



# Green Corridors: Definitions and Approaches

## A Discussion paper from the Global Maritime Forum

### Executive summary

Maritime Green Corridors have swiftly become recognized as one of the most important tools to aid industry and governments in the decarbonization of the maritime sector. Building on the initial conceptualization put forward in [The Next Wave](#) (Getting to Zero Coalition, 2021) and the signatories of the Clydebank Declaration (as initiated by the UK Government, 2021), and responding to multiple requests from industry and governments taking an interest in the concept, the paper considers emerging approaches to defining, initiating, and governing Maritime Green Corridors, and puts forward recommendations in each area. These recommendations attempt to reinforce the most effective and impactful approaches while acknowledging the need for flexibility.

By **definitions**, this paper means the first principles and terms of engagement being used to underpin action on Green Corridors. It takes the simple approach of examining how different actors are defining “Green” – in terms of types of impact and level of ambition – as well as how they define a “Corridor” in terms of operational scope and emphasis.

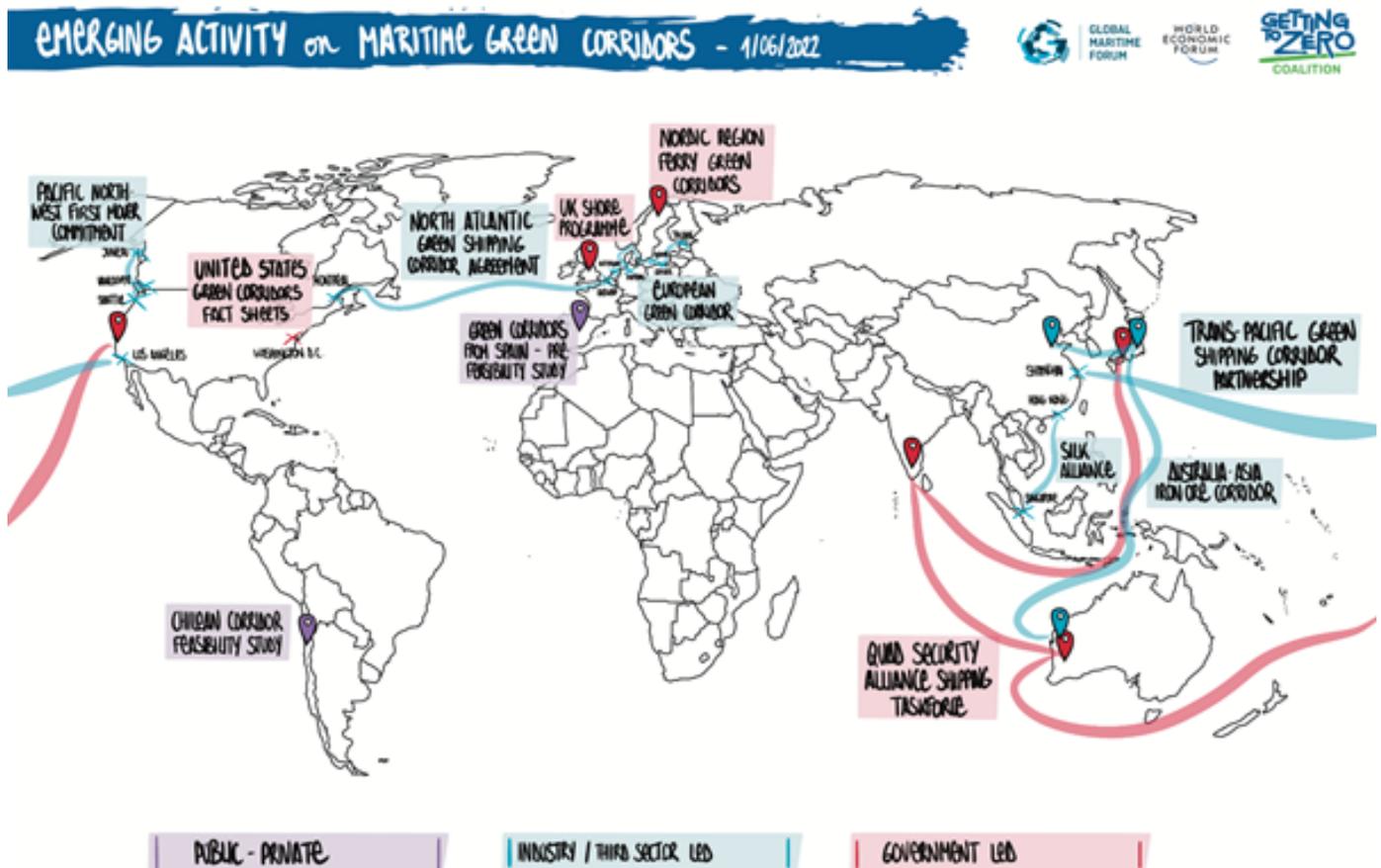
By **initiating actions**, this paper means the approaches taken to prioritizing different corridors, engaging stakeholders, assessing feasibility and requirements, and “route mapping” the corridor’s overall development. Because the eventual governance of Corridors can take multiple forms (see below), these initial actions can be emergent and (ideally) complementary efforts undertaken in parallel or in coordination with each other.

By **implementation**, this paper means the approaches taken to governing and managing the many actions needed to deliver a Maritime Green Corridor. While implementation of policies and deployment of technologies has yet to begin, some of the alternative approaches to governance and management can already be identified.

