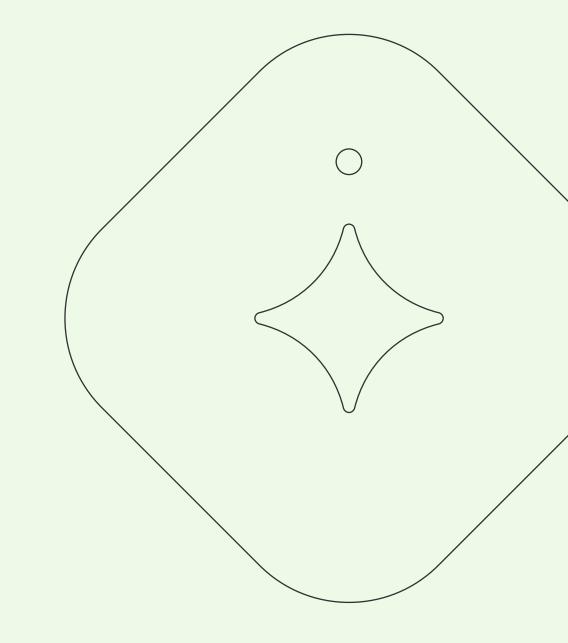
# METHODOLOGY

# Green Corridors Feasibility Study Phase





# Expected outcomes of Feasibility Study phase

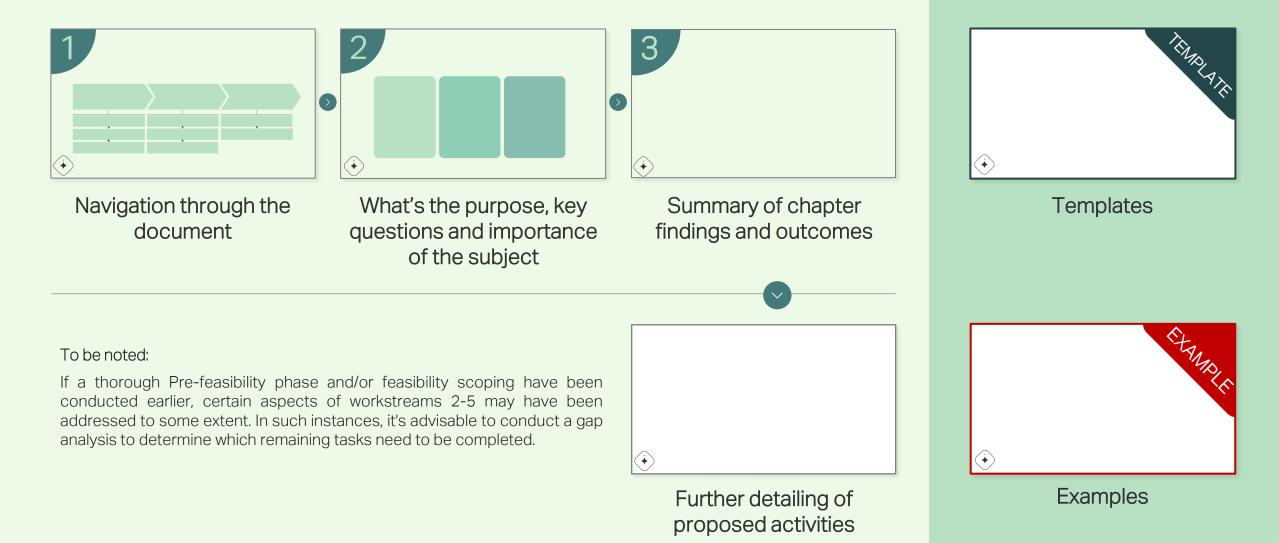
During the Feasibility Scoping phase, as well as before and during the Pre-feasibility Study, thorough work has been carried out to establish a solid project baseline across all dimensions. The management of some projects may commence at the Feasibility Study phase; however, the purpose of this phase is to gather essential information to form the foundation for a comprehensive feasibility assessment — encompassing technical, financial, and regulatory aspects — and to enhance the existing work.

Subsequently, project team members will develop a comprehensive roadmap for advancing to the next stage. This entails selecting the final project concept, defining commercial and financing frameworks, and initiating the solution-building process.

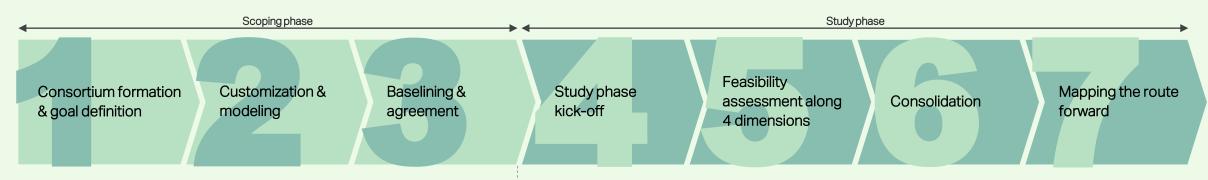




# How this document is constructed



# The Feasibility Phase



The Feasibility Scoping Phase enables participants to form a consortium and project team members to agree on roles as well as ways of working in the upcoming Feasibility Study. It also aims at clearly defining the focus and goals of the Feasibility Study as well as the work that needs to be done for the specific corridor to reach these goals.

The Feasibility Study aims at assessing the technical and regulatory feasibility of a specific green corridor along the fuel, port, vessel, and cargo dimensions as well as defining the residual cost gap. It further includes a risk registry and roadmap, all of which are outlined together with the consolidated findings of the Feasibility Study.

**Project Commitment Letter** 

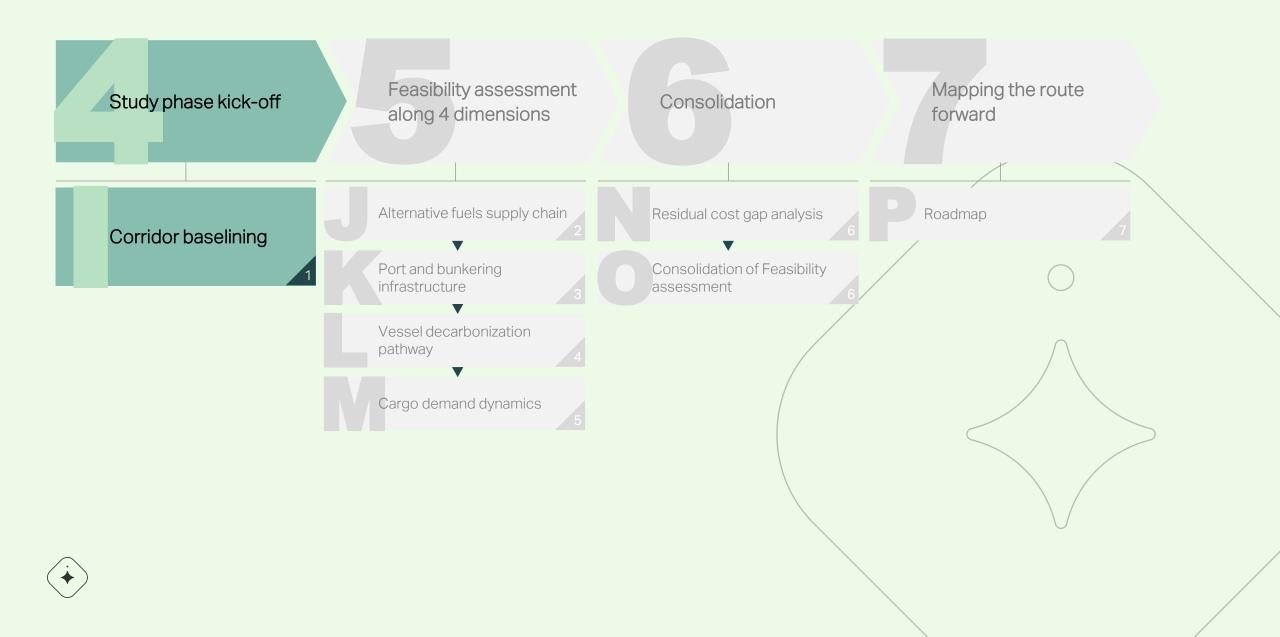


# The Center methodology for Feasibility studies is structured around seven workstreams

		2	3	4	5	6	
Workstreams	Corridor baselining	Alternative fuels supply chain	Port and bunkering infrastructure	Vessel decarbonization pathway	Cargo demand dynamics	Consolidation	Mapping the route forward )
Stakeholders	All stakeholders	Fuel producers	s Port and bunkering operators	Shipowners and operators	Cargo owners	All stakeholders	All stakeholders
Scope	<ul> <li>High-level assessment:</li> <li>Shortlist of potential alternative fuels</li> <li>Vessel and voyage characteristics</li> <li>Trade flows</li> <li>Regulatory framework</li> </ul>	Feasibility asso along value ch Technical feasibility Regulatory feasibility		arbonization pathway Cost assessment	,	<ul> <li>Feasibility assessment summary, highlighting:</li> <li>Technical and regulatory feasibility</li> <li>Main gaps to reach feasibility and the cost of closing them</li> <li>Residual cost gap assessment, including cost sharing in project</li> <li>Proposed options for additional funding of project</li> <li>Risk registry and potential mitigation action</li> </ul>	Development of roadmap and required commitments for the next phases of the project, up to operation



1



# 4I. Corridor baselining

### Purpose



- Conduct a corridor project baselining to create an initial view on relevant fuel, ports, and bunkering infrastructure, relevant vessel characteristics and trade flow as well as just and equitable specifics.
- Summarize key insights into a corridor project baseline that can serve as the starting point for the Feasibility assessment (max 10 pages).
- Include scope drawing.

### Key questions

- What are the **key characteristics** of the green corridor at hand?
- What are the **initial positions** on choice of fuel, port(s), and vessel segment for the Feasibility Study?



### Importance

- Typically, corridor project baselining is conducted in Feasibility Scoping, but may in some cases be conducted at the beginning of the Feasibility Study instead.
- A common baseline document for all project members outlines all relevant parts of the project and ensures the study is conducted in an efficient and swift process.
- The scope drawing ensures that the project team always knows what the project is about and where the interfaces are located.

