

The five steps to zero-carbon shipping

From aspiration to action: How shipping's leaders plan to accelerate the decarbonisation timeline





A change of course

The shipping industry faces a generational challenge. It must transition away from fossil fuels as the dominant marine energy source within the lifespan of today's newbuilt ships, but it must do so amid regulatory, financial and technical uncertainty.

And the industry is behind the curve.

Today's efficiency efforts are not emerging fast enough. The consequence of that is a pathway of CO₂ emissions diametrically opposed to the now-radical reductions required across all sectors by 2030 to make up for the lack of progress made so far.

The sector is on a path that requires urgent correction from both a commercial and policy perspective in order to avoid significant risks to the sector and to global trade.

Our quest for answers

To examine what that means for shipping businesses, we interviewed dozens of the industry's most influential business leaders from across the maritime value chain to discuss the changes that lie ahead and the obstacles yet to be overcome.

Between them they set out the essential elements of the transition ahead: the political, technical, economic and commercial requirements, and the actions needed from the sector to deliver on them.

The industry debate to date has focused on fuel choice and then leapt straight to carbon pricing and policy. This oversimplifies the transition, which is likely to be disjointed and not led by a single policy solution in the near term.

The consensus that emerged among the experts interviewed for this report therefore prioritised industry leadership, collaboration and early-stage public and private investment over and above near-term regulatory clarity as the most important drivers of change today. Following that, first mover action with efforts to secure a global policy framework that will bridge the pricing gap to viable emerging zero-carbon fuels is a given, but the absence of an immediate regulatory framework is no longer seen as a prerequisite to progress.

Rather than focusing on the slow pace of regulatory consensus as the starting point for zero-carbon plans, the priority has now shifted to the quick wins and first-mover projects that can create demand signals and secure public sector and private investment quickly.

Rather than focusing on a single ideal fuel option, multiple fuel pathways and multiple infrastructures are now being assumed.

Rather than investing in siloed projects, the race is now for collaborative solutions to be tested and evaluated, costs reduced, and opportunities and risks crystallised.

The five steps to zero-carbon shipping

Through our conversations with industry leaders we have identified five critical areas of change that will need to happen to get shipping on track to meet zero emissions targets.

1 Demand

First movers need to invest ahead of regulatory certainty

2 Technology

The pace of research and development investment needs to accelerate and scale infrastructure

3 Finance

Transparency will change business models and filter investment

4 Collaboration

A holistic supply chain approach is required to stretch beyond shipping's siloed borders

5 Policy

A carbon pricing framework is required to bridge the gap between fossil and zero-carbon fuels

1 Demand

First movers need to invest ahead of regulatory certainty.

A regulatory framework with carbon pricing at its core will be an essential component of the pathway to zero carbon, but first movers need to invest ahead of immediate regulatory certainty. In the near term, clear demand signals from shipowners and cargo owners are required to catalyse collective investment, reduce costs, and scale pilot projects.

Partnerships between first movers to establish long-term offtake agreements for zero-emissions fuels ahead of the first vessel becoming operational are essential, but the industry still needs to rapidly scale projects, particularly in infrastructure where funding requirements are most significant.

Initiatives such as the US-supported First Movers Coalition, launched during the recent COP26 climate talks, aim to create the framework that will allow this early-stage investment to take place.

The creation of green corridors — specific trade routes between major port hubs where zero-emission solutions have been demonstrated and are supported — aims to create a framework to support growth and de-risk early-stage investment.

In the case of the First Movers Coalition, cargo owners commit to shipping 10% of their cargo using zero-emission fuels by 2030, while shipowners and charterers commit 5% of their fuel use to be zero-emission by the same deadline. This sends a strong demand signal for zero-emission shipping and fuels this decade — crucial for the early deployment of zero-emission vessels.



“If you’re not a first mover, or very close to being a first mover, you could get left behind and indeed left out of the future of this industry.”

Without a near-term regulatory framework to bridge the cost differential between fossil and zero-carbon fuels, such efforts will struggle. However, those we interviewed for this report argue that industry leadership, collaboration, and early-stage investment from both the private and public sectors is critical to kick-start the transition and reduce costs and risks.

