VIEW POINT

CHARTING COURSE TO A GREENER FUTURE: DECARBONIZING SHIPPING AND STEEL

Abstract

As the world of business sets sail on its quest to combat climate change, it is critical that it builds a cleaner cycle of urbanization, industrialization, and commercialization – the building blocks of global economic growth. An imminent energy transition is on the horizon for the maritime industry, considering ocean freight – the driving force of this global economy – consumes 300 million tons of one of the most polluting fuels and is responsible for 3%[1] of the total greenhouse gas (GHG) emissions. Steelmaking, the backbone of urbanization and industrialization, is also under pressure as one of the three biggest producers of CO2 at 8%[2]. Reducing carbon emissions across shipping and steelmaking is a complex challenge that calls for systematic planning and implementation at scale. With extremely slow progress in decarbonizing steelmaking, what complicates matters most is the shared web of Scope 1 and Scope 2 emissions that originate with the mining industry's extraction of iron ore and coking coal, critical inputs for steelmaking. Acknowledging and working toward these carbon-critical concerns can help navigate and create cleaner avenues to a greener tomorrow. This paper provides insights into the challenges and offers recommendations to steer shipping and steelmaking toward a sustainable future.

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Introduction

Post World War II, there were limited viable ocean freight routes with continuous protection from the established western naval fleets. As globalization advanced, the shipments on these routes surged significantly. Ocean freight evolved over the next few decades to be dominated by colossal ships and vessels. But the bunker fuel for these vessels did not simultaneously keep up with transitioning to cleaner options.

The size of container ships translates to economic growth, operational efficiency, and large-scale transportation across the globe. From the world's first commercial container shipment in 1956 with 58 containers on board to the ultra-large container vessels (ULCVs) holding as many as 24,000 containers today[3], the industry has come a long way. Fueled by a surge in iron ore trade, global market dynamics, economies of scale, and spike in homebound consumer demand during the pandemic, Capesize vessels like the MSC Irina – with a 240,000 DWT[4] – are stretching the limits of even the world's largest ports.

In the cost-fixated steelmaking industry, energy-dense coking coal emerged early on as the resource of choice due to two key factors. One was that it met the energy-intensive requirements of traditional steelmaking. The other reason was that its dominance in the global raw material supply chain made it affordable and easily available. The massive cargo capacities of Capesize, Panamax, and ULCVs helped transport this bulk commodity to geographically distant steel mills. The steady supply of these large shipments was fed into the enormous blast furnaces (BFs), which thrived on larger capacities for increased efficiency. Low in impurities, coking coal aided in quick reduction of iron ore into molten iron, transforming BFs into steel mill powerhouses. The abundance of coking coal in exporting countries such as China, India, Australia, Canada, Indonesia, the US, and Russia, coupled with favorable price points, tempted steelmakers to continue with this inexpensive carbon-intensive fuel, disincentivizing any carbon-neutral innovation.

More than 99% of the energy[5] to power international shipping traditionally comes from some of the most polluting oil-based fuels, while about 89% of the energy input[6] in BFs comes from coal. The alarming amounts of carbon emissions from the energy-expensive bulk shipping and coal-based steelmaking have made transformative change imperative. As we confront decarbonizing ocean freight and steelmaking, the limitations and environmental consequences of these historical paradigms become evident. And yet, there are opportunities for innovative solutions and climate-aligned trade lanes.

Net Zero: A Catalyst for Change

Large-scale carbon-neutral transitions within the shipping and steelmaking industries can take decades of collaboration and substantial investments involving billions of dollars in research and development (R&D), shipbuilding, and BF refitment expenses. But if these high-GHG emitters initiate immediate, directed, and collaborative action at scale, they can aspire to achieve the International Maritime Organization's (IMO) common ambition of net-zero GHG emissions by 2050. Greening these industries may not be a linear process. However, with collective efforts to innovatively improve energy efficiencies, reaching the interim IMO checkpoint of 30%[7] carbon reduction by the turn of this decade is a possible, though challenging, aspiration.