This discussion paper is not built on formal research, but reflects the ongoing conversations held by the Global Maritime Forum with its partners, interested governments and leading actors in emerging Corridors. Members of the Getting to Zero Coalition’s Global Green Corridors Advisory Group provided feedback and input to draft versions.

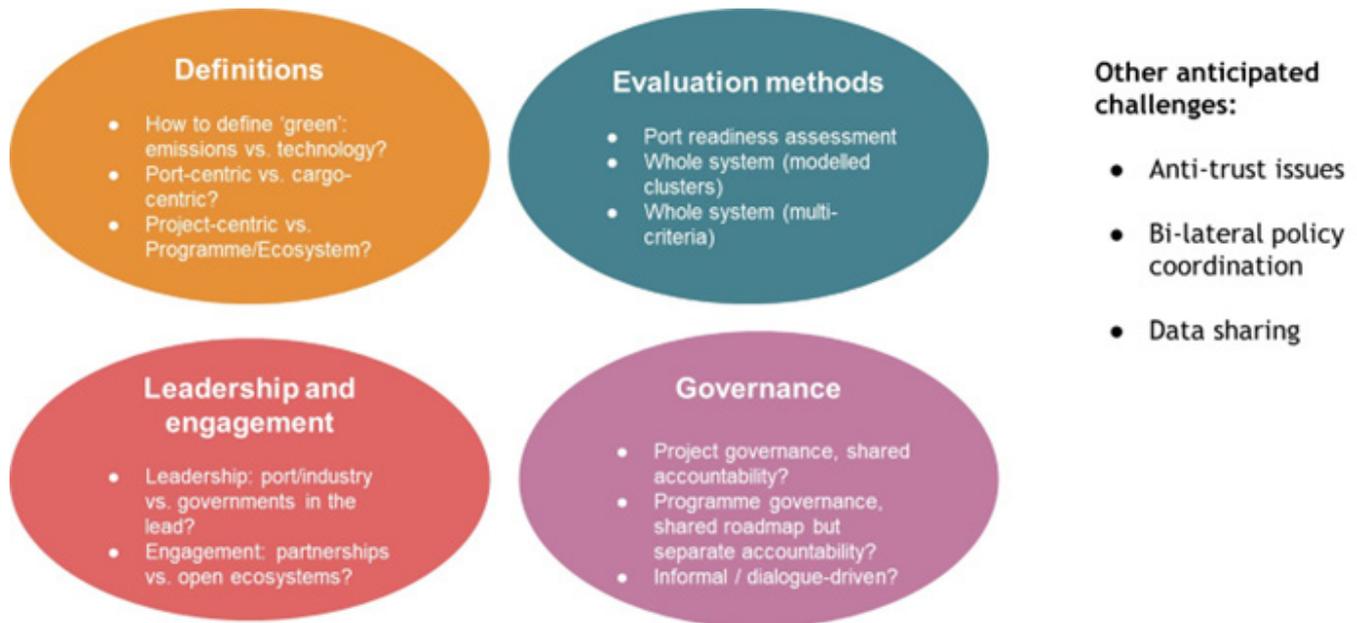
## What kind of activity is emerging?

A number of initiatives, partnerships, and studies have been announced during the first half of 2022, and more are expected. The illustration below includes information about 8 such announcements that had been made as of 1 June 2022. These include initiatives taken by industry and third sector actors, by governments, and in collaboration between the two. This illustration is not meant to be comprehensive but only to give an indication of activity at a point in time.



## What issues are being addressed?

The figure below summarizes some of the issues that these Corridor initiatives are grappling with in their early stages of development. These issues are explored in more detail in the body of the discussion paper.



## Definitions

The Global Maritime Forum and Getting to Zero Coalition have emphasized the definition of a Maritime Green Corridor as:

Specific shipping routes where the technological, economic and regulatory feasibility of the operation of zero-emission ships is catalyzed by a combination of public and private actions.

This definition has influenced and continues to share much in common with other definitions in use (see Figure 1). However since other definitions have emerged, a review of the nuances and emphases can help provide clarity. These nuances essentially involve differing approaches to defining “Green” and to scoping what is meant by “Corridor”.

