO 2020: install scrubbers or convert to alternative fuels. Market predictions point that scrubber installation will only cover 2% of the market by January 2020[6]. This scenario means that shipping companies will switch from high sulfur fuel oil (HSFO) to low sulfur fuel oil (LSFO) and marine gasoil (MGO), potentially displacing 2.4 MMb/d of non-compliant fuel in a one year window[7]. This rising demand for LSFO will impact the price differential between sweet and sour crudes. Additionally, the surge in MGO demand will likely affect the pricing of other distillate products, such as diesel, kerosene, heavy and light gas oil[8]. Although the pricing trajectory of oil products is still uncertain, specialists estimate an increase in the diesel and gasoline spread of about USD 3-8 per bbl in 2020[9].

The second challenge faced by the maritime industry regarding the energy transition is related to decarbonization. The IMO aims to reduce greenhouse gas emissions by at least 50% by 2050 in comparison to the 2008 level[10]. In order to reach this target, the sector will need to focus on logistics improvements, energy efficiency and, especially, fuel substitution. However, alternative fuels and technologies to achieve this goal remain uncertain both in

1. IEA – "Tracking Clean Energy Progress: International shipping", 2018;
2. ABRAN – "The green shipping revolution", 2019
3. IEA – "World Energy Outlook", 2018
4. Columbia SIPA, Center on Global Energy Policy – "Oil market in flux amid uncertainty over shipping's fuel rules". 2019
5. IMO website – "Sulphur 2020 – cutting sulphur oxide emissions"
6. Schroders – "IMO 2020: Short-term implications for the oil market", 2018
7. McKinsey – "Global downstream outlook to 2035", 2019
8. Schroders – "IMO 2020: Short-term implications for the oil market", 2018
9. McKinsey – "Global downstream outlook to 2035", 2019
10. IMO website – "Low carbon shipping and air pollution control"

terms of their technological and economical viabilities. Batteries, biofuels and fuel cells are potential alternatives to achieve the 2050 target, but there are still significant challenges related to scalability and implementation costs, in order for them to become viable solutions for long distance shipping[11]. In this scenario, shipping decarbonization is an unprecedented challenge in the industry that will require a new level of cooperation among stakeholders. Unlocking the necessary technological solutions to succeed in this context will mandate a profitable business case and appropriate funding, in addition to a robust R&D regulation.

Finally, Brazil is well positioned to thrive in this environment. In the short term, the lower sulfur requirement favors Brazilian pre salt's crude oil, which is naturally compliant with IMO 2020[12]. The higher spread between sweet and crude oil will therefore benefit the country's exports, while the domestic refining segment is strategically positioned to increase LSFO supply to the Brazilian domestic shipping market at higher margins[13]. Considering the longer term decarbonization goal, liquefied natural gas (LNG) can potentially be a transition fuel towards the 2050 target. Natural gas gross production in Brazil is expected to grow by 7% annually until 2027[14], while maritime transport could provide a complementary demand to leverage Brazilian pre salt gas usage. Brazil could leverage on its vast and diversified resources in order to position itself as a global supplier of lower emissions fuels, as well as to foster competitive solutions to the long-term decarbonization of maritime transport.

11. DNV-GL – "Assessment of selected alternative maritime fuel and technologies", 2018
12. Schroders – "IMO 2020: Short-term implications for the oil market", 2018
13. Schroders – "IMO 2020: Short-term implications for the oil market", 2018
14. EPE – "Plano Decenal de Expansão de Energia 2027", 2018

1. INTRODUCTION

The sea is home to maritime transport, which accounts for 80% of physical global trade[15]. It also unites activities from diverse sectors of the economy, from fishing to oil and gas exploration, which are all facing a new paradigm in terms of finding the right balance between the economic exploitation of the sea and sustainability.

Structural changes are reshaping the maritime sector, such as containerization, ship liners consolidation, increased consumption from Asian markets, digitalization and energy transition[16]. These trends influence not only the cargo profile - with greater participation of containers, LNG and grains - but also the growth rate of global maritime trade. From 2010 to 2016, seaborne trade grew 3.9% annually. However, a slowdown is expected from now on, with 1% annual growth until 2050[17], a consequence of higher consumption in emerging markets being counterbalanced by increasingly integrated Chinese industries, new technologies and a growing demand for services in detriment of goods[18].

