In Collaboration with
Oliver Wyman

World Economic Forum

Financing the Transition to a Net-Zero Future

INSIGHT REPORT

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Contents

Foreword

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The world stands at a crossroads: as the global economy emerges from the pandemic-driven economic crisis, humanity can choose to uphold the status quo or resolve to "build back better", transforming existing structures to promote growth in alignment with long-term sustainability objectives, including targets established by the Paris Agreement on climate change. Short of demonstrating concerted and rapid action to countervail the climate crisis, humanity will be confronted with a global disaster, crushing our planet and its complex biosphere, with life altering implications for humankind.

To tackle the crisis, public and private stakeholders have announced ambitious pledges to reduce greenhouse gas emissions. In parallel, technological advances, such as the expansion of renewable energy and the exploration of hydrogen, are increasing the attainability of a net-zero future. The proliferation of climate-related social movements around the world is further energizing individuals, institutions and nations to commit to net zero.

Nevertheless, the progress made to date is not sufficient. The Intergovernmental Panel on Climate Change (IPCC) report released in August, entitled *Climate Change 2021: The Physical Science Basis*, reveals an alarming reality: the globe is nearly 1° Celsius warmer than at any point in time in the past 2,000 years, with total warming expected to increase beyond 1.5°C by 2040. To limit global warming to 1.5°C, innovative and bold solutions enabling industrial decarbonization are required. They are a prerequisite to allow the elimination of the final 40% approximately of global emissions. This raises the question of what is preventing these solutions from being deployed in the near future. A few critical drivers provide an answer:

– Several solutions required for industrial decarbonization are early-stage technologies (e.g. green ammonia for shipping) and require expansion through capital flows and thoughtful deployment.

– While a significant amount of capital is flowing into climate solutions (e.g. renewable energy), it appears that on the critical issue of financing technologies that will solve industrial decarbonization, the financing system will not deliver as things stand.

– Since the issue is one of market failure, it will not be resolved by the actions of individual stakeholders alone; instead a mechanism is needed for different stakeholders to co-design solutions and coordinate climate action.

– A targeted analysis of specific decarbonization technologies shows that some of the technologies being relied upon to deliver industrial decarbonization are not likely to be financeable in the next decade without a significant combination of green surcharges, carbon taxes or public incentives.

– The private sector has a key role to play but its efforts will need to be urgently complemented by public-sector intervention, in particular through multilateral development banks as anchor investors.

The *Financing the Transition to a Net-Zero Future* initiative of the World Economic Forum, in collaboration with Oliver Wyman, was launched in 2020 to accelerate the mobilization of capital towards these early-stage decarbonization technologies. The initiative has engaged a multistakeholder community of financiers, industry stakeholders, philanthropists and public institutions to analyse specific technologies in the steel, aviation and shipping sectors to develop particular mechanisms for the different stakeholders to co-design solutions and identify policy interventions necessary to mobilize private capital.

In this critical moment in the fight against climate change, we are grateful for the support and contributions of the financial sector and development finance community, and our industry collaborators from the Mission Possible Partnership (MPP). We hope to continue this dialogue at COP26, and beyond.

Executive summary

A multifold increase in private capital flows is needed to deploy, validate and expand critical breakthrough technologies in the next decade.

Individual stakeholder action will not solve the potential market failures, resulting in significant investment gaps. The co-design of solutions focused on innovative financing approaches, new ways of doing business and de-risking measures are necessary. Today, mechanisms required to bring together stakeholders across the ecosystem to collaboratively co-design solutions do not exist structurally. Mechanisms allowing collective action are the need of the hour.

Approximately $50 trillion in incremental investments is required by 2050 to transition the global economy to net-zero emissions and avert a climate catastrophe.[1] Much of the emissions abatement pre-2030 will be driven by existing technologies (e.g. solar), but post-2030 abatement relies on breakthrough technologies, such as energy efficiency solutions, hydrogen-based fuels, bioenergy and carbon capture/utilization/storage solutions, among others. A prerequisite to the successful expansion and deployment in the 2030s is validation of these breakthrough technologies at commercial scale in the 2020s. Significant capital needs to be steered for the timely industrial decarbonization of hard-to-abate sectors and a global energy transition.

Several technologies are not yet competitive with their greenhouse-gas-emitting alternatives and are in the early stages of development. They typically experience a market failure called "valley of death", characterized as "an inability of businesses to secure financing for the initial commercial-scale deployment" of projects and assets.[2] Furthermore, investments in these technologies can be capital intensive and high risk, which will result in a global financing shortfall, as things stand.

The widespread consensus is that the climate crisis cannot be solved by public capital alone. A successful and sustainable transition requires the mobilization of private capital. While the global financial community is rising to this challenge, an investment gap remains due to supply- and demand-side finance issues. On the supply side, firms, especially non-investment grade counterparties, looking to deploy breakthrough technologies have highlighted difficulties in securing affordable financing. Capital is either too expensive, short-dated or not flowing sufficiently. This is driven by a mismatch of financier risk appetite and inadequate de-risking. On the demand side, investors flag the lack of "bankable" opportunities and a limited pipeline. These issues are further exacerbated by policy/regulatory uncertainty, limited clarity and granularity on transition pathways and a lack of data to inform decisions and track progress.

This report discusses three fundamental findings that help overcome key challenges by solving for increased bankability through replicable blueprints and collective action.

1. **The innovative blending of capital supported by an enabling ecosystem** is needed, where different sources of public and private capital are brought together in technology-specific financing blueprints. To do this effectively, mechanisms that activate collaboration among multiple stakeholders are necessary.

2. **Transformative business models** are essential, where industry participants and capital providers work together to establish new contracts and ways of doing business to increase the probability of commercial success. Transformation can be achieved through measures to stimulate demand and establish reliable, scalable supply.

3. **Targeted public intervention** is critical**,** focused on the design of incentive schemes rewarding early movers adopting innovative technological solutions and de-risking schemes to mitigate investment risks unique to these innovative solutions.

The innovative blending of capital: Sophisticated capital structures, which blend different sources of public and private capital, are necessary to close the investment gap for the deployment of breakthrough technologies. These will allow financing to be offered, consistent with stakeholder investment frameworks and risk appetite. Overall, a far more strategic approach to risk allocation is necessary for innovative solutions than for conventional projects. A prerequisite to this collaborative financing approach is activation of involvement from various stakeholders in the transition finance ecosystem. Such collective action

can be achieved through coordination by anchor investors. Multilateral development banks are best positioned to play this role but will need to work with the private sector to establish specific solutions and structure bankable opportunities.

Transformative business models: Mechanisms to allow businesses to establish bankable projects are the need of the hour. Businesses should look to identify key performance drivers, sometimes in partnership with capital providers to better commercialize operations based on breakthrough technologies, and reduce the costs of innovation, and as a result unlock greater flows of capital. This involves identifying the greatest innovation and investment risks and subsequently new ways of doing business to improve underlying cash flows. Companies will be required to introduce demand- and supply-side contracts (e.g. offtake agreements, tolling structures, availability-based payments, feedstock guarantees), in some sectors moving away from spot pricing, and in general identify mechanisms that allow systemic replication of commercial success. Business models will need to also proactively de-risk the greatest areas of innovation risk, co-developing solutions with stakeholders across the climate ecosystem.

Targeted public intervention: The need to offer incentives for early movers, significantly de-risk investments in innovative solutions and establish clear policy signals is urgent. Four thematic enablers can support progress on this front:

A. *Improve the risk-return profile of breakthrough decarbonization projects,* by offering predictable, adequate and long-dated incentives and de-risking measures.

B. *Coalesce a multistakeholder ecosystem for collective action,* catalysing diverse sources of public and private capital through enhanced investment frameworks and strategic risk allocation/sharing, with multilateral development banks playing the anchor investor role.

C. *Establish clear pathways, standards and mandates globally,* to focus efforts on the most impactful climate solutions, mitigate the risk of stranded assets, avoid financiers having to pick "winners and losers" and ensure a level-playing field with consistent schemes and mandates.

D. *Design away perverse incentives and outcomes,* where policies/regulatory activities may unintentionally divert capital away from the "greening" of hard-to-abate sectors and/or emerging markets and developing countries.

While the transition will likely be complex, there is a real appetite from industry for thoughtful partnership and for collaboration between private and public capital providers. It is mission critical to capitalize upon this appetite immediately through meaningful, structural action. By proposing an initial set of financing approaches and de-risking solutions, this report seeks to initiate an important discussion on how to rapidly accelerate the deployment of capital towards breakthrough technologies.

1 The transition finance challenge

Emissions abatement post-2030 primarily relies on breakthrough technologies. These need to be tested and validated at commercial scale in the coming decade.

Mobilizing capital towards breakthrough technologies for industrial decarbonization at the scale and speed needed will require new ways of doing business.

As things stand, the financial sector is not likely to deliver the radical increase in investment required in the next few years towards these innovative solutions. Several barriers exist, driven by demand- and supply-side financing issues. This will likely lead to significant investment gaps and a subsequent market failure to deliver net zero.

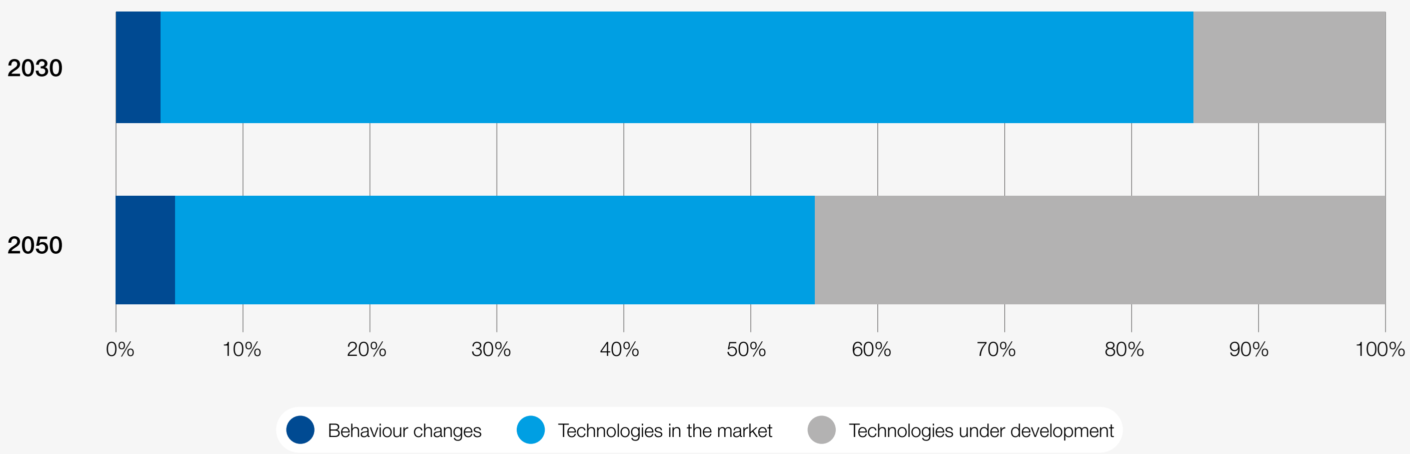
The year 2021 is expected to be a milestone in the global fight against climate change, with tremendous momentum ahead of the United Nations Climate Change Conference (COP26) in Glasgow. A total of 193 countries have adopted the Sustainable Development Goals (SDGs)[3] and 192 countries have submitted nationally determined contributions outlining planned climate actions and ambitions.[4] In parallel, national net-zero commitments are being strengthened through targeted regulation; in July 2020, the European Commission adopted legislative proposals outlining the path to EU climate neutrality by 2050, with an intermediate target of a 55% reduction in emissions by 2030.[5]

Still, the progress made to date and current trajectories are not enough to achieve the target of the Paris Agreement on climate change of limiting global warming to 1.5°C. To avert a catastrophic climate disaster, more needs to be done to aid industrial decarbonization. Global clean energy investments of approximately $4-5 trillion are required annually by 2030 – more than three times the current rate.[6]

To solve the transition challenge, breakthrough technologies are required for both energy transition and industrial decarbonization. Technologies that are currently under development will be responsible for over 40% of global greenhouse gas (GHG) emission reductions in 2050 (Figure 1). Industrial decarbonization requires new, innovative technologies, such as carbon capture and storage (CCS), green hydrogen, sustainable aviation fuels (SAF) and green ammonia, among others. However, several technologies are not yet mature or competitive with their GHG emitting alternatives and are typically in the early stages of development and validation. In the lead up to the Paris Climate Conference in 2015, the focus was on estimating the R&D need across sectors and technologies. Through successful venture funding, these technologies have moved past the early R&D stage but are not yet mature enough for market-based funding. Capital to support their commercial-scale deployment and testing is urgently required.

