INSIGHT BRIEF

National and regional policy for green shipping corridors

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This insight brief is the first in a series of publications on national policy for international shipping decarbonisation - an overview of the ways in which countries can support the different stages of the transition towards zero emissions and thus complement private sector and global efforts.

Introduction

In November 2021 at the Conference of the Parties in Glasgow, 21 countries signed the Clydebank Declaration, signalling their intent to promote the development of green shipping corridors – specific shipping routes where the feasibility of zero-emission shipping is catalysed by a combination of public and private actions. Since then, around 30 green corridor initiatives have been announced by governments and industry stakeholders around the globe.

In a series of parallel developments, several countries – notably the United States, Australia, Germany and Japan – have announced measures to support a hydrogen-based economy, while the European Union has spearheaded regional action for international shipping decarbonisation through the adoption of the FuelEU Maritime initiative and the inclusion of shipping in its Emissions Trading System (EU ETS). These efforts are increasingly seen as potential mechanisms to incentivise green shipping corridors, but whether they succeed in doing so depends on a number of pending design decisions.

In perhaps the single most important shipping event in recent years, the International Maritime Organization (IMO) adopted a new strategy to reduce the greenhouse gas (GHG) emissions of ships at the July 2023 session of the Marine Environment Protection Committee (MEPC 80). The increased level of ambition in this revised strategy and the decision to adopt a well-to-wake approach to emissions send clear signals to the industry to move towards scalable zero-emission solutions. At the same time, the outlined GHG reduction pathway is not fully compatible with the 1.5C trajectory and will have to be combined with industry and national action to reach the goals of the Paris Agreement.[i]

The newly introduced intermediate goal of 5% uptake of zero- or near-zero emission fuels and energy sources by 2030 (and the ambitious 10% stretch goal) within the revised IMO strategy underscores the importance of early action. However, measures to implement the strategy can be expected to enter into force by 2027 at the earliest, and the design of these measures remains uncertain. This means that this strategy alone will have a limited effect on unlocking private sector investments before the second half of this decade. If any investment decisions are to be made before then, governments and industry will have to come together to absorb the risks and maximise the benefits associated with early movement.

Uncertainty remains regarding the ways in which governmental support can best be organised, and the evolving policy landscapes within energy, climate, and shipping provide a rare opening for multiple policy pathways. This insight brief maps the alternatives for national policy intervention at different stages of green corridor development and outlines the main policy considerations.

Green corridors and national policy action

Figure 1 depicts the journey of the shipping sector from emergence, where multiple technological pathways are developed and tested simultaneously to accelerate learning, through diffusion, where the most viable technology options scale up and spread exponentially, and towards a reconfiguration of the whole sector.

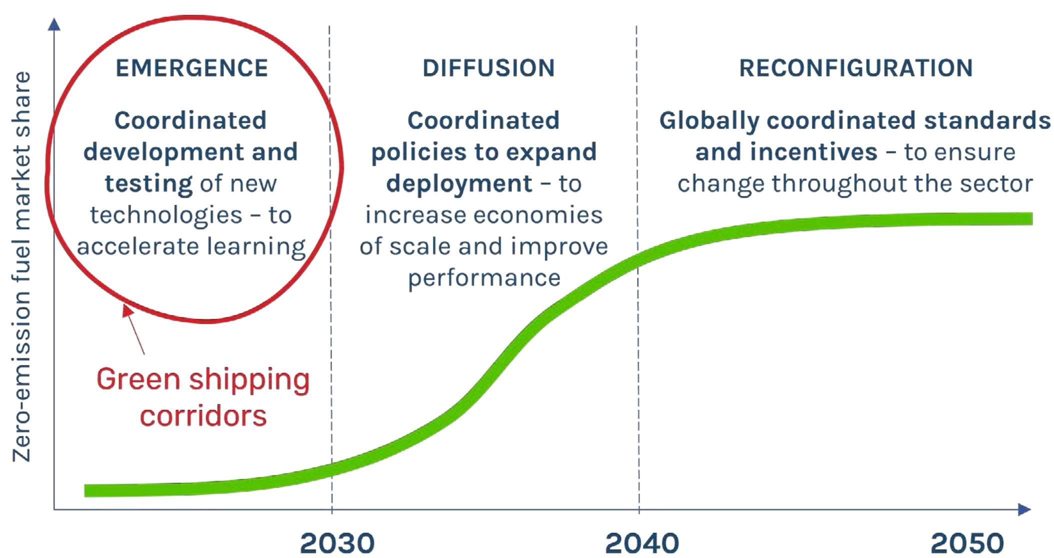

Figure 1: The shipping sector's transition to zero-emission fuels Source: Adapted from Getting to Zero Coalition (2021)[ii]

It has previously been estimated that a share of 5% of scalable zero-emission fuels is required for the sector to enter a rapid diffusion phase around 2030.[iii] Green shipping corridors are key mechanisms to reach that target and crucial enablers of the emergence phase of the transition. Through green corridors, technologies relevant to shipping decarbonisation – fuels, vessels, and infrastructure – are tested and deployed in a coordinated way, generating the learnings required to unlock the rest of the sector's energy transition. A coordinated deployment, in which different parts of the extended value chain agree to align their investment plans around a set of solutions, helps to reduce the risks associated with early movement.

Currently, green corridors are inevitably associated with risks and costs for the parties involved. To make sure that these costs are not prohibitively high, and that the speed and scale of action are sufficient, it has previously been suggested that green corridors be established on selected high impact-high feasibility routes, from where they would subsequently be scaled up, and that both private and public sector actors along those routes must mobilise resources for their successful implementation.

Green corridors, and the related national and regional policy regimes, will ultimately be phased out once the technologies and business models that they trial are sufficiently mature and harmonised global policies are established. Before that can happen, however, governments and industry need to step up and join their efforts in advancing these initiatives.

Countries may choose to support green corridors for different reasons, and understanding how the overarching goal of the green corridor movement can support broader national objectives is key to determining a successful policy strategy. Green corridors can support a country's objectives within the following areas:

1. **Maritime leadership** – where green corridors are seen as a way to modernise the country's shipping sector and to secure, future-proof, or strengthen the country's position as a maritime nation
2. **Energy leadership** – where green corridors represent a mechanism to create early demand for scalable zero-emission fuels, thus securing the country's position in future energy markets
3. **Climate leadership** – where green corridors contribute to the broader decarbonisation agenda and the global climate movement through early reduction of supply chain emissions within multiple sectors
4. **General innovation and technology leadership** – where green corridors unlock a new market for innovations, thus securing the country's position in the global knowledge economy
5. **Strengthening trade partnerships** – where green corridors represent a mechanism to create stronger value chain links and advantageous conditions for trade along significant routes, thus securing strategically important trade flows.

The drivers behind countries' engagement in green corridors will define which policy domains and instruments can realistically be leveraged, as these are often found outside of traditional shipping policy. In addition, understanding the profiles of the countries at both ends of the corridor may help define how policy support can be distributed between the participating governments.

Corridor development stages and policy needs

Approaches for supporting green corridors through national policy fall into two distinct but interrelated categories, linked to the stages of development. As green corridors mature and approach implementation, policy needs to shift from often ad-hoc approaches to encourage creation of new initiatives to more systematic efforts to enable deployment on the corridors (Figure 2).

