Mærsk Mc-Kinney Møller Center
for Zero Carbon Shipping

The path forward

What should stakeholders do now?

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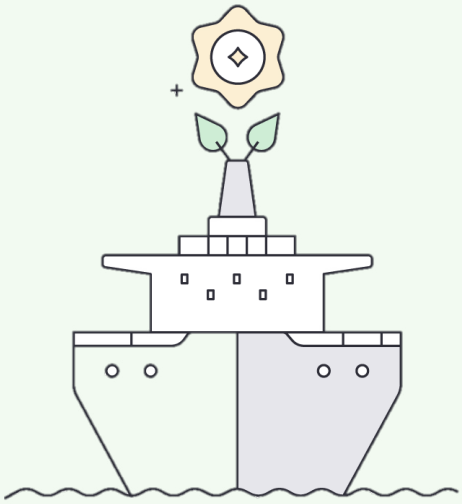

A three-part series explores maritime transportation's decarbonization journey and complements the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping's Industry Transition Strategy report.

The final installment charts concrete steps stakeholders can take to steer global shipping to carbon zero.

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Introduction

Driven by an increasing sense of urgency and equipped with critical decarbonization tools, shipping stakeholders may be asking themselves: what should we actually be doing now?

As we've seen, the fundamental challenge facing global shipping's decarbonization ambition is that the industry isn't capitalizing on the technological advances in ship efficiency and alternative fuels at a quick enough pace to reach carbon zero by 2050. In response, the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping and its partners have been researching feasible pathways and key priority areas for stakeholders to focus on.

The quest ahead is challenging, but not impossible. Our previous article detailed the critical levers across five areas that stakeholders can wield to effect meaningful change. In the series' final article, we spotlight four key priority areas for stakeholders—shipping companies, investors, regulators, and energy providers—to home in on. Success in these four areas would catalyze the critical levers to create a synergistic virtuous circle of positive change.

LEAF: Four priority areas for decarbonizing global shipping

We've identified four key areas in which stakeholders can move to act now, employing LEAF as a mnemonic device:

Level playing field for shipping players

How can regulators create a level playing field for the industry to facilitate an effective and fair transition?

Energy efficiency support

How can the entire value chain be reassessed for energy efficiency?

Alternative fuel deployment at scale

How can we make the widespread adoption of alternative fuels a reality?

First mover support

How can early adopters and first movers be incentivized and how can we minimize the risks incurred?

Level playing field for shipping players

As explained in the first installment in the series, a significant obstacle in the global maritime industry's path to decarbonization is the misalignment of stakeholder incentives. For example, ship owners may be reluctant to outfit vessels with the most energy efficient technologies as they find it difficult to share the financial burden of these upgrades with operators who charter these ships. Another dimension of misaligned incentives is geographical; the burden of decarbonization rests more heavily on developing nations that may not be able to absorb the costs of adopting new technologies.

Therefore, leveling the playing field should be a global priority; an effort that would encompass a mix of market-based and regulatory interventions enforced by local and global authorities. Market-based measures are initiatives that incentivize private actors to adopt emerging technologies voluntarily. Such measures fall under three categories—subsidies, emission trading systems (ETS), carbon carbon credits and taxes. Income generated from some of these measures could be used to fund decarbonization programs—such as retrofits, research and development of alternative fuel production, and building port infrastructure. Some of the money raised through market-based measures may also be channeled to alleviate the financial burden of decarbonization borne by developing countries.

Ensuring such measures have the desired effect of giving the international maritime industry a set of common incentives would require regulatory implementation and enforcement at the global, regional, and local levels. Policies and regulations such as contracts-for-difference schemes and feed-in tariffs may be required to accelerate the affordability of hydrogen-based fuels, for example.

When it comes to passing binding legislation, regional and national authorities may find themselves more able to enact decarbonization initiatives more nimbly, swiftly, and decisively than the International Maritime Organization (IMO). For example, the European Union (EU) has committed itself to cutting emissions by at least 55 percent by the end of the decade and introduced the Fit for 55 package, which contains numerous proposals to realign EU legislation and policies to its climate goals. Some of these initiatives—including FuelEU Maritime, which advocates for a green maritime space within the EU—will have a major bearing on intra-EU shipping and on shipping to and from the bloc. Other port authorities may introduce similar decarbonization requirements for vessels that pass through their jurisdictions.

These regional and local regulatory measures are better able to demonstrate which market mechanisms, commercial models, and technology pilots are feasible and could be applied on a more global scale. However, while revising and enforcing new local regulations, individual authorities run the risk of fragmenting the legal patchwork of global maritime laws

even as they spur the global regulatory agenda forward. If this happens, the cost of compliance may become higher for all participants across the shipping value chain.