# 41. Corridor baselining

### Summary of chapter findings and outcomes

- Description of the target state including vision, goals, and requirements for the green corridor
- Conceptual drawing of scope and workstream delineation

#### Technical:

- Recommendation of the **alternative fuel** to be used in the green corridor, including its required volume, if possible, its **source / feedstock** and its **production location**
- Description of current port, storage, and bunkering infrastructure along the green corridor, including current capacity, as well as the future target port, storage, and bunkering infrastructure, including necessary capacity
  - Overview of current and expected vessels in the corridor, including their specific characteristics and emissions
  - Understanding of trade flows, cargo type, volume and value, cargo owners and consumers

### 03

#### Regulatory:

• Overview of the administrative scheme in place within the green corridor

### Cost:

- Preliminary cost assessment for alternative fuels supply chain, port and bunkering infrastructure, vessel decarbonization pathway
- Potential CO<sub>2</sub> abatement, initial total cost estimate (CapEx and OpEx over 25 years) as well as an initial view on the incremental cost of green

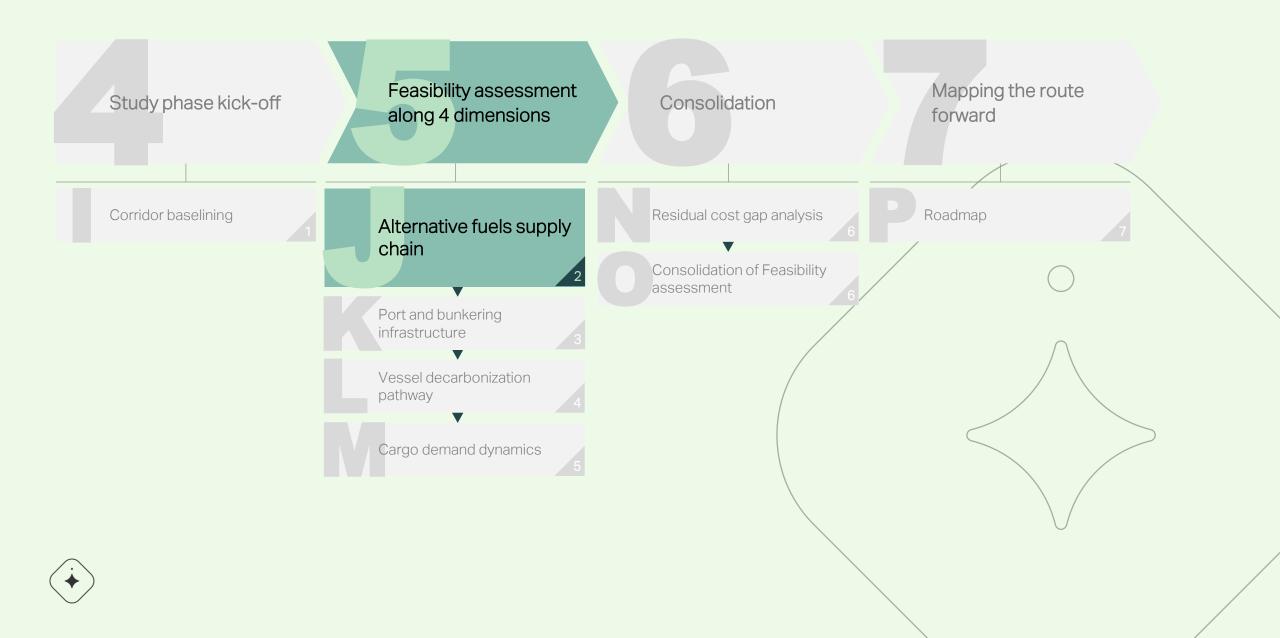


• Initial thoughts and findings on just and equitable aspects



1

Workstream 2



# 5J. Alternative fuels supply chain

### Purpose



- Assess the technical and regulatory feasibility of delivering the amount and type of fuel needed for the green corridor at the required timeline, and quantify related costs (CapEx and OpEx) (insights from workstream 4)
- Define **expected production center(s)** for alternative fuel
- Outline measures related to the alternative fuel supply chain to ensure a **just and** equitable implementation of the project
- Identify cost and **cost-down trajectories** for drivers of fuel costs (e.g., technology CapEx, electricity prices)
- Perform just and equitable assessment for the fuel supply chain (Matrix)

### Key questions

- Can the alternative fuel supply meet the demand for the specific green corridor?
- What is the **required volume of alternative fuel** for this corridor and **range of expected production?**
- What are the main **drivers impacting the cost** of alternative fuels and how will they evolve over time?
- What is the **investment/financing required** to match the expected demand in the specific green corridor?
- Which workers, communities and ecosystems are affected by the transition to a low/zero emission fuel supply chain?
- What are the socio-economic opportunities and risks, and how can they be maximized/minimized, respectively?
- How do we ensure a **just and equitable** alternative fuel production?



### Importance

- There are 3 critical cost elements to be considered for the technical and regulatory feasibility for the green corridor:
  - o Delivering the amount and type of fuel
  - Meeting the **timeline**
  - o Quantifying related costs



# 5J. Alternative fuels supply chain

### Summary of chapter findings and outcomes

 Proposed source of alternative fuels for the specific green corridor (source of renewable energy, feedstock, and fuel production centers) and evolution of alternative fuel supply and demand over time for regions relevant to the corridor (local or international/ imported)

Technical feasibility of alternative fuel production for the specific green corridor, including:

- Expected feedstock production locations and capacity
- Fuel production locations and capacity
  - Transportation of fuel to relevant region in corridor

Regulatory feasibility of alternative fuel production projects and permits related to their development for a specific green corridor:

- Regulatory and policy structure to allow/enable alternative fuel and feedstock production, storage and distribution (e.g., for hydrogen, carbon capture, storage, and transport)
- Regulations on scale of alternative fuel production, and health and safety guidelines on handling, storage, and use
- Carbon credits and other tailwinds
- Measures to ensure a just and equitable alternative fuel production

Cost assessment of alternative fuel production project development relevant to the specific green corridor, including:

04

03

- Resulting CapEx requirements
- Expected cost of production and potential price of alternative fuels, and their evolution over time
- Financing and funding options

#### Just & Equitable:

- 05
- An analysis from a J&E perspective will provide insights on how workers, communities and ecosystems might be affected by the offtake of
  alternative fuels within the green corridor. There might be socio-economic opportunities and risks. It is important that work is done to maximize
  the opportunities and minimize the risks



# Estimate fuel demand for the specific green corridor

Estimate ability to deliver alternative fuel for the specific corridor at

• Input from corridor project baselining, e.g., applicability of fuels by

• Fuel characteristics (e.g., density, calorific value)

Steps

Inputs

Assess expected competition for fuels to be used in the green corridor – high-level alternative fuel requirements from other sectors and availability for shipping

2

- Sectors to use alternative fuels by 2030
- Expected capacity of alternative fuels (per fuel) to be used by each sector until 2050<sup>1</sup>

1. Depending on project timeline

time and capacity outlined

vessel type

Workstream 4

Define expected production centers for alternative fuels, assess their technical and regulatory feasibility

Steps	Estimate total fuel capacity available for the specific green corridor over time	Define and describe where energy and fuel for the green corridor will come from and can relevant land areas be secured	Identify permittings required to produce alternative fuels.	Outline main safety and regulatory aspects for the production of alternative fuels
Inputs	<ul> <li>Capacity of alternative fuels expected to be produced</li> <li>Capacity from announced projects excluding committed volumes</li> <li>Fuel demand estimates for green corridor</li> </ul>	<ul> <li>Renewable energy potential (e.g., solar and wind capacity factors)</li> <li>Mapping of feedstock sources</li> <li>Land surfaces available</li> </ul>	<ul> <li>Different alternative fuels (e.g., biodiesel, hydrogen, ethanol) may have varying permit requirements</li> <li>Zoning laws and land use regulations</li> <li>Permittings for energy supply, feedstock, electrolyzers, fuel synthesis, etc.</li> <li>Relevant government agencies</li> </ul>	<ul> <li>Safety assessment for specific fuels</li> <li>Supportive regulation</li> <li>Policies announced to incentivize development of alternative fuel production infrastructure</li> </ul>

Page 13

# Identify and quantify fuel cost and downward cost trajectories

Identify main drivers of costs for alternative fuel across the value chain and quantify starting points for costs. This includes, as applicable:

- Fuel/feedstock production technology cost (CapEx, OpEx)
- (Renewable) electricity price
- Fuel storage costs (e.g., H<sub>2</sub> liquefaction)
- Fuel transportation costs

2. Depending on project timeline

- Value chain and supply chain for each alternative fuel
- Maturity and deployment of fuel production technology, and feedstock production technology (e.g., new R&D technologies for fuel cells, more mature technology for solar/wind power)
- Key drivers of cost variable costs/costs that are expected to evolve

• Examples of similar technologies and their downward cost trajectories over time

2050<sup>2</sup> based on similar downward cost trajectories for

• Estimated starting points for costs across value chain of relevant alternative fuels

2

Define cost evolution for key cost drivers of alternative fuel until

comparable technologies (e.g., evolution of hydrogen fuel cells vs.

solar panel cost evolution); include evolution of transportation

costs for fuel sourced from other locations vs. produced locally

Inputs

Steps

 $\langle \bullet \rangle$ 

Page 14

# Quantify CapEx and OpEx requirements

Steps	<ul> <li>List new infrastructure/CapEx investments required for each step of the alternative fuel value chain, for example:</li> <li>Feedstock production CapEx</li> <li>Feedstock storage, transportation CapEx</li> <li>Fuel production CapEx</li> <li>Fuel storage, transportation CapEx</li> </ul>	Assess fuel cost evolution during the project development	3 Assess financing and funding options (including cost of capital) to support investments	4 Identify players for each step of the value chain (including manufacturing, utilities, energy, logistics) and identify each player's ability to invest at required scale and pace by player, based on their size and decarbonization commitments
Inputs	<ul> <li>Value chain and supply chain for each alternative fuel</li> <li>Green Corridor Scenario Modeling tool</li> </ul>	<ul> <li>Projection for evolution of drivers of cost for alternative fuels</li> </ul>	<ul> <li>Public and private financing options, including cost of capital estimate and "green" investment subsidies</li> <li>Local funding/subsidy programs for alternative fuel projects</li> </ul>	<ul> <li>Players for each step of the fuel value chain</li> <li>Decarbonization/ESG commitments and involved partnership</li> </ul>

# J&E assessment – Alternative fuels supply chain

Steps

Identify the communities, workers and ecosystems potentially affected by specific corridor

#### Communities:

Affected communities such as those close to new fuel plants or power plants, those connected to the same energy grid as the green corridor, or communities living in the vicinity of water resources or land area that are affected by the new fuel or energy infrastructure.

#### • Workers:

Affected workers such as those working across the alternative fuel supply chain (e.g., workers in fuel plants or solar parks) and those whose jobs might be at risk or change significantly because of the green corridor (e.g., workers in fossil energies).

#### • Ecosystems:

Affected ecosystems such as those in the vicinity of new fuel infrastructure or energy infrastructure developments associated with the corridor or those impacted by land use change, water use, or biochemical flows related to these developments. With the identified groups and ecosystems in mind, go through the questionnaire and identify the risks and opportunities

- Use the questionnaire provided in the J&E Data Collection Sheet.
- If relevant, highlight risks that should go into the risk matrix.

Consider the ESG / Sustainability Strategies of commercial stakeholders involved in Workstream 2

3

 Identify synergies between project objectives and the ESG / sustainability strategies for stakeholders involved in Workstream 2. For inspiration, consult the ESG questions provided in the Prefeasibility data collection Excel tool Tab 5.2.

