

# Understanding & addressing barriers hindering timely investment in sustainable fuel production for marine shipping

*Insight in the financial feasibility, risks and mitigating measures for fuel production of sustainable marine fuels*

Green & Digital Shipping Corridor Rotterdam-Singapore



# Introduction | This publication provides the supply side perspective by detailing a case study for investing in sustainable fuel production, identifying cost drivers, risks and potential solutions to improve feasibility

The Green & Digital Shipping Corridor (GDSC) is a flagship initiative designed to accelerate the transition to sustainable marine fuels on the container trade lane between Rotterdam and Singapore. By jointly addressing technical, regulatory, and financial barriers, the **GDSC aims to create an investable & scalable pathway for decarbonizing maritime shipping.**

Building on last year's [Demand potential](#) publication — which highlighted over 2.5 million tonnes of potential demand for both green methane and methanol by 2028 — this follow-up focuses on the supply side. **This publication examines what it takes to invest in sustainable fuel production, identifies key cost drivers and risks, and explores solutions to improve financial feasibility.**

Without immediate investment in sustainable fuel production, the maritime sector risks missing international decarbonization targets, especially when timelines for build out of production capacity are considered. This publication provides a case study and actionable insights for stakeholders - including governments, financial institutions, and industry leaders - on **how to unlock investment and accelerate the fuel switch.**

## Content & building blocks of this publication

1

### Call to action & context

Explaining the challenges of marine shipping in developing supply & demand for sustainable fuels, and what action is needed to find a breakthrough in the investment impasse

2

### Supplier perspective

Get a thorough understanding of the supply investment perspective, challenges and the requirements for making sizeable investments in sustainable fuel production

3

### Investment case

Provide an in-depth overview of the value chain of key developments, cost drivers, investment risks and influence factors that make or break a production facility investment.

4

### Case Study: Risk factors & mitigating measures

By explaining a real-life investment example, we aim to identify main cost and risk drivers, and aim to identify solutions and mitigating measures that can help stimulate investments

5

### Solutions & Recommendations

Our solution assessment provides a clear overview what market players, governments and the GDSC can do to eliminate inefficiencies, develop best practices and reduce risk

**Call to action** | The transition to sustainable marine fuels is a systemic transformation requiring coordinated action across industry, government, and IMO. By combining innovation, policy support and financial instruments, stakeholders can unlock the scale and certainty needed for timely investment.

## Create an enabling environment

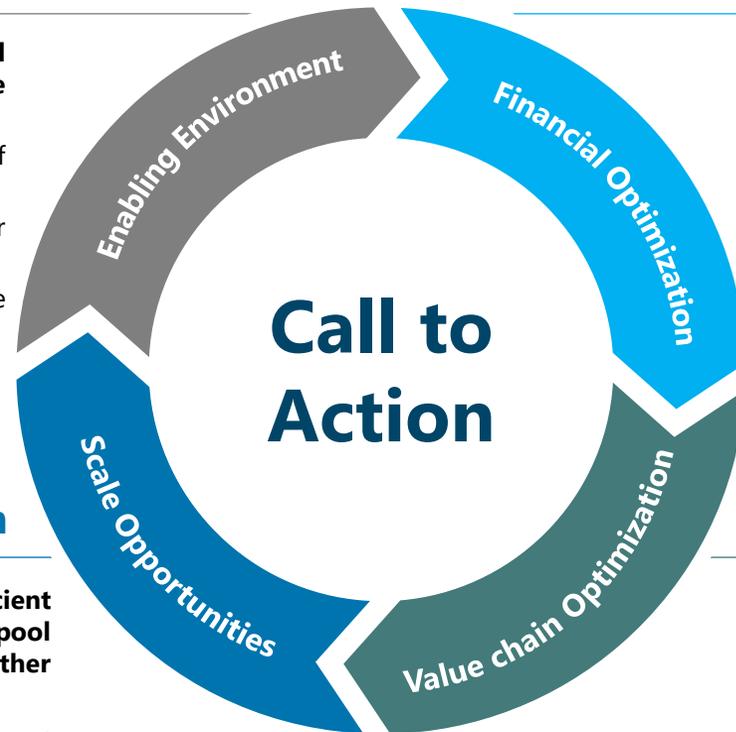
**Clear and aligned regulations at global (IMO), national and regional levels are essential to reduce uncertainty, provide long-term perspective and accelerate investment.**

- ✓ Harmonised frameworks and long-term global acceptance of fuel standards and certification processes.
- ✓ Centralised approvals, streamlined permitting, and clear technology and safety standards to shorten timelines.
- ✓ Create offtake certainty through mandates and address the cost gap through taxation schemes and carbon pricing.

## Scale Demand and Foster Collaboration

**(Cross-sector) Demand aggregation is vital to create sufficient volume and helps to share risk. Intermediary platforms can pool commitments from shipping liners, cargo owners and other sectors, aligning timelines and reducing fragmentation.**

- ✓ Cross-value-chain collaboration—from energy developers to vessel operators—to synchronise progress and avoid stranded assets.
- ✓ Find and leverage demand synergies across sectors to enable derisking & scale.
- ✓ Joint infrastructure development and targeted investments to remove supply chain gaps, especially mid-stream.



## Mobilise Investment & Innovative Financing

**Blended finance models that combine public and private capital from development banks, investors, export credit agencies, and governments can de-risk investments for large scale projects.**

- ✓ Better use and combination of existing instruments for early-stage maritime projects.
- ✓ Introduce support mechanisms and incentives to improve liquidity and transparency, like H2Global's double auction mechanism or Contracts for Difference schemes that bridge the price gap between conventional and sustainable fuels to stimulate demand and supply.
- ✓ Create investable demand and supplier certainty through the reward structure foreseen in the IMO Net Zero Framework.

## Reduce Value Chain Cost & Risk

**Focus on risk and cost reduction in large scale projects by technological development, optimisation of renewable power design, scale and logistics through collaboration across the entire value chain**

- ✓ Standardised plant designs, scaled production, and proven technologies to cut costs and technical risk.
- ✓ Provide financial risk mitigation via guarantees & insurance.
- ✓ Joint efforts on feedstock availability and pricing for renewables, carbon, and bio-based inputs.

**Context |** The GDSC aims to accelerate commercialization of sustainable fuels in shipping. First steps are taken, but an investment impasse needs to be overcome to ensure sufficient & timely availability of sustainable fuels.