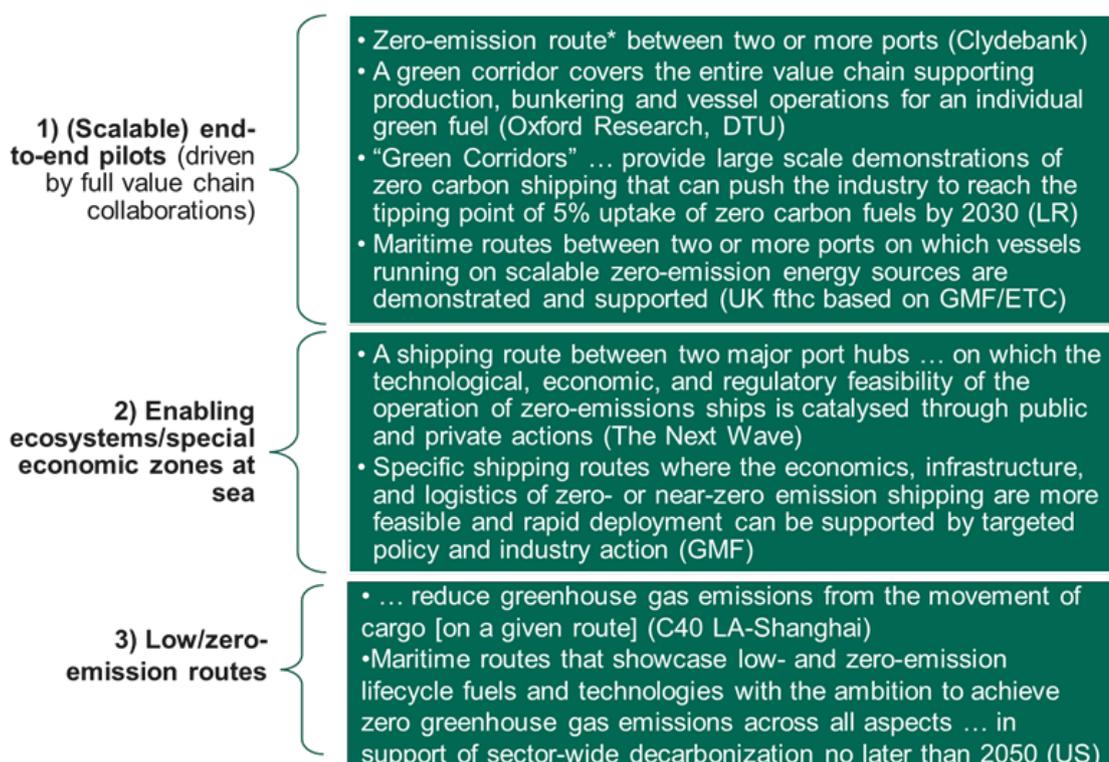


Figure 1: Definitions of Green shipping Corridors, UK DfT, April 2022.

## Definitions of “Green”

One difference is whether stakeholders prefer to define “Green” in terms of emissions reductions per se, or whether the focus is on the technology and infrastructure to be deployed.

**Emission-centric:** The former approach, advanced in some part by the United States Green Corridor Fact Sheet as well as in the preliminary communications from the collaboration between the Port of Los Angeles and the Port of Shanghai, emphasises the potential to reduce emissions on given routes (though the US Framework also mentions technologies). Such approaches may also connect the reduction of emissions from deep-sea vessels to other, potentially shorter-term, sources of emissions (e.g. port operations, full chain logistics, etc.)

**Technology-centric:** The latter approach, emphasizing the demonstration and deployment of zero-emission technologies (fuels, infrastructure and vessels), has been more common. The US Framework mentions both “low and zero-emission” technologies without defining a subset of fuels. Lloyd’s Register refers to “Zero Carbon” rather than “Zero Emission,” though the associated analysis considers fuels with net-zero carbon feedstocks (e.g. blue and green methanol) in scope. The work of the Getting to Zero Coalition has emphasized the technologies associated with “Scalable Zero Emission Fuels” namely those that have the potential to achieve near-zero GHG emissions on a lifecycle basis while also scaling production in line with the pace of the transition. As opposed to the emission-centric approach, this approach addresses the need for targeted and coordinated technology demonstration and deployment to enable the long-term, large-scale decarbonization of the sector.

Corridor efforts looking to take a phased approach may wish to consider the Light Green/ Dark Green typology developed by University College London. This allows for the inclusion of multiple fuels in a Corridor effort while maintaining clarity about what is needed to drive the overall transition.

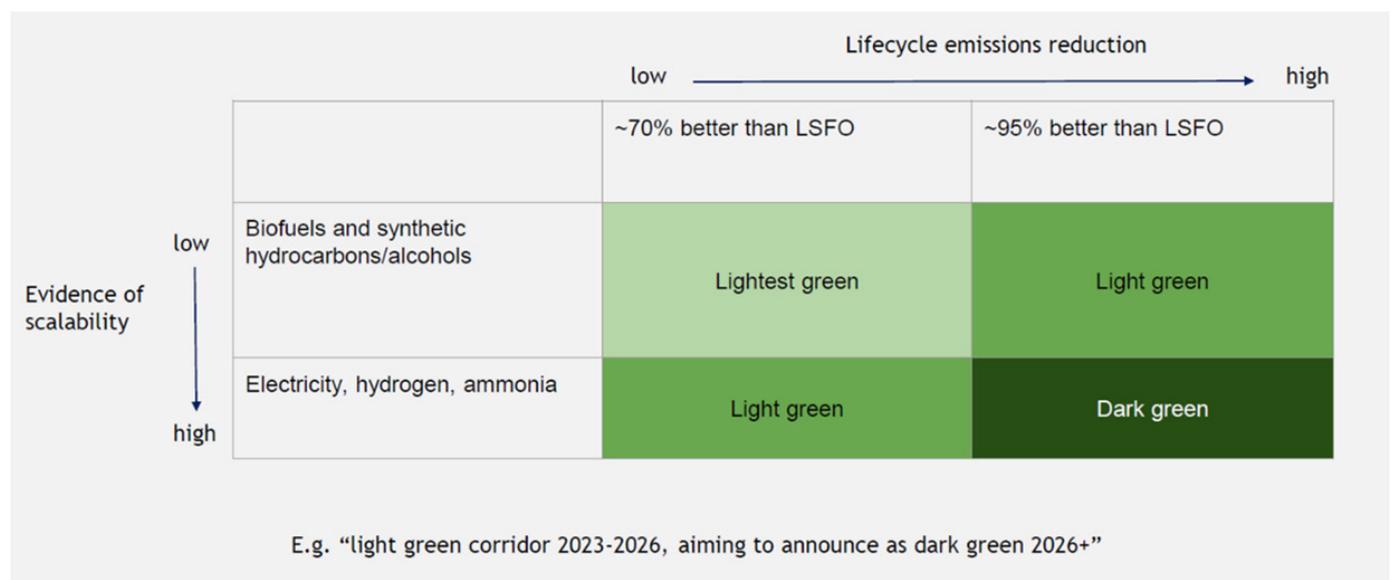


Figure 2: Possible typology for Green shipping Corridors, UC, March 2022.