There was a consensus among the group that by reaching 5% scalable zero-emission fuels in shipping by 2030, there is now sufficient momentum behind first mover projects to create a tipping point that will allow for a rapid uptake across the industry in the following decades.

There was also widespread optimism that the roll-out of pilot projects will allow for early adaptation of technology and infrastructure, driving down costs.

Rasmus Bach Nielsen

Global head of fuel decarbonisation at Trafigura

“The overarching challenge is that we need to create demand signals for the fuels to be produced so they can be widely available.”

Bo Cerup-Simonsen

Head of Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping

“We are at an inflection point. First mover activities are going to inform and inspire the rest of the industry. They need to be enabled and supported, meaning that individual governments need to engage in this process and make sure that we have regulation in place that supports it in the interim until we get global regulation in place.”

Dr Tristan Smith

UCL Energy Institute and director of the Research Council UK funded project Shipping in Changing Climates

“The target shipping needs to hit in 2030 is about 5% of the fuel mix being zero-emission fuel. If we hit that, then we will have developed the supply chains of those fuels, resolved the safety problems and we will have reduced the costs.”

“If you go into a transition and expect to be able to decarbonise the fleet in five years using technologies that have just come out of the laboratory, it’s going to be super-expensive. But if you have this period of learning by experience in smaller experiments, then you can reduce the costs, both on the land side and on the fleet. And you can build the skills base and the processes, which are things that just take time and need iteration to improve things... Those companies that want to be first and have market share in the future are going to be the ones who help finance that in combination with governments.”

Steen Lund

Chief executive, Rightship

“It is important to have some lighthouses who can have the bandwidth to invent, who have the financial muscle and capacity to do the required R&D. We need first movers who are not afraid to take some punts and go out and test. And I have no doubt that the remainder of the industry will pay attention to that, and we’ll learn from it and will join ... Without that bold, forward looking orientation, nothing new will be invented and we will only get small incremental steps towards improving the current assets. That’s not what we require.”

Michael Parker

Chairman of Citi’s shipping and logistics business and chairman of the Poseidon Principles Association

“There’s no choice now, and it’s not just a question for the coalition of the willing. If you’re not a first mover, or very close to being a first mover, you could get left behind and indeed left out of the future of this industry.”

2 Technology

The pace of R&D investment needs to accelerate and scale infrastructure.

Zero-carbon vessel technology is still in early stages of development. However, as there is growing acceptance that multiple fuels and infrastructures will be required, not least because shipping will be competing globally for zero-carbon fuel supply. That will be a costly and complex transition in which energy efficiency and retrofitting will likely guide near-term strategies and flexible dual- or tri-fuel tonnage will dominate the mid-term transition.

“I don’t think anybody today anyone can afford not to invest in some kind of future-proofed ship”

There is now urgent need for accelerated R&D to develop zero-carbon vessels and electrolysis technology to bring down the costs of green hydrogen, the basic ingredient from which all future fuels will be made.

Under the accelerated timelines pledged by industry leaders interviewed for this report, large-scale system demonstrations are needed by 2025 to demonstrate viability and draw lessons learned. These will require collaboration between governments, industry, and financiers. It will also require a balance between the flexibility provided by multiple fuel and infrastructure scenarios and the increasing cost, complexity and availability to shipping competing with multiple sectors vying for zero-carbon fuels.

An industry guided by fragmented decarbonisation strategies may see not only increased costs, but also reduced attractiveness of vessels as an asset class for both institutional equity investors and debt providers. While seed funding for zero-carbon pilot projects is relatively abundant, significant financial backing to scale pilot projects remains scarce amid the absence of a regulatory framework to support growth and de-risk investment. Investments required to ensure the fleet of ships can use scalable zero-emission fuels are significant, and will not be limited to the financing of newbuildings, but also the huge cost of retrofitting the existing fleet.

However, the largest investments will be associated with land-side assets and the ultimate speed and scalability of land-side infrastructure; producing and supplying new fuels will be the key determining factor of shipping’s fuel transition, rather than the shipping industry’s choice of technology or ship design.

Much of the current strategic thinking from leaders interviewed is based on the assumption that growing demand for hydrogen and hydrogen-derived fuels will help lower their costs, especially for green hydrogen-based fuels, by driving up the scale of production.