FIGURE 1

Attribution of CO_2 emissions reduction to select pathways in the International Energy Agency's Net Zero by 2050 scenario



Source: International Energy Agency, *Net Zero by 2050*, 2021, p. 16.

Humanity can ill afford to wait for the innovation and financing ecosystem around industrial decarbonization to develop naturally. The successes of renewable energy must be replicated, such as solar and wind, in five years instead of 30. Mobilizing capital towards breakthrough technologies for industrial decarbonization at the scale and speed needed will require new ways of doing business. Innovative financing mechanisms backed by risk capital, strategic project structuring and collaboration with corporates are necessary to move these technologies on the technology readiness curve. As Bill Gates' notes, "*to accelerate the virtuous cycle of innovation, we need a new model for financing, producing, and buying new clean-energy technology*".[7]

The *Financing the Transition to a Net-Zero Future* initiative, a collaboration between the World Economic Forum and Oliver Wyman, was launched in 2020 to begin identifying solutions that would accelerate financing towards innovative breakthrough technologies in key hard-to-abate sectors.

This initiative engages over 50 leading financial institutions, including banks, insurers, multilateral development banks (MDBs), development finance institutions (DFIs) and asset owners/managers. The initiative sits within the Mission Possible Partnership (MPP) Finance Hub and relies on industry collaboration through its sector verticals.

This report, an interim output of the initiative, seeks to start a dialogue on the solutions and mechanisms necessary to steer capital to breakthrough technologies. It focuses on four sector-technology pairs:

- *Aviation:* Sustainable aviation fuel via gasification/ Fischer-Tropsch (GAS-FT)
- *Steel:* Carbon capture and storage (CCS)
- *Steel:* Hydrogen-based direct reduced iron (H2-DRI)
- *Shipping:* Ammonia-powered ship

These pairs have been prioritized to curate a mix of technologies in high-impact sectors to yield cross-cutting insights. More broadly, these insights are based on input gathered from the following sources:

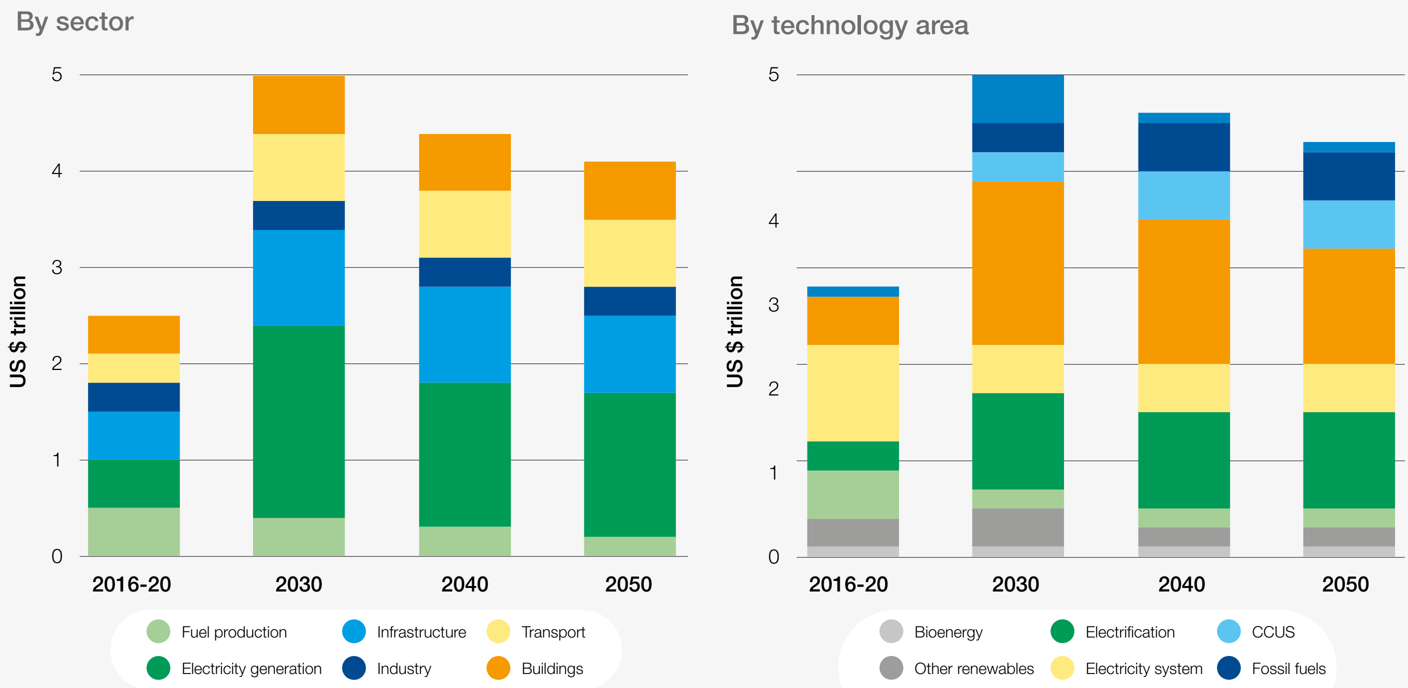
- 10 workshops with corporates from hard-to-abate sectors
- 20 workshops with public and private capital providers
- Several bilateral meetings with the financial sector, MDBs and corporates

1.1 The growing need for transition finance

Scale and nature of the challenge

In the transition to net zero, sectors will transition at different speeds. Heavy industry and heavy-duty transport comprise 25% of global CO_2 emissions, a share that could double by 2050.[8] These sectors face uniquely difficult journeys to net zero, given the early-stage nature of replacement technologies and the high cost associated with replacing existing assets and processes. They require massive capital investments to scale up breakthrough products and processes to a point where they can effectively compete against existing high-emission alternatives (Figure 2). Projects within these sectors will be characterized by high operating expenses, given expensive production inputs (e.g. hydrogen), and are likely to require significant financing for capital and operating expenditures. These realities combined with unmitigated technology and performance risks create a unique investment challenge.

FIGURE 2 **Annual average capital investment in the Net Zero by 2050 scenario (in $ trillion)**



Note: CCUS: carbon capture, utilization and storage.
Source: International Energy Agency, *Net Zero by 2050*, 2021, p. 81.

Public support through mechanisms such as partially enable a level playing field between green and brown technologies. Policy-maker support in establishing a market pricing mechanism, such as the carbon border adjustment mechanism (CBAM), will help inject capital into the structure of these opportunities as producers begin pricing in carbon costs and externalities.[9] However, without a global adjustment mechanism and further technological maturity, breakthrough technologies will not be competitive based on carbon valuation alone. In target state, global carbon markets and a material price on carbon will better align incentives. In their absence, other interim mechanisms must be leveraged to catalyse private finance rapidly to progress breakthrough technologies.

Investment opportunity across in-scope sectors

Across the in-scope sectors of steel, aviation and shipping, rapid advances in the development of technologies have created meaningful paths towards net zero (Figure 3). These sectors collectively account for up to 15% of annual CO_2 emissions.[10] The scale of transition necessary across these sectors is immense, which creates an annual investment opportunity of $0.8 trillion to $1.1 trillion.[11]

FIGURE 3 **Selected transition pathways towards net zero for in-scope sectors**

Steel	Hydrogen-Based Direct Reduced Iron (H2-DRI)	Use of pure hydrogen in place of methane/syngas as the reductant in the production of Direct Reduced Iron
Steel	Carbon Capture and Storage or Use (CCS / CCU)	Capture and store CO_2 before releasing into atmosphere or capture and recycle CO_2 for further use
Steel	Biomass Use	Use of charcoal instead of fuel as a feedstock in Furnace-Basic Oxygen Furnace (BF-BOF) production
Steel	Electrolysis	Reduce iron ore via direct electrolysis
Aviation	Carbon Offsetting	Transitional solution, allows passengers and airlines to invest in carbon reduction projects through additional fees
Aviation	Electric and Hydrogen Fuel Cell (HFC) Aviation	Aircraft powered by electricity, potentially produced through fuel cells combining hydrogen with oxygen from the air to generate electricity
Aviation	Sustainable Aviation Fuel (SAF)	Fuel produced from renewable sources (e.g., agricultural residue, recycled carbon, used cooking oils)
Shipping	Biofuels	Carrier powered by biofuel tank or internal combustion engine
Shipping	Ammonia	Carrier powered by ammonia, produced with zero-carbon hydrogen

Focus of report

Source: World Economic Forum and Oliver Wyman with input from the Mission Possible Partnership.

1.2 An observed increase in capital flows

Ambition and scale of capital flows

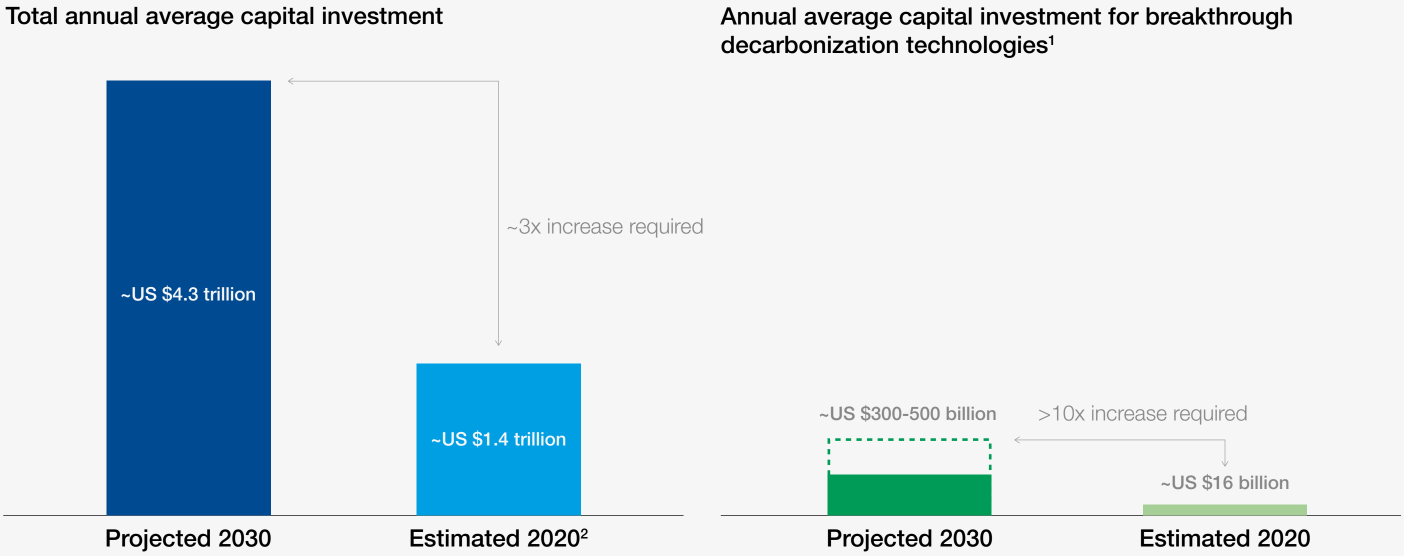
> **While the upward trajectory in capital flows is encouraging, the target both on the scale and coverage of investment is not being met.**

In April, President Biden convened a landmark *Leaders' Summit on Climate* with a pledge "to launch an international climate finance plan to help underwrite the transition to a decarbonized global economy".[12] The United Nations Secretary-General emphasized that to "build a truly global net-zero coalition, we need a breakthrough on finance".[13] These developments send a clear message: *finance has a critical role to play in developing a sustainable global economy*.