## Ambition

Different levels of ambition are possible within both approaches.

- An emissions-centric approach could, for example, adopt modest initial reduction targets to allow for immediate action, and increase stringency over time. No corridor has to this point established such an emissions-centric ambition trajectory.
- A technology-centric approach could manage ambition through milestones or indicators for project initiation, partners engaged, technology development or deployment, for example the number of zero-emissions vessels in operation, the amount of scalable, zero-emission fuel available or other indicators related to the cost and performance of these technologies.

## Recommendation

Maritime Green Corridors are likely to play a particular role in the transition to zero-emission shipping: as enablers of the ‘emergence’ phase, when new solutions are tested and demonstrated at scale to prepare for the coming period of rapid global diffusion. As such the role of Maritime Green Corridors is not to primarily to generate emissions reductions, but to help the industry reach the “tipping point” (estimated in a 2021 paper by the High Level Climate Champions, UMAS, and Getting to Zero to be around 5% of global shipping fuels) where zero-emission solutions begin to diffuse rapidly.

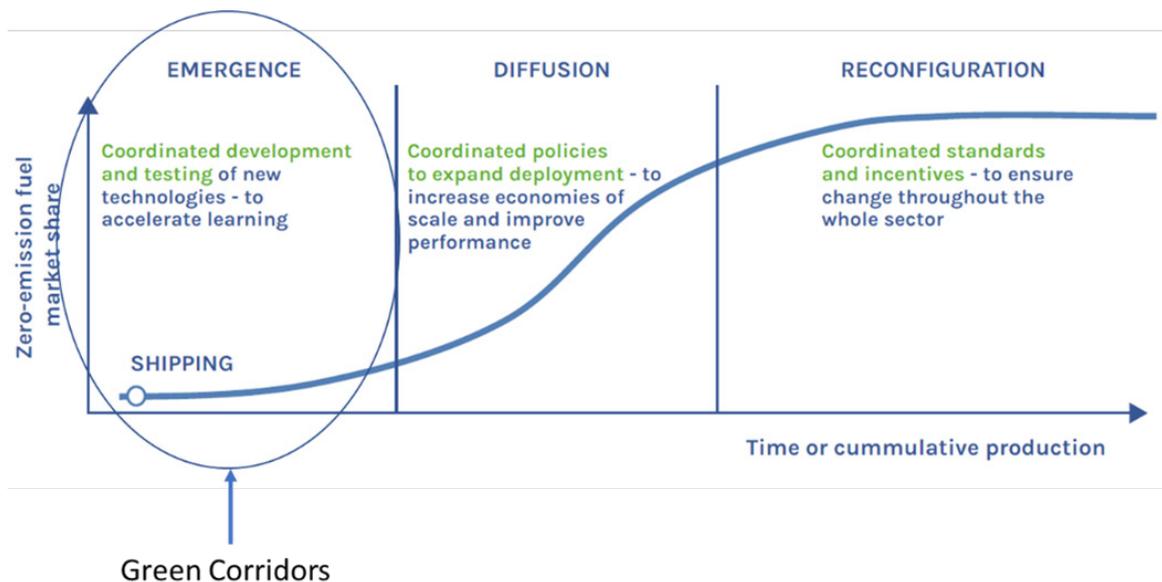


Figure 3: Green Corridors in a transition context.

A focus on incremental emissions reductions, even at a high ambition level, is likely to incentivize short-term measures such as technical efficiency improvements, the use of drop-in biofuels, and changes in port operations. While both might be desirable outcomes, neither requires the kind of end-to-end, full-value-chain coordination that a Green Corridor can provide. If scarce resources are diverted from the area where the need is greatest, that is, towards the establishment of new value chains for scalable zero-emission fuels, then Green Corridors will not have the impact needed.

While the need to achieve measurable emissions reductions is clear, **we recommend that Green Corridor definitions include a clear reference to scalable, zero-emission fuels and associated technologies.**

In terms of ambition, **we recommend that Green Corridor efforts adopt target dates for numbers of vessels in commercial operations using a scalable zero-emission fuel (multiple targets will be appropriate if multiple fuels are included in the proposed fuel pathway), ideally with multiple milestones through 2030.**

## Definitions of “Corridor”

Clarity about what a “Corridor” should strive to encompass is also desirable. Different concepts include the following:

### Port-centric

The corridors initiated by collaborating ports have understandably put the ports at the centre of the system, with decisions about which activities will be greened, with decisions about system boundaries, relevant cargo and voyages and even prioritized technologies likely to follow from the Ports’ priorities. In the Shanghai-Los Angeles corridor, for example, sets the system boundary at the port gate, so that port operations, cargo-handling, etc. are in scope. The importance of air quality issues and local community and environmental interests in both port cities are likely to have an influence on priority-setting and fuel choices.