## Workstream gap analysis – Alternative fuels supply chain

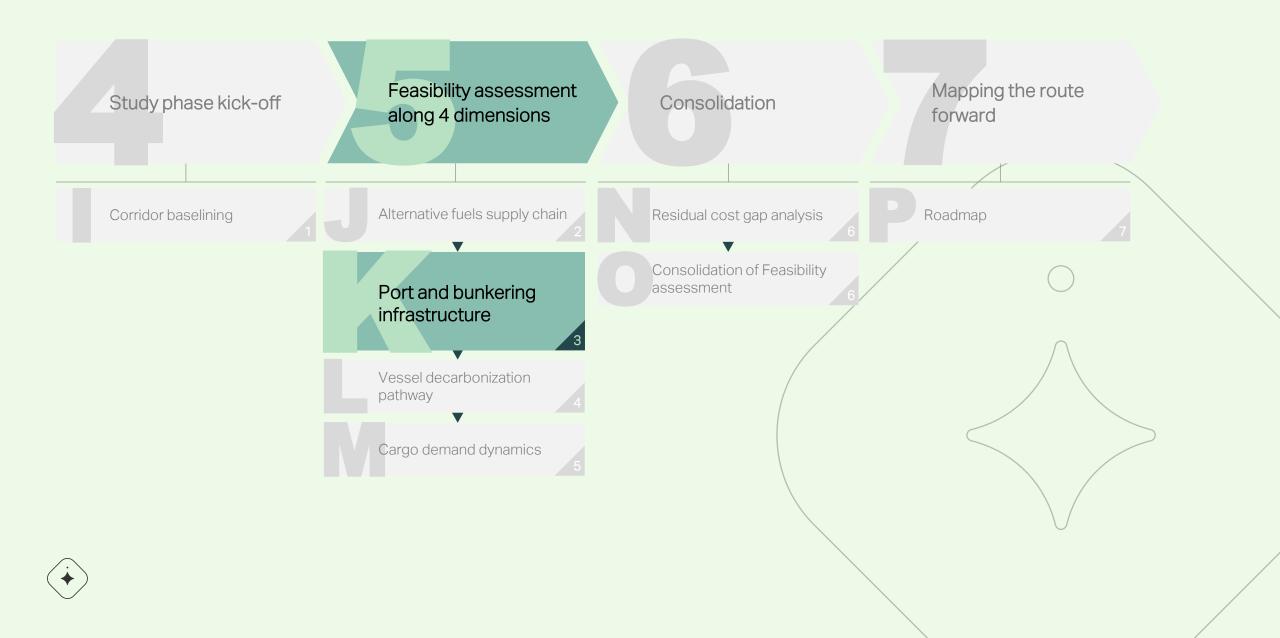
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								Workstream	Scope / Targets					Description Main Gaps	[describe element] [describe gap]
														Main Gaps Solution	[describe gap] [describe solution to close gap, i.e. demonstrators, SOPs, studies, etc.]
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Throughout the Feasibility assessment, fill the table with insights on **technical and regulatory feasibility<sup>3</sup>** – specifically, use this table to highlight **gaps and ways to close them**  Legend and definitions



1

Workstream 3



## 5K. Port and bunkering infrastructure

### Purpose



- Identify potential ports for the specific green corridor.
- For the ports of choice, identify:
  - Capacity for storing and bunkering alternative fuels
  - Existing and planned infrastructure
  - Regulatory frameworks for storage and bunkering
- Estimate the required investments for retrofitting/building new storage and bunkering infrastructure (CapEx/OpEx over 25 years) to meet corridor demand.
- Assess the feasibility of developing storage and bunkering infrastructure for alternative fuel.
- Perform just and equitable assessment for port and bunkering infrastructure.

### Key questions

- What are the **expected port and bunkering sites** for this specific corridor?
- What does the current fuel storage and bunkering infrastructure look like and what additional investments are required?
- How much of the required capacity can be covered by retrofitting existing infrastructure?
- How much extra infrastructure is required?
- Will it be **feasible from a regulatory perspective to develop** the storage and bunkering infrastructure?
- What are the **required investments and financing potential** for retrofitting/developing the required infrastructure?
- What will be the running cost for these facilities?
- Which workers, communities and ecosystems are affected by port, storage and bunkering infrastructure for low/zero emission fuels?



### Importance

- The ports play an important role in the green corridor, but the activities related to the corridor are often managed by several stakeholders.
- As the new fuel (chemical) will be stored and bunkered at the port (most likely the mostpopulated port along the green corridor), the safety, permits and regulation are crucial items to map in the early phases.
- There might be socio-economic opportunities and risks. Therefore, it is equally important that work is done to maximize the opportunities and minimize the risks.

## 5K. Port and bunkering infrastructure

### Summary of chapter findings and outcomes

• Overview of required port and bunkering infrastructure to meet the specific corridor's demand for alternative fuel (location, capacity, technologies)

Technical feasibility of alternative fuel bunkering, storage, and logistics connected to the green corridor ports, including:

- Potential for conversion/retrofitting of infrastructure for alternative fuels
- Logistics solution for transporting alternative fuel to storage sites
- Potential availability of land for new infrastructure (if required)
- Operational capacity based on fuel type (e.g., required skills to handle fuel)

Regulatory feasibility, including the ability to store/bunker fuel at green corridor ports; health and safety guidelines for storage, bunkering, logistics; and fuel handling process definitions, as well as measures to ensure a just and equitable development of the alternative fuel along the entire storage/bunkering process.

Cost assessment for conversion/retrofitting and development of the infrastructure required for the specific green corridor, including:

- Resulting CapEx requirements
- OpEx costs (for storage tanks, ports, new bunkering barges, etc.)
- Opportunities to share bunkering and storage infrastructure based on demand from vessels outside the corridor
- Financing capacity and potential

#### Just & Equitable:



03

An analysis from a J&E perspective will provide insights on how workers, communities and ecosystems might be affected by the development
of fuel storage and bunkering facilities. There might be socio-economic opportunities and risks. It is important that work is done to maximize
the opportunities and minimize the risks.



# Estimate the demand and capacity for storage and bunkering of alternative fuels for the specific green corridor, and identify potential ports

	2	3				
Map current and expected storage and bunkering ports relevant to the specific green corridor, including their infrastructure and capacity	Assess the ability of the green corridor port and bunkering sites to handle the low/zero carbon emission vessel segment and alternative fuels from a technical and regulatory perspective. Develop necessary measures for storage and bunkering infrastructure to ensure a just and equitable implementation of the project	Assess potential gaps between existing/ expected storage and bunkering infrastructure and fuel demand and estimate potential to retrofit or build new infrastructure				
<ul> <li>Voyage characteristics (location of bunkering) – Input from corridor project baselining</li> <li>Storage requirements given the expected fuel volume and physical state of the fuel (i.e., refrigerated, pressurized, etc.)</li> <li>Overview of current and planned infrastructure/capacity for bunkering and storage sites (including barges, storage tanks)</li> <li>Location and potential capacity of new bunkering sites along the corridor</li> <li>Stakeholders of bunkering sites used by vessels in the corridor</li> </ul>	<ul> <li>Regulations for handling alternative fuels</li> <li>Permitting processes for handling alternative fuels</li> <li>Safety standards and verification of fuel suitability related to LCA</li> </ul>	Combination of the previous steps				
• Readiness of fuel storage/bunkering systems and safety standards for handling alternative fuel (e.g., ammonia, hydrogen)	Useful information Another area of consideration is the size of relevant ports in terms of employee count; handling, storage and bunkering of alternative fuel might require additional employees.					

Estimate the investment required to retrofit/build new storage and bunkering infrastructure to meet corridor demand

Assess the infrastructure required to <u>store</u> alternative fuels at the green corridor bunkering sites and estimate investment required to retrofit/develop the necessary infrastructure

- Technical feasibility of converting existing infrastructure
- Regulatory readiness of storage and bunkering sites (safety aspects and permits for e.g. ammonia, hydrogen, etc.)
- Expand demand for storage
- Land available for alternative fuel storage and estimate of its storage capacity
- Cost estimate (CapEx and OpEx over 25 years) of storage facilities for alternative fuel, including economies of scale and sharing infrastructure with other demand sources

Assess the infrastructure required to <u>bunker</u> alternative fuels at the green corridor sites (same sites as Step A) and estimate investment required to retrofit/develop infrastructure

2

- Technical feasibility of converting existing infrastructure
- Regulatory readiness of storage and bunkering sites (safety and permitting for e.g. ammonia, hydrogen, etc.)
- Expand demand for bunkering
- Estimate the number of bunkering barges required for given storage capacity
- Cost estimate (CapEx and OpEx over 25 years) of bunkering facilities for alternative fuel, including economies of scale and sharing infrastructure with other demand sources

Create an overview of the total infrastructure required for the specific green corridor and cost implications, and identify financing capacity for required investments

З

• Combination of the previous steps

Steps

# J&E assessment - Port and bunkering infrastructure

Further explanation

Identify the communities, workers and ecosystems potentially affected by the specific corridor.

With the identified groups and ecosystems in mind, go through the questionnaire and consider the identified risks and opportunities.

2

Consider the ESG / Sustainability Strategies of commercial stakeholders involved in Workstream 3

3

#### Communities:

Affected communities such as those living close to port, storage or bunkering infrastructure, or communities living in the vicinity of water resources or land area that are impacted by the port, storage or bunkering infrastructure.

#### • Workers:

Affected workers such as those at existing and new port, storage and bunkering facilities.

#### • Ecosystems:

Affected ecosystems can include those in the vicinity of existing and new port, storage and bunkering infrastructure associated with the corridor but can also include those impacted by land use change, water use, or biochemical flows related to that infrastructure.

- Use the questionnaire provided in the J&E Data Collection Sheet
- If relevant, highlight risks that should go into the risk matrix
- Identify synergies between project objectives and the ESG / sustainability strategies for stakeholders involved in Workstream 3. For inspiration, consult the ESG questions provided in the Prefeasibility data collection Excel tool Tab 5.2

# Workstream gap analysis – Port and bunkering infrastructure

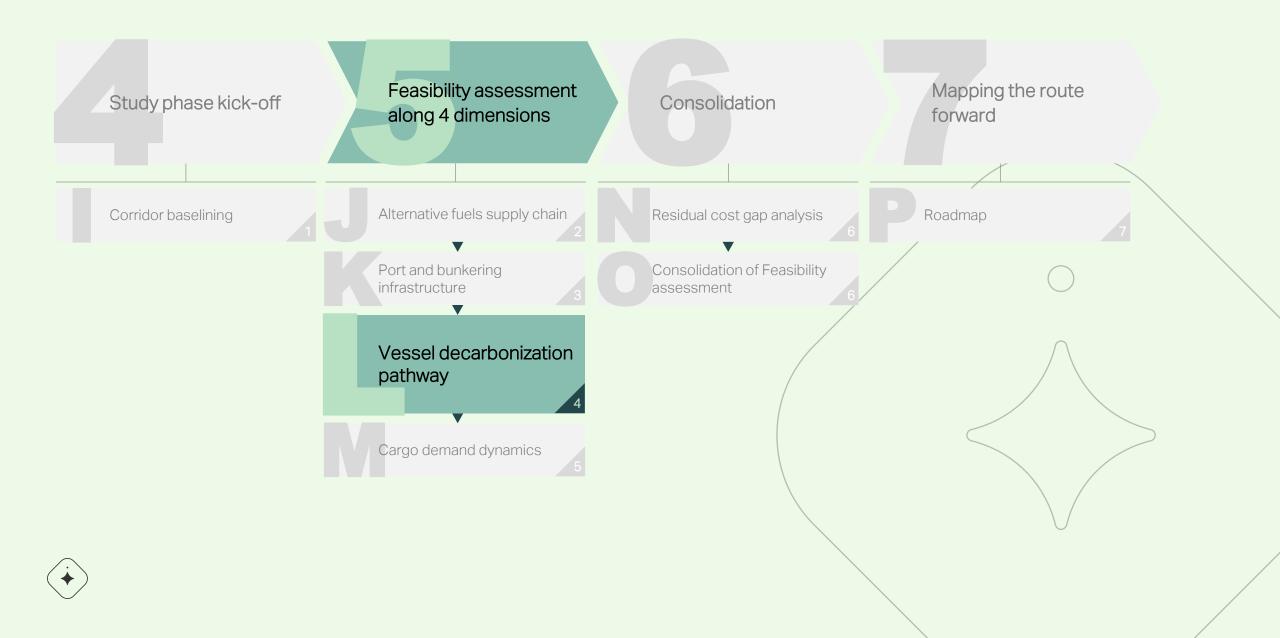
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Throughout the Feasibility assessment, fill the table with insights on **technical and regulatory feasibility**<sup>4</sup> – specifically, use this table to highlight **gaps and ways to close them**  Legend and definitions



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Workstream 4



# 5L. Vessel decarbonization pathway

### Purpose

- Assess the technical and regulatory feasibility of **delivering the required number of vessels** within the specified timeline.
- Estimate the number and specification of vessels required including type and size.
- Assess if the vessels are to be **newbuilds or** retrofitted vessels with modifications (or a mix).
- Create the timeline to deliver the vessels.
- Identify regulations that impact the handling of alternative fuel on vessels along the specific green corridor, and define workstream-related measures to ensure a safe and just operation of the vessels.
- Quantify the CapEx and lifetime OpEx (for 25 years of operation) requirements for newbuilds and retrofitted vessels and review financing potential.
- Perform just and equitable assessment for the vessel decarbonization pathway.