The financial community is rising to this challenge. In recent years, a step change has occurred in the community's ambition on sustainable finance and responsible investing. Sustainable lending totalled $321.4 billion in the first half of 2021, setting a first half all-time record. According to Bloomberg data, in 2020, despite the pandemic, global flows towards energy transition investments totalled approximately $501 billion. In the first half of 2021, about $552 billion in sustainable finance bonds were issued, a 76% increase.[14] In parallel, momentum across the financial community is also being built through ambitious commitments on net zero. Leading MDBs made significant pledges to climate aligned and transition finance opportunities with eight institutions committing at least $66 billion in climate financing commitments.[15] Across the private sector, more than 250 institutions representing over $80 trillion in assets under management have committed to align portfolios with net-zero pathways by 2050 through the Glasgow Financial Alliance for Net Zero. These commitments are across the spectrum of private capital providers, including banks, asset owners and asset managers, with sub-sector alliances, such as the Net-Zero Banking Alliance, Net-Zero Asset Owner Alliance, Net-Zero Asset Managers initiative, Net-Zero Insurance Alliance and Paris Aligned Investment Initiative, among others. Appetite and interest across the financial sector exist and need to be harnessed.

While the upward trajectory in capital flows to climate-aligned, breakthrough opportunities is encouraging, the target both on scale and coverage of investment is not being met. Global investment in breakthrough technologies such as CCS and hydrogen is in the low billions. These capital flows are highly skewed by a handful of large deals and are not reflective of breakthrough technologies being financed and deployed at scale. Investments in critical decarbonization solutions, specifically carbon capture, utilization and storage, hydrogen and bioenergy, totalled only about $16 billion in 2020.[16] While it took a decade to double global energy transition investments from $235 billion in 2010 to $500 billion in 2020,[17] investments in these critical breakthrough technologies must grow more than multifold in the next decade (Figure 4). To address the highly likely investment gap, immediate market-wide stakeholder action backed by enabling public policies is the need of the hour.

FIGURE 4 **Investment needs in the International Energy Agency's Net Zero by 2050 scenario and current levels**



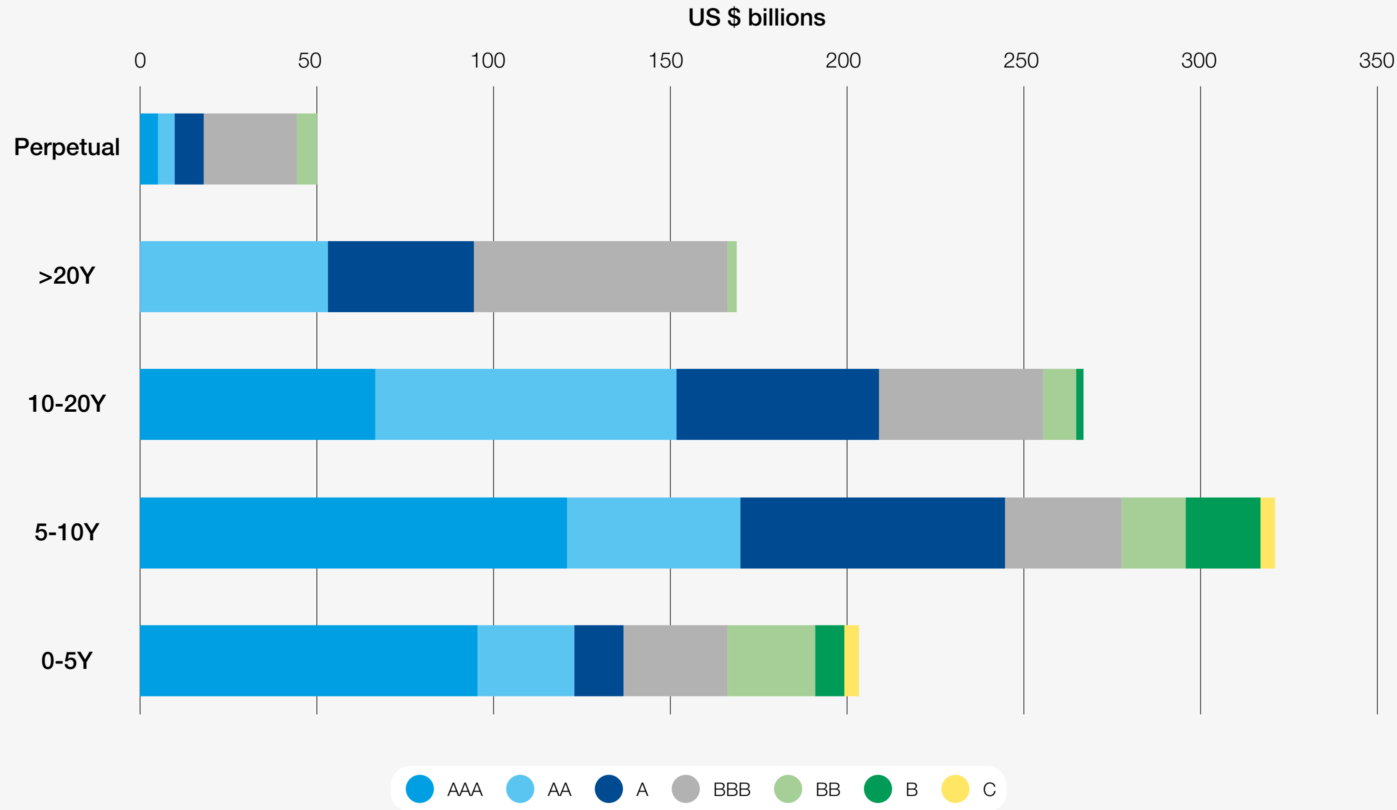
1. Decarbonization technologies here are inclusive of carbon capture, utilization and storage (CCUS), hydrogen and bioenergy.
2. The investment level is reflective of average investment from 2016 to 2020.

Source: International Energy Agency, *Net Zero by 2050*, 2021; BloombergNEF, *Energy Transition Investment Trends*, 2021; Oliver Wyman analysis.

Profile of capital flows

There is no doubt that the innovative, clean technologies that are necessary for industrial decarbonization are not receiving the quantum of investment required. The investigation for this report suggests that the profile of current flows is also not adequate to expand breakthrough technologies. Looking at one segment of flows – climate-aligned bonds – reveals that about 90% of flows are investment grade and rated BBB or better[18] (Figure 5) while, in practice, non-investment grade companies (e.g. SMEs) require significant financing, with their financing needs currently unmet. Climate-aligned bonds are also heavily skewed towards the transport sector, with over 70% issued globally by transport companies. Within transport, over 90% of the volume is made up of large railway companies rather than sub-sectors at greater need of transition financing such as aviation, shipping and public transport. These challenges are indicative of a broader mismatch between needs and current flows.

FIGURE 5 **Rating of climate-aligned bonds by tenor (in $ billions)**

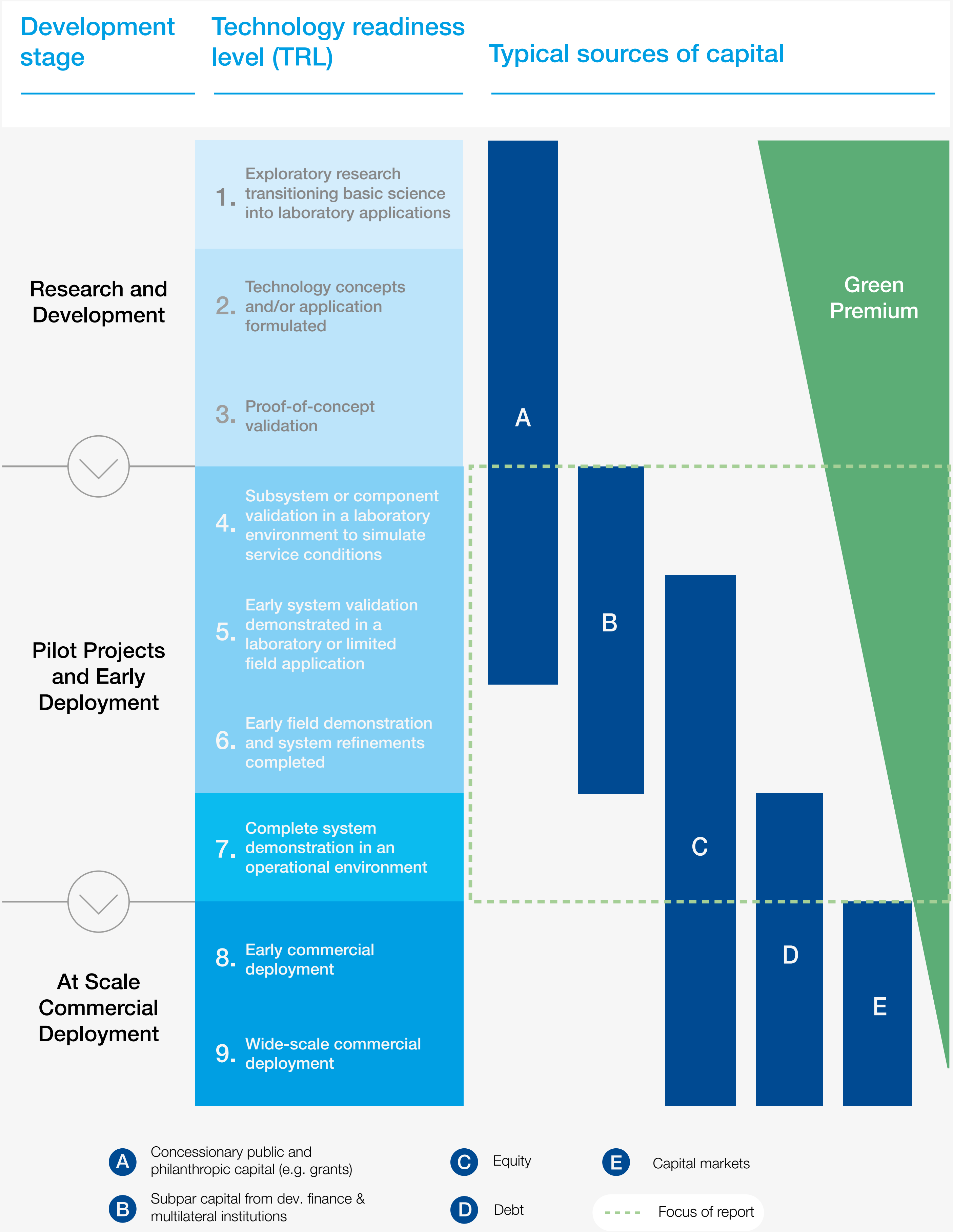


Source: Giorgi, Amanda, and Carlotta Michetti, *Climate Investment Opportunities: Climate-Aligned Bonds & Issuers 2020*, Climate Bonds Initiative, July 2021, p. 6.

So, what is driving the mismatch? This is both a supply and demand issue. Global economies today rely on billions of dollars' worth of property, plant and equipment, and have optimized crucial activities over years to reach maximum efficiency. New zero-carbon technologies require billions of upfront capital investment, but also experience new unmitigated risks and near-term competitive disadvantages. These challenges are reflected in their higher costs compared to current brown technologies. This difference in costs, termed as the "green premium", can be reduced as technologies mature and are commercialized through large-scale investment. However, this will require diverse sources of capital dependent on the technology's maturity, also known as the "technology readiness level" (Figure 6).

Specifically, several breakthrough technologies are in the second development stage: Pilot Projects and Early Deployment. At this stage of maturity, breakthrough technologies cannot be reliably increased based on capital markets alone (e.g. bond markets, carbon prices). Lowering the cost of production and driving down green premiums to improve uptake requires the mobilization of capital with diverse risk-return profiles, tenors and features. These require a combination of concessionary public capital, philanthropic capital, subpar debt and equity from public capital providers and mission-based institutions.