### Route-centric

Other corridors are less likely to be driven by ports. The mooted iron ore Green Corridor between Australia and East Asia builds on the strategic interests of companies in the iron/steel value chain, as well as on the energy strategies of Australia and Japan. With the route likely serviceable through bunkering in Australia alone, the focus will be on making the economics of fuel supply and chartering arrangements work, solutions that could be relevant to a number of voyages making a range of port calls in the region.

### Pilot/demonstration project-centric

One approach to a Green Corridor is to emphasise direct investment in end-to-end pilots/ scalable demonstration projects that prove feasibility of zero-emission shipping by demonstrating the entire chain in operation. These pilots can generate learning and build confidence in technologies but are not necessarily replicable if they are designed as one-off undertakings.

### Programmatic/Niche market

A contrasting approach is to focus the corridor on developing the conditions for multiple actions, pilots, and demonstrations, and eventually, to enable full-scale commercial operations. In such an approach the focus is on creating and maintaining the enabling environment rather than on any given demonstration per se. The port-led initiatives (LA-SH, Mon-Antwerp, Seattle-Vancouver-Juneau) appear to be taking such a programmatic approach, but it remains to be seen whether the governments of the Clydebank signatories will choose to provide direct support to pilots and demonstrations or to focus efforts on the enabling programme (policies, guidance, open innovation funding etc.).

## Recommendations

Different approaches are a natural outcome of different initiative-takers and government structures. However, generally speaking, we recommend

- **A programmatic emphasis on the enabling ecosystem** as an essential part of promoting scalability and learning
- **A strategic emphasis on overcoming obstacles to commercialization faced by shipowners, charterers and cargo-owners** (the “software” of Corridors), as opposed to a narrower emphasis on infrastructure and technology (the “hardware” of Corridors)

## Initial Actions

Establishing Green Corridors requires some initial actions – many of which will be needed even before the “Corridors” have an institutional form.

## Evaluation, assessment, and prioritization

A number of types of evaluation/assessment may be useful in identifying opportunities and prioritizing some routes over others.

**Port readiness assessments** – Both the IAPH and the US government (within the Zero-Emission Shipping Mission) have advanced the notion of ‘port readiness’ assessments as an input to determining which Green Corridors might be feasible. These may assess operational readiness (IAPH) related to issues such as safe handling of new fuels, or they may attempt to determine the potential to develop suitable bunkering infrastructure based on potential for energy supplies, available land or infrastructure that can be repurposed (US/ZESM suggestion).

**Whole system (modelled clusters)** – UMAS on behalf of the Getting to Zero Coalition has developed an approach to modelling fuel demand clusters that can support prioritization of Corridors, essentially identifying which sets of existing voyages could be efficiently served by bunkering of new fuels. This analysis also incorporates a high-level assessment of potential fuel supply based on renewable energy resources.



Figure 4: Visualization of global “First Mover Routes” based on demand clustering, UMAS/Getting to Zero Coalition, 2021.

**Whole system (multi-criteria)** – The Getting to Zero report The Next Wave put forward an approach to evaluating corridors that assesses feasibility and impact through quantitative (emissions reduced, volume of trade, impact on cost of traded goods) and qualitative criteria (stakeholder readiness, policy environment).

		1	2	3	4	5	6	7	8	9	10	
		Australia-China iron ore	Brazil-Asia iron ore	Australia-Japan iron ore	Trans-Pacific containers	Asia-Europe containers	Transatlantic containers	North South Containers	ME-Asia ammonia	Korea/Japan-US automotive	Saudi-China Methanol	
		Large volumes, fewer policy enablers	High volume, with higher shipping costs	Lower volumes with committed stakeholders	Major mainline route	Long, high-emission mainline route	Small volumes, more policy enablers	Low volumes, limited ability to pass on costs	Fertiliser input now, likely future marine fuel	Low volume, high value, and carbon intensive	Potential future fuel, small traded volumes	
From		Australia	Brazil	Australia	Singapore	Singapore	Rotterdam	West Coast LatAm	Saudi Arabia	Korea (intermediary stop Japan)	Saudi Arabia	
To		China	China	Japan	USA	Rotterdam	USA	Europe	India	USA	China	
IMPACT	<b>A. Trade and logistics</b>											
	• Share of global trade volume	BPS	650	195	60	181	210	52	14	2	4	1
	• Expected future growth	CAGR until 2025	4%	3%	3%	2%	3%	3%	8%	5%	2%	6%
IMPACT	<b>B. Emissions</b>											
	• Carbon intensity on route	KgCO2e/tonne cargo	28	48	29	61	93	56	99	104	197	137
	• Current carbon emissions on corridor	Tonne CO2e	20,238,452	10,452,775	1,284,410	12,371,053	36,591,089	3,224,066	1,530,391	268,148	922,619	160,519
FEASIBILITY	<b>C. Value and cost pass-through</b>											
	• Cost structure of traded goods	Relative price increase of end product	11%	28%	11%	3%	2%	2%	12%	4%	1%	4%
	• Scope 3 importance for traded good sector	1= low, 5=high	3	3	3	2	2	4	2	1	3	1
FEASIBILITY	<b>D. Zero-emission fuel supply</b>											
	• Delivered cost of zero-emission fuel	\$/GJ	34.6	37.1	34.6	37.8	29.7	39.7	34.8	29.7	37.8	29.7
	<b>E. Stakeholder readiness</b>											
• National policies/regulations (net zero, green H2)	1= low, 5=high	2	2	4	1	3	3	5	1	3	1	
• Complexity of stakeholder environment	1= low, 5=high	2	1	2	5	5	5	4	2	1	2	

Figure 5: Multi-criteria analysis of 10 potential Green Corridors, GMF/ETC/McKinsey for the Getting to Zero Coalition, 2021.