**The GDSC aims to achieve early commercialization of sustainable fuels**

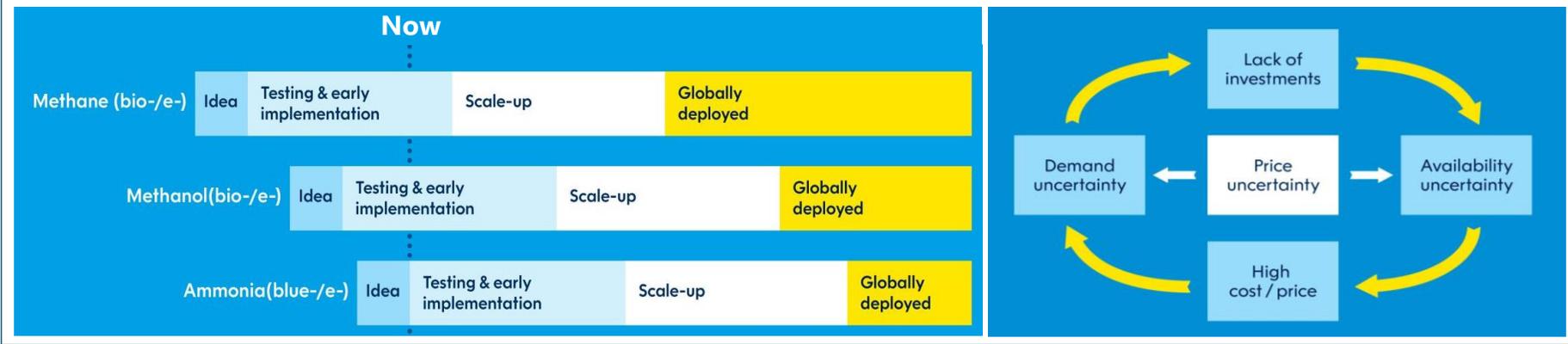
**GDSC pursues a multi-fuel future and has identified substantial demand potential from current fleet development**

**High cost, offtake uncertainty and developments risks of sustainable fuels, create an investment impasse**

- Globally, commercial vessels consume ~300 million tons of fuel consumption per annum.
- Causing ~3% of global GHG emissions, while seaborne trade is expected to grow.
- The GDSC aims to accelerate the fuel switch to sustainable fuels, by jointly addressing challenges on their acceptability, availability and affordability.
- This includes sustainable fuels in their early stages of maturity: (bio-/e-) methane, (bio-/e-) methanol, (blue/e-) ammonia.

- In 2028, GDSC partners will have 200+ vessels (>8,000 TEU) capable of sailing on alternative fuels<sup>1)</sup>
- This creates a potential demand of >2.5 m.t.p.a. for methane and methanol in 2028 based on current order books<sup>1)</sup>
- The expectation is that this will be supplemented with ammonia dual-fuel vessels in the future.
- Vessel fuel choice considerations include - besides fuel price and availability - the availability of technology, crew training, safety and vessel capital expenditures. These items will not be the focus of this publication.

- However, these are all dual fuel vessels, also capable of sailing on conventional fuel oil, providing no certainty on actual demand towards suppliers.
- Commitments on offtake are difficult to make as liners operate in a competitive global market.
- Importantly, >70% of total cost is in the fuel and the premium for sustainable fuel is significant.
- This creates an investment impasse in sustainable fuel production.



Source:  
1) GDSC Demand Signal Publication, 2024

## Supplier perspective | Current demand projections of sustainable fuel adoption in dual-fuel vessels do not provide sufficient certainty for a supplier to invest in production. Investable demand is required.

### Supply perspective

- Most of today's energy supply still comes from fossil fuels. One of the biggest barriers to achieving the transition to a sustainable fuel system is the **lack of firm demand and committed investment in production capacity for these fuels**.
- Therefore, there is limited push for scale and technology immaturity remains. Keeping the cost high and volatile, limiting adoption.
- This creates a vicious cycle: low demand discourages investment, and insufficient supply prevents scale.
- To break this cycle, investment in production facilities and supporting infrastructure - transport, storage, and bunkering - must begin years before demand materializes to ensure availability at the right time and scale.

**There is a timeline mismatch between supply and demand, especially for the sustainable fuels with low maturity, large investments and long development timelines**

### Investment challenges

- All production pathways are different in terms of size and investment. But developing a small-scale fuel production plant, including upstream renewable power infrastructure, potentially requires a \$1 billion USD investment and a **15-year full development timeline** with 5-7 years from Final Investment Decision (FID) to operations.
- Unlike spot-market practices common in maritime shipping, these projects need long-term offtake commitments (10+ years) to secure financing.
- The availability of dual-fuel vessels that can sail on sustainable fuels does not provide any demand certainty as vessels have multiple fuel options.
- At the same time, sustainable fuel competes for capital against profitable fossil fuel investments, slowing transition.

**Investable demand is required, and risks need to be addressed to drive market maturity and ensure timely build out of sufficient capacity**

### In short – the business case for sustainable fuel investments does not hold at this point.

This has the following impact:

- Production uncertainty remains as the lack of firm demand hinders technologies to develop;
- Therefore, economies of scale do not materialize, and price clarity is not found;
- As a result, when demand rises, there will be no fuels due to the long development timelines of production.

### Investment case: Gaining insight through a case study

This publication dives into the different elements that build up the cost & risk profile for sustainable fuel production, and how these can be addressed.

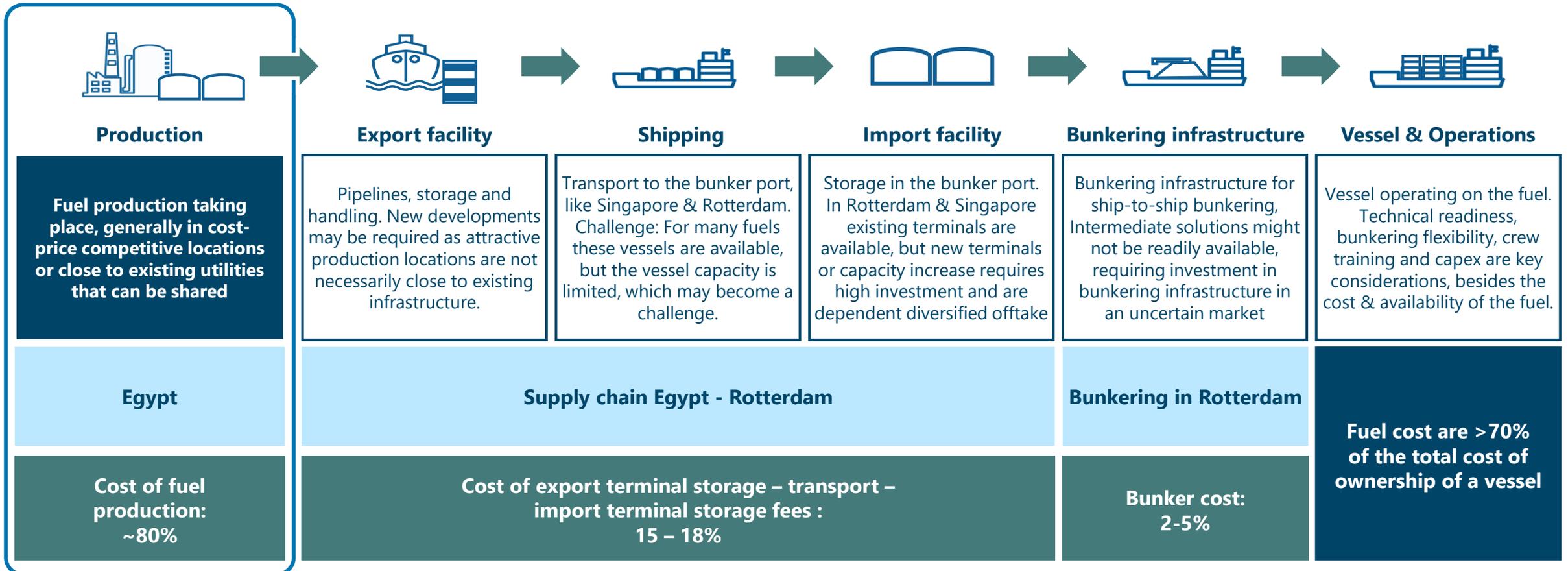
Every production pathway and specific project is different due to many internal & external factors. To maximize insight a publicly known project is analysed as a starting point.