### Key questions

- How many vessels are needed and what are their required characteristics (e.g., vessel type, fuel, cargo, volumes, engine)?
- Can the **shipyards** deliver the required type and number of vessels and what is the **timeline to make the vessels operational**?
- How many of the required vessels are expected to be **newbuilds or retrofitted** over time to meet the decarbonization ambition?
- Which additional modifications can be applied to the vessels (e.g., energy efficiency, onshore power) to reduce the amount of alternative fuel required?
- What are the **regulatory requirements to be fulfilled to** make the vessels operational according to the specified vessel characteristics/timeline?
- What are the resulting **investment requirements** (CapEx and OpEx) and potential financing opportunities?

### Importance

- Vessels are the **ultimate vectors** to meet the corridor's **CO**<sub>2</sub> **abatement targets**.
- It is important to thoroughly analyze the existing and future fleets operating within the green corridor and understand what changes will be needed in terms of upgrading, retrofitting and/or newbuilds.
- Analysis from a J&E perspective will provide insights on how workers, communities and ecosystems might be affected by the transition to vessel decarbonization pathway.

Page 26

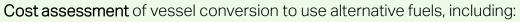
# 5L. Vessel decarbonization pathway

### Summary of chapter findings and outcomes

- Current and future vessel availability and timeline taking into consideration the availability of alternative fuels based on technology maturity
  - Modifications required for existing vessels and characteristics of new vessels (i.e., alternative fuels, onboard storage, technologies)

Technical feasibility of vessel newbuild/conversion to use alternative fuels, including:

- Impact of usage of alternative fuels on vessel, voyage range, and cargo payload
- Fuel and technology availability and maturity over time
- Vessel renewal/new ordering timelines
- Regulatory feasibility of vessel conversion to use alternative fuels:
- Regulations regarding use and onboard storage of alternative fuels
- Measures to ensure a just and equitable conversion and operation of the vessels, including relevant ESG ambitions



- CapEx and OpEx for existing and new vessels' incremental cost of green
- Resulting financing needs and funding sources

#### Just & Equitable:



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Analysis from a J&E perspective will provide insights on how workers, communities and ecosystems might be affected by the change/addition
of new operating vessels and their related new technologies. There might be socio-economic opportunities and risks. It is important that work
is done to maximize the opportunities and minimize the risks.



Estimate the number of vessels required and define the green corridor's future vessel requirements, including type and size of vessels

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Steps

Inputs

Estimate the number of vessels required for the green corridor	Define the vessel requirements needed for the vessels to operate on the specific green corridor (i.e., capacity, type, size) over time, including requirements to decarbonize the vessels	Determine the technology available for newbuilds and retrofitting vessels (e.g., engine, energy efficiency retrofit kit, onshore power connection panel, other equipment) to enable the vessels to operate on the green corridor
<ul> <li>Input from Feasibility Scoping and corridor project baseline</li> </ul>	<ul><li>Evolution of the corridor's shipping demand for vessels</li><li>Expected utilization of vessels</li></ul>	• Technology availability, and approval from classification society and flag state

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Define the number of <u>newbuilds and retrofitted</u> vessels that can operate in the specific green corridor over time

Steps	Define technologies (including onboard fuel storage) for new vessels and the required/available modifications to retrofit the vessels expected to operate on the green corridor	Assess cost, technology availability and shipyard readiness for newbuilding and for retrofitting the vessels	3 Compare costs, capacities, and readiness (e.g., expertise available from shipyards, engine manufacturers, etc.) and define most economic pathway	A Make high-level assessment of mix between newbuilds and retrofit
Inputs	<ul> <li>Information from shipbuilders' classification societies</li> </ul>	<ul> <li>Capacity constraints for shipbuilding value chain players (e.g., shipyards, engine manufacturers)</li> </ul>	<ul> <li>Cost and capacity to deliver newbuilds</li> <li>Cost and capacity to retrofit existing vessels</li> </ul>	<ul> <li>Step 3</li> <li>Factors such as shipyard capacity, technology advancements, regulatory trends, and economic factors influencing costs.</li> </ul>
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Create the timeline to decarbonize the selected vessels based on vessel technology and fuel availability, as well as fuel maturity

Steps

Define timeline required to reach the corridor's target of operating on Compare the high-level sequencing of fuel available with the low/zero emission vessels based on vessel requirements and possibilities for newbuilding and retrofitting vessels

- Matching of fuel maturity, availability and requirement
- Technology availability

sequence of selected vessels on an incremental basis (e.g., per year) based on fuel availability

2

Alternative fuel availability

Identify regulations that impact the availability of the vessel decarbonization pathway

Steps

Identify regulatory frameworks that could impact the development, conversion, and/or operation of conventional vs low/zero emission vessels in the specific green corridor, either acting as drivers or green corridor barriers to the green corridor project

- Input from the Pre-Feasibility Study
- Local and international policies, regulations, and guidelines issued by regulatory institutions, e.g., regulations regarding the use and onboard storage of alternative fuels

Assess the regulatory feasibility of converting existing vessels vs building new vessels and the operation of the same on the specific

2

• Combination of the previous steps

 $\overline{}$ 

# Quantify the <u>CapEx</u> and lifetime <u>OpEx</u> requirements for newbuilds and retrofitted vessels and review financing potential

		2	3
sdalc	Quantify the expected CapEx, on the basis of tech maturity, financial environment, etc.	Quantify the lifetime OpEx (for 25 years of operation)	Assess financing and funding options (including cost of capital) for ship operators and ship owners
SINGUI	<ul> <li>New building, and modifications to existing/new vessels</li> <li>Green Corridor Scenario Modeling tool</li> </ul>	<ul> <li>Vessel operating cost for newbuilding or retrofitted vessel</li> <li>Assumptions on new crewing requirements (additional training, more automation, safety requirements, etc.)</li> <li>Green Corridor Scenario Modeling tool</li> </ul>	<ul> <li>Public and private financing options, including cost of capital estimate and "green" investment subsidies</li> <li>Local funding/subsidy programs</li> </ul>

# J&E assessment - Vessel decarbonization pathway

Identify the potentially-affected communities, workers and ecosystems.

Steps

Inputs

Affected communities such as those in the vicinity of vessel operations such as port- and/or coastal communities.

### Workers:

Affected groups such as seafarers

#### Ecosystems:

Affected ecosystems such as marine ecosystems along the green corridor in question With the identified groups and ecosystems in mind, go through the questionnaire and consider the identified risks and opportunities

2

Use the questionnaire provided in the J&E
 Data Collection Sheet

• If relevant, highlight risks that should go into the risk matrix

Consider the ESG / Sustainability Strategies of commercial stakeholders involved in Workstream 4

3

 Identify synergies between project objectives and the ESG / sustainability strategies for stakeholders involved in WS4. For inspiration, consult the ESG questions provided in the Pre-Feasibility data collection Excel tool Tab 5.2

## Workstream gap analysis – Vessel decarbonization pathway

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2 3 4							₩orkstream Scope / Targets									[see workstream-specific spreadsheets for a list of elements] [describe element]
5 6 7															Main Gaps	[describe gap]
6															Solution Time	[describe solution to close gap, i.e. demonstrators, SOPs, studies, etc.] [timeframe to close gap]
															Cost to close	[demonstrators, pilots, etc.] [\$M]
8														Criticalit	gap Investments	(demonstrators, pilots, etc.) [444]
9	₩orkstream	Торіс	Feasibility Assess	ment	Elements	Description	Main Gaps	Solution/ Mitigating Actions	Timing	Cost to Close Gap	Investments	Dependencies/ Commitments	Gap Factor	Uniticalit y	Investments	[Capex/Opex to reach project scope]
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13			and mitigat actions. WI													Traffic Light Table Definition
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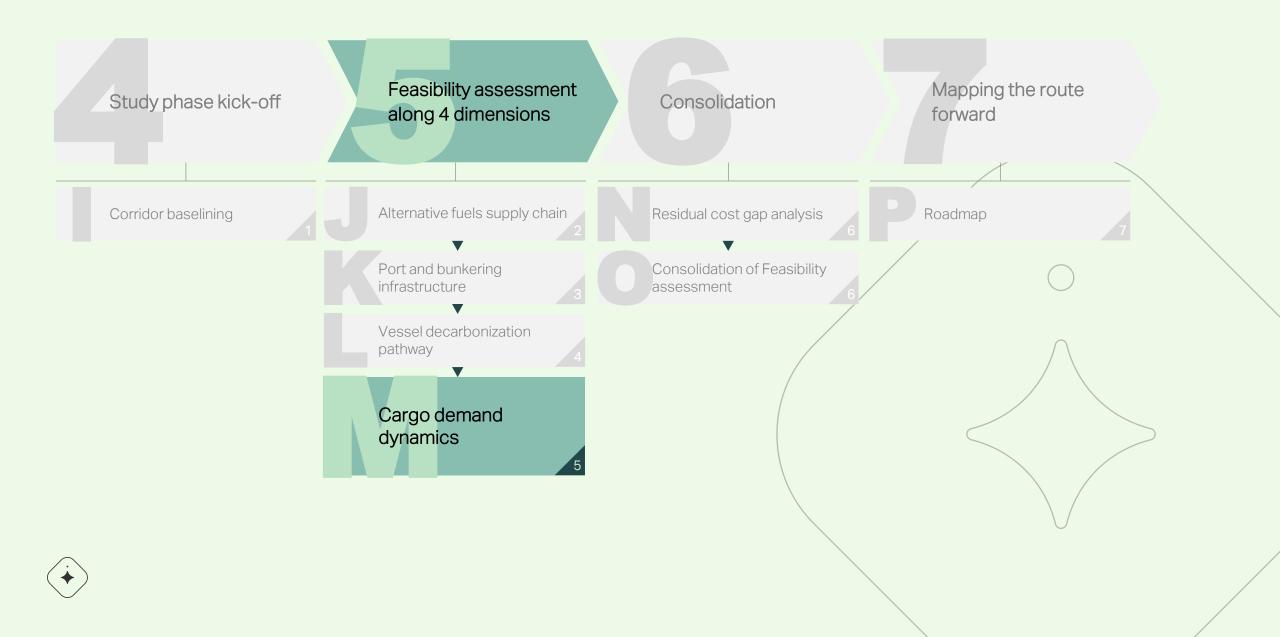
I hroughout the Feasibility assessment, fill the table with insights on **technical and regulatory** feasibility<sup>5</sup> – specifically, use this table to highlight gaps and ways to close them

Legend and demnitions



1

Workstream 5



# 5M. Cargo demand dynamics

### Purpose

- Examine expected growth and development, trade patterns, and the cargo value chain
- Assess the cargo's sensitivity to changes in shipping/transportation costs over time, including share of shipping as part of overall product cost and emissions.
- List possible alternatives of transporting the cargo and identify competing routes and transportation modes.
- Evaluate the cargo owners' and endconsumers' willingness to pay.
- Identify mechanisms and regulations that likely impact the cargo owners' and/or end consumers' willingness to pay.
- Perform just and equitable assessment to identify communities, workers and ecosystems potentially affected by the shift in cargo transportation mode and/or demand dynamics.