FIGURE 6 | Mapping of capital sources to the technology readiness of projects

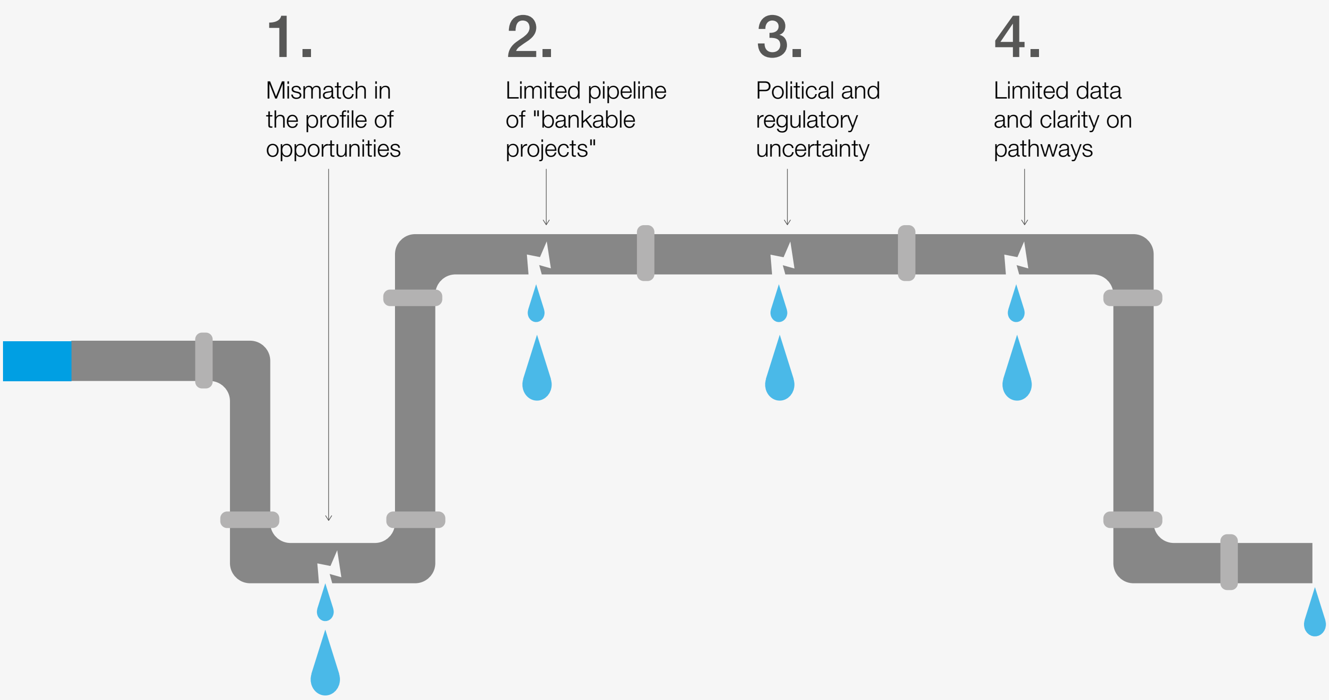


Source: World Economic Forum and Oliver Wyman; adapted from National Academies of Sciences, Engineering and Medicine, *The Power of Change: Innovation for Development and Deployment of Increasingly Clean Electric Power Technologies*, National Academies Press, 2016.

1.3 Key unmitigated challenges

While trillions in dollars in capital have been committed in recent years, the deployment of committed capital has been slow. The solution requires steering a significant portion of private capital towards climate technologies and supporting infrastructure, but both supply- and demand-side finance issues remain (Figure 7).

FIGURE 7 **Key challenges slowing private capital deployment towards breakthrough technologies**



Source: World Economic Forum and Oliver Wyman, based on *Financing the Transition to a Net-Zero Future* initiative insights.

1. Mismatch in the profile of opportunities between capital supply and demand

Companies have identified difficulties in securing affordable financing to deploy breakthrough technologies. Key drivers limiting financing include:

– *Returns are not commensurate with the levels of risk posed*: A combination of high capital requirements, high technology risk and general volatility in the price of production inputs and outputs in pilot projects means financial institutions across the spectrum are not able/willing to finance these opportunities at low levels of returns.

– *A mismatch between offered debt financing tenors and financing needs*: Banks, which are required to finance significant debt levels, have relatively short tenors of 5 to 7 years on average, given capital treatment pressures and broader risk appetite. These opportunities, however, require longer-term financing due to sizeable construction periods and the slow ramp up on operations to profitable levels.

– *Limited liquidity when financing sustainable, decarbonization infrastructure:* Multiple investment opportunities, especially early-stage validation projects, will be fairly illiquid. Consequently, the investments pose a liquidity risk, especially in the absence of adequate securitization solutions as securitization markets for sustainable infrastructure projects have not yet developed. The financing needs of these projects range from 10-20 years in duration, creating a mismatch between project financing needs and the average appetite of infrastructure investors.

– *The fiduciary duty of longer-term institutional investors:* Exacerbating the issue, investors such as pension funds and asset managers have a fiduciary duty and are unwilling to take on significant levels of risk without de-risking measures. They typically look for low but stable returns, which these opportunities do not guarantee given the risk levels involved.

2. Limited pipeline of bankable projects

On the demand side, investors flag the lack of "bankable" opportunities and a limited pipeline of projects. While the risk-return curve may partly explain limited bankability, a key driver is also limited demand by companies themselves. COVID-19 associated economic disruption has resulted in stressed balance sheets for several firms, especially in hard-to-abate sectors. Additionally, many production inputs are still expensive, with no "first-mover advantage" to be gained. Consequently, firms may choose to delay projects until the price and volatility of critical inputs have declined.

Finally, capacity and resource constraints within financial institutions are leading to a preference for investments in a "portfolio of ready projects" and "counterparty-level financing" as opposed to project-specific financing, which tends to require significant time, effort and the upskilling of front office teams. These factors potentially limit investors from actively structuring and originating these opportunities to help create a pipeline of viable projects.

3. Political and regulatory uncertainty

" Companies have identified difficulties in securing affordable financing to deploy breakthrough technologies.

Most jurisdictions face political uncertainty, with politicians considering the implementation of progressive policies, such as a carbon tax or green fuel mandate, facing potential fallout and backlash. Consequently, the possibility of political rollbacks will likely result in an increased risk of stranded assets. Furthermore, current short-dated policies and incentive schemes introduce unpredictability in demand and supply drivers. Consequently, investors are unable to effectively hedge risks around longer-term investments (e.g. commodity price risks for green fuels) and thus hesitate to invest sizeable sums in non-recourse opportunities.

On the regulatory end, frameworks are not yet coordinated or consistent, adding to investor hesitance regarding green investments. An absence of codified, widely accepted certification schemes, standards, methodologies and taxonomies adds to the challenge. With no clear criteria for "green activities" and "green technologies", an absence of definitions and guidelines for climate-aligned investment is potentially hindering further investment activity.

Further, dissonance in policies and frameworks across jurisdictions can inadvertently hinder capital flows to emerging markets and developing countries (EMDCs). The surge of green bond issuance in developed economies has not been mirrored in EMDCs, with less than 20% of green bond issuance in developing countries.[19] The need for a just transition will only continue to grow as energy access expands globally.[20] These challenges, if not addressed, will limit capital flows to the regions that are likely to have the greatest need for breakthrough technologies.

4. Limited data and clarity on pathways

Amidst the rapid development of innovative technologies, investors are faced with an absence of critical data and information inputs that would otherwise inform their financing strategies. With no universally agreed upon transition pathway for each sector, investors are expected to identify "moonshot technologies", and pick winners and losers. Without sector policies and transition pathways, the scalability of financing will be diminished as investors may diverge in their selection of solutions.

Exacerbating the information gaps, financiers seeking credible methodologies and metrics to assess portfolio alignment and the impacts of investing are met with weak or non-existent data, including:

– Limited data on the emissions reduction potential of new opportunities

– Lack of granular sector transition plans

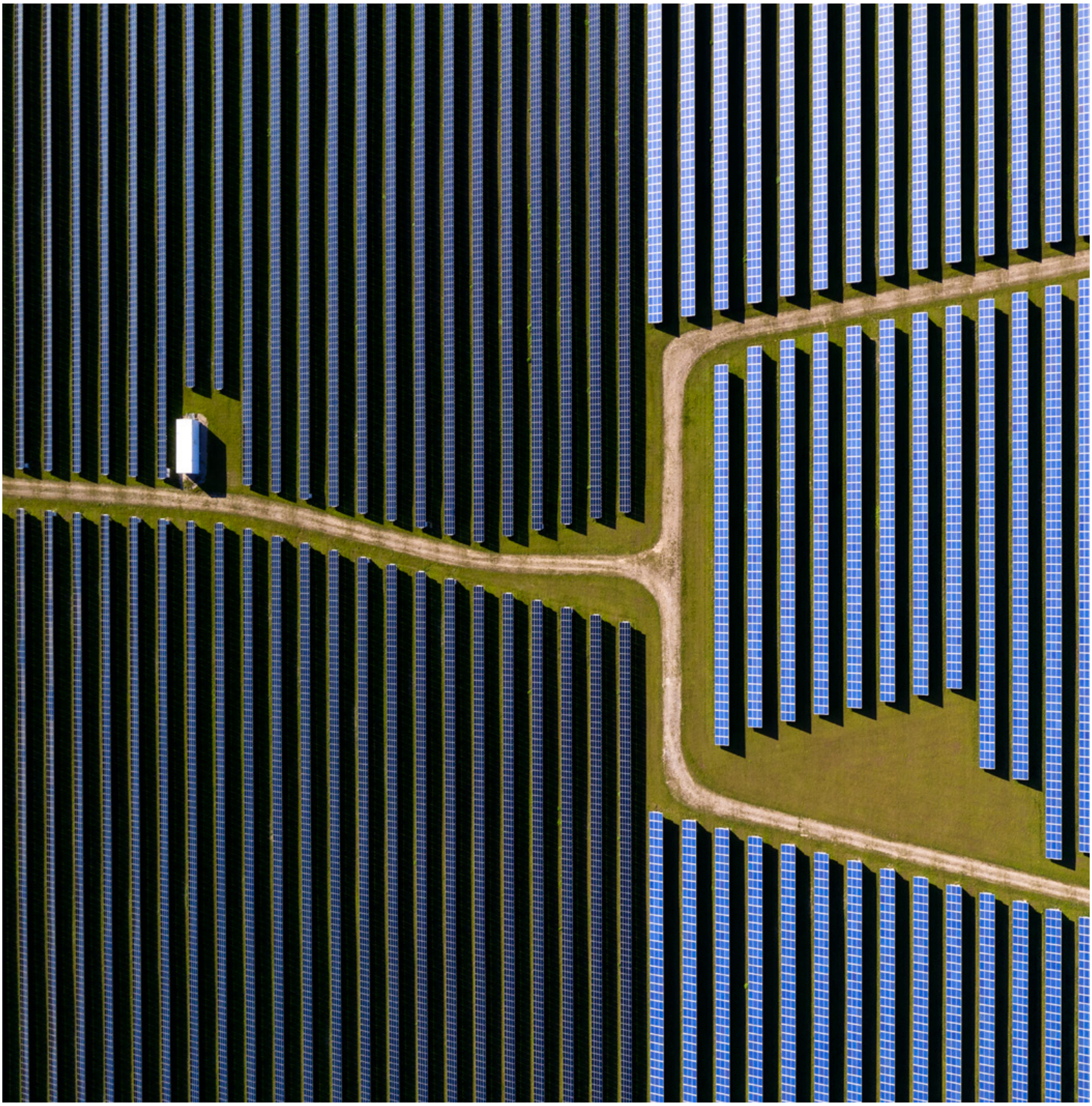
– Inconsistent or incomplete climate-related disclosures

– Limited data on the past performance of comparable investments

Addressing these key challenges that the financial sector faces will be key to mobilizing the capital necessary. The next section illustrates potential approaches to mitigate some of the challenges outlined through technology-specific financing blueprints and deal structures.

2 Innovative blueprints for capital mobilization

Learning from the mixed successes of solar energy expansion, it is clear that replicable blueprints are necessary to improve the bankability of projects rapidly.



The findings for this report highlight key solutions for breakthrough technology blueprints. These include:

– Sophisticated capital structures that blend different sources of public and private capital, operating within stakeholder risk-return frameworks

– The activation of involvement from various stakeholders in the finance, industry and public sectors in an enabling ecosystem. MDBs are best positioned to coordinate these activities and processes.

– New, transformative business models, reliant on specific contracts and mechanisms that mitigate cash flow risks and reduce green premiums. These will inherently require companies to work more closely with their financiers.