IMO's revised strategy this year paves an urgent and much-needed carbon-reduction path with a holistic focus on lifecycle emissions. IMO's strategy may not be legally binding[8], but maritime and sustainability experts believe the measures to get there can be. Alternative fuels, new propulsion methods, energy-efficient vessel design, and innovation in carbon-neutral iron reduction methods are pivotal to catalyze tangible change.

Likewise, the Global Maritime Forum's 'Getting to Zero Coalition' is an alliance committed to fast-track the decarbonization of maritime shipping. An industry-led platform bringing together over 200 organizations, it aims to commercialize zero-emission vessels by 2030 as part of its broader mid-century mission of complete decarbonization across the shipping and fuels value chain[9]. Its ambition is to support transformation in deep-sea shipping through commercially viable, inclusive, and safe solutions.

There are other associations and groups worldwide that are engaged in similar initiatives. The IMO GreenVoyage 2050, a public-private partnership project between Norway and IMO, supports developing countries in their commitment toward a low-carbon future for shipping. It is currently working on around 35 pilots across 12 countries[10]. The Clean Shipping Coalition, H2Sea, SEA-LNG, and the Sustainable Shipping Initiative, among others, clearly demonstrate the growing efforts to create a decarbonized future.

Let us now take a closer look at each of these two critical industries to understand the challenges involved and the strategies as well as initiatives needed to surmount these for successful decarbonization.

Decarbonization of ocean freight trade

Decarbonization of the maritime industry has become as much a compliance obligation as a competition asset today. Ocean freight trade is driven by market forces and customer demands, as well as the undeniable need for a responsible supply chain. A diversified supplier portfolio and a blend of low-carbon and traditional bunker fuels is the immediate way forward until newer marine fuels can be made more affordable. Interest in alternative fuels, including bio-methanol, hydrogen, ammonia, and bio-based liquefied natural gas (LNG) has taken the spotlight, with the promise of green gains from these untapped renewable resources. However, the emerging marine fuels may require new engine designs and mechanical modifications that cannot be immediately implemented without massive capital commitments. Therefore, in the interim, sustainable drop-in fuels such as renewable diesel, biodiesel, bio-oil, as well as feedstock-based fuel[11] are being trialed in existing infrastructure, supporting almost-immediate, near-negative lifecycle GHG emissions.

However, navigating through this sea change has its own challenges. Transitioning from bunker fuels to low-carbon fuels comes with a large price tag, requiring significant capital outlay. Changes to the fuel value chain entail substantial infrastructural investments for fuel storage and distribution, vessel upgrades and retrofits, as well as research and fuel production.

Furthermore, building sustainable fleets involves greater adoption of technology and a marked shift in operational practices. These include multiple levers involving vessel size and speed, port infrastructure, as well as fueling, loading, and voyaging logistics. Charting out potential green corridors requires greater stakeholder commitment to decarbonization, stronger collaboration across relevant value chain actors, and higher uptake on climate-conscious shipping and demand pooling. Some companies are leading the way. Early last year, BHP chartered five LNG-fueled Newcastlemax bulk carriers for a period of five years[12]. The bulk carriers from Eastern Pacific Shipping (EPS) have an LNG fuel contract with Shell.

Crafting a robust and practical decarbonization plan is essential to overcoming these challenges. Strategies within the plan must provide for global maritime collaborations and include miners, steel mills, shipbuilders, vessel operators, fuel producers, port operators, and policy makers. The Silk Alliance, initiated by Lloyd's Register Maritime Decarbonization Hub[13], is one such promising example that brings together key stakeholders from multiple maritime value chains, and has regulatory support toward positive decarbonization transition. Named after the historic Silk Road linking intra-Asia routes, its initiatives include decarbonizing bunkering locations, working out a green-financing system to share costs and investments across fuel and shipbuilding value chains, and other agreements for the creation of a green corridor. The BHP-led Maritime Decarbonization Center in Singapore[14] is another example of such a multi-stakeholder, industry-wide non-zero-sum collaboration.