In terms of energy and environmental aspects, seaborne trade accounts for 5% of global oil demand[19], 2% of CO_2 emissions[20] and 13% of sulfur emissions[21]. Even though the maritime industry has not been considered in the Paris Agreement, it can be part of the solution. On average, sea transport is about four to ten times more efficient than rail and road transport, respectively, in terms of CO_2 emissions per nautical miles[22]. Nevertheless, the International Maritime Organization (IMO) set ambitious goals in 2016 to tackle the industry's sulfur and carbon emissions. Firstly, the IMO set a guideline to limit the sulfur concentration in marine fuels from 3.5% to 0.5% by 2020[23]. Even though a 0.1% sulfur limit is already applied in the Emission Control Areas (ECA) – North America and Northern Europe coasts since 2015, a global sulfur cap has significant implications to the energy sector. Secondly, it has a target to reduce greenhouse gas emissions by at least 50% by 2050 in comparison to the 2008 level[24]. In line with these commitments, maritime transportation will have to promote logistics improvement, energy efficiency and fuel

15. IEA – "Tracking Clean Energy Progress: International shipping", 2018;
16. McKinsey – "The future of trades and value chain", 2019; BCG – "The new normal in global trade and container shipping", 2016
17. DNV GL – "Maritime forecast 2050", 2018
18. McKinsey – "The future of trades and value chain", 2019
19. IEA – "World Energy Outlook", 2018
20. IEA – "CO2 emissions form fuel combustion", 2018
21. Columbia SIPA, Center on Global Energy Policy – "Oil market in flux amid uncertainty over shipping's fuel rules". 2019
22. ABRAN – "Green shipping revolution", 2019
23. IMO website – "Sulphur 2020 – cutting sulphur oxide emissions"
24. IEA – "IEA Commentary: Commentary: International Maritime Organization agrees to first long-term plan to curb emissions". 2018

substitution, by introducing LNG, biofuels and electricity in an energy mix currently fueled by oil products[25].

In this scenario, the maritime energy transition can be divided in two phases: short-term sulfur limit and longer-term GHG emissions reduction. Alternative fuels and technologies will play different roles in each of these time frames, and present decisions must consider the uncertainties over the variables shaping the maritime business scenario.

Given the challenges and opportunities that arise in this context, CEBRI's Infrastructure and Energy Program organized an event on July 11th, 2019, with the support of the Royal Norwegian Consulate in Rio de Janeiro, to discuss the energy transition in the maritime sector. The event's main goals were to **understand global trends**, their impact on the **Brazilian energy and logistics sector**, as well as the response from **major exporters**.

The opening remarks were delivered by Marianne Fosland – Norwegian Consul General in Rio de Janeiro, followed by two discussion panels. The first panel benefitted from insights presented by Jonas Mattos – Business Development Manager Maritime South America at DNV-GL, Ricardo Cesar Fernandes – Executive Director at the Norwegian Shipowners´ Association Brazil (ABRAN), and Erik Ianssen – CEO at Selfa. The second panel relied on remarks by Claudia Sousa – Marketing and Trade General Manager at Petrobras, Letícia Villa-Forte – CEO at BP Prumo, and Ricardo Mendes – Head of Energy at Vale.

This paper aims to consolidate the event's main discussions. The inputs reflect the panelists' opinions, as well as additional desk research, respecting Chatham House rules of non-attribution.