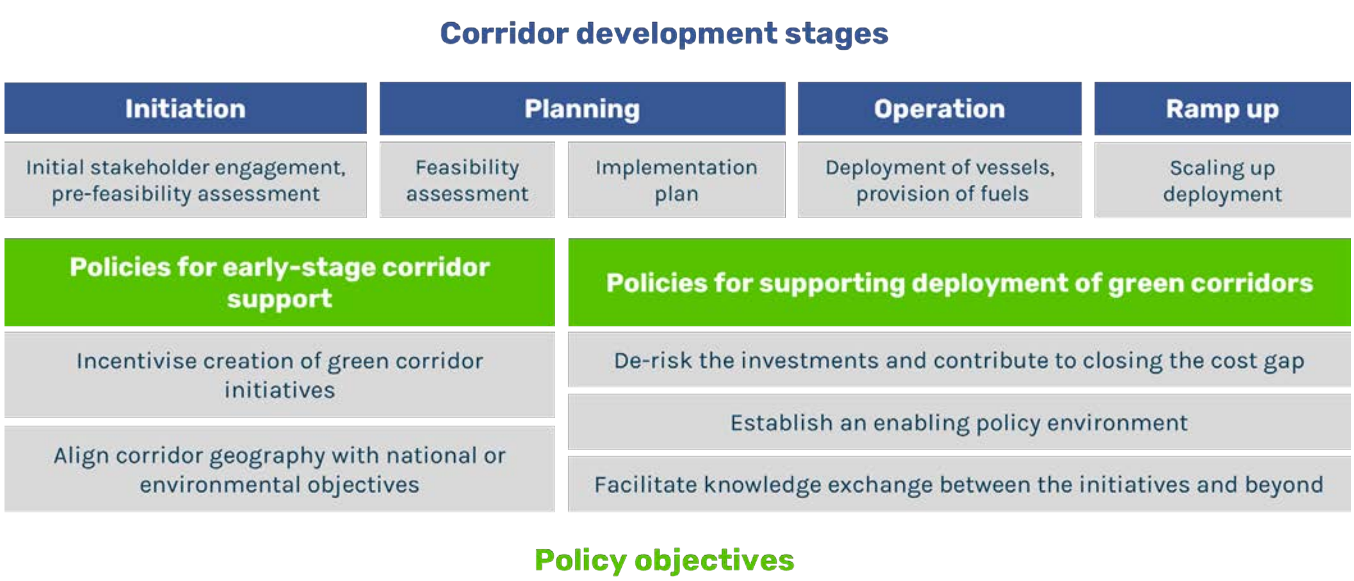

Figure 2: Potential policy objectives at different stages of green corridor development

At the early stages, the goal of national policy is to encourage the creation of a portfolio of industry-driven or government-led initiatives along promising routes, maximising the potential environmental benefits and the chances of success for future corridors. As the planning process progresses, economic considerations come further into play, and the nature of the required policy intervention shifts drastically. At this stage, investment decisions are being made, and the cost gap between the less developed, and thus more costly, zero-emission solutions and their traditional counterparts becomes a major obstacle for greenlighting investments. The goal of policy at this stage is to provide sufficient de-risking mechanisms to unlock private-sector funding and eliminate any administrative bottlenecks for the implementation of the required technologies.

Because of the significant amount of time between when the investment decisions are made and when the vessels are deployed, and the fuels bunkered, any policies aiming at closing the cost gap and de-risking the investment must be agreed on much earlier than the date of deployment. A structured dialogue between green corridor stakeholders and policymakers is therefore required throughout the development.

The required policy effort can be expected to intensify as green corridors approach implementation. With over half of the existing corridors initiated by industry stakeholders, it has been demonstrated that the initiation and the early planning phases can happen without the involvement of governments. The nature of the challenges in the implementation phase, however, makes green corridor success unlikely without robust public action.

Still, the way the governments choose to engage at the earlier stages will have implications for the tools and mechanisms available to them going forward. For example, establishing a corridor along a route with favourable conditions for fuel production may decrease the need for financial aid required to enable deployment.

Approaches for supporting the initiation of green corridors

The ways governments have approached the task of incentivising green corridor creation, outlined in the Clydebank Declaration, have varied significantly among the signatories. One central difference is the degree of governmental influence over the portfolio and placement of future corridors.

Governments that adopt a soft steer approach let the industry define the scope and the placement of the initiatives. This allows governments to focus on providing information, facilitating dialogue to spur interest among stakeholders, and increasing the visibility of industry initiatives. With a hard-steer approach, governments take a more active role in defining the placement of future corridors, either through bilateral partnerships with other countries or by conducting or commissioning assessments to identify potential corridors. In between the two are medium-steer approaches, in which industry-led initiatives have to pass a governmental filter in order to receive support. Figure features examples of the tools available for countries seeking to support green corridors at their early stages. Governments can deploy multiple tools at once, and indeed, in the first two years of the movement, many have adapted their approach based on evolving stakeholder activity and changing industry needs.

Figure 3: Tools to support the initiation of green corridors

General **information provision** targets the issue of industry unfamiliarity with the concept. This was a particularly sought-after approach in the first months following the launch of the Clydebank Declaration, when the low level of understanding of green corridors was a major bottleneck for industry progress. While many of these efforts were not publicly announced, one example is the **US Green Corridors Framework**, which introduced relevant definitions, process steps and building blocks for green corridors. Canada's **Green Shipping Corridors Preliminary Assessment** is another example of informing national stakeholders, notably ports, of the potential value of green corridors.

Even when there is familiarity and a high eagerness to engage with green corridors, stakeholders might experience a lack of channels or platforms to have the cross-value chain dialogues that are needed to form initial consortia. Governments can facilitate such discussions and matchmaking by **convening stakeholders and establishing platforms for industry dialogue**.

Stakeholders who manage to come together might experience a lack of resources to explore the prospects for further cooperation. Providing **funding for pre-feasibility and feasibility studies** allows for a higher degree of governmental steer through defining the criteria for projects to receive support. National innovation programmes, both shipping-specific or broader mobility- and energy schemes, represent particularly fitting structures to provide this funding. A prominent example of such a scheme is the **UK Clean Maritime Demonstration Competition** (CMDC), which has to date financed three international green corridor feasibility studies. The latest round of CMDC funding focuses on the demonstration of vessel and infrastructure solutions in an operational setting and includes specific provisions on domestic green shipping corridors. It should be noted that the private sector is often willing to finance feasibility studies on its own, especially for corridors that represent a significant business development opportunity.

Initiating or commissioning country-level assessments is a tool that helps governments narrow down the multitude of green corridor opportunities to a handful of promising options. These assessments often lead to the formation of consortia but may also seek to inform the sector on the best options. One example of this approach is the **Chilean Green Corridors Network**, a collaboration between the Chilean Government and the Mærsk Mc-Kinney Møller Center for Zero Carbon Shipping. Another example is the collaboration between **DNV and the Nordic Council of Ministers**, in which six intra-Nordic routes were identified.

Some governments have opted for signing **bilateral agreements and memoranda of understanding** to establish green corridors. Several such agreements were announced at COP27 in Egypt as part of the **Green Shipping Challenge**. A few have since progressed towards technical cooperation. The **United States and the United Kingdom**, for example, have recently issued Requests for Information (RFI) seeking to understand the issues related to green corridor development between the two countries. Umbrella agreements like these can potentially provide a framework for future policy action and a platform for bilateral policy dialogue, but their progress pathway remains to be seen.