Alexander Saverys

Chief executive CMB

“I think the hardest part is to develop the very first applications. It’s hard because you need to convince yourself or your investors to put money into something that’s going to be loss-making. It’s hard because you need to convince regulators that don’t know what you’re doing, that it is safe. And it’s much harder when your customers don’t want to pay because it’s too innovative, and they don’t really understand what you’re doing. But if you have a bit of tenacity, and you continue doing it, it’s like a small snowball. And then it becomes bigger and bigger and bigger.”

You need to be a little bit crazy to invest in these things, because it doesn’t make any money. And of course, there’s a difference between being positively crazy and totally stupid. But I don’t think anybody today anyone can afford not to invest in some kind of future-proofed ship. Either you wait, and you don’t order any newbuildings, or if you do order you make sure that you have something that will still be around in 15 to 20 years from now.”

Andrew Forrest

Chairman, Fortescue Future Industries

“The shipping industry itself has set itself a pretty mealy-mouthed target of 5% by 2030. I think that 15% is a respectable target. By 2030 we shouldn’t have any engines which are not dual-fuel capable so that by 2040, we’ve got a shipping industry which can go carbon neutral.”

Karrie Trauth

Head of Shipping and Maritime at Shell

“I think the best-case scenario for decarbonisation is that LNG adoption continues, and that LNG becomes truly a fuel in transition, so that synthetic LNG and bio LNG accelerate and become widely available to the ships and ports that have made an LNG choice. Meanwhile, we want to accelerate the production of blue and green hydrogen and find ways quickly to learn from the LNG bunkering development. In under 10 years we should not only have the first zero-carbon vessels on the water, but also be at a point that we can scale those.

We need anywhere from \$1 trillion to \$1.4 trillion of investment to decarbonise the shipping industry and 80%-90% of that is imports. So, while we can talk about ships and the choices that shipowners and fuel providers like Shell will need to make, it’s the infrastructure that’s going to make the difference and I think that’s the biggest blocker we’ve yet to overcome”.

Andreas Sohmen-Pao

Chairman of BW Group

“If one looks at solving the technology challenge around new fuels, I would estimate that the ships can be ready within 5-10 years, but to change the entire world fleet of 60,000-plus ships, that’s going to take at least 20 years, even if we start now. Having a fully decarbonised fleet by 2050 is possible, but the blockers, which I think we all recognise, are that you need infrastructure and you need proper pricing to be able to get these new fuels. So it’s not really about building the ships, it’s about being able to get the right fuels at the right price.”

3 Finance

Transparency will change business models and filter investment.

In the short term, the industry needs to bridge the gap between aspirational rhetoric and the minuscule quantities of cash currently scaling siloed pilot projects. Advances in the production and distribution of zero-carbon fuels are still required before a business case can be made, so the short-term challenge for shipowners to at least 2030 rests on energy efficiency, transitional dual-fuel flexibility and financing retrofits of the existing fleet.

Longer term, clarity is required on the pricing of sustainability risk and how big the carrots and sticks will need to be to make shipping’s accelerating zero-carbon transition a reality.

The largest finance requirements will be associated with land-side assets, but the investments required to ensure the fleet of ships are able to use scalable zero emission fuels are significant and these will not be limited to the financing of newbuildings, but also require significant expenditure on the existing fleet. That presents a challenge to the increasingly stringent requirements of ESG lenders.

The zero-carbon transition will challenge traditional ownership models ill-equipped to adapt, but decarbonisation alone is not a business strategy and the overall ability to yield a return on invested capital in shipping will not improve just because the fuel mix changes.



Most of the owners interviewed for this report anticipate more structural shifts as part of the energy transition longer term, that will in part be driven by environmental, social and governance requirements; political, regulatory, and financial transparency requirements; cost of capital and shifting trade patterns. While that will not necessarily equate to a sea change for all sectors and individual companies, those factors will encourage trends towards companies with scale, likely integrated into cargo supply chains, where the predictable stability of long-term contracts and financial requirements end speculative building cycles.

It is more difficult to identify a scalable business case for tramp operators that do not operate on long-term cargo contracts for specific cargo owners. The natural conclusion of that will increasingly challenge mid-sized private entities that have dominated shipping's fragmented business models for much of the last century.