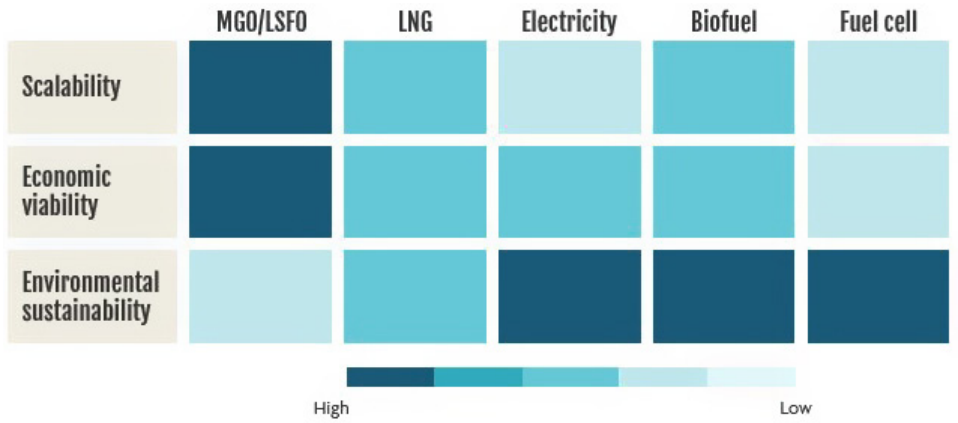
25. DNV GL – "Assessment of selected alternative maritime fuel and technologies", 2018

2. IMO 2020 SULFUR CAP: UNCERTAINTIES AND IMPACT ON THE ENERGY SECTOR

By 2020, a global sulfur cap will be established at 0.5%. **In order to comply with the new guidelines, ships will replace high sulfur fuel oil (HSFO) by either installing scrubbers or converting to alternative fuels**[26]. The pros and cons of each option may vary widely, according to the region, sector and the evolution of unknown variables. In this scenario, three main aspects must be taken into consideration for fuel and alternative technologies assessment: economic viability, environmental benefits and scalability[27].

Scrubber installation does not require fuel substitution. Scrubbers act as a filter for sulfur emissions and remain as the cheaper short-term solution for shipping retrofit[28]. However, upfront investments are still required, and future regulation for the open loop scrubber type remains uncertain, as it avoids sulfur air emissions, but pumps wastewater into the sea[29]. From 2018 to 2019, ships with installed or ordered scrubbers increased fourfold, with 80% of them having the open loop design. Even with this sharp increase, only 1,200 out of 60,000 ships that shall adapt to the new rule will have installed scrubbers by 2020[30].

Figure 1. Analysis of different alternative fuels according to specific criteria



Source: DNV GL – "Assessment of selected alternative fuels and technologies", 2018

26. Schroders – "IMO 2020: Short-term implications for the oil market", 2018
27. DNV GL – "Assessment of selected alternative fuels and technologies", 2018
28. A. Halff, L. Younes, T. Boersma – "The likely implications of the new IMO standards on the shipping industry", 2019
29. A. Halff, L. Younes, T. Boersma – "The likely implications of the new IMO standards on the shipping industry", 2019
30. Schroders – "IMO 2020: Short-term implications for the oil market", 2018

Other alternatives for ships are: sourcing low sulfur fuel oil (LSFO), switch to marine gasoil (MGO) or liquefied natural gas (LNG). At present time, LSFO and MGO present high scalability and economic viability, but low environmental benefits since GHG emissions remain significant[31]. The economic analysis over time might change, considering the evolution of complex variables such as energy commodities prices, carbon pricing and regulation. On the other hand, the assessment of LNG should consider a longer-term perspective, given that the fuel currently offers medium scalability, economic viability and environmental results, but the changing landscape may benefit it as a transition fuel towards the IMO 2050 net zero carbon emissions target[32]. Some forecasters expect the LNG bunker demand in the shipping sector to reach between 20 and 30 million tons *per annum* (mtpa) by 2030, from less than 1 mtpa today, as will be discussed in more detail in the next section.[33]

One important aspect to be considered when analyzing the short-term IMO sulfur limits is a slow response from industry players. Although the IMO sulfur cap rules were announced in 2008, the implementation plan was still uncertain and shipping companies did not decide which path or technology to adopt until less than two years prior to the effective date[34]. These last-minute decisions were potentially a consequence of the five-year delay possibility that the IMO kept open until fuel-availability studies were concluded[35].

Under this shady scenario and since a number of different ship liners and refineries took longer than expected to respond to the new regulation, the marine fuel market may suffer a significant overhaul by 2020.