While multiple tools can be deployed for early-stage green corridor support, the following considerations may guide the overall strategy:

- Countries may leverage the existing body of knowledge for more robust policy action. Examples include the **dataset to evaluate potential partnerships** for the development of international green corridors and the upcoming corridor prioritisation tool, both developed by UMAS, as well as several pre-feasibility **methodologies**, all to some extent striving to balance the impact of potential corridors with the feasibility of their implementation.
- Countries may want to build on existing structures, such as innovation programmes and platforms for public-private dialogue, to the extent possible, to minimise the costs and maximise the speed of support.
- Since most high-impact green corridors are international, countries may consider including stakeholders beyond their jurisdictions, either through partnering with other countries or through extending support to projects with international stakeholder participation.
- Countries may strive to incentivise cross-value chain collaboration and extend the coverage to stakeholders outside of the traditional maritime sector.

Approaches for supporting deployment on the corridors

Once a critical mass of early-stage initiatives is reached, the policy focus should shift towards unlocking private sector investments within the initiatives. As previously mentioned, a central function at this stage is narrowing the cost gap, which is expected to remain present until the underlying technologies reach sufficiently high development levels.

The structure of the cost gap depends on many corridor-specific factors, but a key determinant is the types of energy sources that would be deployed. For scalable zero-emission fuel solutions, particularly relevant for deep-sea shipping, it is generally acknowledged that the cost of alternative fuel production represents the lion's share of the cost differential. Figure 4 features illustrative examples of annualised cost gaps for a container vessel running on green ammonia and a dry bulk vessel running on e-methanol, compared to vessels running on heavy fuel oil (HFO).

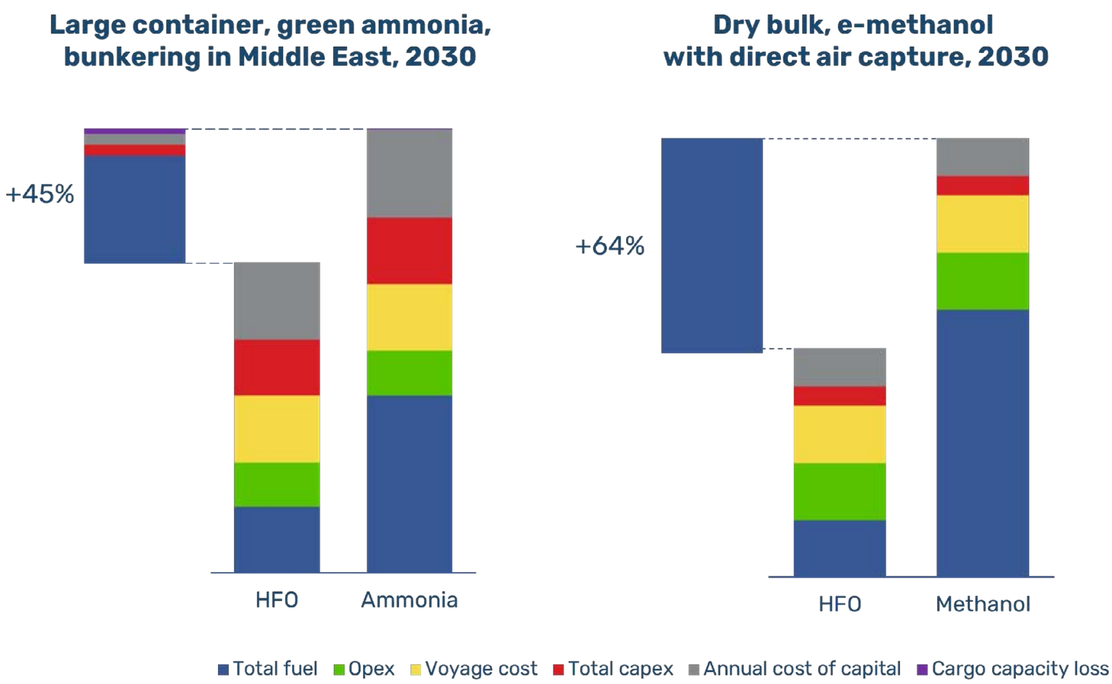

Figure 4: Illustrative examples of cost gap structure, annualised end-to-end total cost of ownership.
Source: Adapted from The Next Wave (2021).

In both cases, the increased cost of fuel constitutes the biggest element of the cost gap, while additional elements include the cost of zero-emission vessels and the annual cost of capital. We argue that multiple cost gap elements may have to be addressed to maximise the effectiveness of policy support.

In addition to national and regional policies, the following mechanisms may, and indeed in many cases should, be deployed to narrow the cost gap:

1. Voluntary value chain action, through, for example:
   - Green premia (cargo owners)
   - Operational efficiencies (shipping companies)
   - Reduced port dues and other port-side incentives (ports)
2. International policy action
3. Private finance, including sustainability-linked loans

These measures are, to some extent, complementary. Value chain action and national policy action must go hand in hand, as any meaningful value chain action would improve the cost efficiency of national policy intervention. As previously mentioned, IMO action is first likely to influence financial decisions within green corridors towards the end of the decade, subject to the adoption of global market-based measures and a favourable design of revenue recycling mechanisms. The potential of international policy to contribute to green corridors business case is also limited by the very nature of green corridors as "special economic zones" at sea, where non-standard arrangements are trialled and supported. In a similar fashion, the possibility to mobilise private finance hinges on the success of the efforts to de-risk the investment and is likely to increase in significance towards the beginning of the diffusion phase of the transition.

Against this background, national policy becomes an obvious complement to value chain action for closing the cost gap. Countries often possess sufficient incentives to support green corridors, the fiscal and administrative means to contribute to bridging the cost gap, and the agility to do so in a timely manner. The most direct way, and the most frequently mentioned option, for governments to contribute to narrowing the cost gap is through subsidies, while alternative approaches involve shifting the cost burden to the industry through a combination of economic and administrative measures. Whichever option is chosen, it should be seen as a bridge to a future international regime, with the timeline reflecting the need for early implementation of support measures and their gradual phasing out from 2030 onwards.

Subsidies as a key mechanism to narrow the cost gap

Direct subsidisation of international shipping through domestic budgets is a relatively novel concept and thus can prove politically challenging. The political feasibility of direct subsidies will depend on how well green corridors align with the broader national objectives outlined in the previous chapter, and how well these strategic benefits are captured and communicated in the policy process.

Relevant design parameters

Potentially relevant support schemes could include everything from fuel subsidies to vessel subsidies to research and development funding for the enabling technologies. Each of these can be designed in multiple ways and be combined with others for increased impact. These design parameters will determine whether the subsidy package can be meaningfully leveraged to support green corridors. Figure 5 features relevant design considerations, namely, target recipients, target costs, support mechanisms, processes to determine the level of support, and geographic scope.

Figure 5: A typology of potentially relevant subsidies

Recipient (demand-side and supply-side subsidies)

A subsidy scheme can either target fuel production (supply side, production of fuel and derivatives for the purpose of selling it) or incentivise the uptake of those fuels among certain categories of consumers (demand side). These consumers are often found in hard-to-abate and energy-intensive sectors such as shipping, where transitioning to a new energy source is associated with significant additional costs, including capital expenditure, and changes in the way the companies operate.

Demand-side subsidies can target one or more sectors. They also often cover multiple solutions for the transition of the sector(s), such as blend-in fuels, near-term options, or efficiency measures. Supply-side subsidies may define eligible end uses in their scope or even earmark part of funding to specific demand sectors.