**We have used the green ammonia production by Fertiglobe in Egypt<sup>1</sup>, which is supplemented by a reflection on the differences with other fuel pathways to ensure a broader understanding for all fuels important to maritime decarbonization and this GDSC.**

# Investment case | The availability of fuels requires readiness of the full value chain, including transport, storage and bunkering infrastructure. Analysis shows that the large majority of cost is however found in fuel production.

## Basis for the analysis

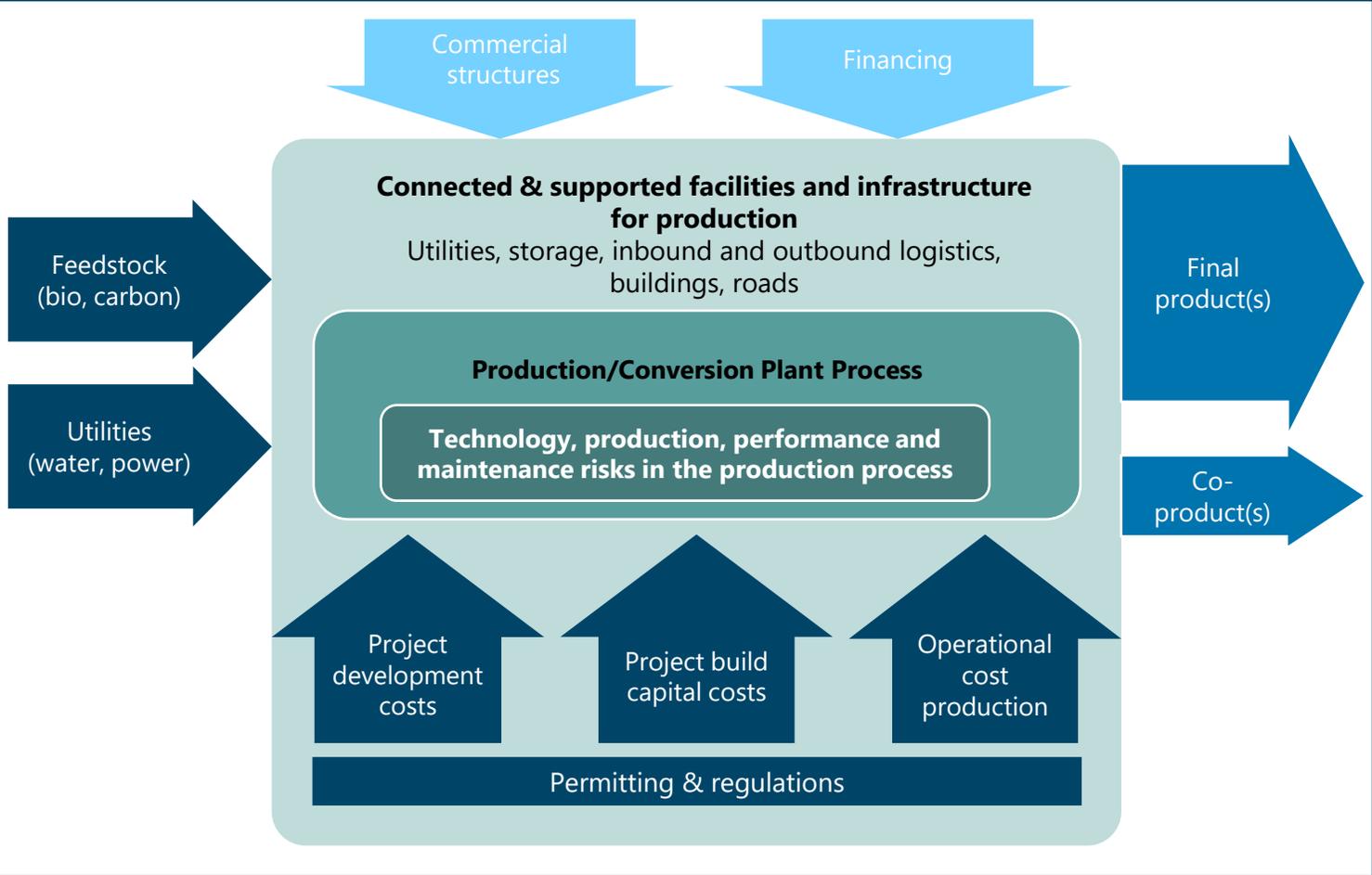
The first green ammonia import contract under the H2Global scheme to Fertiglobe, priced at €1,000/mt delivery FOB in Rotterdam. The ammonia will be produced in Egypt using green hydrogen, powered by solar and wind energy. The contract guarantees minimum annual deliveries of 40,000 mt from 2028, with optional additional volumes up to 33,000 mt/year.



1) Calculations and the ammonia case study are based on the H2Global auction results from Fertiglobe. More details in the appendix

# Investment Case | Zooming in on sustainable fuel production - many different internal & external elements tie into the establishment of such facilities, each have their specific risks, creating a complex investment puzzle

**Investment risks & considerations**  
 Investments are influenced by a high level of uncertainty in external and internal factors on many different elements. The overview below shows the inputs & outputs of a production plant and provides a list of key uncertainties in such projects. These elements and their impact will be further explored in the publication



**Key investment elements and related uncertainties**  
 high level overview of key elements in production investment, adding up to the complete picture.