When looking at the impacts of the IMO's 2020 regulation on the energy and fuels sector, it points towards a collapse in HSFO consumption. HSFO demand shall be reduced by 2.4 MMb/d by 2020[36], being replaced by LSFO and MGO. The significant displacement of HSFO in such a short period of time will impact the price differential between sweet and sour crudes[37]. Additionally, the surge in MGO demand will likely affect the pricing of other distillate products, such as diesel, kerosene, heavy and light gas oil [38]. According to a McKinsey analysis, the price differentials between diesel and gasoline, for example, may rise by USD3-8/bbl in 2020[39]. Although the challenge for the refining industry is undeniable, it is important to notice that the diesel price trajectory will also be dependent on the demand coming from a wide variety of sectors such as road transport,

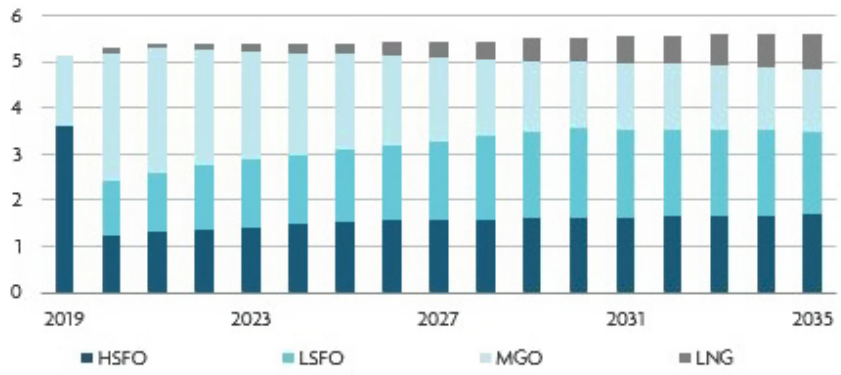
31. DNV GL – "Assessment of selected alternative fuels and technologies", 2018
32. DNV GL – "Assessment of selected alternative fuels and technologies", 2018; A. Halff, L. Younes, T. Boersma – "The likely implications of the new IMO standards on the shipping industry", 2019
33. Columbia SIPE CGEP – "Uncertainty Ahead: The Outlook for LNG Demand in the Marine Transportation Sector". 2019
34. Columbia SIPE CGEP – "Uncertainty Ahead: The Outlook for LNG Demand in the Marine Transportation Sector". 2019
35. A. Halff, L. Younes, T. Boersma – "The likely implications of the new IMO standards on the shipping industry", 2019
36. McKinsey – "Global downstream outlook to 2035", 2019
37. Schroders – "IMO 2020: Short-term implications for the oil market", 2018
38. Schroders – "IMO 2020: Short-term implications for the oil market", 2018
39. McKinsey – "Global downstream outlook to 2035", 2019

heating, agriculture and industries, pointing to a higher level of uncertainty regarding the market equilibrium under this new scenario[40].

Apart from prices, there are also challenges and issues related to enforcement and to the net impacts on emissions. The IMO 2020 chose a performance standard, rather than a technical one. This means that shipping companies are free to choose the fuel or technology they will adopt, as long as they achieve the target set by the IMO. In other words, players have the incentive to innovate and introduce the best option at the lowest cost. Nevertheless, some specialists believe that performance standards are naturally harder to be enforced[41]. At the same time, the uncertainty regarding the effective date of the sulfur cap induced shipping companies to choose the options with the lowest cost and shortest implementation time, leading to choices that might not necessarily mean the most efficient pathways in terms of carbon emissions[42].

Given this scenario, the global marine fuel mix is set to face significant changes by early 2020, as can be seen in the graph below. McKinsey's reference scenario projects that the displaced HSFO demand is converted equally into LSFO and MGO by 2020. However, LSFO gains market share over time, from 22% in 2020 to 36% in 2030, while MGO is gradually replaced. This sharp increase occurs as refiners adapt their operations to increase LSFO output. On the other hand, LNG presents a 14% CAGR over the 2020–2035 period, outpacing the relative growth from others.