This section synthesizes key findings on the design of the blueprint through two subsections:

– Capital blending blueprints through a coordinated multistakeholder ecosystem

– Transformative business models to scale breakthrough technologies

2.1 Innovative blueprints supported by an enabling ecosystem

Projects based on breakthrough technologies are characterized by a relatively higher risk profile, in large part due to the lack of established business models. Investments in this space are uniquely sensitive to risks, with the key risks encountered detailed in Figure 8. At a project level, the evolution of risks through the life cycle can be mapped to mechanisms that can enhance the bankability of projects. These are analysed at a project/asset-level to decouple the risks to financial viability of breakthrough technologies from that of counterparties being financed.

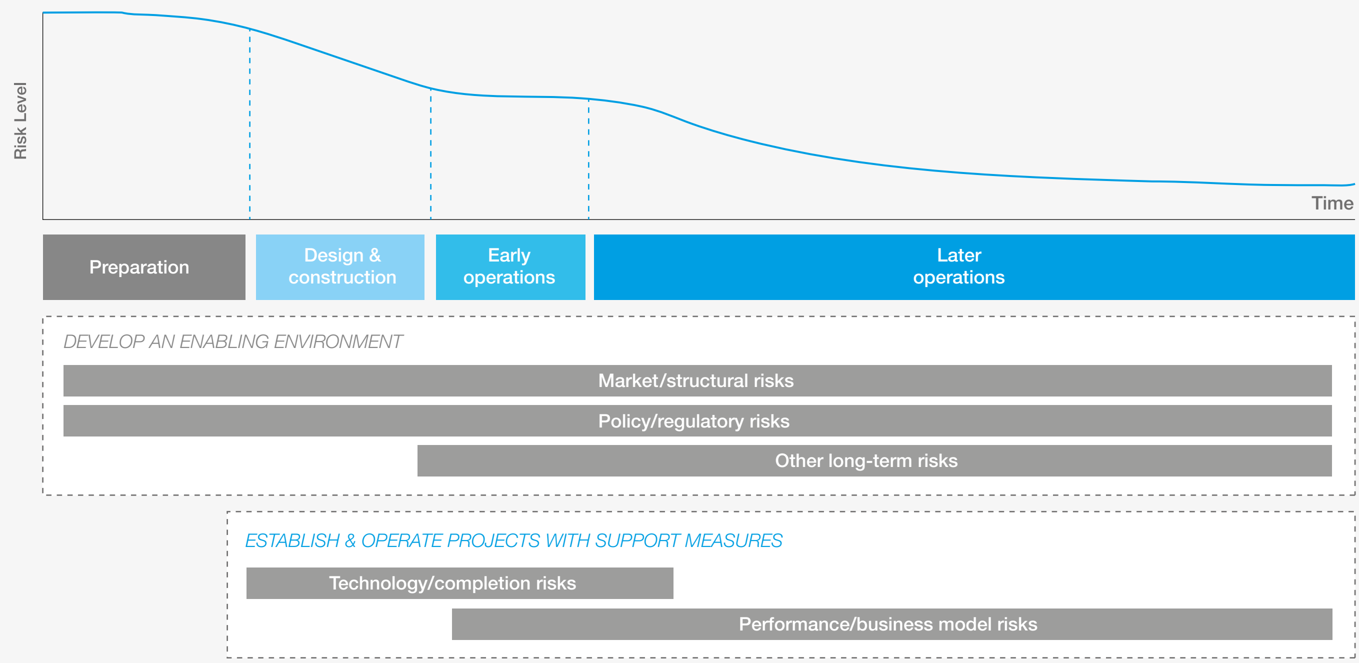
These mechanisms to enhance bankability can be designed based on two components:

– Capital blending blueprints that require capital providers to each play a unique role, consistent with their risk-return frameworks and financing objectives

– New, transformative business models that will help scale each breakthrough technology

This subsection discusses the first component, outlining the proposed role each stakeholder could play in the enabling ecosystem, as part of the collective action necessary.

FIGURE 8 **Key investment risks across the project life cycle**



Source: World Economic Forum and Oliver Wyman, based on *Financing the Transition to a Net-Zero Future* initiative insights.

Market/structural risks: These include macroeconomic risks (e.g. interest rate fluctuations, exchange rate volatility), sector-specific risks (e.g. industry growth rate, market concentration), and risks within the context of the existing market (e.g. price of steel).

Policy/regulatory risks: These arise from the potential for change in policies, specifically if these result in a less favourable regulatory environment for the technology/sector (e.g. changes in the definition of climate-aligned investing) and/or removal of supportive incentives. Arbitrary government decisions on state ownership and control may increase the cost of capital given high levels of unpredictability.

Technology/completion risks: These include technical challenges in the technology's deployment or failure of the technology altogether. Also included are typical design and construction risks, such as potential planning insufficiencies, deficient technical standards, time delays, overruns in cost, issues with quality and completion risk.

Performance/business model risks: These stem from the novelty of the technology/business model, and the quality of operational performance of products and processes. Business model risks can be segmented into the following groups: 1) demand-side risks: uncertainty about demand size, the presence of willing offtakers (buyers of the good being produced or service being provided), and the illiquidity of demand; 2) supply-side risks: uncertainty and challenges around project operations and key production inputs (e.g. the uninterrupted availability of inputs, such as municipal feedstock, input commodity prices).

Other long-term risks: Some risks will persist across the project life cycle. These include product safety and quality (e.g. the potential for malfunction or defects), and risks associated with the stability of the investor appetite for the given technology over time, which in turn affects the ability to refinance. Another key risk is that of stranded assets, which can be exacerbated by limited clarity early on regarding national transition plans and pathways.

To effectively overcome and, in some cases, mitigate these risks, different stakeholders are needed to play critical roles across the project life cycle. Most importantly, the ecosystem of stakeholders needs to find new ways of working and collaborating to ensure:

- The production of sufficient revenues through new types of contracts

- Consortium-led approaches, with risk sharing across stakeholders to provide affordable financing

- Targeted public and private intervention with effective de-risking measures

While stakeholder roles may vary across projects because of variations in technology readiness levels, sectors, idiosyncratic project characteristics and geographies, commonalities in terms of the solutions and mechanisms required are expected. Recommendations on stakeholder roles are outlined in Figure 9, and specific findings under the lens of sector-technology opportunities are discussed in section 2.2.

FIGURE 9 | Sources of capital and de-risking in a multistakeholder ecosystem

Ecosystem stakeholders		Develop an enabling environment	Establish & operate projects with support measures		
		Preparation	Design and construction	Early operations	Later operations
Private sector–Financial Institution	Banks	Net-zero pledge; Transition finance commitments	Debt financing (e.g. Term A loans, bond issuance) / refinancing		
	Alternative investors /asset owners	Net-zero pledge; Transition finance commitments	Equity/tax equity investments	Green/sustainability linked bond investments	
	Insurers	Net-zero pledge; Sustainability linked products	Tech and normal risk measures	Credit enhancements; Green bond investments	
Private sector – Industry	Project owner (borrower)	Equity investments; Deconsolidate green unit into SPVs	Warranties, equipment performance guarantees	Sale of by-products	Portfolio/utility approach to create scale
	Project customer /other players	Net-zero pledge	Equity investments; Offtake agreements/green premiums		Tolling structures/lower green premiums
	Technical firms /standard setters	Certification standards	Independent verification of technology	Performance/safety assessments	
Public sector	Governments /policy-makers	Procurement requirements; Green mandates; Carbon tax/carbon pricing	Loan guarantees; Capex grants; Capital/tax incentives	Contract for difference/feed-in tariff	
	MDBs/state financiers	Technical assistance/ capacity building	Loan guarantees / blended finance / subordinated debt tranche; Traditional debt financing		
	Export credit agencies		Debt financing; Financial guarantees	Credit insurance	

Financing/primary project activities | De-risking measures

Note: SPV: special purpose vehicle
Source: World Economic Forum and Oliver Wyman, based on *Financing the Transition to a Net-Zero Future* initiative insights.

Financial institutions

Private-sector involvement in financing and de-risking investments can take a variety of forms. Net-zero pledges and tangible transition finance commitments can help provide clarity of ambition and plans, while making dedicated capital for hard-to-abate sectors, counterparties and innovative solutions available. Relatedly, the design of new sustainability-linked products can incentivize the "users of capital" to deploy proceeds responsibly and towards areas of greatest sustainability impact. With regard to financing and refinancing of decarbonization projects, stakeholders such as banks, insurers and asset owners/managers have a unique role to play consistent with their risk-reward frameworks.

Banks have traditionally provided a significant proportion of financing for green infrastructure. Looking ahead, they are expected to continue to provide the majority of debt finance, as the climate bond and securitization markets are scaled up. Experts indicate financing towards decarbonization will increase, especially as top-down commitments are made and opportunities are understood better. Banks are also considering "originate and distribute models" and optimal instruments leading to much-needed financial innovation in the area of climate finance. Still, experts have indicated that banks are unlikely to take full construction/ completion risks or provide financing over longer tenors. This underlines the importance of the blending of capital from various sources, in the absence of which investment gaps will arise.

Asset owners/managers have a major role to play given the large pools of institutional capital they hold. Historically, their role in financing breakthrough technologies has been limited given a mismatch with their risk-return frameworks. Institutional investors typically look for assets with established track records, which early-stage technologies will lack. Furthermore, investors such as pension funds are restricted from relatively illiquid long-term debt investments and have tightly defined target investment profiles. Financing new types of opportunities also requires them to dedicate resources to building internal expertise and capability. It is essential, however, that they be engaged strategically and through targeted incentives given the sizeable role they could play on asset/infrastructure-based financing, and provide longer tenor patient capital as well as help scale transformative business models which innovative corporates will establish.

Insurers have a unique role to play through a combination of financing and de-risking actions. While several insurers have made net-zero commitments and are financing sustainable/green bonds, the focus has begun to shift to the potential for impact through underwriting activities. It is critical that a role for insurers be defined, otherwise a green protection gap will develop in the absence of insurance cover for investments and technology/performance de-risking – both essential to attract capital and expertise.

Specifically at the project level, early engagement on engineering and construction risks associated with emerging transition/sustainable technology will be important, together with the willingness of the technology providers to guarantee performance. The performance guarantees may also be supported by insurers through the provision of surety bonds for construction, operational performance and reclamation.

From a credit, political and performance risk perspective, insurers play a very active role today in helping secure equity and reduce the capital costs of debt by underwriting risk, which needs to be extended to innovative climate solutions, an area currently underserved. Insurers indicated higher likelihood of providing these forms of insurance for new technology investments, when working under the preferred creditor umbrellas of export credit agencies (ECAs) and MDBs. Still, underwriting activities could be better leveraged to support transformative business models through their portfolio steering abilities. It is critical for insurers to be part of the collective action to address early signs of a green protection gap, which has been observed in sectors vital for climate transition.[21]

Industry

Companies can take specific action to unlock greater flows of capital. They can influence the financial viability of projects through thoughtful project structuring (e.g. special purpose vehicles [SPVs]) and new ways of doing business. Careful strategic planning is necessary to identify levers that can generate economies of scale that are important to drive down the costs of innovation and associated green premiums. Several companies are considering developing a portfolio of projects in which technologies are used to provide utility-like services and, consequently, diversify demand. Companies can further solidify cash flows under the business model by selling by-products (e.g. synthesis gas) and co-producing complementary products with established incentives (e.g. biodiesel). De-risking measures, such as equipment performance guaranties, performance assessments and employing independent technical firms (e.g. engineering, procurement and construction (EPC) contractors) to certify and verify underlying technologies and their green eligibility, can further enhance attractiveness. Corporate customers (e.g. automakers for green steel) could help reduce revenue uncertainty through contracts, such as long-term offtake agreements (a contractual arrangement where the customer and the producer commit to selling and purchasing a fixed quantity of a product), tolling structures (where the facility's owner provides a service for a fee), availability-based payments (where periodic payments are made based on the facility's availability at the specified performance level[22]) and pricing in voluntary green premiums. These mechanisms will allow businesses to transform and introduce new ways of doing business, which in turn will require further market-based solutions to be designed.

“ MDBs have a key role to play as anchor investors and coordinators. They can use financing abilities to syndicate flows and activate capital flows from across stakeholders.