The *US Inflation Reduction Act* is an example of a supply-side subsidy targeting, among others, domestic clean hydrogen producers.[1] New Zealand's *Equitable Transition Package* is an example of a demand-side subsidy that provides incentives for several industries, including fertilizer producers and large transport operators, to adopt green hydrogen solutions. The German *Carbon Contracts for Difference funding programme* is a broader demand-side scheme, which encourages several energy-intensive industries (steel, cement, paper, and glass) to transition towards green hydrogen and renewable electricity. The newly announced Norwegian *Ammonia in Vessels* programme is a demand-side subsidy for shipping, creating an incentive to adopt the hydrogen-based fuel by reducing the cost of zero-emission vessels.

Under the perfect market conditions, both the demand- and supply-side subsidies have the potential to simultaneously drive down the cost and increase the availability of zero-emission energy sources. However, several factors may limit the extent to which this potential materialises.

The main concern with supply-side subsidies is that they may risk putting the shipping sector at a disadvantage compared to other sectors. The low cost of the fuels used in the maritime sector means that shipping's willingness to pay for zero-emission solutions is comparatively low, making it hard for the sector to compete for fuel offtakes with other industries. In addition, depending on the design, a supply-side subsidy can lead to an artificial inflation of the price by the fuel producer, thus negating part or all of the potential benefits for the consumer.

Broad demand-side subsidies risk introducing two types of undesirable competition: between shipping and other industries, and between zero-emission fuels and other solutions for environmental impact reduction. One concern with shipping-specific demand-side subsidies is that they would not generate the necessary volumes to justify the investments for fuel producers. The extent to which this risk would materialise depends on the balance between the projected demand and supply, as well as the curve of the economies of scale for the fuel in question. A related concern is a potential preference from the producers' side to spread the market risks by serving multiple markets.

Table 1 outlines the main options, potential risks and mitigation strategies for different subsidy options relevant for green corridors.

1 *See* **Table 2** *and* **Table 3** *at the end of this chapter for detailed descriptions of the announced subsidy schemes.*

Table 1: Risks and mitigation mechanisms of demand- and supply-side subsidies

Subsidy option	Potential risks	Mitigation strategies
Supply-side subsidy for zero-emission fuels in multiple sectors	• Competition with other sectors for offtakes may limit fuel availability for shipping • Price inflation by fuel producer	• Earmarking part of the support budget for offtakes within shipping • Reducing the producer's preference for higher offtake price through subsidy design features
Shipping-only demand-side subsidy	• Volumes not sufficient to justify new production • Producers exposed to market risks • Potential competition with blend-in fuels and other solutions (depending on the design)	• A separate pot or target for zero-emission technologies as opposed to other emission reduction measures • Indirect producer incentive through subsidy design features
Demand-side subsidy for multiple sectors	• Competition with other sectors may limit availability of funding to shipping • Competition with blend-in fuels and other solutions	• A separate pot for shipping with support scheme reflecting sector-specific challenges
Combination of supply and demand-side subsidies	• Cost-efficiency concerns • Concerns over double subsidising	• Splitting the costs between the two countries that share a green corridor • Targeting various cost elements in demand- and supply-side subsidies, or other design tweaks to avoid double subsidising

Target costs (capital expenditure, operational expenses, research and development)

On the supply side, capital asset (capex) subsidies cover the construction of facilities and the purchase of equipment for production of the fuel, while operational expenses (opex) support covers the cost of running these facilities (including, sometimes, the cost of transportation of the fuel to the consumer). Often, opex subsidies include a return-on-investment component (amortisation of upfront costs through revenues), blurring the line between the two.

In this paper, the distinction between capex and opex subsidies is primarily considered for subsidies on the demand side, where capex subsidies represent, for example, support for the purchase of zero-emission vessels, and opex subsidies cover the purchase of zero-emission fuels. This distinction is relevant due to the incentive structure within the sector, where opex and capex are often borne by different parts of the value chain (charterers and shipowners).

Capex subsidies for shipping often represent an extension of sector-specific R&D funding, where first-of-their-kind vessels are financed through high technological readiness level (TRL) research funding. Even after the first vessels are developed and built, a cost gap may remain, and capex subsidies can help close that gap. Countries with shipbuilding capacity might have a particular interest in providing such funding. The policy mechanisms historically deployed by these countries, such as scrap-and-build subsidies, can be leveraged by conditioning support on a zero-emission vessel requirement.

With split incentives in mind, it is unclear whether operational expense subsidies alone will be enough to justify an investment in zero-emission vessels. On the other hand, providing shipping-specific opex subsidies on top of capex support can be considered excessive and cost-inefficient by governments. A way around this is to provide a combined subsidy where operational expenses are covered indirectly through a broader subsidy to fuel producers, while shipping is awarded direct capex support.

Support mechanism (upfront payment, fixed price, fixed premium, sliding premium)

Upfront payment subsidies often take the form of grants or investment credits and are used to finance capital assets or research and development. These are often one-off payments related to the value of capital assets or the estimated research needs, although a payment schedule can be developed. The following three – fixed price, fixed premium, and sliding premium – are continuous payments linked to the production or consumption process.

A **fixed price** model differs from the premium models by distributing the price risk between the government and the receiving entity. As the name suggests, the price at which a commodity is produced or consumed is fixed by the government, fully absorbing the risk related to price fluctuations in the fuel market. Below are two variants of a fixed price logic: feed-in-tariffs (technically not a subsidy) and the market-maker model.

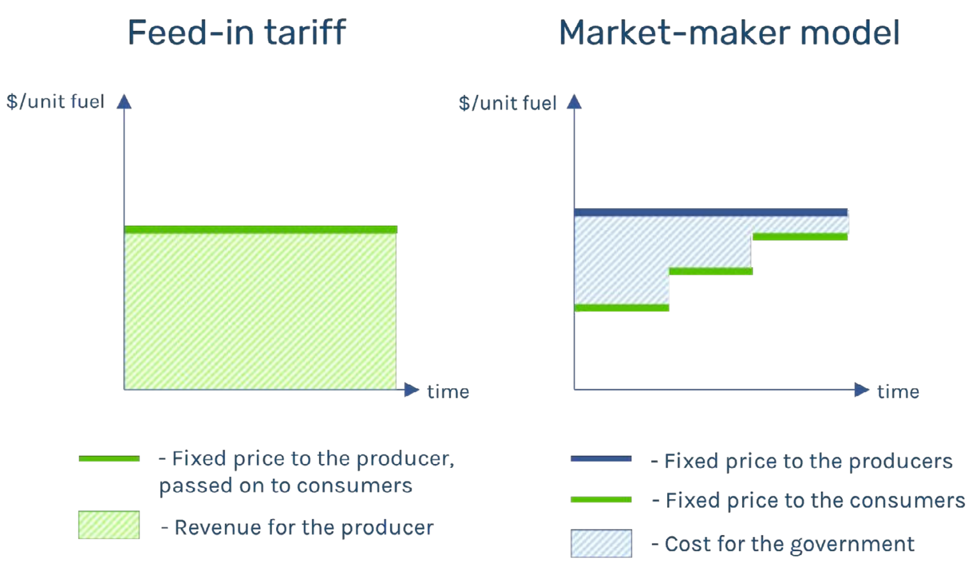

Figure 6: Examples of fixed price support schemes

The **market-maker** model is a combined demand- and supply-side support starting to emerge in the hydrogen space. Under this scheme, the government buys the fuel at a pre-agreed price and sells it to consumers at a lower price, indirectly subsidising the gap between the consumers' willingness to pay and the price that can justify the investment for the producers. An example of a market-maker model is Germany's H2Global scheme. Under this scheme, the price for the producers is fixed for ten years, while consumers are awarded shorter term contracts in hopes that their willingness to pay will gradually increase, reducing the gap over time.