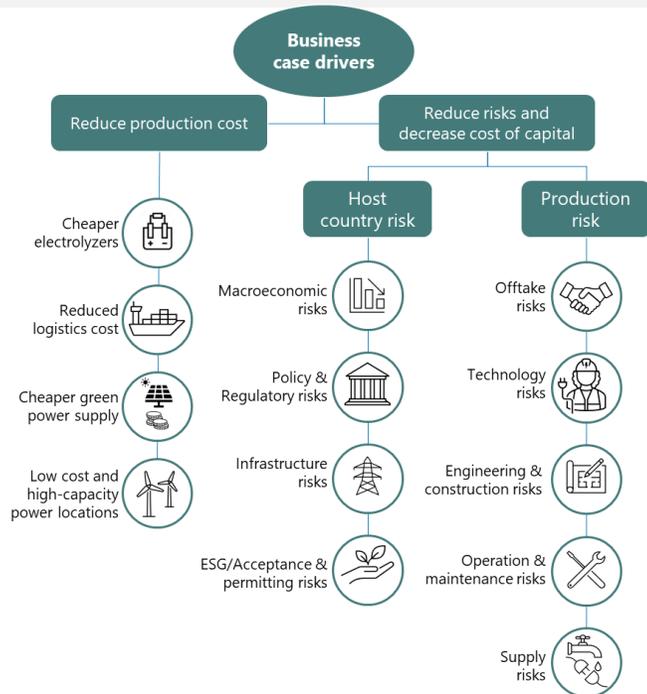
<b>Offtake risk</b>	Lack of offtake contracts and stable market demand for long-term investable demand
<b>Political and regulatory risk</b>	Country risk, mandates, support form and level, limitations and constraints
<b>Infrastructure risk</b>	Access to export infrastructure and utilities or delay in enabling infrastructure
<b>Permitting and compliance risk</b>	Delay in acceptance, land rights, environmental and social permits
<b>Technology risk</b>	Component degradation, defective, underperformance and failure/maintenance risk
<b>Macroeconomic risks</b>	Currency depreciation, inflation and interest rate risk
<b>Design, construction &amp; completion risks</b>	Cost and time overruns Scope misinterpretation
<b>Operational &amp; maintenance risk</b>	Failure to achieve key performance metrics, schedules
<b>Supply risk</b>	Power and feedstock unavailability and price. Non-compliance with renewable taxonomy

# Investment case | Key drivers for sustainable fuel investments are the reduction of technology cost and reducing the cost of capital by lowering offtake, regulatory, infrastructure, permitting, technology and economic risks

## Cost & Risk Reduction Need

**Focus on cutting costs is key for electrolysers, logistics, and renewable power.**

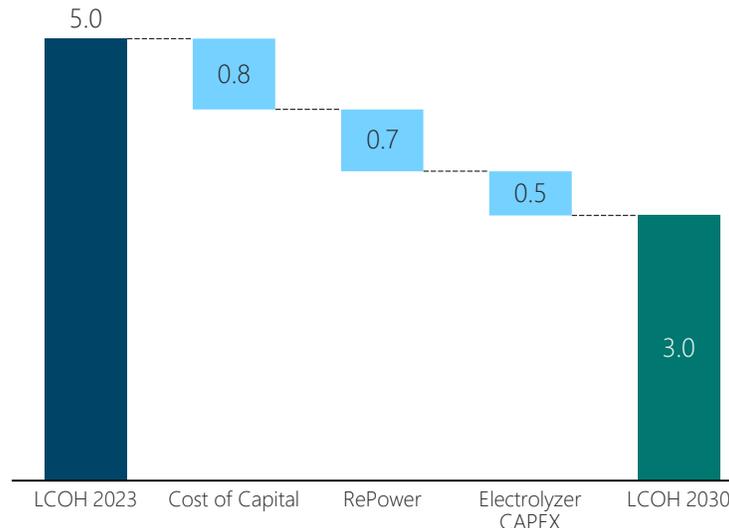
Cost of capital makes up 30–50% of total cost<sup>1</sup>; reducing host-country and green hydrogen project risk can lower this significantly.



## Cost Expectations

**Research shows green hydrogen production costs will drop significantly by 2030** through technology improvements, economies of scale, and optimized renewable energy locations - also lowering the high Cost of Capital. The LCOH is very much depending on the production location and applicable regulatory requirements.

**LCOH cost reduction – Realistic Scenario WB**  
(LCOH (US\$/kgH2))

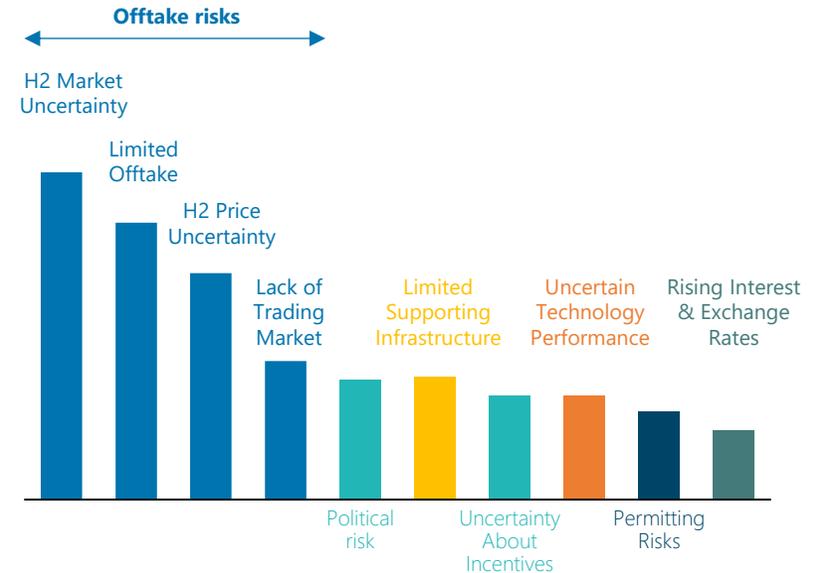


## Risk Categories

**There are 6 categories of risks in priority order<sup>1</sup>:**

- 1) Offtake risks
- 2) Political and regulatory risks
- 3) Infrastructure risks
- 4) Permitting & compliance risks
- 5) Technology risks
- 6) Macroeconomic risks