Meanwhile, lending to shipping has already begun to hinge on shipowners' ability to satisfy the banks' environmental, social and governance criteria. While many of the remaining bank lenders to shipping and capital market providers have long held so-called ESG targets linked to projects, a combination of regulatory pressure from governments keen to accelerate climate change policy and ratings agencies factoring in sustainability risk on rated debt has intensified pressure on lenders to tighten standards on lending.

That process is expected to accelerate and while banks have no ambition to regulate by proxy, they also have no obligation to lend. Banks and financial institutions merely have to figure out which clients to select and that will increasingly be a case of capital only flowing in the direction of companies that are doing 'the right things'.

“I think it is now recognised that that we have no choice but to make these decisions. It will make shipping more expensive, but that will also be a price that people are willing to pay.”

Michael Parker

Chairman of Citi's shipping and logistics business and chairman of the Poseidon Principles Association

“Retrofitting is going to be by far the most important capital expenditure up until 2050, whereupon enough zero-emission vessels will have been delivered and I think the willingness of the cargo owners to employ those ships will help the lenders lend to finance that retrofitting... The market will eliminate the ships that are not retrofitted, so it won't be that the banks won't lend — they won't lend because those ships are not actually carrying any cargo.

Whether it's through the capital markets or the banks' lending, the market will ultimately define how big the carrot and how big the stick are going to need to be. Right now, neither is really very big because people are still feeling their way around how to price this sustainability. As the definitions of this become much clearer, we will see what this means in terms of cost of capital and availability of capital. And that's what shareholders, consumers and the regulators all want...

“I think it is now recognised that that we have no choice but to make these decisions. It will make shipping more expensive, but that will also be a price that people are willing to pay.”

Jan Dieleman

President of Cargill's ocean transportation business

“There will be winners, and there will be losers. We will have stranded assets and we will have people that are not going to be able to keep up with the pace of change required and for a period we may have to accept that there will be a two-tier market.

“There are some tough decisions to be made, but I think the reality is the old business models that we had are not going to survive this and I think that a lot of companies will have to figure out how they actually deal with this.

“I don't see the market being extremely at risk in the near term, but in the medium to longer term there is going to be a big shake up in how the industry looks.”

4 Collaboration

A holistic supply chain approach is required to stretch beyond shipping's siloed borders.

The decarbonisation challenge is shared across industries and sectors, but maritime will not be able to make progress alone. Feasible fuel pathways exist. But accelerated action and cross-industry collaboration are needed to spur research and development and realise large-scale system demonstrations by 2025.

Specifically, collaboration between governments, industry and finance, with governments playing a larger role early on to catalyse first mover activity, is now needed. But it also requires individual companies to collaborate on innovation and create new business models and new ways of sharing costs in the search for a more efficient supply chain.

“Nobody’s going to be able to work to figure this out by themselves — you need people working together.”

Industry leaders interviewed acknowledged that the maritime sector’s traditionally insular and siloed approach had slowed progress, but the emergence of cross-sector platforms pulling in expertise from across the maritime value chain has catalysed collaboration.

Christian Ingerslev

Chief executive, Maersk Tankers

“We need to stop worrying about what slice of the pie we get in this great opportunity and be open to being part of creating the pie. So, what collaboration really means to me is being willing to share your knowledge, your capabilities, your data, and also creating solutions that are good for the industry, not just for an individual company.”

We need scale in everything we do. Because the industry that I’m in, on the tanker side, we are very concerned the average tanker owner owns fewer than four ships. And it’s very difficult to optimise a system to invest into innovation and new ideas if you do not have the scale. So, to me, collaboration is coming together, being willing to participate in something where you do not have full control and develop solutions where you do not discuss who owns the IP Rights... Carbon pollution should not be a competitive advantage.”

Hugo De Stoop

Chief executive Euronav

“We need to get closer to our customers and co-operate on making this industry more efficient. Because there’s so much waste. The moment you put a value on carbon and decreasing the carbon footprint, I think that people have a tendency to be more friendly, open to discuss and see how they can co-operate together. So, I really want to see that happening between us and our clients and I believe that that will mean a dramatic change of the contractual relationship that exists between the two of us.”