Feed-in tariffs are another example of a supply-side fixed price logic, though these are not technically considered subsidies since the costs are passed on to the consumers. They have previously been mentioned in the hydrogen context as one of the options for the EU Hydrogen Bank and have come up in early policy discussions in the Netherlands. There, it was suggested that they could be coupled with a demand-side subsidy to compensate for the increased cost to consumers.[iv] In both cases, other options were subsequently chosen, and it remains to be seen whether feed-in tariffs are a viable option for the increasingly global hydrogen market.

In **fixed premium** schemes, typically awarded to fuel producers, the producers receive an additional stable stream of revenue per unit of fuel sold on top of the market revenues. The suggested design for the EU Hydrogen Bank scheme is a supply-side fixed premium subsidy. The US IRA Production Tax Credit for hydrogen is, in effect, a fixed premium subsidy, awarded through a different fiscal process.

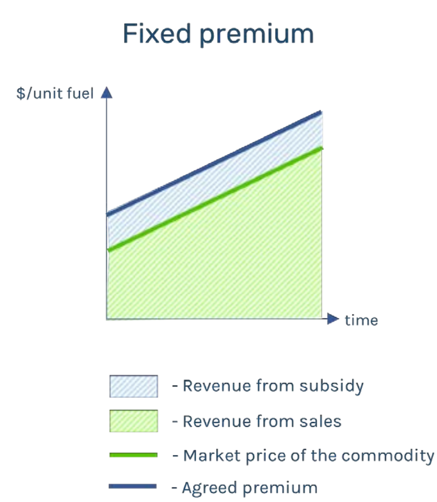

Figure 7: Fixed premium support scheme

In **sliding premium/contract for difference** models, the recipient is compensated for the difference between a pre-determined and fixed amount (strike price) and a variable amount (reference price). In a two-sided scheme (classic contracts for difference, symmetrical market premium model), the recipient is obligated to pay back the government when the strike price is lower than the reference price. In a one-sided scheme (classic sliding premium, though sometimes called one-sided contract-for-difference), no such obligations exist.[2]

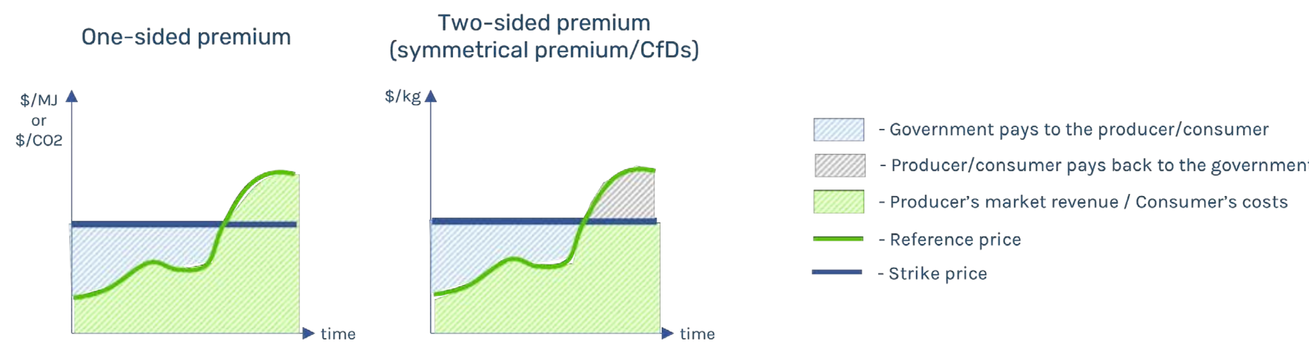

Figure 8: Sliding premium/contract for difference support scheme

What the strike and the reference prices represent depends on whether it's a demand-side or a supply-side subsidy, and whether it is a typical Contract for Difference (CfD) or a Carbon Contract for Difference (CCfD). Figure 6 features examples of how reference and strike prices can be set.

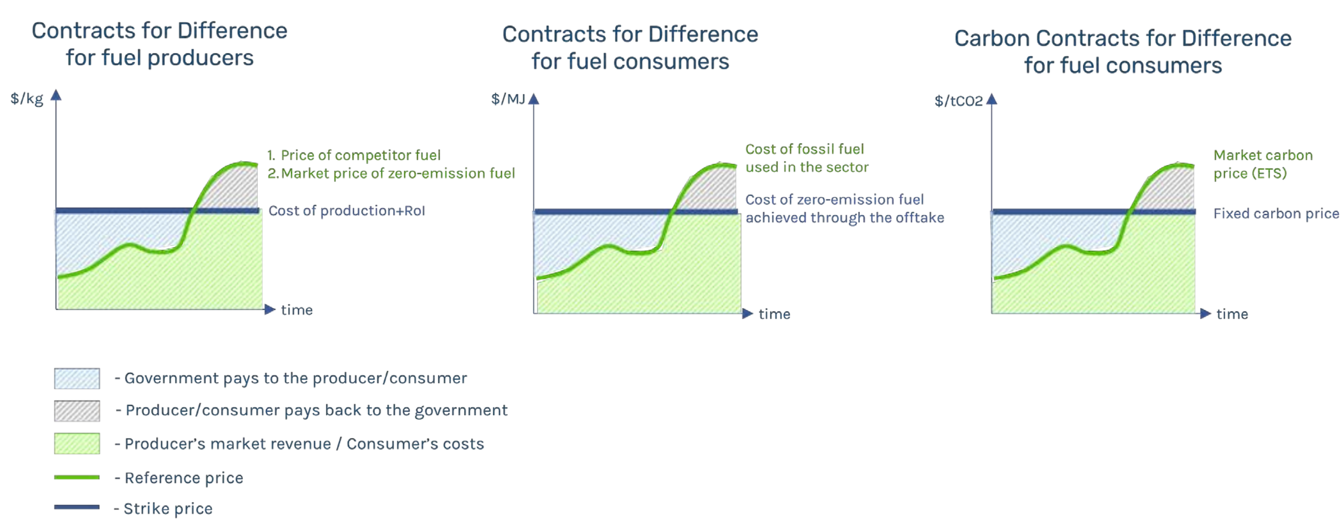

Figure 9: Examples of reference and strike prices for different Contract for Difference (CfD) schemes

2 *Variations of the two exist, such as through introduction of the upside sharing mechanism, where the recipient is only obligated to pay back a certain percentage of the positive difference, or after a certain threshold is reached. Another variation is the provision of two reference prices, with the level of support defined as the difference between the strike price and the highest of the two reference price options.*

For **supply-side CfDs** for hydrogen, the reference price may represent the price of the alternative production method (for example, grey hydrogen) or the achieved market price, while the strike price may be set as the cost of production, often with an inclusion of a justifiable return on investment. Setting the reference price for supply-side CfDs in the hydrogen space can prove challenging due to the absence of an established price-setting mechanism, the nature of the fuels green hydrogen and derivatives are intended to substitute, and the globalised market. The UK Low-Carbon Hydrogen Agreement scheme is an example of a supply-side CfD, with the difference calculated against the highest of 1) the natural gas price and 2) the achieved market price.

For **demand-side CfDs**, the reference price represents the cost of a fossil fuel alternative[3] typically used within the sector, such as marine gasoil (MGO) in the case of shipping.[v] New Zealand has recently announced demand-side CfDs for multiple sectors, including shipping.