Public sector

The public sector has an equally critical role to play by developing a supportive environment through targeted incentive schemes and de-risking measures. Policy-makers should establish time-limited incentives for early movers. These could take the form of carbon taxes/pricing (e.g. European Union Emissions Trading System (EU ETS) rebates), contracts for difference, capital/tax incentives, project-specific grants, loan guarantees and other demand- and credit-enhancing measures.

Specifically, MDBs have a key role to play as anchor investors and coordinators. They can use financing abilities to syndicate flows and activate capital flows from across stakeholders. They should also play a broader role by giving credibility to breakthrough technologies, providing targeted concessionary capital, providing technical assistance and developing a pipeline of investable opportunities. Similarly, ECAs can help address market failures by extending targeted debt financing and providing credit insurance/enhancements.[23] ECAs, MDBs and, increasingly, DFIs distribute some of the risk they assume into the commercial credit and political risk insurance market. Insurers see their primary role as reducing risk they would not otherwise underwrite commercially. When properly understood, this mechanism can be a powerful way for public capital to mobilize and leverage commercial capital at lower cost to the public purse. Each of these actions would catalyse private flows but would need to be considered carefully in the context of the given country/sector/technology to ensure the efficient use of public capital. The specific enabling actions the public sector can take are discussed in more detail in section 3.

2.2 Transformative business models based on industry-finance collaboration

This subsection discusses business model considerations for four technologies to illustrate potential levers that can be employed to enable bankable projects to be established. Key measures are summarized in Table 1 and explored in technology-specific deep dives in the context of hard-to-abate sectors. These are not exhaustive but are indicative of solutions that are likely to be required.

Technologies covered in this section include:

- Aviation: SAF
- Steel: CCS
- Steel: H2-DRI
- Shipping: Ammonia-powered ship

TABLE 1 | **Summary of financing blueprints**

Archetype	Owner/equity provider	Capital	Contracts	De-risking measures
SAF for aviation	– SAF producer	**Private capital** – Expected to be financed using Term A/B loans or project finance – Up to 60% bank debt, with 5-7 year tenor – Range of equity providers expected **Public capital** – Subpar debt/capital grant necessary for affordable cost of capital – Alternatively, municipal bonds historically used	**Demand** – Offtake agreements with airlines with in-built green premium – Voluntary green premium from passengers – Purchase of SAF certificate by corporate customers – Tolling structure with airlines (little short-term appetite from airlines) **Supply** – Contract with municipality for feedstock – Affordable supply of renewable energy – Biofuel certification	**ECA measures** – ECA-backed loans/loan guarantees **Policy enablers** – At least 10% blending mandate – Contract for difference scheme – Incentive schemes (e.g. renewable fuel standards, blender's tax credit) **Private measures** – Revenue de-risking through co-production of other fuels (e.g. biodiesel) – Construction/performance insurance
CCS for steel	– Steelmaker to establish SPV for CCS module – Banks would expect steelmaker/joint venture partners to provide 30-40% equity – Option for portfolio approach where CCS is set up as a utility around industrial clusters	**Private capital** – Typically financed using project finance – Up to 60% debt – ~8-year tenor **Public capital** – Subordinated debt/patient capital necessary for affordable cost of capital and longer tenors	**Demand** – Offtake agreements for green steel in-built green premium – Sale of CO_2 by-products **Supply** – Guaranteed CO_2 supply to ring-fenced SPV – Independent verification of CCS technology by EPC firms	**ECA measures** – Up to 100% ECA equipment guarantee for CCS module **Policy enablers** – Public procurement – Incentive schemes (e.g. EU ETS rebate, contract for difference) – Subsidies with border protection measures **Private measures** – Risk insurance, especially for construction, transportation and storage risks – Credit enhancements – Inflation hedges

TABLE 1 **Summary of financing blueprints** *(Continued)*

H2-DRI based steel	– Steelmaker
	– Hydrogen plant and infrastructure provider
		– Option for a) consolidated financing structure or b) separate financing for steel plant and hydrogen facilities
		Private capital
		– Typically financed using project finance
		– Steel plant:
		  – Up to 60% debt
		  – 5-8 year tenor
		– Hydrogen plant:
		  – Up to 65% debt
		  – 8-12 year tenor
		Public capital
		– Subordinated debt/patient capital necessary for affordable cost of capital and longer tenors
		– Up to 14-year tenor
			Demand
			– Offtake agreements for green steel with green premium
			– Tolling structure for hydrogen plant
			– Availability-based payments and pass-through operation and maintenance costs from steelmaker
			Supply
			– Affordable supply of renewable energy
			– Independent verification of H2-DRI technology by EPC
			– EPC construction or equipment guarantees
				ECA measures
				– ECA-backed loans/loan guarantees
				Policy enablers
				– Public procurement
				– Capital/construction grants
				– Incentive scheme (e.g. EU ETS rebate)
				– Price support subsidies for steel (e.g. contract for difference)
				Private measures
				– Technology/engineering insurance
				– Construction risk insurance

Green ammonia for shipping	– Vessel owner/operator – Potential for cargo owner and/or fuel developer to provide equity	**Private capital** – Typical instruments used for ship financing **Public capital** – Subordinated debt/patient capital necessary for affordable cost of capital and longer tenors – Up to 50% debt	**Demand** – Offtake agreements with green premiums across value chain – Long-term (15+ years) chartering agreements **Supply** – Affordable supply of green ammonia – EPC oversight of engine development – Storage and provision of green ammonia by bunkering supplier	**ECA measures** – ECA-backed loans/loan guarantees and specific credit enhancement measures **Policy enablers** – Global regulatory framework (e.g. tax on emissions, fuel mandate) by International Maritime Organization **Private measures** – Technology and performance risk insurance – Credit enhancements – Maintenance of dual-fuel engine capability by vessel owner

Notes: CCS: carbon capture and storage; ECA: export credit agency; EPC: engineering, procurement and construction; EU ETS: European Union Emissions Trading System; H2-DRI: hydrogen-based direct reduced iron; MDB: multilateral development bank; SAF: sustainable aviation fuel; SPV: special purpose vehicle
Source: World Economic Forum and Oliver Wyman

Aviation SAF

> Unless the counterparty is able to absorb risks itself, a variety of capital sources are expected to be required to finance SAF projects, especially non-recourse opportunities.

Sector and technology overview

Although the pandemic has brought unprecedented challenges, aviation activity is expected to exceed pre-pandemic levels, which makes the implementation of transition pathways very important for net zero by 2050. SAF are the most promising near-term decarbonization solution, given their potential to reduce between 70% and 99% of GHG emissions compared to conventional jet fuel on a life-cycle basis.[24] In view of the limited technological readiness levels of next-generation decarbonization technologies like battery-electric and hydrogen-powered flight, SAF is the immediately available emissions abatement solution, especially for medium- to long-haul air transportation. SAF can be produced from various forms of feedstock, allowing different regions to select the technology pathway based on optimizing for the feedstock that is most readily available. As a drop-in fuel, SAF is compatible with existing fuel delivery infrastructure, with no need for significant infrastructure investments, and can be blended in directly with conventional fossil-based jet fuel.

SAF is currently constrained by the limited capacity of production facilities and nascent feedstock supply chains. Additionally, its price hinders further adoption, with SAF generally costing approximately 2-6 times more than traditional jet fuel, depending on the production pathway.[25] Building out additional SAF production facilities and reducing the cost differential to conventional jet fuel will be critical in accelerating the aviation's transition to net zero.

Of the production pathways, GAS-FT is a particularly promising technology. While it is lower on the technological readiness scale than hydroprocessed esters and fatty acids (HEFA)-based SAF, GAS-FT leverages readily available municipal waste and agricultural and forestry residues. In this context, the mechanisms key to scaling up GAS-FT-based SAF production facilities are explored.

Challenges and risks

SAF production is highly capital intensive. Given build costs can range from hundreds of millions to low billions, banks are unlikely to finance with 100% debt or take on design and construction risks. Unless the counterparty is able to absorb risks itself, a variety of capital sources are expected to be required to finance SAF projects, especially non-recourse opportunities. Specific challenges and risks are outlined in Figure 10. These are expected to drive the design of mechanisms that will best position business models for success and attract financing.

FIGURE 10 **Sustainable Aviation Fuel: key risks across project life cycle**

Preparation	Design and construction	Early operations	Later operations

Market/structural risks
Absence of a global markets scheme, unclear specifications/blend limits, and limited current scale of production preventing large-scale uptake by airlines

Policy/regulatory risks
Inconsistent global approaches to blending requirements and incentives; evolving policies risk investments in fuel that do not qualify as 'green'; better incentives for other renewable fuels (e.g. biodiesel) resulting in repurposing of SAF facilities

Technology/completion risks
Construction and production development-related risks; absence of standard certification schemes globally and few long-term feasibility studies

Performance/business model risks
Demand: Lack of a liquid demand market globally
Pricing/margin risks: Significant margin exposure for investors; significant green premium required as SAF is 2-4x costlier than traditional jet fuel
Business model risks: Feedstock availability, logistical challenges relating to fuel transportation, and potential for fragmentation of producers

Policy/regulatory risks
Concerns of fuel quality and safety given infancy of market

Source: World Economic Forum and Oliver Wyman.

Capital

Capital providers' perspective on financing illustrative SAF investment opportunities

- **Debt service coverage ratio:** Minimum of 1.15x
- **Debt-to-equity:** Up to 60% debt financing from banks; equity necessary given high margin of risk
- **Financing instruments:** Variety indicated, including Term A/B loans, bonds, project finance
- **Tenor/amortization period:** 5-8 years for commercial bank debt
- **Other capital sources:** Municipal bonds, ECA and MDB capital likely to be required. Potential for government grant based on borrower profile (e.g. state-owned/innovative engineering companies entering SAF production)

Contracts

Demand: Airlines, corporate and individual customers can all play important roles in sustaining demand with in-built green premiums. Revenue certainty will fundamentally be driven by offtake agreements with airlines. Early mover airlines could be rewarded for their initial support through reduced green premiums in later years. This ensures sustained, long-term demand, allowing SAF producers to develop business models rooted in a predictable revenue stream. Green premiums can also be incurred by retail and corporate passengers. Corporate customers could also purchase a SAF certificate, an accounting instrument that provides a market-based mechanism for corporates to claim the emissions reductions resulting from SAF use while promoting the use of SAF-based flights.[26]

"Airlines, corporate and individual customers can all play important roles in sustaining demand with in-built green premiums. Revenue certainty will fundamentally be driven by offtake agreements with airlines.

Tolling structures between airlines and fuel producers can also mitigate demand risk. A precedent for these tolling agreements can be found in liquefied natural gas (LNG) plants, where gas producers historically paid a "toll" to the LNG plant owner to liquefy and transport gas to companies, industrial customers and power plants. While these structures would mitigate margin risk for the SAF producer extensively, airlines have indicated a lack of appetite for these contracts in the short to medium term.

Business models can be further strengthened through product diversification. Production facilities can be used to produce renewable biodiesel and other by-products, such as light ends (light hydrocarbon gases and liquids that condense during the petroleum refining process) and naphtha (a flammable liquid produced through the distillation of petroleum). Further to increasing revenues, this could also enable producers to take advantage of the incentives non-SAF biofuels are offered.

Supply: Securing access to an uninterrupted supply of municipal feedstock and an affordable supply of green energy is critical to business models. To ensure green SAF production and supply, municipalities need to establish and guarantee sufficient waste material supply — otherwise further agricultural land or forest matter will be used. Additionally, technical certification of SAF through sustainable biofuel certification labels will encourage corporates to produce SAF and will reduce regulatory uncertainty around biofuels, which was historically a key deterrent to biofuel production (e.g. for corn ethanol).