Figure 2. Global marine fuel demand mix (MMb/d)



Source: McKinsey – "Global downstream outlook to 2035", 2019

40. A. Halff, L. Younes, T. Boersma – "The likely implications of the new IMO standards on the shipping industry", 2019
41. Columbia Global Energy Dialogue Report – "Sulfur Regulations on the High Seas", 2018
42. A. Halff, L. Younes, T. Boersma – "The likely implications of the new IMO standards on the shipping industry", 2019

3. THE PATH TOWARDS LONG-TERM DECARBONIZATION IN THE MARITIME SECTOR

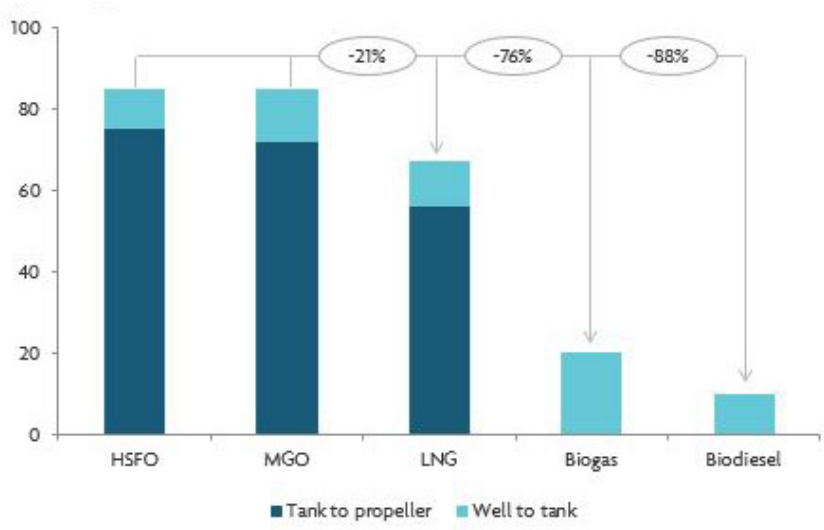
Looking specifically into IMO's long-term commitment to reduce GHG emissions in maritime transport by 50% by 2050, in comparison to the 2008 level, fuel substitution will be crucial. However, alternative fuels and technologies to achieve this goal remain uncertain. Although LNG is seen as a transition fuel, batteries, biofuels and fuel cells are potential alternatives to achieve the target, but they still need to increase scalability and reduce implementation costs in order to become a viable solution for long distance shipping[43].

On the order hand, short distance shipping may already benefit from batteries and set the first steps towards maritime decarbonization. Globally, there are 169 operating ships, and another 103 that are under construction, running on batteries, which together still represent only 0.5% of the global fleet[44]. Approximately 35% of the electrical fleet is located in Norway, which has set passenger and car ferries as the starting point for the maritime decarbonization[45].

As for LNG, its role as a shipping fuel still faces challenges regarding scalability and economic viability, but it is finding increased momentum in the global debate. By 2021, for example, the 25 largest global ports will have LNG refueling[46] and 434 ships are already committed to be running on LNG by then[47]. Nevertheless, the fuel still faces the challenge related to its carbon emissions reduction potential. Compared to oil-based fuels, LNG emits 21% less carbon, while biogas and biodiesel present 76% and 88% lower carbon emissions, respectively (see graph below). At the medium-term horizon, biodiesel and biogas are still not seen as economically viable solutions, although they are crucial to achieve the established environmental targets by 2050.

43. DNV-GL – "Maritime forecast to 2050", 2018
44. UNCTAD – "Handbook of statistics", 2018
45. DNV-GL "Transição Energética no Setor Marítimo", 2019
46. Schroders – "IMO 2020: Short-term implications for the oil market", 2018
47. DNV-GL "Transição Energética no Setor Marítimo", 2019

Figure 3. Alternative shipping fuels emission (gCO2/MJ)



Source: DNV GL – "Assessment of selected alternative fuels and technologies", 2019

Given the uncertainties regarding the different technologies assessment to achieve the IMO's 2050 target, policy makers should analyze how to foster green shipping with an integrated vision of maritime activities. By definition, maritime transport is a global activity with no physical border between nations. Therefore, stakeholder cooperation in the industry is crucial to thrive in the challenging path towards decarbonization. The stakeholders include shipyards, energy companies, shipping companies, ports, marine fuel distributors, exporters, governments, regulators, banks, investors and society. Players in the maritime industry should establish partnerships to tackle regulatory, technological and financial barriers to mitigate climate impacts. Beyond IMO's actions, the Poseidon Principles proposed by financial institutions and the Green Shipping Programme, established by the Norwegian maritime industry, are two examples of stakeholder cooperation aimed at mitigating climate change with a focus on the maritime sector.