For **Carbon Contracts for Difference (CCfDs)**, typically a demand-side subsidy, the difference is calculated on a carbon intensity basis.[vi] The recipients are paid the difference between the pre-agreed fixed carbon price, reflecting the cost of transition to a zero-emission or environmentally friendly production process and the market carbon price.[4] The German Carbon Contracts for Difference are an example of this type of scheme.

Shipping-specific demand-side CfDs have received support in the green shipping corridor context due to their potential to fully close the fuel cost gap for shipping operators while simultaneously providing a fixed price incentive for fuel producers through an offtake requirement. However, it is unclear whether the incentive and risk reduction they provide to fuel producers is enough to justify the investments in production facilities, and whether they are compatible with supply-side subsidies currently under development in several countries. Other alternatives and their combinations should not be discarded. That being said, demand-side carbon contracts for difference may not provide a sufficient incentive for the uptake of scalable zero-emission fuels. CCfDs represent a more technology-neutral approach to subsidising, which has not been historically successful in driving early stages of technology development.[vii] Similarly, supply-side feed-in tariffs would have to be complemented with a demand-side subsidy to compensative for the increased cost of the fuel to the consumer.

Process to determine the level of subsidy (administrative, competitive incl. price-competitive)

A competitive (auction, double auction, competitive bidding) or an administrative process to determine the level of support can be applied to all subsidy schemes. For example, the *EU Hydrogen Bank* fixed premium is set through an auction, while the support levels within the US *Production Tax Credit* are set administratively, based on tiers of emission intensity. The German *H2Global* double auction scheme is an example of a competitive fixed price subsidy (market-maker model). The UK's *Low-Carbon Hydrogen Agreement* CfD scheme is expected to move towards price-competitive determination of the strike price around 2025.

Cost efficiency is typically the main driver behind the introduction of price-competitive schemes. It is assumed that the auctions would encourage cost-reduction efforts among the bidders, thus reducing the marginal cost to the government. However, it has been argued that since smaller actors are often unable to compete with established production facilities, this same mechanism could effectively exclude them from the innovation process and potentially cause negative effects on early-stage technology development.[viii]

Given that green corridors are typically established on routes with favourable conditions, both competitive and administrative processes can be considered, as long as shipping is not directly or indirectly competing with other offtake sectors for support.

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3 When the reference and the strike price represent different molecules, the difference should be paid on an energy content basis, to account for the differences in energy density.

4 Transition costs covered by the scheme typically include both the capex and the opex delta.

Geographic scope (domestic, regional, international)

Supply-side subsidies may target both domestic and international producers, with the scope usually dictated by the government's overall energy strategy and the extent to which self-sufficiency is prioritised. Supply-side subsidies may either include or exclude consumption for export from the list of eligible offtakers or introduce a production sub-target for domestic consumption purposes. Demand-side subsidies would typically target domestic consumption. In the case of shipping-specific capital expenditure and R&D subsidies, access to funding is often restricted by factors such as the time spent in a country's waters, the number of port calls in a given country, or the vessel's country of registration.

For green corridors, this implies that eligibility for the subsidy may ultimately depend on the chosen fuel production and/or bunkering location and the ship flag. At the early stages of development, the parties behind the corridors may want to align or adjust these decisions based on the policy landscape and support prospects.

Examples of announced subsidy schemes

Table 2 and Table 3 feature a selection of recently announced, planned or implemented support schemes in relevant policy domains. Table 2 focuses on subsidies in the hydrogen space, while Table 3 provides examples of shipping-specific R&D and capital expenditure subsidies. The following conclusions can be drawn from the overview:

1. While the existing subsidies in the hydrogen space contain limited to no mechanisms to incentivise the uptake of the fuels in shipping, many schemes are still under development or undergoing a stakeholder consultation process. This introduces the potential for green corridors to influence the final design and **tap into the emerging policy landscape, as opposed to advocating for additional subsidies, thus reducing the timeline for the introduction of policy support.**

2. There are indications that demand is shaping up to become the main restricting factor for hydrogen market development, and that a **combination of demand- and supply-side support will be needed for shaping early hydrogen markets**. This is evidenced by the US decision to complement supply-side IRA subsidies with an additional package aiming at incentivising the use of green hydrogen, and by the design of the German support scheme. Combined demand- and supply-side support does not automatically translate to a higher bill for the government, since, ultimately, both forms of support intend to fill the same cost gap.

3. The New Zealand example demonstrates that **existing demand-side subsidies that predominantly target selected heavy industries could, in principle, be extended to shipping**, even if these would likely come with geographic restrictions.

4. Many countries, notably within the EU, prioritise securing future supplies of fuels and not domestic production. This means that **interactions between subsidies in different countries are much more important to future development than they were in the electricity markets**. This also means that lessons from the implementation of renewable electricity subsidies may not be directly transferrable to hydrogen.

5. There are early indications that countries are moving from small-scale demonstration funding towards late-stage TRL, large demonstration and capital expenditure support, as exemplified by Enova's newest funding programme and the increased focus on demonstrating solutions in an operational setting within the UK's CMDC. Going forward, this may mean that **shipbuilding nations may start expanding their engagement with green corridors**.

Table 2: Examples of demand- and supply-side subsidies for green hydrogen (including broader schemes supporting the uptake of zero-emission technologies in various sectors)

Country	EU	Germany	Netherlands	Norway	United Kingdom
Name	European Hydrogen Bank	(1) H2Global Double Auction (2) Carbon Contracts for Difference	(1) NL participation in H2Global (2) Stimulation of sustainable energy production and climate transition (SDE++)	CfDs for hydrogen	Low-Carbon Hydrogen Agreement (LCHA)
Support scheme	Fixed premium (EUR per kg H2) auction-determined production subsidy	(1) Fixed, auction-determined prices for producers and consumers (2) Sliding premium (EUR/tCO2) - difference between the total cost of the climate friendly and traditional production systems, auction-based	(1) Auction for producers (2) Supply-side CfD, EUR/kWh basis for all categories except CCS/CCU (renewable electricity and gas, renewable and low-carbon heat, low carbon production incl. hydrogen).	Sliding premium	Sliding premium based on the difference between the strike price (production costs + RoI) and the higher of (1) sales price and (2) natural gas price.
Geographic scope	Domestic (Directorate-General for Climate Action, EU Innovation Fund) and international (Directorate-General for Energy, tbd) production	(1) International production, EU consumption (2) Domestic consumption by energy-intensive industries (e.g., steel, cement, paper, glass)	(1) International production (2) Domestic production	TBD	Domestic production, domestic consumption (excluding gas blending)
Type of fuels	Renewable hydrogen (RED II)	(1) Green hydrogen-based ammonia, methanol and eSAF (2) Renewable electricity, EU Taxonomy rules for hydrogen	(1) See H2Global (2) hydrogen by electrolysis	N/A	Max 20gCO2e /MJLHV H2 on a Well-to-Gate basis
Funding	First auction - $877M for domestic production	(1) First auction for producers - $987M, further $3.84B until 2036 (2) Around $50B	(1) $329M for the first auction (2) €8B for 2023 – for all technologies, total budget around €30B until 2025	N/A	N/A
Duration of subsidy	10 years	(1) 10 years for producers, shorter contracts for consumers (2) 15 years	(1) 10 years (2) 12-15 years	N/A	10-15 years
Status	Pilot auction planned for Q3-4 2023 (as of April 2023)	(1) First deliveries scheduled for Q4 2024. (2) Ongoing preparatory procedure	(1) Auction planned for Q4 2023-Q1 2024 (2) Next opening round Q3 2023	On hold after the revision of the 2023 budget	Allocation round planned for end of 2023
Links	European Commission	(1) Federal Ministry for Economic Affairs and Climate Action (2) Overview in English and details in German	(1) See H2Global (2) Netherlands Enterprise Agency and details	Norwegian Hydrogen Forum	Department for Energy Security and Net Zero
Comments	Mentions potential CCfDs for industry decarbonisation, ongoing discussion on shipping subsidies	Agreement to link H2Global to EUHB	(2) non-stackable with capex subsidies		Additional capex support from Net Zero Hydrogen Fund under discussion (current scheme runs out 2025). Price competition planned for 2025