### Key questions

- What are the **trade patterns** for the cargo types in the specific green corridor? Who owns the cargo?
- What is the value of the cargo and what is the cost of the green transportation per cargo unit?
- What are the **alternative** routes outside the green corridor or alternative means of transportation?
- How much of the incremental cost can be covered by cargo owners and through the full customer chain?
- Which **levers** will have an expected positive or negative impact on the cargo owners' and/or end consumers' willingness to pay?
- How might the use of alternative fuels affect the cargo beyond emissions?
- Are there any **socio-economic opportunities and risks**, and how can they be maximized/minimized, respectively?

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### Importance

- While work on fuel, ports and vessels aggregates the total cost of the green corridor, the cargo assessment addresses the **options of closing the cost gap with the price on cargo**.
- Within the supply chain, one central dimension is the **willingness of cargo owners and end-customers** to pay for green transportation.

### 5M. Cargo demand dynamics

#### Summary of chapter findings and outcomes



Description of the nature of the cargo in its current configuration and future developments (e.g., growth, trade patterns)



Description of the cargo value relative to the incremental cost of green transportation under current and expected developments



Identification and description of the alternatives and competing options for green transportation of the cargo



Quantitative and qualitative assessment of the cargo owners' and end consumers' willingness to pay for decarbonized shipping, mapped vs volume of cargo transported in the corridor per stakeholder



Overall drivers, such as ESG focus areas, which impact the cargo owners' and end consumers' willingness to pay (e.g., regulatory mechanisms, industry drivers and constraints) and workstream-related measures to ensure a just and equitable implementation of the project



# Examine expected growth and development, trade patterns, and cargo value chain

Steps	Describe the selected cargo's origin and basic characteristics (e.g., weight, necessary safety measures, temperature requirements, etc.)	ldentify current volume, expected growth and volume fluctuations in the cargo trade	3 Describe the cargo industry's sustainability ambition and decarbonization adoption levels	Outline the cargo value chain, including the cargo's end usage
Inputs	<ul> <li>Market research reports (raw material, final goods, etc.)</li> <li>Historical shipping services sales data</li> </ul>	<ul> <li>Inbound/outbound products/commodities per segment over time (fronthaul-backhaul)</li> <li>Historical intra-year volume development (seasonality)</li> </ul>	<ul> <li>Industry decarbonization maturity level and investor/consumer pressure</li> <li>Total industry emissions</li> <li>Total life cycle emissions per unit of cargo</li> <li>Just and equitable questionnaire including ESG- related considerations</li> </ul>	<ul> <li>Market reports for downstream cargo/final goods</li> </ul>

### Assess the cargo's value

Steps	Estimate the cargo's value (e.g., sales revenue, retail value)	Describe and estimate the future price and growth basics of the cargo (consider also green shipping potential for value adds)	3 Assess shipping costs relative to cargo value	Determine the cargo owners' and/or end consumers' ability to absorb additional green transportation costs	5 Estimate the shipping emissions and costs in comparison to the total emissions of the cargo
Inputs	<ul> <li>Cargo owner and end consumer value chain mapping</li> <li>Cargo market sales reports</li> <li>Retail value per unit for most relevant cargo types</li> </ul>	<ul> <li>Future price and value estimation</li> <li>Market sizing of sectors/industries that can potentially consume or use the cargo as input</li> </ul>	<ul> <li>Cost breakdown to understand the potential to absorb additional green transportation cost</li> <li>Scenario modeling of 'locked-in' costs from empty handling, commitments or alternative trading</li> </ul>	<ul> <li>Cost breakdown of downstream products and final goods, including their retail value</li> </ul>	<ul> <li>Breakdown of total emissions in the value chain</li> <li>High-level cost estimate of decarbonizing the full value chain</li> </ul>

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List potential alternatives for transporting the cargo and identify competing routes and transportation modes

Steps	Assess alternatives and substitutes to the cargo in the value chain – Can the cargo be substituted?	Identify alternative transportation options and sourcing or production methods that become more competitive in light of increased green transportation costs in the green corridor – Will cargo be moved via other modes of transport?	3 Assess the feasibility of cargo bypassing the corridor's trade route	d Identify opportunities to bundle demand from multiple cargo owners and end consumers (e.g., options for combining cargo types and optimization of fronthaul- backhaul) in the green corridor
Inputs	Downstream market analysis	<ul> <li>Insourcing/outsourcing alternatives</li> <li>List of alternative sources</li> <li>Alternative production methods</li> </ul>	Trade flows	Cost estimation and splits of bundling services

Make a quantitative and qualitative estimation of the willingness to pay (WTP) for sustainable shipping

Steps	Assess the quantitative willingness to pay for decarbonized shipping services in the corridor	Specify the retail value of the cargo and establish the relative monetary cost and impact of transitioning to green transportation	3 Map monetary outcome of commercial alternatives, either for transportation or production / development	4 Identify monetary value and impact from transition mechanisms (e.g., tax / subsidies, book and claim, etc.)	5 Estimate the quantitative and qualitative willingness to pay of cargo stakeholders
Inputs	<ul> <li>Historical transportation data, market trends, growth projections, and competitive landscape.</li> <li>Consumer chain surveys to assess the WTP of stakeholders for decarbonized shipping services</li> </ul>	<ul> <li>Cost for moving cargo on fossil fuels and cost of green transportation</li> <li>Green corridor scenario modelling tool</li> <li>Incremental cost of green per cargo unit</li> </ul>	<ul> <li>Identification of relevant key financial metrics</li> <li>Definition of the commercial alternatives being evaluated</li> <li>Evaluation of the revenue potential of each alternative</li> </ul>	<ul> <li>Potential subsidies, grants, tax incentives, book and claim, green tax or market mechanisms that may influence stakeholders' willingness to pay.</li> </ul>	<ul> <li>Cost and pricing models, including subsidies development as well as add-on value from green shipping transition</li> </ul>

Identify mechanisms and regulations that likely impact the cargo owners' and/or end consumers' willingness to pay

Steps	Identify the drivers of willingness to pay for decarbonized shipping and create an overview of stakeholder decarbonization commitments and commercial alliances relevant to the green corridor	2 Identify other stakeholders' ability to influence the energy transition and assess high-level abatement opportunities for non-shipping emissions of the specific cargo	3 Assess contract / charter dynamics to understand potential commercial or contractual constraints related to the corridor	4 Assess opportunities from longer-term offtake agreements that de-risk alternative fuel costs in the green corridor	Jdentify regulatory frameworks which could influence the fuel transition and assess how other ESG principles will impact the decarbonization focus, and define workstream-related measures to ensure a just and equitable implementation of the project
Inputs	<ul> <li>Industry decarbonization maturity level and investor / consumer pressure</li> <li>Cargo owner / end consumer surveys</li> <li>Published reports detailing Scope 3 emission targets</li> <li>Consumer chain surveys to assess the willingness to pay for decarbonized shipping services</li> </ul>	<ul> <li>Membership of decarbonization alliances (e.g., Sustainable Freight Buyers Alliance, First Movers Coalition, coZEV Coalition)</li> </ul>	Contractual review	<ul> <li>Estimate cost savings from longer-term offtake agreements</li> <li>Regulatory/commercial frameworks for offtake agreements</li> </ul>	<ul> <li>Overview of regulatory factors on cargo and transportation</li> <li>Green Corridor Scenario Modeling tool</li> <li>Just and equitable assessment including overview of relevant ESG focus areas and evaluation of their impact on decarbonization</li> </ul>

### J&E assessment - Cargo demand dynamics

If relevant, identify the potentially-affected communities, workers and ecosystems.

Affected communities such as port communities, coastal communities or communities in the vicinity of new fuel or energy infrastructure.

#### • Workers:

Workers handling cargo who are affected by the shift in cargo transportation mode and/or demand dynamics.

#### • Ecosystems:

Affected ecosystems on land and ashore such as those in the vicinity of new fuel or energy infrastructure developments, and port and bunkering facilities associated with the corridor but also those affected through land use change, water use, or biochemical flows related to these developments. With the identified groups and ecosystems in mind, go through the questionnaire and consider the identified risks and opportunities

2

- Use the questionnaire provided in the J&E Data Collection Sheet
- If relevant, highlight risks that should go into the risk matrix

Consider the ESG / Sustainability Strategies of commercial stakeholders involved in Workstream 5

3

 Identify synergies between project objectives and the ESG / sustainability strategies for stakeholders involved in WS2. For inspiration, consult the ESG questions provided in the Pre-Feasibility data collection Excel tool Tab 5.2

Steps

### Workstream gap analysis – Cargo demand dynamics

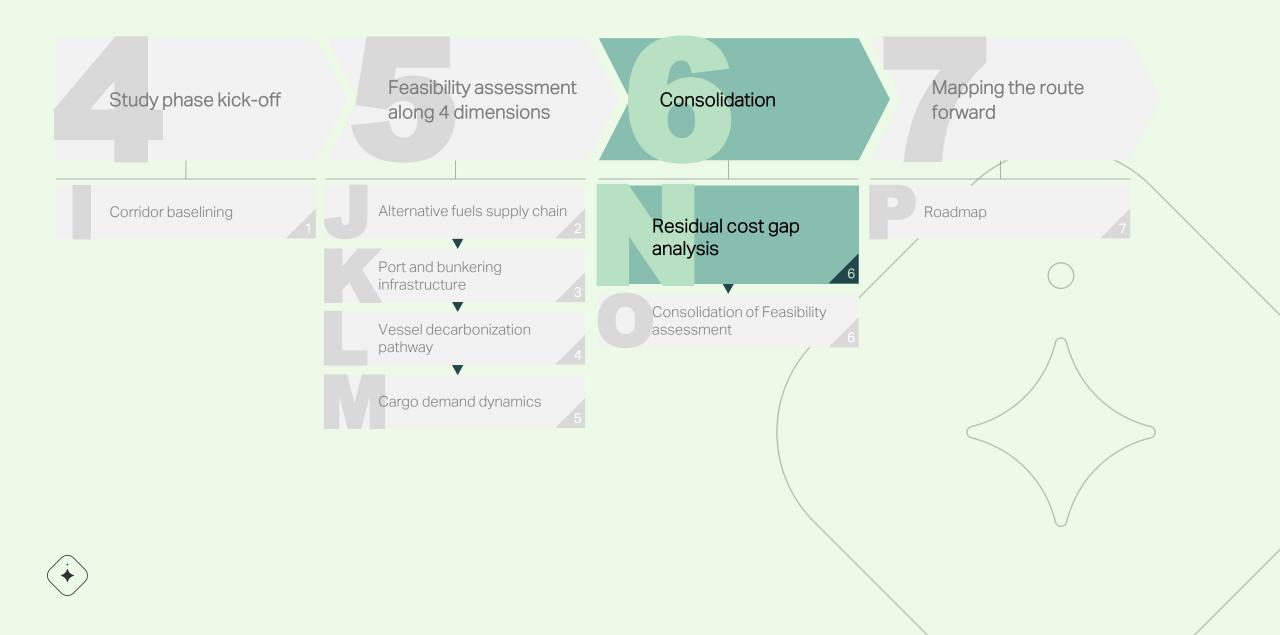
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•									Workstream Scope / Targets						Description Main Gaps	[describe element] [describe gap]
>															Solution	[describe gap] [describe solution to close gap, i.e. demonstrators, SOPs, studies, etc.]
7															Time	[timeframe to close gap]
														Cost to close gap	[demonstrators, pilots, etc.] [\$M]	
	Workstream	Topic	Feasibi	ity Assessment	Elements	Description	Main Gaps	Solution/ Mitigating Actions	Timing	Cost to Close Gap	Investments	Dependencies/ Commitments	Gap Factor	Criticalit y	Investments	[Capex/Opex to reach project scope]
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Throughout the Feasibility assessment, fill the table with insights on **technical and regulatory feasibility<sup>6</sup>** – specifically, use this table to highlight **gaps and ways to close them**  Legend and definitions



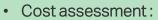
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Workstream 6



### 6N. Residual cost gap analysis

#### Purpose



Estimate the total corridor cost as well as the residual cost gap throughout the value chain of green shipping and outline potential actions/measures to close the cost gap.