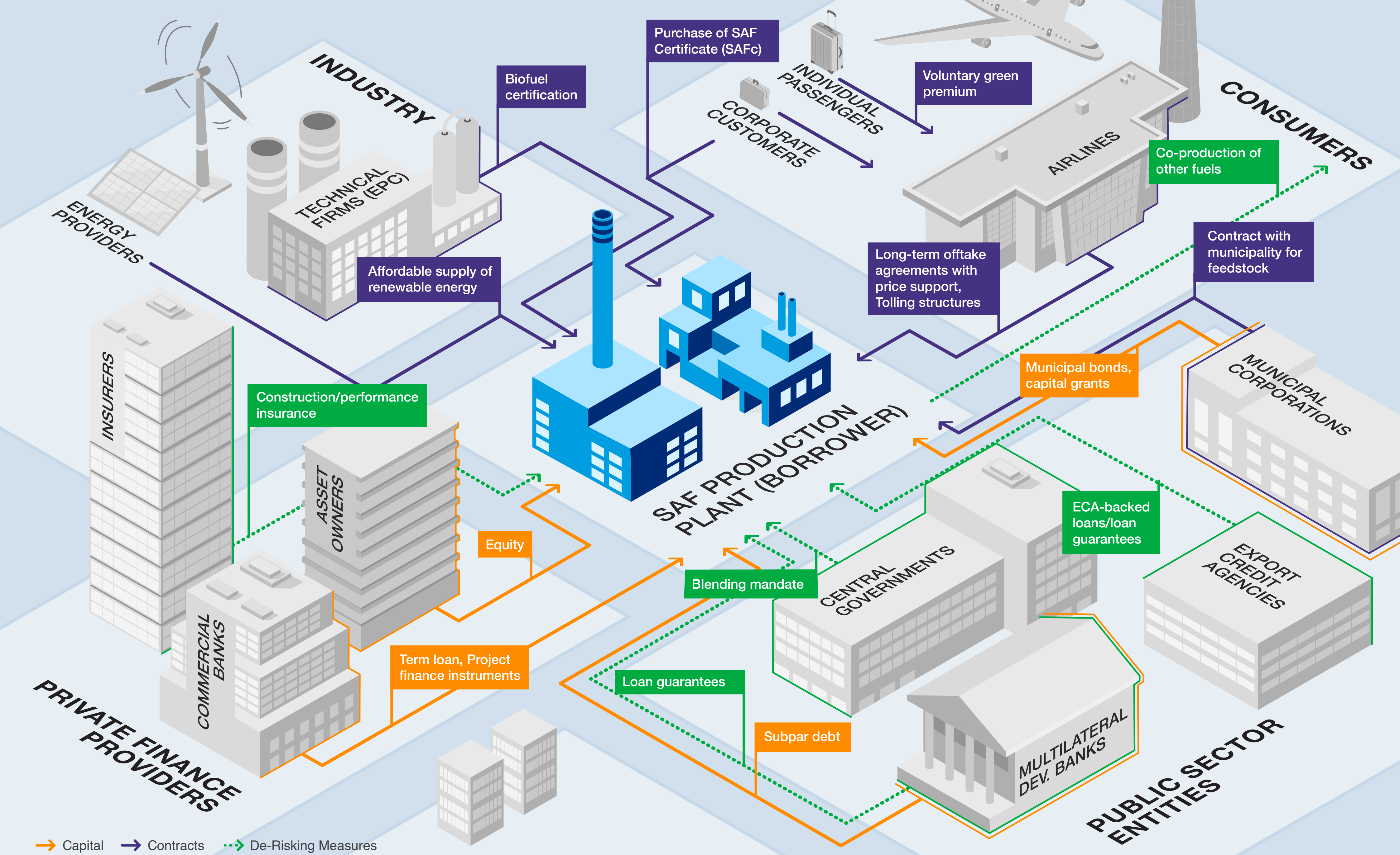
De-risking measures

Public-sector-driven measures are critical to establish markets and de-risk business models. At a macro level, global incentive schemes could spur production, if designed with renewable diesel incentives as a precedent. For example, the Blender's Tax Credit in the United States provides biofuel blenders with an incentive of $1 per gallon of biodiesel/renewable diesel. These measures are especially effective when they are of longer tenor, offering longer-term revenue predictability. Governments can also de-risk demand through fuel blending mandates, which can encourage offtake agreements. For example, a recently proposed SAF blending mandate in the EU would require airplanes departing from airports within the EU to refuel with a SAF share, which is expected to drive the creation of a SAF production and uptake market. The public sector can further catalyse flows by de-risking the investments of first mover financiers.

Insurers, too, have an important role to play in de-risking investments and business models through performance risk insurance in the form of surety or credit insurance, which can help reduce capital costs and increase lending capacity.

ENABLING AVIATION DECARBONIZATION

Deal structuring and financing blueprint for SAF production and deployment



Source: World Economic Forum and Oliver Wyman, based on industry input

Steel CCS

Sector and technology overview

Steel is responsible for about 7% of GHG emissions,[27] with emissions estimated to increase by 43% given likely production growth by 2050. Deploying zero-carbon primary production processes at scale is the only viable route to achieve net zero.[28] These production processes, however, require scaling and are still in the initial stages of commercial validation and deployment. In the meantime, CCS can support emissions reduction. This breakthrough technology has the potential to reduce over 80% of CO_2 emissions and can be appended to various industrial processes. It is potentially easier to deploy than alternative decarbonization technologies, given that it can be retrofitted on existing production processes, requiring minimal changes to equipment and assets. CCS' technology readiness level is approximately 7-8 (on a scale of 1 to 9) and is ready for market-wide deployment from a technological perspective, though it requires development of a carbon transport and storage infrastructure network, which is currently being developed.

Challenges and risks

CCS requires financing across its value chain (i.e. capture, transportation, storage infrastructure), increasing the risks across the project, since the transportation and storage infrastructures are still being established. For non-recourse projects, the risks are significant, especially since the supply of CO_2 to the CCS modules is key to the viability of business models of ring-fenced CCS entities. These risks are outlined in Figure 11.

FIGURE 11 **Steel CCS: key risks across project life cycle**

Preparation	Design and construction	Early operations	Later operations

Market/structural risks
Risk of stranded assets, overcapacity of existing steel sector; overseas competition from lower-cost, highly carbon intensive producers; uncertain route for monetization of carbon/emissions benefits, by geography

Policy/ regulatory risks
Long-term political risk associated with use of subsidies and tax incentives; potential for regime change and volatility in quantum of emissions-based incentives

Technology/completion risks
Design and execution challenges with development & construction; third-party permits and approvals; equipment implementation uncertainty

Performance/business model risks
Pricing/margin risks: Cyclicality of steel industry and volatile steel prices
Operations: Opex uncertainty for CCU (e.g., energy, maintenance, inflation, forex)
Performance: Equipment and technology performance

Other long-term risks
Shifting investor appetite for CCS investments, environmental risk

Source: World Economic Forum and Oliver Wyman.

Capital

Capital providers' perspective on financing illustrative CCS investment opportunities

- **Debt service coverage ratio:** Minimum of 1.0x, ideally at least 1.15x
- **Debt-to-equity:** Up to 60% debt financing; 30-40% equity necessary to absorb steel price risks
- **Financing instruments:** Project finance, at 3-5% rate of return
- **Tenor/amortization period:** 5-8 years for commercial bank debt
- **Other capital sources:** ECA-provided financing for eligible equipment, steelmaker/joint venture partners expected to provide 30-40% equity by lenders

> Long-term offtake agreements are a fundamentally different model of steel buying compared to today.

Contracts

Demand: A key revenues source is expected to be a private, voluntary "green premium" paid by buyers of green steel (e.g. automakers). These long-term offtake agreements are a fundamentally different model of steel buying compared to today, where sales may be based on the spot market and index-based contracts. Further sources of sustained revenue and demand to the ring-fenced, non-recourse-based CCS entity could be measures such as public procurement and incentive schemes, such as EU ETS rebates, CBAM, contracts for difference, among others. The sale of CO_2 by-products (e.g. synthesis gas) to other downstream sectors, such as chemicals, can further fortify revenues across the business model.

Supply: Critical input on the supply-side is sustained and consistent CO_2 supply, without which the module cannot operate as intended, with reduced cash flows. CO_2 offtake agreements with steelmakers (e.g. the project developer) as well as regional and national governments will allow the CCS module to provide uninterrupted service.

De-risking measures

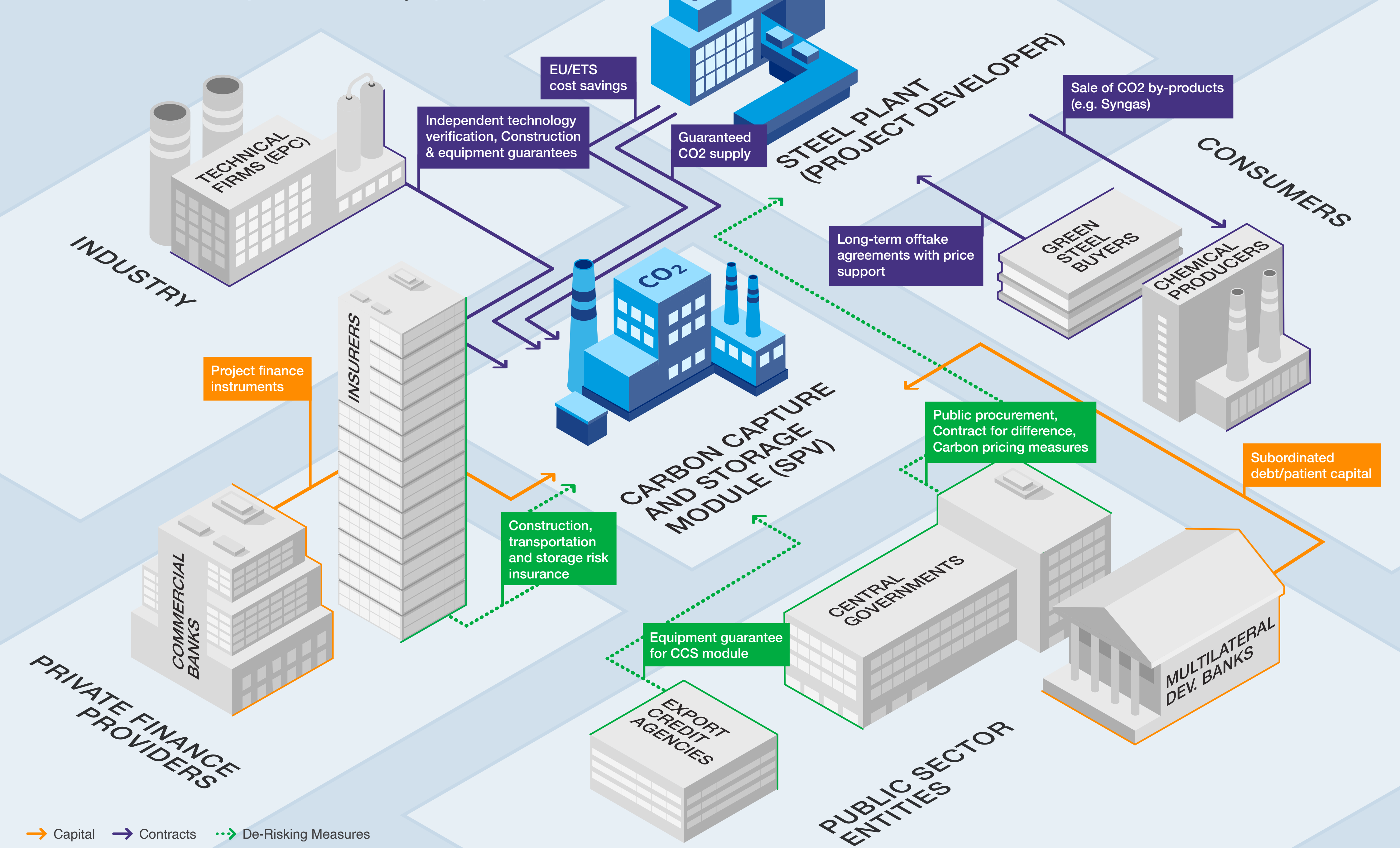
Given significant concerns about the competitiveness of green steel, CCS deployment in this sector will require de-risking measures to unlock private capital. Governments can de-risk investments through an existing arsenal of subsidies and credit enhancement measures. The success of the business model for the SPV rests upon a continuous supply of CO_2 and a maintenance of CO_2 pricing. Government support in establishing a price floor through contracts for difference or feed-in tariffs can mitigate business model risk and hedge against commodity price risk and against volatility in steel prices.