Country	France	United States	Canada	Australia	New Zealand	Japan
Name	Support for low-carbon hydrogen production	Inflation Reduction Act – (1) Clean Hydrogen Production Credit, (2) Clean Energy Investment Credit	(1) The Clean Hydrogen Investment Tax Credit, (2) potential CCfD	Hydrogen Production Credit (HPC)	New Zealand Equitable Transitions Package – Green Hydrogen Consumption Rebate	Subsidy scheme announced in the Revised Hydrogen Strategy
Support scheme	Potential CfD covering the difference between grey hydrogen and low-carbon hydrogen. 70% price criteria, 30% non-price criteria	(1) Fixed premium in the range $0.6-3/kg H2 (based on emissions intensity), administratively set (2) Up to 30% tax reduction, max 6% of value of qualifying capital assets	(1) 15-40% tax reduction on qualifying capital assets, additional 15% for capital assets for conversion to ammonia (2) TBD	Premium (per kg H2) representing the difference between sales price to each offtaker and the cost of production, auction determined HPC value	Sliding premium for industrial users of hydrogen reflecting the difference between the cost of green hydrogen to the consumer and the cost of typical fossil alternative	Premium reflecting "all or part of the difference" between the price of green H2 (incl. RoI) and grey H2"
Geographic scope	Domestic production	(1) Domestic production, (2) bonus for domestic sourcing of materials	(1) Domestic production (2) Likely domestic consumption	Domestic production. Both domestic consumption and export (all end users of hydrogen and derivatives)	Domestic consumption. Industrial uses: fertilizer and large transport operators, including shipping	Japan-affiliated companies, both domestic and international
Type of fuels	Low-carbon hydrogen, criteria to be announced in consultation	Max emissions intensity 4 kg CO2/kg H2	Max emissions intensity 4 kg CO2/kg H2	Green hydrogen compliant with the Australian GO scheme (under development). Blue hydrogen excluded.	Green hydrogen	Threshold of clean hydrogen: 3.4 kg CO2 /kg H2 on a Well-to-Gate basis. Threshold for ammonia: 0.84 kg CO2/kg NH3 on a Gate-to-Gate basis
Funding	$4.3B	Around $100B (est.)	(1) $4.17B over 5 years plus additional $8.9B until 2035	$1.33B under Hydrogen Headstart subsidy programme	$61M total. $18M for initial four years outlined in 2023 budget	Around $50B over 15 years in public investment for the whole strategy (est.)
Duration of subsidy	15 years	10 years	N/A	10 years	10 years	N/A
Status	Consultation launches in Q3 2023, planned allocation rounds 2024-2026	Implemented	(1) Legislative finalisation Q3 2023 (2) Upcoming consultation	Ongoing consultation on the suggested design (August 2023)	Launch Q1 2025	N/A
Links	French Minister of Energy Transition	Office of Energy Efficiency and Renewable Energy	Government of Canada	Australian Renewable Energy Agency	New Zealand Treasury	Ministry of Economy, Trade and Industry
Comments		Ongoing consultation on the design of a $1B support package for demand-side subsidies for hydrogen users				

Table 3: Examples of shipping R&D and capital expenditure subsidies

Country	Norway	Germany	Netherlands	United Kingdom	EU	Japan	South Korea
Name	(1) Enova (2) Enova Hydrogen in vessels and Ammonia in vessels programmes	BMWK support for construction of zero-emission vessels	(1) Sustainable Shipbuilding Subsidy extension 2023 (2) Maritime Masterplan	(1) Zero Emission Vessel and Infrastructure Competition (2) Clean Maritime Demonstration Competition	(1) Innovation Fund - Shipping (2) Horizon Europe	NEDO programme - Next-generation Ship Development	Shipbuilding support package
Support scheme	(1) R&D grants for larger ammonia- and hydrogen-powered vessels (2) ship capex grant for commercial operation of vessels for up to 80% difference in capex and a total of $14M and 1-3 vessels per project by 2026 (both newbuilds and retrofits)	Grant to promote the construction of zero-emission vessels	(1) Grant of up to $1.35M per project, retrofits or newbuilds (2) Grant for development, construction and deployment of 40 demonstration ships by 2030 with focus on hydrogen, methanol, LNG with carbon capture	(1) R&D grant for development, deployment and operation of solutions within electric vessels and charging infrastructure, shorepower, alternative fuels and bunkering. Demonstration in an operational environment for three years to be completed by 2028, up to $25M per project (2) R&D grant, including demonstration in operational setting, specific provisions for green corridors. Singles out ammonia	(1) TBD (2) R&D grants, 15 relevant projects financed to date	Grant, TRL 8+ to 11 for introduction of 10 zero-emission vessels by 2030. Demonstration operation for hydrogen-based vessels completed by 2030, commercial operation of ammonia-fuelled vessels by 2028	Support for development of core technologies for future ships. Aims for 75% of the global market for eco-friendly ships with fewer or zero carbon emissions by 2030 (ammonia, hydrogen, electricity included)
Geographic scope	(1) 1/3 of time in Norwegian waters or Norwegian-flagged vessels (2) either registered in Norway, up to 1/3 time spent in Norwegian waters or 1/3 port calls in Norway	N/A	(1) inland or seagoing Dutch-flagged vessels with gross weight of more than 100t or a tugboat with 365kW+ capacity	(1) Demonstration within UK waters or international waters by a UK registered vessel, if benefits to UK can be justified (2) focus on domestic green corridors in Round 4	N/A	Japan flagged vessels	South Korea flagged vessels
Funding	(1) $187M total for 16 ships and hydrogen hubs to date (2) N/A	$32M per year until 2025	(1) $2.5M in 2023 (2) $228M awarded from the National Growth Fund for implementa-tion of NMP	(1) $97M (2) $162M across the four competition rounds (2021-present)	(1) Expected $280-370M per year 2024-2030 (2) N/A	$240M total	$135M in 2023
Links	Enova	Offshore Energy	(1) SDS (2) Maritime Masterplan	(1) ZEVI (2) CMDC	European Commission	NEDO	Pacific Environment, Business Korea

Summary of important considerations

There are multiple ways in which economic support for green corridors can be organised. Ultimately, the final design depends on which configurations provide the best balance between incentivising production and shipping-specific consumption in a given context, and which policy measures are already under development in a given geography. The effectiveness of subsidies in supporting green corridor development will be determined by the following factors:

- Whether international shipping and green corridor consortia are eligible given the scope of subsidies (either as a potential offtaker for fuels or as a direct recipient of support).
- Whether the support package sufficiently incentivises the development of transformative solutions (scalable zero-emission fuels) as opposed to near-term solutions.
- Whether the support package contains mechanisms to funnel funds to shipping and minimises competition with other demand sectors.
- Whether the support package incentivises added production capacity.
- Whether the support package addresses the issue of split incentives within the shipping sector.