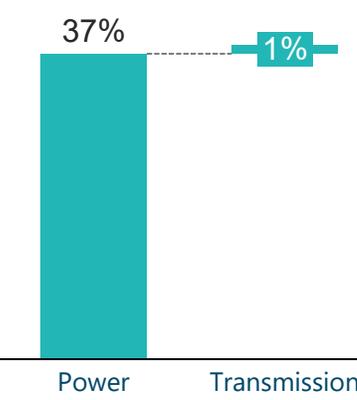
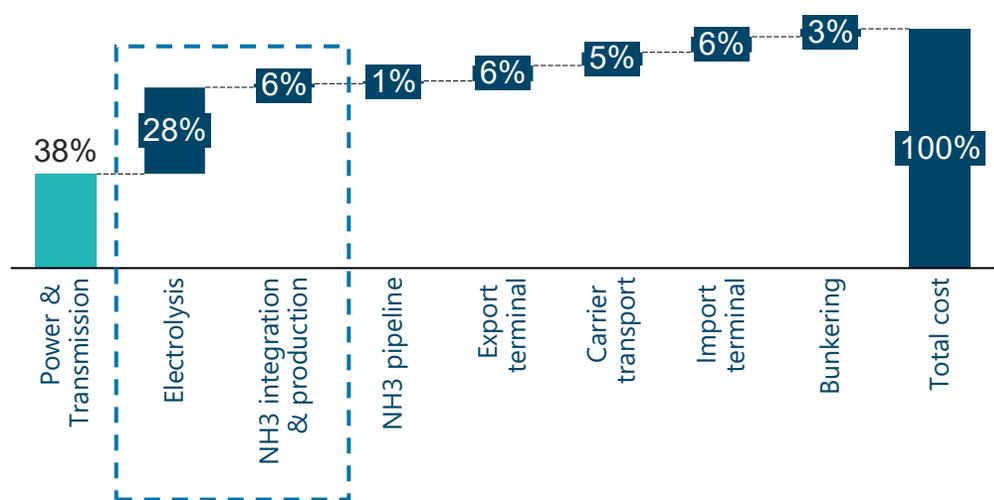
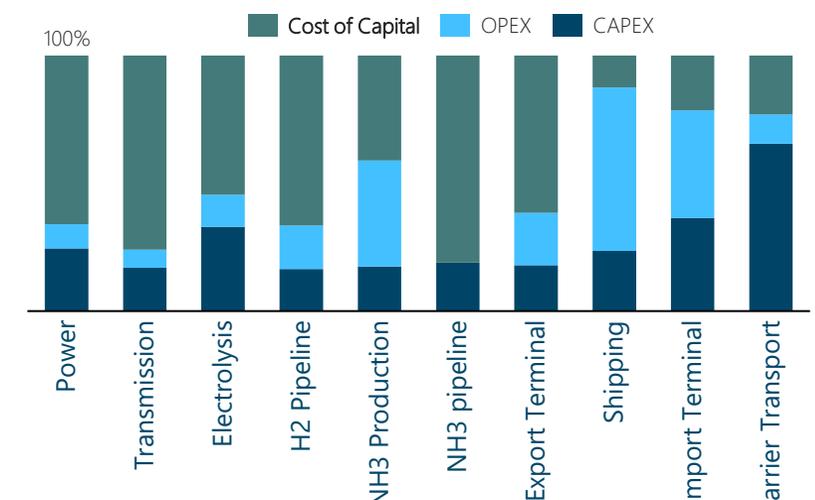
**Mentioned risks factors by industry players**  
(%, source: ESMAP<sup>1</sup>)



1: ESMAP World Bank Study SCALING HYDROGEN FINANCING FOR DEVELOPMENT (February 2024)

# Case study | An initial view on the value chain shows that cost benefit & risk reduction efforts should evolve around power production, electrolysers and the cost of capital when considering a green fuel

We have established a cost-build up for green ammonia based on the H2Gether platform and the H2Global auction results – At a similar price level of € 1,000/mt. This case is used as an example and is very much dependent on the selected fuel, volumes, production location and regulatory requirements

Delivery of Energy	Fuel Production plant	Financial cost & risk
 <p><b>Feedstock</b>   <b>Utilities</b></p>	 <p><b>Development expenditure</b>   <b>Capital expenditure</b>   <b>Operational expenditure</b>   <b>Technology</b></p>	 <p><b>Capital cost</b>   <b>Financing</b></p>
<ul style="list-style-type: none"> <li>The continuous and stable delivery of feedstock and utilities via integrated assets or external suppliers.</li> <li>Large dependency on location and yield of solar, wind, etc.</li> <li>Process efficiency, e.g. minimizing conversion losses</li> </ul> 	<ul style="list-style-type: none"> <li>Investment size ranging between EUR 0.5-1 billion for a long-term operational plant of 30-50 years</li> <li>Operational cost and reinvestment requirements over time. A lot of project risk factors that may increase the cost</li> <li>Cost overruns, delays and operational uncertainties</li> </ul> 	<ul style="list-style-type: none"> <li><b>Significant financial risks lead to high cost of capital, which make up over 2/3 of the cost for key investment items.</b></li> <li>Risk in reaching return requirements – related to country, market and financial risks .</li> <li>A high level of financial cost on top of the cost structure</li> </ul> 

**Case study | e-ammonia production** was taken as a starting point, while many factors are similar, every production pathway has its specific challenges and opportunities as well.