The Lloyd’s Register Maritime Decarbonisation Hub report ‘First Mover Framework’ also uses an approach with several criteria to assess corridors, but applies them to a given regional context, assessing suitability of vessels in use, cargo traffic in the region, number of port calls, emissions, detailed regional analysis of the fuel supply (not only based on renewable energy resources) etc.

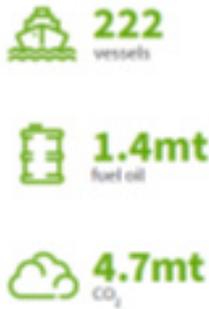


Figure 6: Assessment Criteria from the Lloyd's Register First Mover Framework.

Criteria	Candidate Fleet: Singapore-Hong Kong containership feeders
The type of vessels in the fleet should be in the 'first mover' category.	This candidate fleet and selected shipping route inspires first-mover projects because: <ul style="list-style-type: none"> <li>• Containerships are used to transport manufactured goods, often sold directly to end consumers that may be willing to absorb the pass-through costs. Consumer pressure to address climate change is more heavily felt in this vessel type segment, unlike bulkers and tankers, which are further down the chain and less subject to consumer pressure.</li> <li>• Shippers in this fleet also own more vessels outside of this fleet, and therefore are incentivised to prepare for the eventuality of turning over their wider fleets. Gaining an early technical and practical advantage leaves these owners less exposed to sudden decarbonisation policy changes in future.</li> <li>• These feeders can benefit from regional financial support offered by local port authorities.</li> </ul>
The fleet mainly operates in a specific geographical area with a fairly high concentration of large traffic regularly calling at specific major hubs/ports so that <b>stable and reliable energy demand</b> can be inferred or defined.	By their nature, feeders remain largely region bound, unlike larger containerships on longer haul voyages, so these feeders mostly call at regional ports, with the majority of activity falling within the South China Sea. As a result, demand is localised, meaning reliable and relatively stable energy demand estimates can be inferred for this particular fleet. <ul style="list-style-type: none"> <li>• The transition of this feeders fleet offers a significant potential impact by targeting approximately 4.7 million tons in current carbon emissions. When placed alongside the 31 shortlisted corridors identified in the study commissioned by GDF<sup>14</sup>, this fleet would represent the 5th highest ranking by potential impact (the GDF study's corridor with the 4th highest impact, South Asia from one corridor, is estimated to currently emit 33.4 million tons of carbon, while the 3rd highest impact corridor in the GDF ranking is the Transatlantic containerships corridor with an estimated 3.2 million tons of carbon – therefore the fleet in our study would rank between these).</li> <li>• The fleet operates in Singapore, which is a leading container trans-shipment hub and busy trade region, so has potential to act as a catalyst for all the other ships calling in Singapore or Hong Kong. According to the GDF report<sup>14</sup>, the use of new fuels could tap into Singapore's position with extensive regional feeder activities and bunkering capabilities and lead to collaboration between Singapore and industry stakeholders, enabling co-sharing of risks of new investments and sharing of knowledge on common issues.</li> </ul>
While the transition of this fleet should deliver a <b>significant potential emissions reduction</b> , the fleet transition should also act as a <b>catalyst for other ships</b> that call at the identified ports, or ships operating nearby, so that it is likely to have a wider impact, spreading beyond this fleet into a larger market.	

All three types of assessment can be useful. Port readiness assessments cannot identify promising corridors on their own, as they do not address non-port issues that are likely to be crucial to a Corridor's feasibility. The UMAS model can provide rich information about the current demand for fuel, but assumes that operational profiles are static, while Green Corridors may create an opportunity for companies to experiment with business and operational models including using more dedicated vessels. Conversely the Next Wave approach does not assess operational profiles and thus may underestimate the complexity of deploying zero-emission shipping on otherwise promising routes. The LR First Mover framework considers both fuel supply and operational profiles, but not "softer" considerations such as stakeholder readiness.

## Recommendations

We recommend a whole-system approach to evaluating corridors, especially when the evaluation is being undertaken by one or more national governments seeking to set priorities. For routes serviced by many and/or smaller operators, and for domestic and regional routes, a modelled approach that builds on existing operations may be the best starting point, as smaller operators may have less flexibility in changing operations. For larger routes with fewer charterers/carriers, the multi-criteria approach may be a better starting point, as large players may be able to adjust operations in order to take advantage of special conditions on a Green Corridor.

## Stakeholder engagement

A key success factor for Green Corridors will be the ability to engage the crucial stakeholders for implementation. The primary considerations appear to be whether industry, ports, or governments are in the lead, and what whether participation model is partnership-based or more open.