Before additional policy measures are considered, it should first be determined whether the existing subsidies in the energy and shipping space already provide sufficient support or can be extended to include provisions for green corridors. Building on the existing policy landscape could help shorten the timeline of introducing policies to match the required urgency of action. An alternative approach is for green corridor stakeholders to negotiate support on a contract basis, separate from any broader subsidy scheme, in a similar way that CfDs have previously been awarded for standalone projects. In this case, attention should be paid to ensuring the consistency of these dedicated contracts with trade rules, World Trade Organization procedures, and competition law.

The cost efficiency of subsidies is determined by the subsidy design parameters. However, two additional strategies exist that could decrease the costs for each country: splitting the funding between the countries along the corridor and encouraging broad value chain action.

The split of funding between the participating countries should be based on the nations' incentives and respective strengths. One potential model represents a split in which one country covers the fuel side, while the other covers the ship side through capex and R&D. In some cases, however, only one side can realistically provide financial support.

Governments should strive to maximise value chain action, notably green premia, operational efficiencies, and port-level incentives, to avoid over-subsidising. When demand-side subsidies are implemented, a green premium can constitute a condition for receiving this subsidy as a co-financing requirement. Alternatively, realistic green premia levels should be considered when deciding the appropriate support level. However, it is important to consider the differences between the potential for green premia within different shipping segments. Particularly in commodity segments, often served by bulk shipping, profit margins and willingness to pay for green shipping are low compared to the markets served by container vessels or cruises. These differences should be accounted for when designing policy support, and competition between several shipping segments within one support package should be avoided.

Alternatives to subsidising for closing the cost gap

Subsidies imply that governments directly absorb part or all of the cost gap. An alternative to subsidising would entail a government-stipulated, bilaterally agreed-on, "industry pays" mechanism, where the governments activate green premia in one of two ways:

1. Top-down requirements for the introduction of zero-emission fuels and vessels on a given route.
2. Bottom-up, through allowing the shipping lines to pass on the costs to their consumers in a uniform way.

The first option essentially entails the creation of bilateral or multilateral climate regimes. However, it is associated with risks in terms of international relationships and trade and will likely require that a higher-level agreement be reached to strengthen the legitimacy of such measures. This could be done under the umbrella of the Clydebank Declaration but would require a drastic rethinking of its envisaged role, rendering it unlikely. In addition, uncertainties surrounding the design of the potential global market-based measures at the IMO will likely hinder governments from acting on this front before later in this decade.

The second option could be feasible for corridors with a relatively small number of actors, and on routes serving strategically important exports and imports. In practice, this would entail governments agreeing to create exemptions from competition law, encouraging shipping companies to create joint fuel offtake agreements, and allowing charterers to pass on the costs to consumers in a uniform way, either directly or through book and claim,[5] should the demand on the route not be enough. On routes with fewer stakeholders, this could be achieved by establishing joint ventures.

Both options require the creation of bilateral agreements and careful considerations to avoid negative trade impacts. However, the main issue with both is their transformative potential: historically, targeted deployment policies and the provision of positive incentives have been more successful in driving early-stage technology development within various sectors.

Complementary policy measures

Closing the cost gap is the central challenge for green corridor deployment, but it is not the only one. Therefore, policies targeting the cost gap will have to be developed in parallel with other complementary measures to eliminate potential bottlenecks and create the enabling conditions for deployment. These measures should aim to achieve the following objectives:

- Building credibility and trust by, for example, developing fuel-side certification schemes or advocating for green corridors at the IMO level
- Reducing the administrative barriers to deployment by facilitating faster permitting and approval processes on the fuel, port infrastructure and vessel sides
- Mobilising skill force by providing support in (re)training and education
- Further de-risking the investment by providing loan guarantees
- Facilitating knowledge exchange between the initiatives and beyond

For most of these measures, national action represents only one piece of the puzzle. Other actors such as classification societies, IMO, knowledge organisations, financial institutions, and industry consortia also play important roles. However, governmental intervention is critical to facilitating knowledge exchange as no other stakeholder group can be expected to take the lead. Knowledge exchange is a key condition for scaling up the business models and the technologies currently being developed under the umbrella of green corridors. At the same time, green corridor initiatives often either don’t have an intrinsic incentive to share data or are restricted by non-disclosure agreements. This creates an opportunity for individual governments and the Clydebank Declaration to act as data brokers or central nodes for ensuring early data sharing within the green corridor movement. In fact, the availability of comparable data on green corridors may well be required to determine the scope and conditions of governmental support and to maximise the environmental benefits of the movement.

5 Book and Claim chain of custody systems allow the emission profile of a zero-emission fuel to be separated from the physical flow of that fuel in a transportation supply chain.

Conclusions

Green shipping corridors are entering their make-or-break moment, and the next couple of years will define whether the movement succeeds in overcoming the chicken-and-egg problem and unlocking decarbonisation of the shipping sector. Beyond the private sector's own actions, national governments are the only stakeholders that have the means, and arguably the incentives, to enable this success and shape the future landscape of international shipping. In doing so, the single most important function for governments – and the one where no feasible alternatives currently exist – is to unlock private sector funding by de-risking the investments in scalable zero-emission technologies and narrowing the cost gap associated with early technology development.

Just as green shipping corridors challenge the traditional ways of doing business within the shipping sector, they also require innovative approaches to policymaking. The corridors' cross-border, cross-sectoral nature calls for countries to set aside the principle of technological neutrality, strengthen collaboration between governmental agencies and across the governments, and embrace a participative, proactive, and systems-wide approach to designing and implementing policies. Through green corridors, international shipping has a unique opportunity to become a driving force behind the global energy transition, but the extent to which this opportunity becomes a reality hinges on robust but focused, timely, and transformative national policy action.

Endnotes

i Smith, T., Shaw, A. (2023). An overview of the discussions from IMO MEPC 80 and Frequently Asked Questions.

ii Getting to Zero Coalition. (2021). A Strategy for the transition to zero-emission shipping.

iii Getting to Zero Coalition. (2021). Five percent zero emission fuels by 2030 needed for Paris-aligned shipping decarbonization.

iv Royal HaskoningDHV, Roland Berger. (2022). Making the hydrogen market. Requirements for Netherlands to become a hydrogen hub (White paper).

v *More on contracts for differences for shipping*: Zero Emission Resource Organisation. (2022). Contracts for difference for hydrogen (in Norwegian). *Discusses the following options for shipping: 1) demand-side CfD (auction-based and administratively set strike prices), 2) supply-side CfD (auction-based and administratively-set prices, 3) market maker model. Evaluates the alternatives in terms of their effectiveness, cost efficiency, market creation potential and feasibility of implementation. Argues that auction-based demand-or supply-side CfDs provide the best balance.*

vi *More on carbon contracts for difference:* 1) How EU Contracts for Difference can support zero-emission fuels, 2) Carbon Contracts for Difference (CCfD) in a European context, 3) Why Carbon Contracts for Difference could be the policy measure Europe needs to decarbonise industry.

vii Grubb, M. et al. 2021. The New Economics of Innovation and Transition: Evaluating Opportunities and Risks. Discusses the following options: 1) market-maker 2) feed-in tariff with potential for complementary demand-side subsidy 3) Supply-side Contracts for Difference with an optional additional demand-side subsidy. Suggests market-maker or feed-in tariff in the short-term with a transition to Contracts for Difference scheme in the mid- to long term.

viii Clark, A. et al. 2021. Zero-Emissions Shipping: Contracts-for-difference as incentives for the decarbonisation of international shipping. *Discusses shipping-specific Contracts for Difference, main design choices, technical details for implementation. Includes draft contract agreements.*