Decarbonization of steelmaking

The decarbonization of steelmaking could also be a long journey. The industry is expected to continue its reliance on coal as an inexpensive and effective reducing agent for several years to come. Therefore, it is critical to develop effective technologies to address Scope 3 emissions in the steelmaking sector to be able to capture the entire value chain from mining and extraction to transportation and end-use.

The CO2 emissions from steelmaking come primarily from metallurgical coal that is used to reduce iron ore and to supply 90% of the energy to power BFs[15]. While the increasing use of electric arc furnaces (EAFs) can bring down the reliance on coal to power steelmaking, using biogenic carbon sources and hydrogen to reduce iron ore can also cut GHGs. Unlike conventional BFs, EAFs can use carbon-neutral electricity and 100% scrap steel or direct reduced iron (DRI) for low-carbon steelmaking. Green hydrogen based DRI can further bring down GHGs by up to 20%[16],and must be piloted at scale for deeper insights. Blue hydrogen can also help in similar reductions by adding carbon capture and storage (CSS) technologies to the reforming process.

Despite the steel industry's potential to catalyze decarbonization, it faces significant hurdles. The availability of scrap steel is far from the current demand. Green hydrogen-based DRI production relies on high-quality ore that is not universally available. There is a pressing need for current policy frameworks to make a stronger case for affordable green steelmaking and support technological innovation. Amidst these challenges, global climate-aligned agreements such as the Sustainable STEEL Principles that help banks set impactful net-zero portfolio targets in steel and shipping, and the Climate Bonds Steel Industry Package to mobilize wide-ranging net-zero initiatives, among others, are a beacon of light.

Navigating Shipping and Steelmaking toward Decarbonization

Being deeply interconnected, the ocean freight and steelmaking industries critically impact each other's Scope 3 emissions. Therefore, new as well as existing decarbonization efforts must be accelerated to achieve mid-century net-zero goals. These must primarily rely on green fuels such as LNG and hydrogen, along with digital technology and infrastructural improvements, to boost energy efficiency.

In the case of freight vessels, efforts include investing in maritime informatics for predictability and fleet visibility, adopting integrative solutions for on-time voyaging, climate agility and efficiency, as well as leveraging digital twins for fleet/port optimization, channeling container logistics, and enhancing real-time connectivity. Installing power-saving devices on board can assist in intelligently unifying operational, technical, and implementation efficiencies.

In a groundbreaking move, the world's largest agricultural shipping firm, Cargill, has joined hands with Mitsubishi Corporation to trial WindWing technology[17]. The wind-powered wings, measuring over 37m in height, can be retrofitted to cargo ship decks to generate average fuel and emission savings of up to 30%. With large vessels challenging port infrastructure and contributing more GHGs, smaller and mid-sized wind-powered vessels are better climate-aligned. Research for commercial scalability of renewable resources also includes the fuel chain, as seen in a recent TotalEnergies and Green Marine partnership study on methanol bunkering in Singapore[18].

In the steelmaking industry, rapid decarbonization efforts are creating new long-term market opportunities. Biomass reductants with quality feedstock, hydrogen-based DRI-EAFs, iron ore electrolysis powered by renewable energy, and CCS technologies for blue hydrogen are being explored as enablers for greener production.

Conclusion

Fully decarbonizing the maritime and steelmaking industries will require a strong grasp of the circularity principles across critical value chains. Concerted efforts to align the fuel, shipbuilding, and operations value chains can establish a unified approach to steering decarbonization efforts. Innovative technologies do hold immense possibilities. But they are potentially high-risk, high-cost, or both. Seeking support from governments and authorities to accelerate financial aid will help de-risk some of these innovations to a large extent. Defining standards could set the benchmark in climate-aligned goals for other industries. Ultimately, creating market demand for green shipping and steel will help establish a level playing field in end-to-end decarbonization of these industries.

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