Jan Dieleman

President of Cargill’s ocean transportation business

“Nobody’s going to be able to work to figure this out by themselves — you need people working together. We need to share some of the burden, otherwise we will be running in circles and get nowhere and I think that is starting to sink in across the industry. The pressure is clearly coming from the end user, probably more so than from the regulator in our industry, so I think that notion of shared responsibility is absolutely there. But it’s also about the financial de-risking of some of these decisions, and there you’re talking about longer-term contracts and exploring different mechanisms to share profits and losses. It’s not uniform yet, but it’s starting to happen.”

Andreas Sohmen-Pao

Chairman of BW Group

“Decarbonisation is like a complex puzzle where some actors need to be working on defining boundaries and working on the borders, others need to be sorting the pieces and other aspects of the puzzle. And I think what programmes like the Global Centre for Maritime Decarbonisation, which I’m chairing in Singapore, are able to do is map out and look at this puzzle in its entirety. They are mapping out where there aren’t enough people working on an area, and then going in to plug that missing piece by pulling together the right stakeholders. I think in terms of concrete steps, let’s make use of these centres as conveners of the right players.”

5 Policy

A carbon pricing framework is required to bridge the gap between fossil and zero-carbon fuels.

A political and commercial consensus is growing around a push to accelerate shipping's decarbonisation targets to net-zero emissions by 2050, effectively doubling the ambition of the current internationally agreed targets.

But the process of agreeing that lift promises to be a divisive battle inside the International Maritime Organization between developed and developing states still wrangling over the basics of climate finance contributions, not to mention the mechanics of market-based mechanisms and which institutions control climate cash. No proposal that fails to explain and address the cost burden to developing countries will pass at the International Maritime Organization (IMO) – or anywhere else. This problem helped doom COP26, and future talks over carbon pricing cannot ignore it.

But the IMO's push for a global regulatory consensus is by no means the only regulatory game in town.

The European Union has committed to an economy-wide greenhouse gas emissions reduction target under the Paris Agreement, which has been translated into European Climate Law. This makes the EU climate objectives — of at least 55% net GHG emission reductions by 2030 below 1990 levels and climate neutrality by 2050 — legally binding for EU member states, and shipping is firmly in the mix.

The regulatory piece of the industry's decarbonisation jigsaw puzzle is yet to fully take shape and, until it does, uncertainty will continue to create risk for businesses.

While industry leaders agree that early-stage progress is not entirely dependent upon a global regulatory framework. But without new policies, the price gap between green and dirty fuels will persist for decades, hindering the decarbonisation of shipping and that of the global economy dependent on shipping.

Regional and bilateral policies will help early mover short- to mid-term decarbonisation efforts, but ultimately a global regulatory system will be required. Pricing carbon and reducing the costs of zero-emission alternatives through subsidies, using a basket of market-based measures, will help those alternatives compete. How fast the IMO can agree this is not clear, but it has barely scratched the surface and a long war looms. Few countries have managed carbon prices; agreeing a global measure is incomparably harder.



Back in 2013, when market-based measures were last on the table, the IMO debate spectacularly imploded, as climate economics created a schism between developed and developing nations. Not enough has changed in the intervening years to instill any confidence that history won't be repeated.

So, while technology, demand signals and collaboration have an important part to play, this is ultimately a climate finance battle, not an engineering problem.

For the IMO, there is also the added question of who controls those funds once they are agreed. The IMO itself is not an agency capable of administering billions of dollars of climate funds. The World Bank is already eyeing the opportunity, and if it can ensure that the money is ring-fenced to shipping, would seem to have the more apt skill set.

It will also be essential to adopt a tough mid-term measure, from around 2023, to close the price gap between fossil and green fuels by 2030.

An enforceable global IMO-led market-based mechanism therefore remains the key to unlocking the shipping industry's ultimate decarbonisation.

Rasmus Bach Nielsen

Global head of fuel decarbonisation at Trafigura

“The by far best and most efficient way is, in our view, to have a global carbon levy implemented sooner rather than later.

“I think we have to be realistic, that collaboration cannot bridge the significant price gap on the fuels. And this is obviously the biggest challenge that we have as an industry.