#### Key questions

- What is the incremental cost of green?
- How can the cost gap be closed?
- What are the **financing requirements** and the funding sources to enable the green corridor?
- What are the **potential risks** for the implementation of the green corridor and how can they be **mitigated?**

## 

• This is a crucial step in **evaluating the trajectory of a green corridor**. It helps determine if the project is receiving **sufficient funding** to move towards execution.

Importance

- Based on the **results of the cost gap analysis**, the project team will take the next steps.
- The project team will **engage stakeholders outside the consortium**. The goal is to identify options to **close** the residual cost gap. These options could include subsidies or loans.
- The accuracy of the cost assessment and its relevance depends on the quality of the technical and regulatory assessment. This implies that a **thorough and accurate technical and regulatory assessment is essential** for a valid cost assessment.

### 6N. Residual cost gap analysis

Estimate the incremental cost of green

Continuously refine with more data

D.

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Reduce the incremental cost of green through the consortium

Reduce costs among

business development

of cargo owners (E1) &

customers (E2)

consortium members through

opportunities and synergies

Assess the willingness to pay

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Assess funding options to close the remaining cost gap

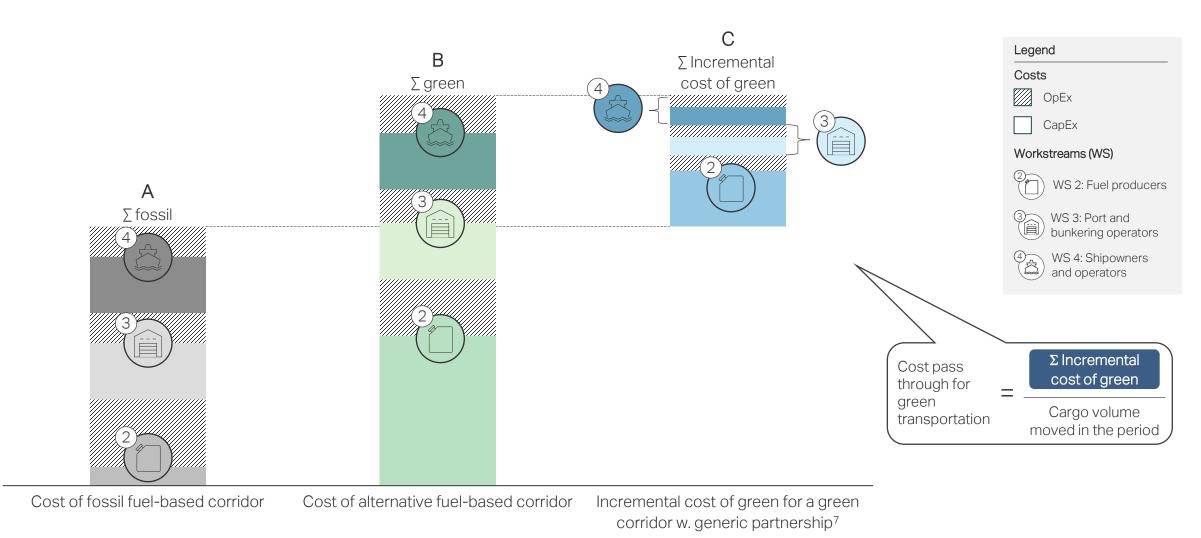


- F. Identify the remaining cost gap = residual cost gap to be covered by other stakeholders
- Identify sources of funding to close the remaining cost gap
  - Subsidies
  - Attractive loans
  - Repayment of ETS
  - Philanthropic organizations
  - Guaranteed minimum auctions
  - Other financial instruments

- A. Estimate costs of fuel, port and bunkering infrastructure, vessel for fossil fuel-based corridor
- B. Estimate costs of fuel, port and bunkering infrastructure, vessel for alternative fuel-based corridor
- C. Incremental cost of green.
  - Calculate the incremental cost based on (A) and (B). Estimate the high-level cost pass through on cargo and the CO<sub>2</sub> price, to cover the incremental cost of green
  - II. Assess any pre-investments done amongst consortium members to update incremental cost of green
  - III. Update the **incremental cost of green** based on technical insight during Feasibility Study

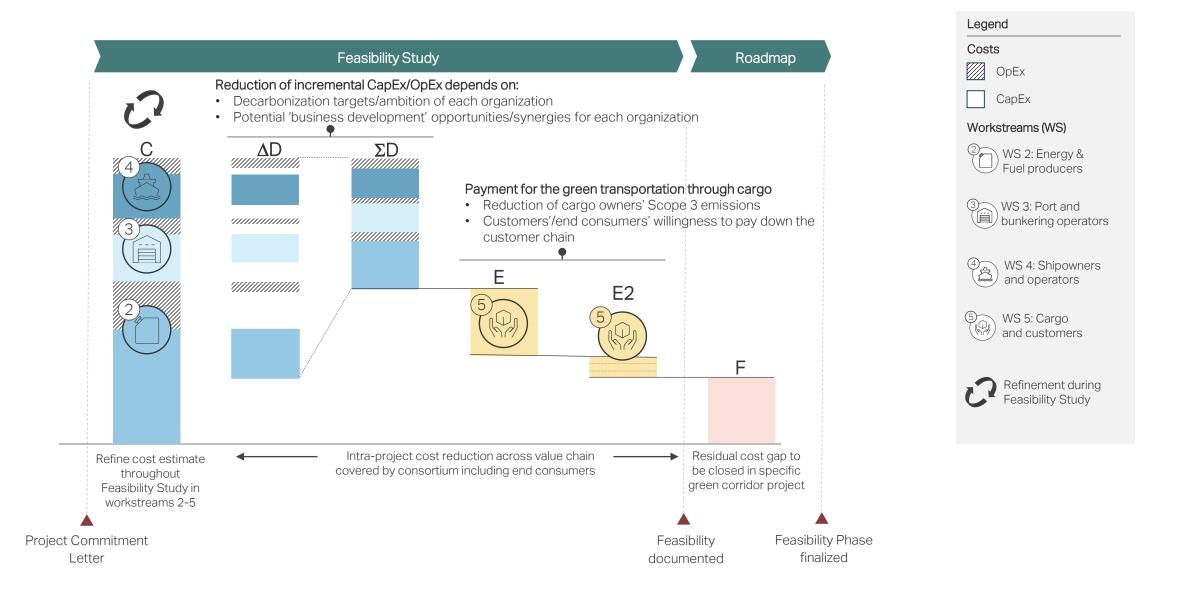
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### Initial estimates on the incremental cost of green for a green corridor

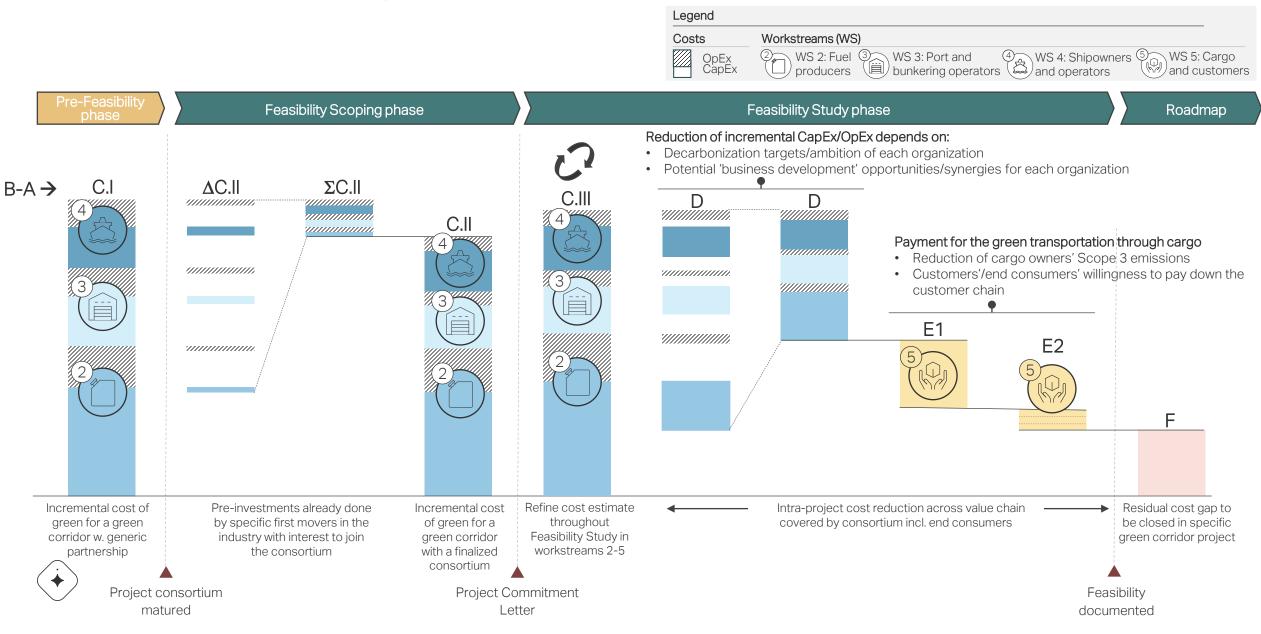


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### Estimating and addressing the incremental cost of green in Feasibility

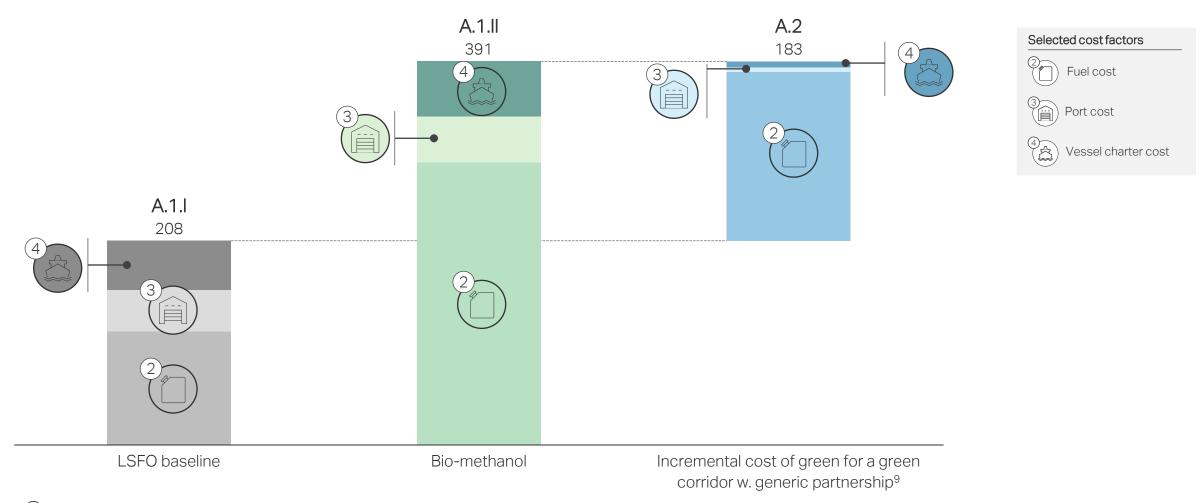


The incremental cost of green – full overview



### A. Calculating the incremental cost of green – Example

Incremental decarbonization cost along the value chain compared to LSFO (selected cost factors), USD/TEU<sup>8</sup>