**Port leadership** -- (see above).

**Government leadership** – it is to be expected that Clydebank signatory governments will play the ‘convening’ role in their Corridor efforts. Thus far the United Kingdom has been the most proactive government, engaging industry, commissioning evaluations and earmarking funding. The government of the United States has focused on the definitional underpinnings and overall framework, and has shown interest in proactively identifying corridors with partners in the Quadrilateral Security Dialogue (with Japan, Australia, and India).

**Industry/third sector leadership** – there is potential for the sector to convene itself. While early government involvement will probably be necessary in order to resolve policy issues, attractive Corridors could be initiated by industry activity. The Southeast Asia regional container trade, explored in the LR Decarbonisation Hub’s First Mover Framework, could be an example where industry leadership may be essential to capture a relatively attractive opportunity.

**Partner-driven** – The LA-Shanghai and Pacific Northwest Corridors have launched with a ‘partnership’ model, wherein companies are invited (or not invited) to participate as partners. This allows first movers to have an influence on the Corridor’s arrangements and potentially ensure that the eventual benefits/credit flow to them.

**Open ecosystem** – An alternative is to develop a Corridor following an open model, allowing any company to take advantage of the conditions being created to develop and offer technologies or services on the Corridor.

**Recommendations** - [No recommendation offered at this point – all models seem feasible]

## Roadmapping/planning

Depending on the approach to stakeholder engagement (above) and governance (below), different approaches to guiding and planning the Corridor’s development may be appropriate.

**Project implementation:** For Corridors where participation is based on formal partnership, and where governance structures such as a project consortium is in place, the partners may be able to adopt a joint implementation plan that establishes specific tasks, milestones and targets for which specific partners will be accountable.

**Programme “Route Map”:** For Corridors pursuing a more open model of participation, where companies, ports, class societies etc. may make independent but relevant contributions to the Corridor on the basis of common guidelines, available incentives etc., it will not be feasible to assign tasks and accountabilities to specific actors. In such a model, the more useful guidance for planning and implementation could be something like a shared roadmap (or “Route Map”), providing some level of consensus guidance as to the actions needed on the

appropriate timelines. Such route maps will have a greater impact on stakeholder decision-making if they are developed in a participatory way with input from industry, the public sector and research/third sector. Roadmapping processes of this kind are increasingly common and can be convened by industry associations, government agencies, or research/third sector actors, as long as participation includes all stakeholder groups.

The Los Angeles – Shanghai Green Corridor is currently beginning the development of an implementation plan, though it is not yet clear how specific the activities will be to the partners involved, though input will be gathered from non-partner stakeholders through thematic working groups.

*The Next Wave* report included indicative “Route Maps” for the Corridors studied, which included input gathered from industry stakeholders (though not from governments or civil society). For reference as to what such a Route Map might include, the example for the Australia-Japan Iron Ore Corridor is included below.