Sustainable fuel specific challenges				
Pathway	E-fuel without carbon	Blue fuels	Bio-fuels	E-fuel with carbon
GDSC fuels	e-ammonia	blue ammonia	bio-methane & bio-methanol	e-methane & e-methanol
<b>Availability</b> Location & Scale	<ul style="list-style-type: none"> <li>Significant time is required for renewable power &amp; grid infrastructure developments, especially in emerging renewable fuel regions</li> <li><b>There are no/limited existing facilities and infrastructure to produce hydrogen</b></li> <li><b>The most efficient, cost-effective and optimal scale of production facilities and supply chains still needs to develop</b></li> </ul> <p><b>Additional infrastructure required for handling of ammonia, building on existing trade</b></p>	<ul style="list-style-type: none"> <li><b>Optimized scale and value chain for blue ammonia is established, using gas-producing regions.</b></li> <li>CO<sub>2</sub> transport/storage networks need to be developed</li> </ul>	<ul style="list-style-type: none"> <li><b>Technology risk is limited because most solutions are proven;</b> e.g. bio-methane projects are generally small-scale.</li> <li><b>For advanced bio-fuels immature production pathways are still challenging.</b></li> <li>Limited feedstock availability, competition with land for food and risk of deforestation require attention.</li> </ul> <p><b>Both methanol &amp; methane are traded globally and can leverage existing infrastructure</b></p>	<ul style="list-style-type: none"> <li>E-fuels with carbon have similar issues as e-fuels without carbon. In addition, biogenic carbon needs to be sourced, which <b>adds supply and integration risks.</b></li> <li>The location becomes dependent on the availability of a biogenic carbon source. This is not necessarily in optimal cost locations for renewable energy.</li> </ul>
<b>Acceptability</b> Fuel specification	<ul style="list-style-type: none"> <li>High dependency on renewable power availability and price.</li> <li><b>Technology risk and need for cost reduction in hydrogen production and transport.</b></li> <li>Safety acceptance of hydrogen carriers is still under development.</li> </ul>	<ul style="list-style-type: none"> <li>In the EU, blue fuels are recognized as a transitional low-carbon fuel for sector-specific targets.</li> <li><b>To qualify as low-carbon, blue fuels must achieve ≥70% emission savings vs. fossil baseline.</b></li> <li>CCS must capture &gt;90% of emissions for viability; current CCS is costly, energy-intensive, and suited to specific plants.</li> </ul>	<ul style="list-style-type: none"> <li>Current sustainability standards may not cover emerging feedstocks, creating compliance uncertainty.</li> <li><b>Uncertainty around long-term regulatory acceptance of certain feedstock increases investment risk.</b></li> </ul> <p><b>Methane specific: as a gaseous fuel, methane can utilize existing gas grids.</b> This only works if mass balance supply chain approaches are accepted. <b>Regulatory complexity adds cost to transporting gaseous fuels.</b></p>	<ul style="list-style-type: none"> <li>These fuels will have similar challenges for renewable power and hydrogen production.</li> <li><b>These fuels have risk on co-locations and integration of different assets (mainly integration with electrolyzers and carbon source)</b></li> </ul>
<b>Affordability</b> Price & cost	<ul style="list-style-type: none"> <li><b>Renewable electricity and electrolysis are costly with relatively immature supply chains and technology.</b></li> <li>It is not financially attractive to use batteries for temporary storage on site and secure continuous supply to the electrolyser for hydrogen production.</li> </ul>	<ul style="list-style-type: none"> <li><b>Blue fuels benefits from low feedstock costs and CCS developments, especially in regions like the Gulf of Mexico.</b></li> <li>Carbon infrastructure develops alongside CCS markets, but CCS adds significant CAPEX and OPEX.</li> </ul>	<ul style="list-style-type: none"> <li><b>Increasingly competitive with fossil fuels, especially under EU ETS.</b></li> <li>Increasing multi-sector demand improves supply developments but could drive up feedstock prices, making biofuel costs high. E.g. aviation is dependent on carbon-based fuels and will compete for supply.</li> </ul>	<ul style="list-style-type: none"> <li><b>There is competition with the CCS-market for supply of carbon, like bio-fuels there is large competition from other markets influencing price &amp; availability.</b></li> <li><b>Availability of CO<sub>2</sub> is challenging, but the main difficulty is to have availability of suitable carbon close to the plant location</b></li> </ul>
Investment case investigated				

# Case study | There are multiple ways to reduce the price and delivery risk of renewable power, ranging from optimized asset ownership & commercial operations to diversification of renewable power with secured delivery.

## Delivery of Renewable Energy

### Influencing factors & challenges

#### Renewable energy cost

- Renewable electricity costs are key to the cost competitiveness of e-fuels, making up 72% of the hydrogen production cost.
- Competitive prices for solar PV have been demonstrated. However, inflation, high interest rates and supply chain congestion have recently increased price levels significantly.
- **Developing scale of cost competitive renewable power with adequate grid infrastructure is essential for marine e-fuel production.**

#### Price stability & Predictability

- A key consideration is the inclusion of the renewable energy supply in the project scope. The benefits are price stability & lower transmission cost
- **Keeping the cost stable and competitive limits the production risk and with that the cost of capital of the total investment.**
- **However, it will demand a higher capex, increases intermittency risks, adds land & permitting complexity and technical integration risks.**
- Projects may also miss out on cheaper grid electricity and lack flexibility.

#### Energy availability & security

- **The continuous & stable delivery of feedstock & utilities and resilient logistics is essential.**
- For a production facility it can be beneficial to have power production in your own hands to secure delivery certainty, improved carbon accounting, operational synergies, strategic independence and feedstock flexibility.
- Distance from production to the power source adds to the cost: 100km of added distance could add around 1% in the total levelized cost of energy.

### Risk mitigation & solutions

- 1. Alternatives for renewable power development:** Split the renewable investment and/or the ownership/operating model from fuel production. This can be split within the company/consortium itself or by a third-party. This will reduce operational and investment risk and can optimize grid capacity, power supply stable delivery and prices.
- 2. Co-location:** Partnerships to share renewable energy production to increase scale, reduce risk and improve the business case. E.g. to balance out or sell excessive supply to others.
- 3. Hybrid renewable energy solution:** Alternatively, develop on-site renewables for base load while supplementing with grid electricity during low-price periods.
- 4. Power Purchase Agreements (PPAs):** Firm the business case with PPAs for production and external supply. Tailored PPAs with price bandwidths or hybrid PPAs that combine several renewable technology resources in one PPA.
- 5. Offtake diversification:** Renewable production could be optimized by looking at different offtakers within the vicinity of production site
- 6. Infrastructure accessibility:** Consider presence and accessibility of fundamental infrastructure, including electrical grids and transportation networks. These reduce project capital requirements and enhance economic viability.
- 7. Replicable project designs:** Key success factors for optimal site selection, project designs, and best practices for grid infrastructure should be scaled to similar projects. Experience from one project informs others and helps to create economies of scale.
- 8. Include storage facilities:** Storage close to the production facility can drive up the investments but could create a buffer to counter availability and price risks and enable peakshaving (e.g. batteries or hydrogen storage)

Development optimization

Commercial optimization

Project optimization

**Case study |** Reducing cost and risk depends on reducing electrolyser cost, increasing scale and optimising design & building. Centralized approvals, industry best practices and public financial tools would support this.

## Fuel Production plant

### Influencing factors & challenges

#### Electrolyser cost

- Electrolyzers at \$500/kW by 2030 could enable green hydrogen at \$2/kg, assuming additional renewable power costs of \$0.02/kWh.
- Cost reductions depend on stack optimization, plant scaling, standardization, and industry-specific customization.
- **Production improvements require standards, advanced technology, and reduced reliance on critical raw materials.**

#### Project development risk

- Renewable fuel plants face high development, investment, and operational costs, with risks from underperformance, equipment degradation, and system integration failures due to limited GW-scale experience.
- **Typical small to medium size investments run over €1 billion for a 30–50-year operational plant, plus substantial opex and reinvestment. Risks include design overruns, delays, and operational uncertainties.**

#### Scale & Offtake

- Realizing economies of scale through production optimization and automation boosts production rates and cost savings.
- **Offtake certainty and pricing stability are critical for large-scale development in immature markets. Public players must drive innovation and reduce risk.**

### Risk mitigation & solutions

- 9. Trusted technology suppliers:** Select reputable and financially stable technology providers to minimize risks of unfulfilled guarantees.
- 10. Centralized approval processes:** Governments can develop one-stop-shops to streamline permitting and approval procedures, reducing time and complexity.
- 11. Ensure timely availability mid-stream infrastructure:** Address uncertainty from limited/absent infrastructure (pipelines, ports) and permitting delays, which increase CAPEX and risks.
- 12. Regulatory clarity & long-term guarantees:** Ensure clear and fully implemented regulation including (state-backed) mandates (e.g., FuelEU, IMO, REDIII) to reduce market hesitation and create a secure investment climate.
- 13. Hydrogen hub development:** Support public-private partnerships for hub development to connect producers, consumers, and infrastructure, reducing costs and risks.
- 14. Long-term Sales Purchase Agreements (SPAs):** Secure predictable revenue through long-term SPAs with reliable buyers, preferably under take-or-pay models.
- 15. Intermediary demand aggregators:** Use intermediaries to aggregate demand via long-term offtake while selling energy in short market cycles, bridging producers and buyers.