The recently released Poseidon Principles, led by 11 banks representing US$ 110 billion in loans, established a framework for assessing and disclosing the climate alignment of ship finance portfolios[48]. The initiative is divided into four guidelines – assessment, accountability, enforcement and transparency. First, signatories will measure the carbon intensity of their shipping portfolios annually and assess their climate alignment relative to established decarbonization trajectories. Second, to guarantee practical, unbiased and

48. Poseidon Principles website – "A global framework for responsible ship finance"

accurate information, signatories will only use data, sources, standards and service providers established by the IMO. The third guideline requires that the Poseidon Principles are made contractual in new business activities through standardized covenant clauses. Lastly, signatories are obligated to report their portfolio alignment annually[49].

With the objective of fostering the energy transition in the maritime sector, the Norwegian government developed the Green Shipping Programme, in partnership with key industry players. The Programme's ambition is to establish the world´s most efficient and environmentally friendly shipping. In this context, it developed a roadmap structured in four distinct phases from 2015 to 2030. The first phase (2015-2016) had the objective to assess battery and gas-based maritime transport potential in Norway. The second phase (2016-2017) focused on the analysis of the business and socio-economic consequences of emission reduction measures. The third phase (2018-2019) aims to remove barriers to green solutions through the assessment of challenges and opportunities. Finally, the last phase (2019-2030) is expected to scale the solutions for shipping decarbonization[50].

Unlocking technological solutions for the maritime industry decarbonization requires profitable business cases, funding and a robust R&D regulation[51]. To achieve the IMO 2050 target, fuel substitution will play a key role. While hydrodynamics and machinery energy efficiency solutions may reduce emissions up to 20%[52], alternative fuels and technologies are the way forward to achieve the full decarbonization of the maritime sector.

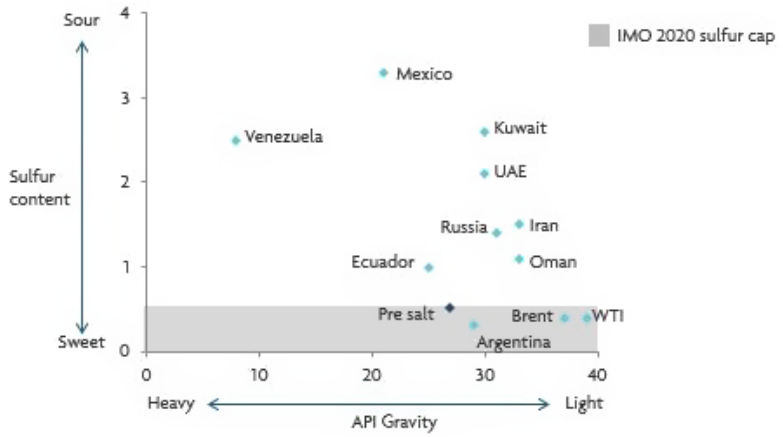
49. Poseidon Principles website – "A global framework for responsible ship finance"
50. DNV-GL website – "Green shipping programme"
51. Energy Transition Commission – "Reaching zero emissions from shipping", 2018
52. DNV-GL – "Transição Energética no Setor Marítimo", 2019

4. BRAZIL POSITIONED TO THRIVE IN THE MARITIME ENERGY TRANSITION

Brazil is a key market supplier in the short-term scenario for shipping fuel in the global landscape. The country is currently the 8th largest nation in terms of refining capacity with 2.3 MMb/d and 2.4% of the global market share[53]. Petrobras's share of Brazil's refining capacity reaches 98.6% at present time, although the company announced the divestment of eight units with a total capacity of 1.1 MMb/d (47% of domestic capacity)[54]. Considering its assets characteristics, mainly due to the type of oil found in Brazilian reserves and the refinery processes undertaken, the company is strategically positioned to experience higher margins in crude oil, leverage LSFO exports and increase the attractiveness of its refining units[55].