Thus, the IMO could play a more proactive leadership role by identifying the best regional and local regulatory measures to inform the creation of global regulatory blueprints. This way, the IMO could serve as a collaborative platform where all stakeholders can meet to set new global norms around the end-to-end life cycle approach for emissions, as well as discuss and conduct impact analyses.

Energy efficiency support

Onboard energy efficiency is a key driver of the global shipping industry carbon-zero journey; it will be responsible for about half of the industry's decarbonization by 2050. To start, the industry could benefit from an assessment of the emissions reduction potential of existing energy efficiency (EE) technologies to identify the most promising solutions.

This would require further transparency on vessel efficiencies and stakeholders would need to standardize industry-wide performance metrics and inform new standard practices. For example, carbon intensity indicator (CII) scores could be employed to price charters differentially. Meanwhile, gap analyses of known EE levers could be used to set realistic goals and targets, as well as to identify potential avenues of technological development.

On the business side of things, new commercial structures focusing on sharing costs and benefits among relevant parties

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could be explored. Best practice and knowledge sharing could also become more commonplace. On the regulatory front, local and global authorities could strengthen the enforcement of EE regulations even as they engage with the private sector on the most appropriate measures to regulate new technologies as they mature and to drive the innovation of new EE options.

Alternative fuel deployment at scale

There are numerous fuel pathways available to the industry, each with strengths and challenges pertaining to widespread adoption:

- **e-Fuels**: Hydrogen carriers with high volumetric energy density produced from renewable electricity looks to be gaining momentum. Maritime e-Methanol technology is already known and vessels running on such fuels are soon to be in operation while ship engine manufacturers anticipate that the first ammonia engine could be in operation by 2024. Countries with some of the world's largest container ports, including Australia, the United Kingdom, Japan, and Saudi Arabia, have also recently announced zero-emission fuel strategies containing new large-scale hydrogen-based projects. And looking further out into the future, ammonia is forecast to become the cheapest e-fuel that can be produced and achieve the magnitude required to transform the industry to net-zero emissions.

- **Blue fuels:** Blue fuels may play a role if they're scalable fast enough or if the costs of renewable energy don't decline at a fast enough rate. Two specific challenges hinder the uptake of blue fuels: lack of industry standards for proven permanence of carbon capture and storage, and the mitigation of upstream methane emissions that have a negative impact on the environment.

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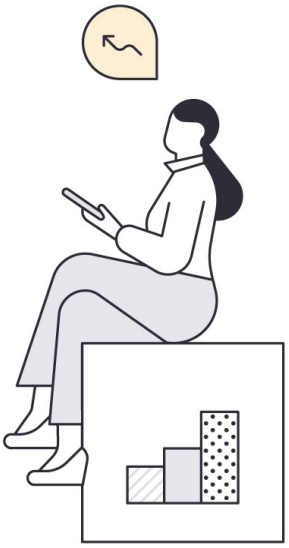


- **Biofuels:** While biofuels may not be prohibitive in terms of cost, they are currently being challenged by other constraints such as limitation of global production capacity, a need for new established supply chains, various technical maturity of the different fuel options, and increased cross-sectoral competition with other industries also looking for green alternatives (for example, cement, steel, and aviation). Conquering these challenges on a global scale means bio-methane is projected to have a more dominant role as a maritime transition fuel from 2030s onwards, while bio-methanol and bio-oils are projected to significantly impact the fuel mix from 2040s. And, of course, if their supply could be doubled from current forecasts, bio-methane and other bio-oils would become more prominent in the early years of the transition.

High cost remains a major obstacle standing in the way of the widespread deployment of alternative fuels. Finding a way to bring down prices to a reasonable and affordable level around the world would unlock the way to zero-carbon shipping. Traditionally, prices decline as a technology matures and becomes easily scalable, so incubating and accelerating the maturation process of emerging and nascent technologies may be key.

For example, ship owners and fuel producers can enter into large off-take agreements with maritime parties to secure alternative fuel production and infrastructure investments. Customers can also send clear demand signals to the shipping industry by signaling their willingness to pay for green transportation for their cargo through a green-credit scheme.

However, as we have seen, uncertainties surround the economics, scalability, and the technological and regulatory challenges of potential fuel options. Thus, it may be prudent to keep an open mind in different fuel pathways—such as investigating ways to increase the supply of biofuels—to ensure optionality in the event that a specific fuel pathway becomes unviable. By providing access to capital open for investment in the research and development of under-explored fuel pathways, governments and investors may be able to reduce the financial risks involved for energy providers and encourage innovation.