#### Intermediary demand aggregators - Double auction mechanism – H2Global

The H2Global double-sided auction removes risk and provides certainty by signing long-term purchase contracts for sustainable fuels at fixed prices with suppliers, while short-term sales agreements are signed with offtakers. On both sides competitive auctions are used to nominate the best price. The difference between purchase and sales prices is covered by public funding to bridge the market gap.

Project optimization

Enabling Environment

Commercial optimization

**Case study | Cost of capital ranges between 30 to 50% on sustainable fuel projects due to high risk associated with these investments. The combined use of public and private financial instrument during project development stages reduces the Cost of Capital significantly. Political guarantees & regulatory certainty further push investor confidence.**

## Cost of Capital

### Influencing factors & challenges

#### Economic risks

- **Research shows risks are significant leading to a high cost of capital which range between 30 to 50% on these projects.**
- Important risks evolve around the economic risk factors like: market, country, regulatory, investment climate, credit and liquidity risks.
- Development finance institutions have a strategic role to play in developing sustainable economies. Together with governments they are vital in creating an enabling climate with low macro-economic risk

#### Commercial risks

- In early stages of maturity there is a significant level of commercial risk in terms of demand uncertainty, price volatility, supply chain and infrastructure risks which translate to high financial cost
- **Only through application of dedicated risk mitigation mechanisms the large-scale clean fuel projects can achieve financial viability**

#### Financial risks

- **Utilizing financial instruments that both help project reducing project specific risk combined with government incentives and guarantees to improve the investment viability is essential in this stage.**
- Implementing cost-effective and efficient de-risking mechanisms could greatly decrease the cost of capital and improves investment viability.

### Risk mitigation & solutions

16. **Dedicated development funds:** A lot of MDBs, national development & investment banks have mobilized financial resources supporting pre-feasibility and feasibility studies.
17. **Guarantees and support:** Development banks and Export Credit Agencies offer guarantees for country risks, provide development capital, bankability support and pilot financing
18. **Government-Supported CfDs:** Contracts for Difference guarantee a fixed strike price and compensate for market price differences, reducing price risk and ensuring income stability.
19. **Unlocking voluntary markets:** The Zero Emission Maritime Buyers Alliance (ZEMBA) is a good example where cargo owners collectively tender for sustainable transport.
20. **Partial credit guarantees:** Instruments from multilaterals that protect commercial lenders against all risks during a specific financing period.
21. **Political risk insurance:** Protects projects from country-specific political and legal actions, covering risks like expropriation, war, civil unrest, and currency restrictions.
22. **Cost overrun guarantees:** Third-party commitment to cover costs exceeding the agreed project budget, reducing financial risk for investors and lenders.
23. **Performance guarantees & insurance:** Manufacturers provide guarantees and insurance for product quality, performance, and availability to mitigate risks of underperformance.
24. **Liquidity accounts:** Multilateral or development banks set up accounts to cover payment disruptions caused by technical failures or missed performance targets.
25. **Currency & interest rate risk mitigation:** Use FX hedging (swaps) to manage currency volatility and interest rate swaps or fixed-rate loans to protect against rising rates.

#### MDBs - World Bank example

The World Bank secured the support of 15 development financing partners and mapped an overview of available financing and risk mitigation instruments by participating institution.

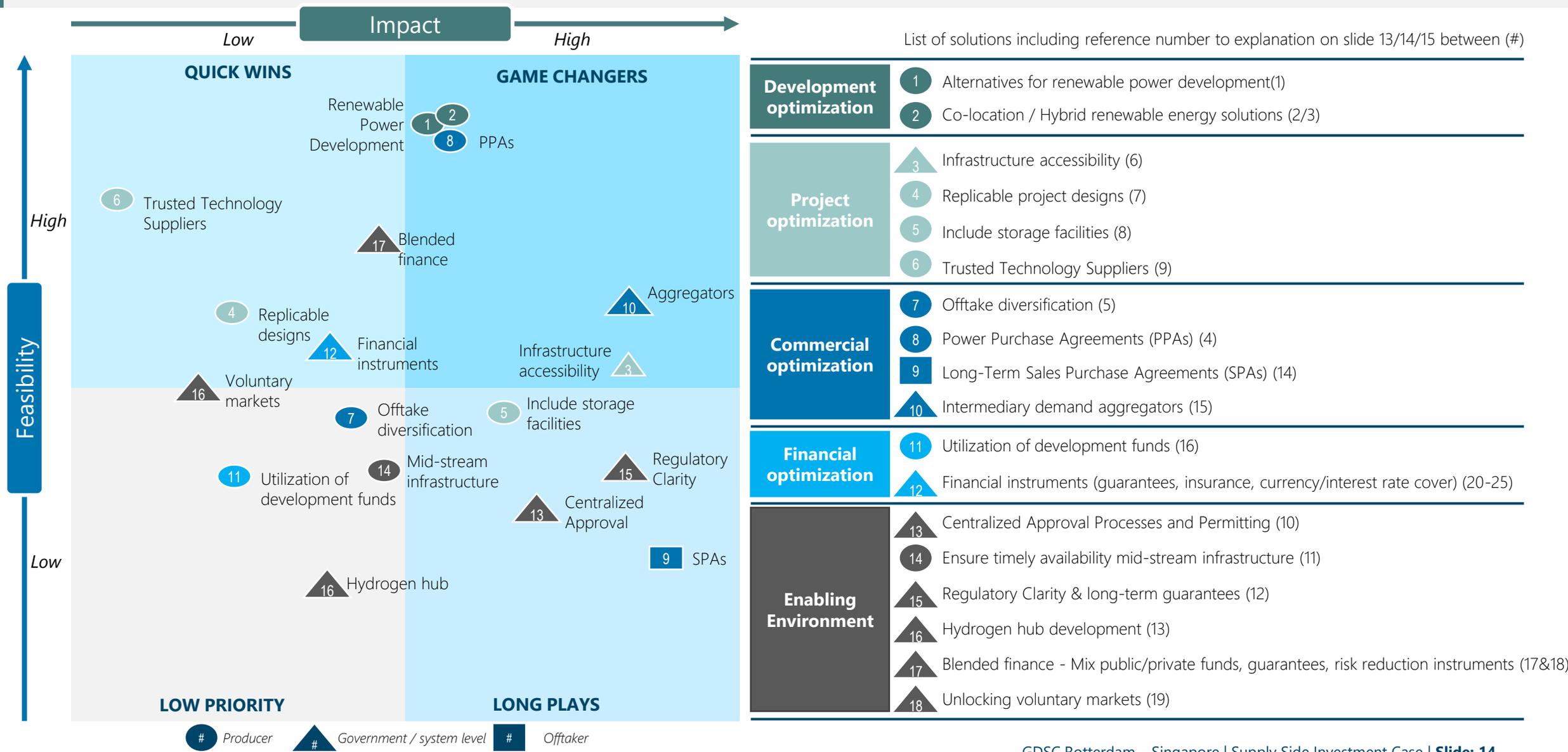
#### Invest International (Netherlands)