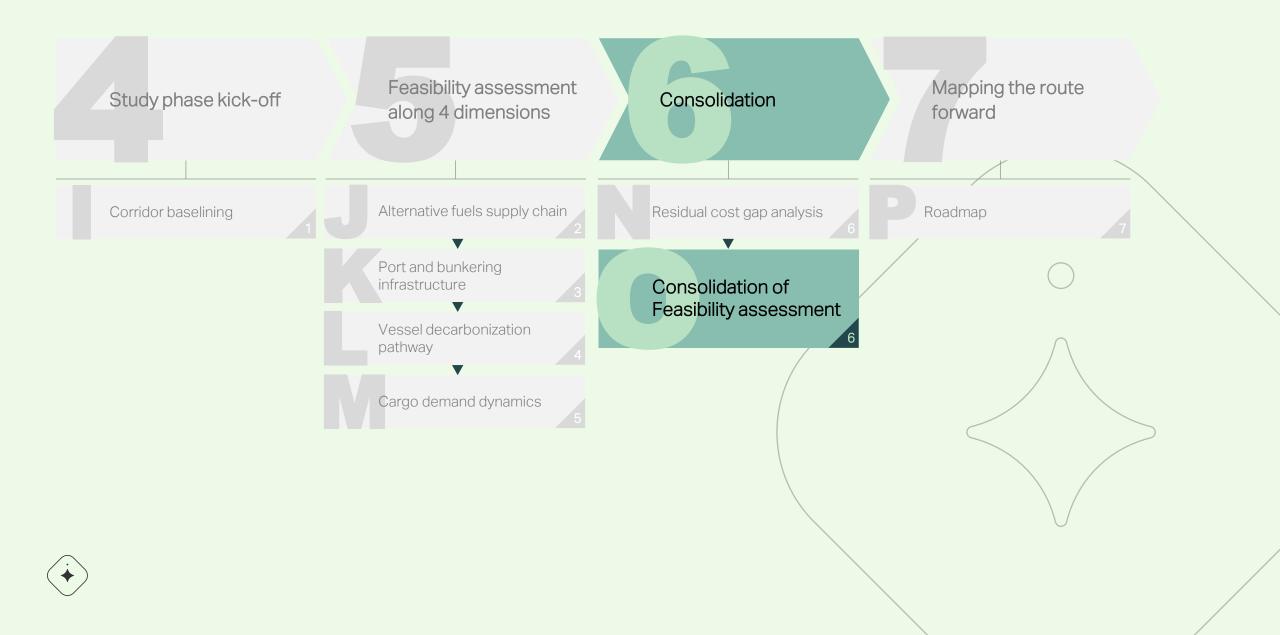
8 Cost per TEU for a 1,500 TEU ship sailing on different fuel types from Hamburg, Germany to Kotka, Finland. Source: Maritime Decarbonization Strategy 2022

9 Estimate to be further refined with cost inputs received from consortium members after the Project Commitment Letter has been signed

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Workstream 6



### 60. Consolidation of Feasibility assessment

#### Purpose

- Consolidate findings from the Feasibility assessment along the green corridor.
- Technical feasibility assessment: Identify technical challenges and define actions to accelerate the implementation of the corridor.
- Regulatory feasibility assessment: Regulatory and policy changes for the green corridor to go ahead.
- Estimate the total corridor incremental cost of green as well as the residual cost gap.
- Just and equitable assessment: Consolidate J&E assessments across workstreams 2 to 5 with the general J&E assessment (performed by Project Lead in scoping phase).
- Develop a **risk register** and identify potential **mitigation actions**.
- Summarize insights on technical, regulatory and J&E feasibility as well as costs.

#### Key questions

- What are the technical challenges (if any) for the implementation of the green corridor? What actions are required to reach technical feasibility?
- What are the regulatory and policy constraints? What actions are required to reach regulatory feasibility?
- What are the costs (CapEx and OpEx) through the value chain to deliver the development, construction and operation of the green corridor?
- What are the **options for cost reduction** in the value chain elements?
- Are there **synergies** that can be realized across these steps?
- What needs to be addressed to create a just and equitable corridor?

## 

• Quantifying the residual cost gap is essential to evaluate the trajectory of a green corridor in terms of receiving sufficient funding to move towards execution. Based on the outcome of the analysis, the project team will engage stakeholders outside the consortium to identify options to close the residual cost gap (e.g., subsidies or loans).

Importance

- The validity of the cost assessment as well as the relevance relies on the **quality of the technical and regulatory feasibility assessments.**
- About **Just and Equitable**, this step enables stakeholders to **make informed decisions and facilitates necessary policy changes** for the green corridor.
- The just and equitable assessment ensures that the **benefits** of the green corridor are **distributed fairly among all stakeholders**, including affected communities and worker groups.

3

### 60. Consolidation of Feasibility assessment

#### Summary of chapter findings and outcomes



#### Technical feasibility:

• Identify the main gaps between baseline status and aligned project scope per chapter (see Feasibility matrix), evaluate and rank them



03

#### Regulatory feasibility:

• Identify the main gaps and hurdles to achieve the aligned project scope per chapter (see Feasibility matrix in Appendix 6.5), evaluate and rank them

#### Cost assessment:

- Calculate residual cost gap of green shipping using CapEx and OpEx (for 25 years of operation) results of Workstreams 2-5 (list pre-project investments also)
  - Identify possibilities to eliminate residual cost gap and sequence them (starting with cost reduction measures within the project consortium)



#### Risk register and a list of potential mitigation actions:

• Develop respective mitigation actions and sequence them

#### Just and equitable assessment:



- Summarize which communities, workers and ecosystems are most likely to be affected by the green corridor. Consider how to ensure their representation in the project going forward. In addition, ensure transparent project governance systems
- Develop an overview of the socio-economic risks and opportunities throughout the corridor. Develop mitigation actions for risks that are not included in the risk register and consider how the opportunities can be maximized



Consolidate <u>technical feasibility</u> results, specifying main gaps between assessments and target state throughout value chain

Steps	Identify technical challenges (if any) across the value chain, and develop a risk register	Define how technical challenges are expected to evolve/be resolved over time (e.g., timing for availability of ammonia- fueled engines) and how this aligns with the project timeline, and include these mitigation actions in the risk register	3 Categorize technical challenges based on their severity and impact on the green corridor (critical vs. lower-priority challenges) as well as a high-level estimate of the cost associated with resolving the technical challenge	4 Define scenarios for timing the resolution of main technical challenges, assessing project timeline implications and actions required	Define actions and their sequencing to accelerate the technical enablement of green corridors, highlighting stakeholders who should be involved and ensuring critical actions are prioritized
Inputs	<ul> <li>Technical assessment – Input from Workstreams 2- 4</li> </ul>	<ul> <li>Technical assessment – Input from Workstreams 2- 4</li> <li>Technical/technological trends and outlook based on market reports</li> <li>Overall project timeline – Input from Pre-Feasibility Study</li> </ul>	Technical challenges	<ul> <li>Technical assessment – Input from Workstreams 2- 4</li> <li>Current proposed decarbonization pathway – Input from Workstream 4</li> </ul>	Technical assessment – Input from Workstreams 2- 4 Current proposed decarbonization pathway – Input from Workstream 4 Scenarios for the resolution of technical challenges

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### Consolidate regulatory feasibility of the green corridor

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<ul> <li>Identify potential regulatory challenges across the value chain and relevant levels of governance (international, regional, national, local) and compliance with applicable sustainability conventions and guidelines, including:</li> <li>Regulatory/policy constraints</li> <li>Permitting</li> <li>Areas with lacking policy/regulatory structure or guidelines</li> <li>Compliance with conventions and guidelines, such as UN Global Compact, Just Transition, and individual stakeholder commitments</li> </ul>	categorize regulatory challenges based on their severity and impact on the green corridor (critical vs. less urgent challenges) into a risk register and estimate the costs associated with resolving the regulatory	Identify required policy changes across the value chain and levels of governance to realize or accelerate the green corridor (e.g., policies to expedite safety measures) and map the timing for expected policy changes	Map and prioritize policy and regulatory changes by expected feasibility and impact, identifying timeline implications (e.g., actions to put policy changes on appropriate agendas)	Assess the overall regulatory feasibility for the green corridor, highlighting areas of concern
<ul> <li>Input from Workstreams 2-4</li> <li>UN Global Compact commitments</li> <li>Just Transition targets and commitments</li> <li>Commitments from partners/stakeholders</li> </ul>	• Current regulatory challenges	• Current regulatory challenges	<ul> <li>Expected feasibility and impact of policy/regulatory changes</li> </ul>	Combination of the previous steps

Steps



Consolidate cost assessments throughout value chain, estimate the total corridor incremental cost of green as well as the residual cost gap

Steps	Aggregate the total value chain cost for establishing (CapEx) and operating (OpEx) the specific corridor and compare with a similar fossil-fuel corridor	Estimate the cost of the green corridor in absolute terms, incremental cargo unit cost, as well as the cost per ton of abated $CO_2$ , and compare with similar projects/options. Identify options for cost reduction through synergies, ESG value and business development along the value chain	3 Identify the 'willingness to pay' for green transportation in the specific green corridor: • Cargo owners • Customers through the downstream chain	Identify the residual cost gap to be closed for the green corridor at hand and identify options for closing the cost gap (see Appendix 6.3) for the residual cost gap guideline)
Inputs	<ul> <li>Input from 6N</li> <li>Dialogue with consortium members to understand options for cost reduction through synergies, ESG value and business development</li> </ul>	<ul> <li>Insights from cargo owners specific to the project</li> <li>Specific and/or general view on the end customers' willingness to pay</li> </ul>	<ul> <li>Input from Workstream 5</li> <li>Insights from cargo owners specific to the project</li> <li>Specific and/or general view on the end customers' willingness to pay</li> </ul>	<ul> <li>Combination of the above</li> <li>Public and private funding options available in region, segment, etc.</li> </ul>

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### Develop a risk register and identify potential mitigation actions