“There are many good intents to reduce emissions but the challenge that the shipping industry has with current transport fuels is that they emit carbon, and that will not stop regardless of how many short-term optimisation efforts are engaged upon.

“There are billions and billions of pension fund dollars ready to invest into the hydrogen renewables but we need the shipping industry to be there to offtake the fuels and without regulation then it is beyond difficult to expect a rapid transition as it will simply be too uneconomical as to what companies can cope with.

“A global carbon levy would mean competition on an equal level playing field, which would further encourage investments.

“The overarching challenge is always the fact that we need to create demand signals for the fuels to be produced so they can be made widely available.”

Andreas Sohmen-Pao

Chairman of BW Group

“It’s not really about building the ships, it’s about being able to get the right fuels at the right price.

“But uniformity is important in regulation to have a level playing field. Otherwise, you get regulatory arbitrage because we’re in a global business where people can move to the place of least resistance.”

Dr Tristan Smith

UCL Energy Institute and director of the Research Council UK funded project Shipping in Changing Climates

“You don’t necessarily need the IMO for early adoption. I’m not saying at all that the IMO is irrelevant – I’m saying it has a certain role that it’s particularly well equipped to play, which is in the mass market transition which is likely to come in the 2030s. We need the IMO to have very clear policy in place before we get to that point, but you don’t need it to get us to the steps that we need to see happening this decade.

“I can’t think of a good historical example of where the IMO policy was what enabled early adoption. If we look at sulphur limits, for example, it was the emission control areas, and even before, that some of the actions taken in individual countries that caused people to start exploring alternative fuels and scrubber technology. It wasn’t that the IMO had some policy that enabled people to fund their experiments with scrubbers. So why are we imagining that the IMO is suited to do the kind of innovation stage that we are entering at this point in time? What’s the precedent for that?”

Alexander Saverys

Chief executive CMB

“It would be wonderful, of course, if we would have a carbon levy of \$300-\$400 a tonne of CO₂. But I think even without that, there is already business to be had in green shipping and green developments. And today, not in 10 years from now.”

“The by far best and most efficient way is, in our view, to have a global carbon levy implemented sooner rather than later.”

Creating clarity from complexity

The shipping industry's action plan to accelerate decarbonisation is not reliant on any single factor. Rather, it requires levers to be pulled across all five identified areas of action simultaneously.

Regulation is needed to help bridge the initial zero-emission fuel cost premium and kick-start the transition, but initial investment must come first.

Freight purchasers need to commit to using decarbonised maritime freight to create a strong demand signal for zero-emission shipping and fuels this decade — crucial for the early deployment of zero-emission vessels.

Investment structures with longer maturity periods, a shift towards longer-term charters and stronger adoption of more stringent environmental, social and governance standards are required to support scaled zero-carbon investment.

Companies must be ready to consolidate, integrate, and collaborate across the value chain, using the full breadth of the capital markets to become more competitive, if they are to survive.

Ultimately, market-based measures will be required to close the competitiveness gap between fossil fuels and zero-emission fuels by increasing the costs of using fossil fuels through setting a price on carbon. However, the immediate absence of a global agreement does not preclude progress at a regional level. Embracing actions at all regulatory levels is also more likely to accelerate adoption of global IMO solutions.

It seems clear that the industry's decarbonisation efforts will fundamentally alter the competitive landscape and ultimately require different business models. Companies must be ready to consolidate, integrate, and collaborate across the value chain, using the full breadth of the capital markets to become more competitive, if they are to survive.

Lloyd's List 

The five steps to zero carbon shipping



**From aspiration to action:
How shipping's leaders
plan to accelerate the
decarbonisation timeline**

To learn more about our Thought Leadership programme,
see lloydslistintelligence.com/about-us/thought-leadership

For permissions and media enquiries, please be in touch
hellomarketing@lloydslistintelligence.com

About Lloyd's List Intelligence

We are the trusted expert partner providing professionals
connected to maritime trade with transparent data,
validated analysis, and actionable insight for 300 years.

Asia Pacific: +65 6973 3570

UK/Europe: +44 (0)20 8052 0560

Americas: +1 212 600 3460

[Lloydslistintelligence.com](https://lloydslistintelligence.com)