- Provides guarantees to reduce country risk
- Offers development capital to project developers
- Equity and debt for project implementation
- Grants to EMDC governments for public infra

Enabling Environment

Financial Optimization

# Solutions | A first glance at the solutions shows there are quick wins to optimise projects and the use of offered financial instruments. Game changers require public players to provide financial, regulatory and permit backing.



**Recommendations** | Action can be taken jointly by industry and public stakeholders to eliminate inefficiencies, develop best practices and reduce risk. The GDSC will support and drive the maritime sector to early commercialisation.

*Each fuel has its own dynamics, level of maturity and risk profile, and requires a different type of support. Bio-fuels are more mature and need more effort on feedstock availability and fuel acceptance. E-fuels need a push towards early commercialisation and market-making and therefore calls for incentives to bring down cost and risks to scale production against competitive price levels.*

### ADDRESS INEFFICIENCIES

- 1 Electrolyser technology and component innovation, cost reduction and reliability & efficiency increase
- 2 Supply chain efficiency and reliability
- 3 Further development and harmonization of technological and bunkering standards

#### Green and Digital Shipping Corridor role:

- ✓ Support technology, certification and port readiness

### REDUCE FINANCIAL RISK

- 1 Increased awareness of available financial instrument and development funds and smart combination of possibilities
- 2 Cost gap support – intermediary competitive double auction bidding mechanism under EUs STIP and combinations with international frameworks
- 3 Regulatory Clarity & Government Policy Guarantees (e.g. IMO Net-Zero Framework and EU Maritime GHG regulations)

#### Green and Digital Shipping Corridor role:

- ✓ Develop and support financial options, push policy & regulatory drivers

### RAISE INDUSTRY DEVELOPMENT

- 1 Development of best practices and industry standards for designs, permitting, contracting
- 2 Stimulation of innovation and new (small) technology players
- 3 Development of renewable power capacity, transmission and enabling infrastructure for sustainable marine fuels

#### Green and Digital Shipping Corridor role:

- ✓ Foster value chain collaboration and stakeholder awareness

### SCALE OFFTAKE

- 1 Stimulate and mobilize diversified offtakers and purchase agreement options to firm demand
- 2 Develop projects for demand aggregation across sectors
- 3 Pilots for and development of a spot market, stimulated in early maturity phases with public support

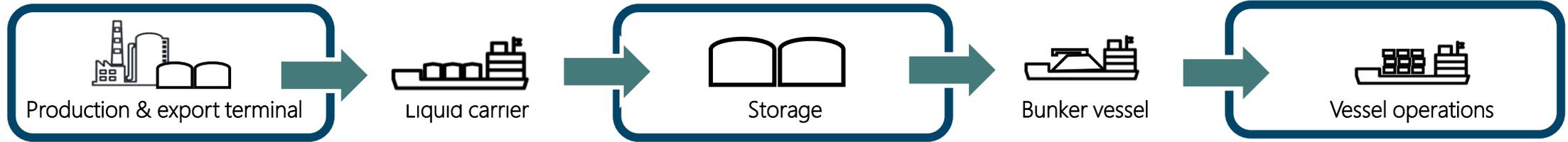
#### Green and Digital Shipping Corridor role:

- ✓ Mobilising demand amongst partners and industry players



# Ammonia Case | Our case is based on developing a green ammonia supply chain from production in Egypt to bunkering in Rotterdam before setting sail to Singapore, for which we have detailed requirements and cost.

The first green ammonia import contract under the H2Global scheme to Fertiglobe, priced at €1,000/mt, with deliveries starting in 2027 and totaling up to 397,000 mt by 2033. The ammonia will be produced in Egypt using green hydrogen, powered by solar and wind energy, and supported by a consortium including Fertiglobe and Egypt's Sovereign Fund. The contract guarantees minimum annual deliveries of 40,000 mt from 2028, with optional volumes up to 33,000 mt/year. Germany allocated €900 million across three initial tenders. Hintco, the intermediary, will manage procurement and resale through competitive tenders, aiming to mobilize private investment.



<b>Location</b>	Country with competitive H2 production cost levels: Egypt	Transport route Egypt - Rotterdam	Import and storage at the Port of Rotterdam	Bunkering at the Port of Rotterdam	GDSC trade lane to Port of Singapore
<b>Infrastructure</b>	Hydrogen infrastructure in the port Ammonia production plant Export facility	Ammonia gas carrier	Import & storage facilities	Fuelling facility & ship2ship bunker vessel	Fuel on board the vessel, no infrastructure required for this case at MPA
<b>Volume</b>	Early days: 100 ktpa Average project size: 250 ktpa	Medium Gas Carrier 30 kt/vessel	Capacity assumption: 1.2 mtpa Expansion: 3 million tons per year	Bunker volume: Total and per call Bunker frequency Bunker vessel: 10 kt/vessel	50,000 – 60,000 ton per vessel Bunkering requirements on route
<b>Investment</b>	CAPEX & OPEX for feedstock and production facility	CAPEX: Vessel investment OPEX: Operational cost vessel	CAPEX & OPEX storage facility and connectivity infrastructure	Bunker vessel and related investments: EUR 50-75 mln	(Extra) Vessel investment/conversion cost: EUR 10-20 million
<b>Cost</b>	<b>Cost of fuel production: 80 – 85%</b>	<b>Cost of export terminal – freight – import terminal and storage: 15 – 18%</b>		<b>Bunker facilities &amp; cost: 1-2%</b>	<b>Total fuel cost: 100%</b>
<p style="text-align: center;">Fuel production cost + fuel transport and storage cost + barging fees + port charges/dues + bunker adjustment factor + taxes/surcharges</p>					