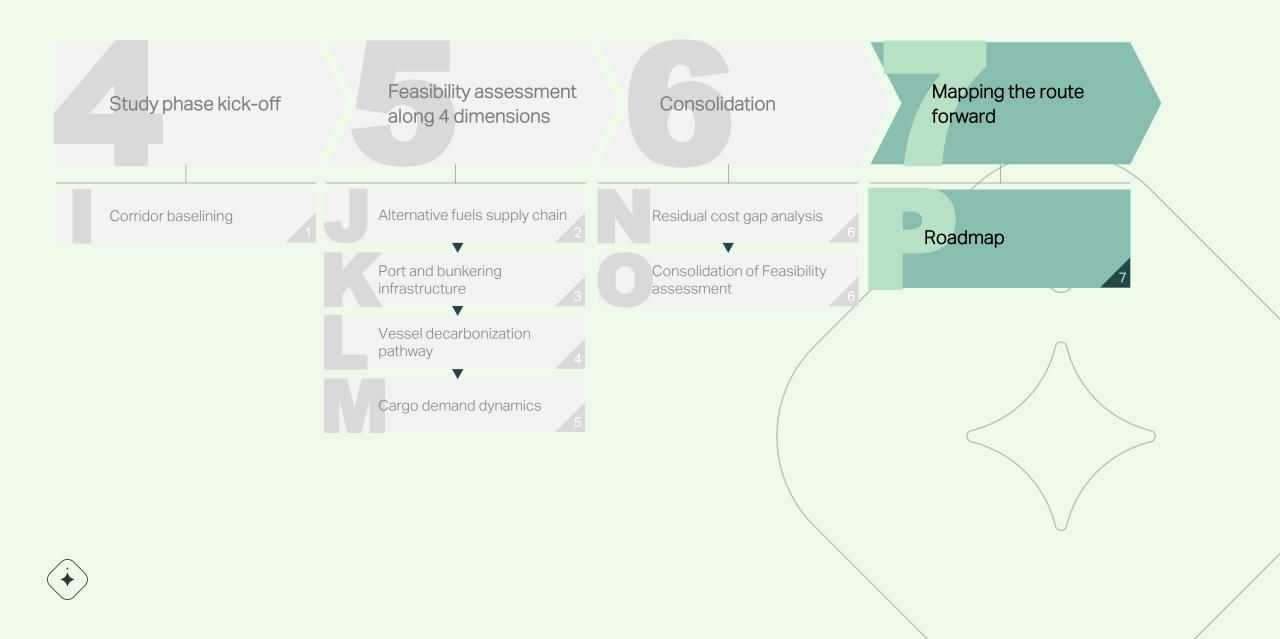
Steps	Aggregate risks acrossdimensions, incl.:• Technical• Regulatory• Costs	2 Identify risks for • Executional • Organizational • Commercial • Just & Equitable workstreams 2-5	pr ea pr	stimate the high-level obability and impact of ach risk, quantifying the oject's probability- djusted risk		JB Identify mitigation actions to either reduce risk probability or impact on the green corridor, prioritizing risks with a high impact and/or high probability	Propose metrics/indicators to identify and measure risks throughout the project as it moves forward
Inputs	Identified challenges	<ul> <li>Implementation and completion of tasks</li> <li>Individuals or teams responsible for execution</li> <li>KPIs, progress, timelines</li> <li>Market research</li> <li>Activities related to diversity, equity, and inclusion</li> </ul>	CC	ast examples of omparable projects takeholder interviews	•	Risks identified	N/A

### J&E assessment - Consolidation

If relevant, identify the potentially-affected communities, workers and ecosystems.	With the identified groups and ecosystems in mind, go through the questionnaire and consider the identified risks and opportunities	Consider the ESG / Sustainability Strategies of commercial stakeholders involved in Workstream 5
<ul> <li>Communities: Affected communities such as port communities, coastal communities or communities in the vicinity of new fuel or energy infrastructure.</li> <li>Workers: Affected workers such as those handling cargo or low/zero emission fuels etc.</li> <li>Ecosystems: Affected ecosystems on land and ashore such as those in the vicinity of new fuel or energy infrastructure developments, and port and bunkering facilities associated with the corridor but also those affected through land use change, water use, or biochemical flows related to these developments.</li> </ul>	<ul> <li>Use the questionnaire provided in the J&amp;E Data Collection Sheet</li> <li>If relevant, highlight risks that should go into the risk matrix</li> </ul>	<ul> <li>Identify synergies between project objectives and the ESG / sustainability strategies for stakeholders involved in WS2. For inspiration, consult the ESG questions provided in the Pre- feasibility data collection Excel tool, Tab 5.2</li> </ul>

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Workstream 7



#### Purpose



- Build an integrated roadmap for each value chain participant, considering the sequencing and lead time of projects and risk scenarios, and map relevant milestones:
  - Select and Define phases:
    - o Detailed roadmap
    - o Project governance and resources
    - Communications and engagement plan for internal and external stakeholders
  - Execute and Operate phases:
    - High-level timeline including lead times
- 2. Create a comprehensive roadmap with required investment decisions and outline funding options to close the incremental cost of green.
- **3.** Outline initial thoughts regarding commercial arrangements, offtake agreements, etc.
- 4. Sign off on the integrated roadmap

#### Key questions

- What are the **short and long-term steps** to **operationalize** the green corridor?
- What are the steps needed for a final investment decision (FID) of the project?
- What are the commitments and investments/projects required from each stakeholder to close part of the incremental cost of green and enable the integrated business case?
- What is the overall roadmap toward operationalizing the green corridor and what actions does each stakeholder need to take?
- What is the required **project governance** to deliver the roadmap for the next phases (Select and Define)?
- What are the **resources and capabilities required to complete the next phases** (Select and Define) of the project?
- What is the internal and external stakeholder communications plan?



#### Importance

- The roadmap is a **key decision tool** for these project participants both for planning to move the project forward, and for discussing public **funding options**.
- Public funding (along with private funding) will be required to ensure that the first green corridor will move forward.
- For **public funding** to be unlocked, thorough documentation validating the green corridor's decarbonization potential is needed.



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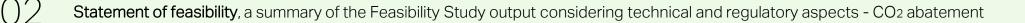
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Workstream 7

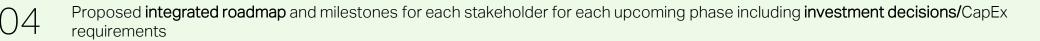
### 7P. Roadmap

#### Summary of chapter findings and outcomes

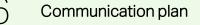
Summary of feasibility study



- Summary of incremental and residual cost gaps
- Funding options
- \$/t CO<sub>2</sub>



- Immediate next steps and investment requirements for next phases (Select and Define)
- Potential commercial arrangements and commitments



Build an integrated roadmap for each value chain participant and map relevant milestones

For the Select and Define phases:

- Define the list of activities/projects required across the value chain, outlining interdependencies and considering sequencing and lead times
- Overlay risk assessment onto roadmap (e.g., high-probability execution risks built into the timeline)
- Create a detailed list of milestones planned over time, linked to above activities

For the Execute and Operate phases, develop a high-level view on the main milestones per phase and associated timeline for each activity

2

- From Section 6
- Risk register Input from Workstream 6

- Decarbonization potential, ambition and timeline (if available) for the corridor
- Lead time for key equipment

Steps

Catalog investment decisions, expected lead times, and required commercial arrangements planned over time by value chain participant

Steps	Catalog investments required by each element of the value chain over time per concept (e.g., alternative fuel, propulsion engine), and identify expected lead times per investment/project	Review commitments outlined by stakeholders to partly close the incremental cost gap and enable the integrated business case for the green corridor for each feasible concept, including CapEx investments	3 Summarize the financing needs over time to secure sufficient funding for the project	Catalog the dependencies and commercial arrangements required with partners outside the consortium (e.g., engineers, manufacturers, shipyards, financial institutions)• Offtake commitments (e.g., for fuel producers from shipping, other sectors)• Contracting commitments (e.g., from cargo owners)
Inputs	<ul> <li>CapEx requirements per stakeholder over time – Input from Workstreams 2-5</li> <li>Feasible solutions for corridor – Input from Workstream 6</li> </ul>	<ul> <li>Commitments required per stakeholder – Input from Workstream 6</li> </ul>	<ul> <li>Financing requirements and sources (e.g., public and private financing options, "green" investment subsidies, local funding/subsidy programs) – Input from Workstream 6</li> </ul>	<ul> <li>Commitments and capacity requirements for external stakeholders – Input from Workstreams 2-6</li> </ul>

Define the project governance and resourcing requirements to complete the Select & Define phases (1/2)

Steps

Map all relevant stakeholders (internal and external) for the green corridor, and define their roles in the project, e.g., core consortium participants, knowledge partners, external stakeholder Define groups and capabilities required for the project governance and their responsibilities, participants, resources, and cadence, for:

2

- Decision making (steering committee)
- Central coordination/PMO<sup>10</sup> group
- Engineering teams from stakeholders
- Central regulatory affairs group

Engagement with consortium members

- Central business case analytics group
- Legal / contractual activities

Examples of other consortia

• NGOs or local civil society groups

• List of stakeholders

- Consortium format Input from Pre-Feasibility
  - Examples of other consortia
  - Engagement with consortium members

3

Determine the processes (i.e., cadence of

meetings, participants, forum, escalation

working/reporting lines within the project

management) and ways of

1

Define the project governance and resourcing requirements to complete the Select & Define phases (2/2)

5

Outline possible consortium configuration and structure, considering the option to establish a legal entity structure, and define implications for project funding Estimate investments required to complete the next phases (Select and Define) of the project, based on outstanding steps toward FIDs and required project governance

Identify stakeholder appetite and funding availability to enter next phases (Select and Define), given investment requirements

6

- · Discussion with stakeholders
- Legal and economic considerations

- Roadmap for Select and Define phases
- Resources for project governance

- Next-phase investment requirements
- Discussion with stakeholders

Develop a communication and engagement plan for internal and external stakeholders in the Select and Define phases

Steps	Map all stakeholders (internal and external – e.g., government, national/international regulators, industry leaders, industry coalitions, general public) for the green corridor and assess prioritization of engagement by level of criticality and level of urgency to contact	2 Identify project milestones that require/prompt external communications	Develop core messages per external stakeholder for each phase of the green corridor project, syndicating with project team and consortium stakeholders	Build an action plan for each stakeholder group, incl. mode, timing and cadence of communication, and person/group responsible for communication per stakeholder group
Inputs	<ul> <li>List of stakeholders – 7.1 output</li> </ul>	<ul><li>Project phases and respective milestones</li><li>Map of stakeholders</li></ul>	Communication milestones	Combination of the previous steps

# Activities to be included in the roadmap for next project phases

Select					

- Agree on criteria to rank project concepts along value chain (e.g., timing, cost)
- Identify and gather additional insights required for ranking
- Select final concept based on project concept ranking

Define

- Create detailed design plans & schedule for the technical work required for each step in value chain, highlighting interdependencies
- Detail **regulatory and policy changes required** (e.g., ammonia handling)
- Create implementation plan for required regulatory and policy changes
- Draft **commercial frameworks** (e.g., offtake agreements)
- Detail **financing frameworks** for FID (e.g., subsidies, local funding)
- Define the **consortium legal structure** for the execution and operation of the green corridor (e.g., asset ownership, project funding)

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Execute	Operate

- Execute project in a safe and costefficient way, with all testing, validation, training, and frameworks completed (further details per project needed)
- Hand over to operators on corridor

### Congratulations on successfully completing the Feasibility Study phase of your green corridor project!

Thanks to the collaborative efforts across various workstreams, the project team has achieved a comprehensive understanding of the key components comprising the green corridor: fuel, ports, vessels, and cargoes, considering their technical, financial, and regulatory aspects.

This culmination is presented in a comprehensive final report, complete with a **risk matrix and mitigation plan**, offering a holistic view of the **global feasibility** of the green corridor project.

### What comes next?

With all essential elements now assembled, stakeholders are poised to determine the project's direction, establish a **roadmap**, define **governance** structures, and allocate **resources** for the next critical phase: the engineering and commercial design of the green corridor.



### Disclaimer

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