Given the new dynamics of the energy sector imposed by IMO 2020, upstream companies producing sweet crude oil will experience a premium price over sour crude oil. Considering that most refiners do not currently have the ideal infrastructure to produce LSFO and MGO, the most likely outcome is the switch in the crude oil input specification[56]. A low sulfur requirement favors the Brazilian pre salt's oil (see graph below), which is naturally compliant with IMO 2020.

Figure 4. Crude oil specification by region - Sulfur content (%) and density (API gravity)



Sources: Catavento analysis based on EIA – "Crude oils have different quality characteristics", 2012; ANP – "Regulatory framework of the pre salt", 2016; Schroders – "IMO 2020: Short-term implications for the oil market", 2018

53. EPE – "Opportunities in Brazil's Refining Industry", 2019
54. EPE – "Opportunities in Brazil's Refining Industry", 2019
55. Petrobras – "Webcast – Resultados do 2º trimestre 2019", 2019
56. Schroders – "IMO 2020: Short-term implications for the oil market", 2018

On the other hand, Brazilian exporters might face additional challenges with regards to operating expenses to supply Asian markets. The mining company Vale, Brazil´s second largest exporter, sells 58% of its iron ore to China[57], which stands 13,200 nautical miles[58] away from the Brazilian coast, while its greatest competitors, the Australian miners, are roughly 3,700 nautical miles[59] away from Chinese ports. Currently, Petrobras sells 75% of its crude oil production to China, competing with Middle Eastern players[60]. In this scenario, any change in maritime transportation prices can impact Brazilian exporters' competitiveness. To adhere to the short-term sulfur cap, for example, Vale decided to equip its fleet with scrubbers, after analyzing different options and costs. By 2018, Vale's new long-term Contracts of Affreightment were designed with 48 ships (47 very large ore carriers and one Valemax) installed with scrubbers[61].

In the long term, shipping decarbonization remains uncertain in the Brazilian landscape. Nevertheless, the positive outlook for the Brazilian natural gas market points to LNG as a potential candidate to pave the way towards shipping decarbonization. Natural gas gross production in Brazil is expected to grow by 7% annually until 2027[62]. However, this additional supply comes from associated gas from the pre salt, which requires a stable and predictable market in order to be fully developed. By 2026, associated gas will represent 78% of the gas supply[63]. In this sense, industry and power generation are natural candidates as potential consumers, but new markets such as maritime transport could provide a complementary demand to leverage the Brazilian pre salt gas. Brazil could leverage on its vast and diversified resources in order to position itself as a global supplier of lower emissions fuels, as well as to foster competitive solutions to the long-term decarbonization of maritime transport.

57. MDIC website "Comex stat 2018"
58. Estimated by Google maps: distance between Port of Itaqui and Port of Shanghai
59. Estimated by Google maps: distance between Port of Itaqui and Port of Shanghai
60. Petrobras – "Webcast – Resultados do 2º trimestre 2019", 2019
61. Vale – "Vale's Performance in 2Q18", 2018
62. EPE – "Plano Decenal de Expansão de Energia 2027", 2018
63. EPE – "Perspectivas para a produção de gás natural", 2018

5. FINAL REMARKS

The most effective way to accelerate the energy transition in the maritime sector is through collaboration among major industry players, targeting economic and environmental solutions. Recent anthropogenic emissions of greenhouse gases are the highest in history, and the potential impacts of climate change over humankind may be devastating[64]. Shipping is the invisible backbone of the global economy and is the most energy efficient way of moving goods.

Nevertheless, the industry also has a stake in global sulfur and carbon emissions. The growing pressure from governments, regulators, customers and society urges the maritime industry to acknowledge the challenge and move forward in the energy transition. Shipping companies shall comply with short-term regulation and prepare for long-term decarbonization, while remaining competitive in the business landscape. Given this unprecedented challenge in the sector, partnerships across the maritime value chain and effective public policies to foster energy transition will play a key role.

64. IPCC – "Global warming of 1.5 °C", 2018

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