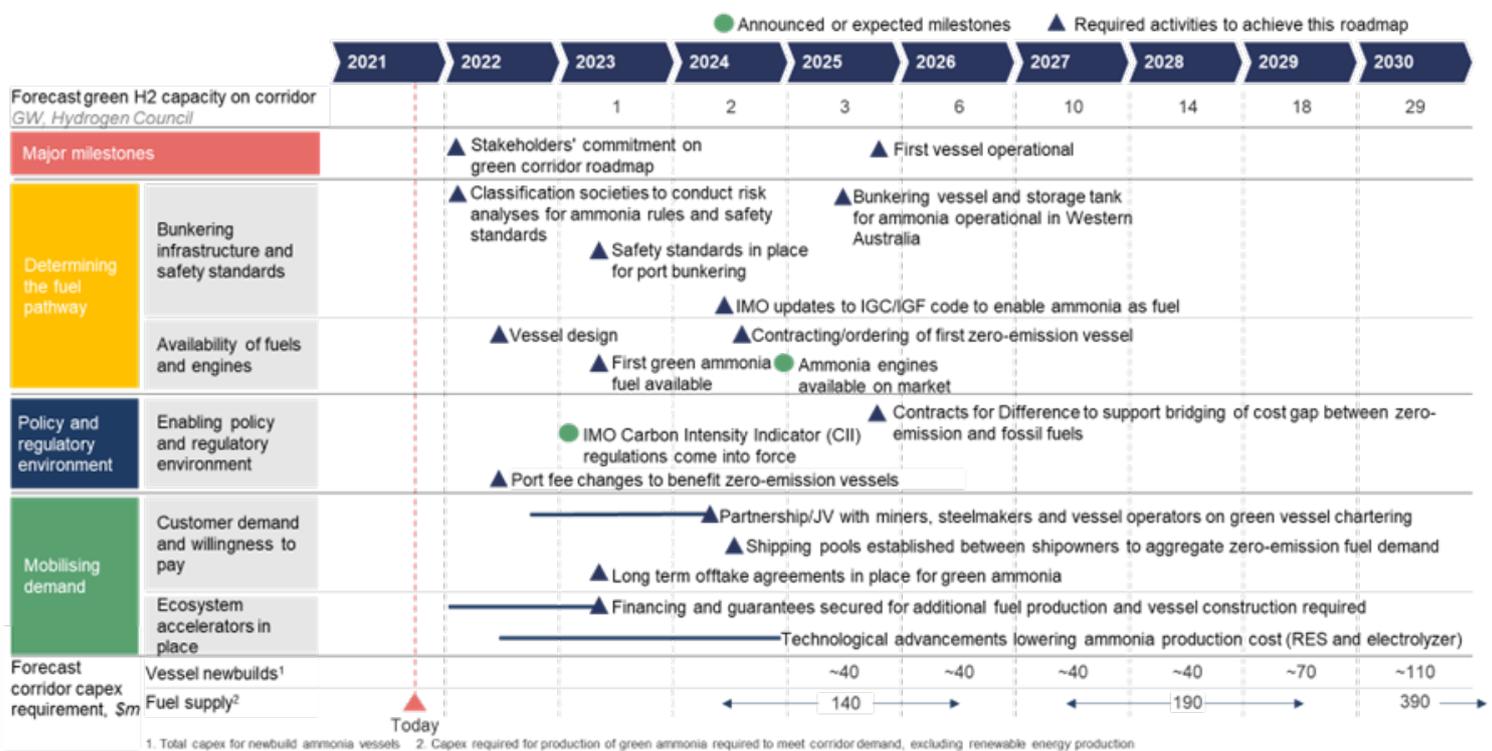


Figure 7: Indicative “Route Map” for a Green Iron Ore Corridor from Australia to Japan, GMF/ETC/McKinsey for the Getting to Zero Coalition, 2021.

The Silk Alliance will likewise build on the First Mover framework to evaluate different scenarios and reach consensus through a ‘scenario-driven roadmapping’ approach.

## Recommendations

The appropriate approach to planning a Corridor’s development will depend heavily on the approach to stakeholder participation, partnership and governance. An important recommendation, however, is that even Corridors develop shared guidance and/or planning documents, and to the extent possible, make these public so they can inform the broader ecosystem. Such documents need not be officially ‘owned’ by a government or industry

stakeholder to be influential and useful reference points for public and private sector planning.

## **Governance**

There are no “Green Corridors” in operation today, and which governance models may be appropriate remains an open question.

Some information has been collected about two of the port-led Corridors (LA-Shanghai and Seattle-Juneau). These two, as well as the Corridor between Port of Antwerp and Montreal and the Silk Alliance, are initially ‘governed’ by light partnership agreements/memoranda of understanding that only set out broad shared visions and ambitions. This initial approach is likely to change as actions are identified, targets are set, and roles are refined.

### **Project governance**

One possibility is that partnerships will evolve into projects, with project governance models involving steering committees, mutually committed resources, shared targets/timelines/metrics etc. Given the large number of partners likely needed to deliver an impactful corridor, a single project may be difficult to scale to the challenge. Spin-off project consortia focused on specific problems may be necessary to manage complexity, effectively turning the project model into a programme linking multiple projects.

### **Programme governance**

Another possibility, perhaps mostly likely to be relevant where governments are in the lead, is the creation of a ‘programme’ of activities, where overall targets/timelines/metrics are set and managed by e.g. a government agency or agencies, while other stakeholders can apply to participate via specific projects. These corridors could be managed in similar way to national innovation programmes, with some government resourcing, matching/funds from industry, multi-stakeholder advisory boards, and the like.

### **Informal governance**

A third possibility is that Corridors not be ‘managed’ at all, but be allowed to emerge informally, with different stakeholders signalling interest through targeted ventures, policies, and initiatives, and coordination taking place through markets and via informal public-private dialogue. This approach may be the “default” approach but may prove slow and dogged by uncertainty. Where the strong institutional leadership from a public or private body is not forthcoming, there may be a need for coordinating initiatives from e.g. third sector actors to ensure that expectations remain aligned, ambitions remain high and information is effectively shared.

## Anticipated governance challenges and preliminary recommendations

Based on what is known about the decarbonization challenge in shipping, and early reports from the port-led Corridors, several key challenges will need to be considered in governance design.

### Anti-trust issues

Given that a major purpose of Corridors will be to coordinate the actions of actors (including competitors and suppliers/customers) across the emerging zero-emission shipping value chain, governance approaches will have to either:

- Restrict formal partnerships to pre-commercial activities and/or
- Include within their frameworks legally appropriate vehicles for commercial actions (e.g. investment partnerships, joint ventures)

### Unilaterality vs. Bilaterality

For government-led Corridors, there will likely be challenges related to coordinating approaches between governments on “either end” of the Corridor. Coordination will be required to align regulatory frameworks for ports, fuels, etc. as well as the use of public funds to support innovation and close the competitiveness gap for of zero-emission fuels. **While some Corridors may be possible to initiate unilaterally, the potential to share costs and increase scale speaks in favour of bilateral coordination from an early stage.**

### Data-sharing

The speed and scale of deployment of zero-emission shipping solutions will be significantly impacted by how effectively learning occurs both within and between Corridors. A crucial element of this learning will happen through the collection and sharing of data related to emissions reductions, technology performance, costs, and more. An early and important task for leading actors in Green Corridors will be to explore the options for collecting, anonymizing, storing and sharing this kind of data. Governments will have an especially important role in enabling this framework, though transparency requirements on government agencies may hinder them from acting as the actual brokers of the data. **Governments may look to, for example, existing industry innovation programmes and public-private partnerships as starting points for this process but should aim to maximize the participation of industry in data sharing by using innovative approaches.**

The sharing of data across corridors may prove even more complex. **The Clydebank signatory governments should take a proactive approach to harmonization globally from an early stage to avoid building in roadblocks to sharing later.**