First mover support

First movers on any emerging technology take on greater risk than their peers

because there's no guarantee of ubiquity and the technology in question may have to undergo further refinement before it can be adopted more widely, if it ever is. As such, many companies—be they fuel providers or shipping companies—may be reluctant to invest in and employ new decarbonization technologies. To overcome hesitation, other participants in the shipping value chain may have to underwrite some of these risks.

More needs to be done to encourage future fuel providers to invest in the R&D of alternative sources of power before the demand for them exists and to incentivize shipping companies to order vessels that can run on alternative fuels before the fuel supply infrastructure is in place. Developers of new technology could be given more platforms to demonstrate the commercial viability and feasibility of their innovations to other maritime and industry-adjacent participants to inspire confidence and raise the necessary capital.

Meanwhile, there's reason for first movers to look beyond the strict confines of the maritime industry while raising capital from investors. A number of innovations that are percolating in the maritime industry can be applied in other adjacent sectors, too. For instance, investments in the development of e-ammonia as an alternative fuel source could reap dividends for both the power industry and the shipping industry.

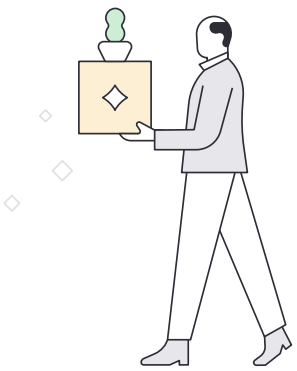
One mechanism that incentivizes first movers is the establishment of "green corridors," which are specific trade routes between major port hubs reserved exclusively for zero-emission solutions.

Stakeholders including fuel providers, port operators, shipping companies, beneficial cargo owners, and policymakers and regulators could coordinate activity to accelerate the testing and deployment of decarbonization technologies. Both public and private sector players could have a positive reinforcing effect that may result in end-to-end zero-carbon shipping solutions that could be deployed beyond these green corridors.

Conclusion

As the global shipping industry looks to the decade ahead, it's clear that both private players and public sector play equally crucial roles in the sector's decarbonization journey. We've summarized a list of next steps that stakeholders could take.

What's clear at this stage is that a successful transition to carbon zero will require a certain culture of collaboration and innovation to succeed. Leaders across the ecosystem need to participate and act—and they can peruse our recently launched Industry Transition Strategy for a deeper dive into the themes explored in this series. The better industry players and relevant stakeholders are able to work together and take action, the higher the odds are for the sector to become the global decarbonization catalyzer the world needs.



	Private sector (shipping companies, alternative fuel providers, investors etc.)	Public sector (regulators at the local, national, and international levels)
Level playing field for shipping players	Leverage available subsidies and funding to innovate and develop new technologies. Adopt global decarbonization norms and standards so ship owners and operators can send demand signals to technology providers.	Supranational bodies like the IMO could coordinate and lead in the setting of decarbonization norms and standards. National regulators could introduce and enforce decarbonization standards at domestic ports. Market-based measures such as carbon levies and funding could be implemented.
Energy efficiency support	Embrace greater transparency when it comes to vessel efficiencies. Explore new commercial structures with partners; share best practices with other players. Engage with authorities on regulatory matters.	Lead assessment of the emissions reduction potential in existing energy efficiency (EE) technologies to identify the most promising solutions. Strengthen EE regulations governing ship design and ship operations with an ambition to drive transparency. Collaborate with the private sector to frame regulations needed for the future EE technologies.
Alternative fuel deployment at scale	Alternative fuel providers could continue to improve handling and safety standards of alternative fuels. Research and develop operationally and economically viable solutions across the variety of fuel pathways, e.g. exploring ways to increase the supply of biofuels.	Coordinate investors and alternative energy providers to ensure that the various fuel pathways are receiving sufficient investment.
First mover support	Seek investment capital from the shipping industry and shipping-adjacent industries. Ship owners can invest in vessels with alternative-fuel infrastructure before the supply of alternative fuels becomes widely available. Consumers can push for zero-carbon shipping and the use of alternative fuels. The more they are willing to pay a premium for green transportation, the faster the transition can happen.	Provide more platforms for developers of emerging decarbonization technologies to demonstrate solutions to potential investors. Establish green corridors - defined as trade routes between major port hubs where zero-emission solutions have been demonstrated and are supported.

About

Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping

The Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping is a not-for-profit, independent research- and development center working across the energy- and shipping sectors to mature viable decarbonization pathways for shipping globally.

With Partners, the Center facilitates the development and implementation of new energy and maritime technologies and drives the required systemic and regulatory change. The Center is Copenhagen-based and has a partner base of global companies across the maritime eco system.

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