ECAs, too, have an irreplaceable role to play, as lenders have highlighted that significant amounts are unlikely to be financed for non-recourse projects or projects with non-investment grade counterparties without a vast majority of debt (i.e. 80% and upwards) being covered by ECA guarantees. Additionally, equipment guarantees for eligible equipment can further unlock private capital. Similarly, lenders are looking to MDBs to provide equity-like products, like subordinated debt, without which smaller debt-to-equity ratios will be observed.

Finally, subject to insurers receiving the same assurances about economic viability and operational risk as other financiers, the following de-risking measures may become available: investment risk insurance (for political and some elements of regulatory risk), engineering and construction risk insurance, and credit enhancements provided by insurers, which would also be additive in mitigating the risks outlined above, particularly for lenders (who can realize regulatory capital and counterparty lending limit benefits). To reduce potential financing costs and mitigate construction and development-related risks, technical firms can provide independent verification of the CCS technology and construction/equipment guarantees to further mitigate technology and performance risks.

ENABLING STEEL DECARBONIZATION

Deal structuring and financing blueprint for blast furnace retrofit with carbon capture and storage (CCS)



Source: World Economic Forum and Oliver Wyman, based on industry input

Steel H2-DRI

Technology overview

H2-DRI is a process that exclusively uses hydrogen as the reduction agent in the ore-based steel production process, as compared to conventional processes that use a combination of hydrogen and methane/syngas. Typically, the deployment of this technology requires financing for two separate facilities: a hydrogen (H2) plant as well as an electric arc furnace (EAF) steel plant. Given a limited precedent for decently sized plants using H2-DRI, financiers have identified considerable scale-up risk, which is likely to limit the provision of debt with conventional covenants.

Challenges and risks

In view of the significant risks associated with the new technology, some lenders have highlighted the attractiveness of a deconsolidated project structure, where the hydrogen plant set-up and EAF retrofitting are financed separately. Such a structure is said to facilitate a more strategic allocation of project risks (Figure 12). However, there is no widespread convergence among lenders on this deconsolidation of hydrogen production from the steel plant.

FIGURE 12 **Steel H2-DRI: key risks across project life cycle**

Preparation | Design and construction | Early operations | Later operations

Market/structural risks
Overcapacity of existing steel sector; overseas competition from lower-cost, highly carbon intensive producers; uncertain route for monetization of carbon/emissions benefits, by geography

Policy/ regulatory risks
Long-term political risk associated with use of subsidies and tax incentives; indirect impact of renewable energy policy on viability of hydrogen production and usage

Technology/completion risks
Deploying a greenfield technology at commercial scale; little to no technology risk insurance available

Performance/business model risks
Demand: Impact of sales price and supply on demand
Revenue risks: Green steel price expected to be volatile and reduce over time, revenue uncertainty will persist
Business model risks: Several O&M risks, given the integrated nature of the project

Other long-term risks
Hydrogen fuel-based concerns; interim use of 'blue hydrogen' may have associated reputational risks

Source: World Economic Forum and Oliver Wyman.

Capital

Some financiers have indicated that the decoupling of facilities would allow for the deconstruction of risks by de-linking the hydrogen production, transport and storage infrastructure from the EAF infrastructure. Deconsolidating the project structure allows for technological and business model risks to be managed independently and a reduction in complexity, and distributes risks across stakeholders, all of which can enhance business model viability. A precedent for this type of de-linked financing structure can be found in petrochemicals and LNG projects.

Capital providers' perspective on financing illustrative H2-DRI investment opportunities

- **Debt service coverage ratio:** 1.75x-2.25x for steel plant; 1.20x-1.35x for H2 plant
- **Debt-to-equity:** Up to 60% commercial debt for steel plant; lower for H2 plant given higher risk and limited precedents for large-scale plants. Equity could be from diverse players, such as specialized investors, traditional asset managers/owners, industrial counterparties and steel purchasers
- **Financing instruments:** Project finance for non-recourse, ring-fenced projects
- **Tenor/amortization period:** 7-10 years for commercial bank debt, less than 14 years for ECA debt for steel plant; 15-20 years for commercial bank debt for H2 plant
- **Other capital sources:** ECA-provided financing, junior debt from MDB/state financier; up to 60% with tenor of over 14 years. Potential for government grant if H2 plant is financed separately

“ Deconsolidating the project structure allows technological and business model risks to be managed independently and a reduction in complexity, and distributes risks across stakeholders, all of which can enhance business model viability.

Contracts

Demand: The success of the H2-DRI project rests on long-term offtake agreements with price support between the green steel producer and buyers. If the hydrogen production is deconsolidated, steelmakers could establish a contract with the hydrogen plant (i.e. SPV), based on availability-based payments. If the capacity of the hydrogen plant were to be expanded in the future, there would be an opportunity for other companies to establish tolling structures, allowing for the diversification of revenues for the SPV. As with CCS, public procurement for green steel is an additional enabler that can enhance bankability and drive decarbonization given the various downstream applications of steel.

Supply: For a hydrogen plant to be commercially viable, renewable energy must be accessible and relatively inexpensive. The project developer could secure a long-term contract for energy to ensure that operating costs remain stable and/or predictable throughout the project life cycle. Other arrangements that would support the viability of the H2-DRI project would be independent technology verification by technical firms to decrease technology/performance risks. EPC firms could also offer construction or equipment guarantees, further increasing investor confidence.

De-risking measures

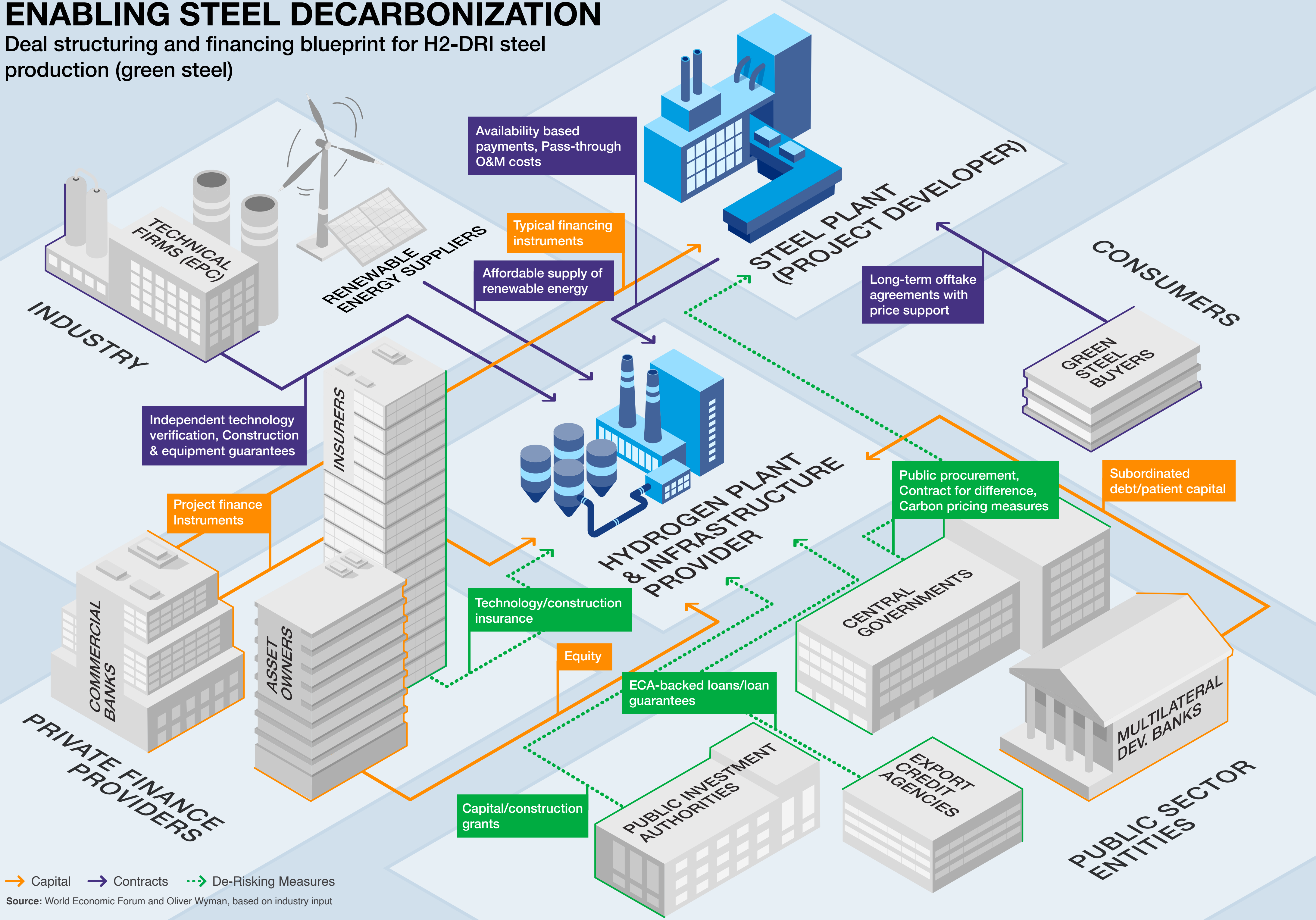
Given the operating structure of the H2-DRI project, the hydrogen plant and EAF steel plant will require distinct de-risking mechanisms. Hydrogen producers will require de-risking measures to mitigate innovation and performance risks. The EAF steel plant, a well-established technology and commercially scaled production process, will instead require de-risking measures to ensure that green steel is competitive with existing alternatives, and that there is sufficient long-term demand.

Similar to CCS, the involvement of ECAs is key, as lenders have highlighted that significant amounts are unlikely to be financed for non-recourse projects or projects with non-investment grade counterparties without a vast majority of debt (i.e. 90% and upwards) being covered by ECA guarantees. Similarly, lenders are looking to MDBs to provide equity-like products, like subordinated debt, without which smaller debt-to-equity ratios will be observed. With regard to private-sector measures, insurers have indicated they could be more willing to provide insurance when working under the umbrella of the preferred creditor status of MDBs and ECAs.

For the EAF steel plant, central governments could provide price support to enhance the competitiveness of green steel through targeted incentive schemes for early movers. Finally, given the need to develop new assets and infrastructure, the risk of stranded assets is significant in the context of the steel industry's transition to net zero. It is critical that governments establish clear policy signals to mitigate the risk of assets and infrastructure falling into disuse due to regime change.

ENABLING STEEL DECARBONIZATION

Deal structuring and financing blueprint for H2-DRI steel production (green steel)



Source: World Economic Forum and Oliver Wyman, based on industry input

Shipping

Sector and technology overview

Shipping accounts for approximately 3% of annual CO_2 emissions globally,[29] with emissions expected to nearly double by 2050. The sector presents an opportunity of $300 billion to $500 billion annually, with investments mainly required to build land-based infrastructure and sustainable fuel compatible ship engines.[30] While energy efficiency improvements can decrease shipping emissions, the deployment of alternative fuels is key to decarbonization. Green ammonia is considered a promising fuel, given higher energy density versus hydrogen, a complete absence of carbon atoms, and scalability/usability on long-distance routes. A pipeline of ammonia-based feasibility studies and small-scale pilot projects are being designed to further test the technology's potential.

Positively, stakeholders are committed to accelerating the sector's transition to net zero. In 2018, the International Maritime Organization (IMO) set an ambition to reduce sectoral CO_2 emissions by 50% by 2050. The IMO has adopted binding measures at a global scale, including the International Convention for the Prevention of Pollution from Ships (MARPOL), the Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP). Additional technical and operational requirements were adopted in June 2021 to accelerate reductions in carbon intensity, by requiring ships to meet a specified Energy Efficiency Existing Ship Index (EEXI) and a carbon intensity indicator (CII) rating.

Financial institutions have indicated their commitment to mobilizing the capital required to meet the IMO's emissions reduction ambition through the Poseidon Principles. Launched in 2019, the Principles provide a framework for financial institutions to assess and disclose their alignment with the IMO's climate goals. The Principles have 27 signatories, comprising the equivalent of $185 billion or 50% of shipping lending. In a similar vein, the Sea Cargo Charter was launched in October of 2020 to develop a comparable framework that would apply to charterers; the Charter has 21 signatories. These efforts by the shipping industry and the financial sector signify the growing momentum to progress towards net-zero targets.

Challenges and risks

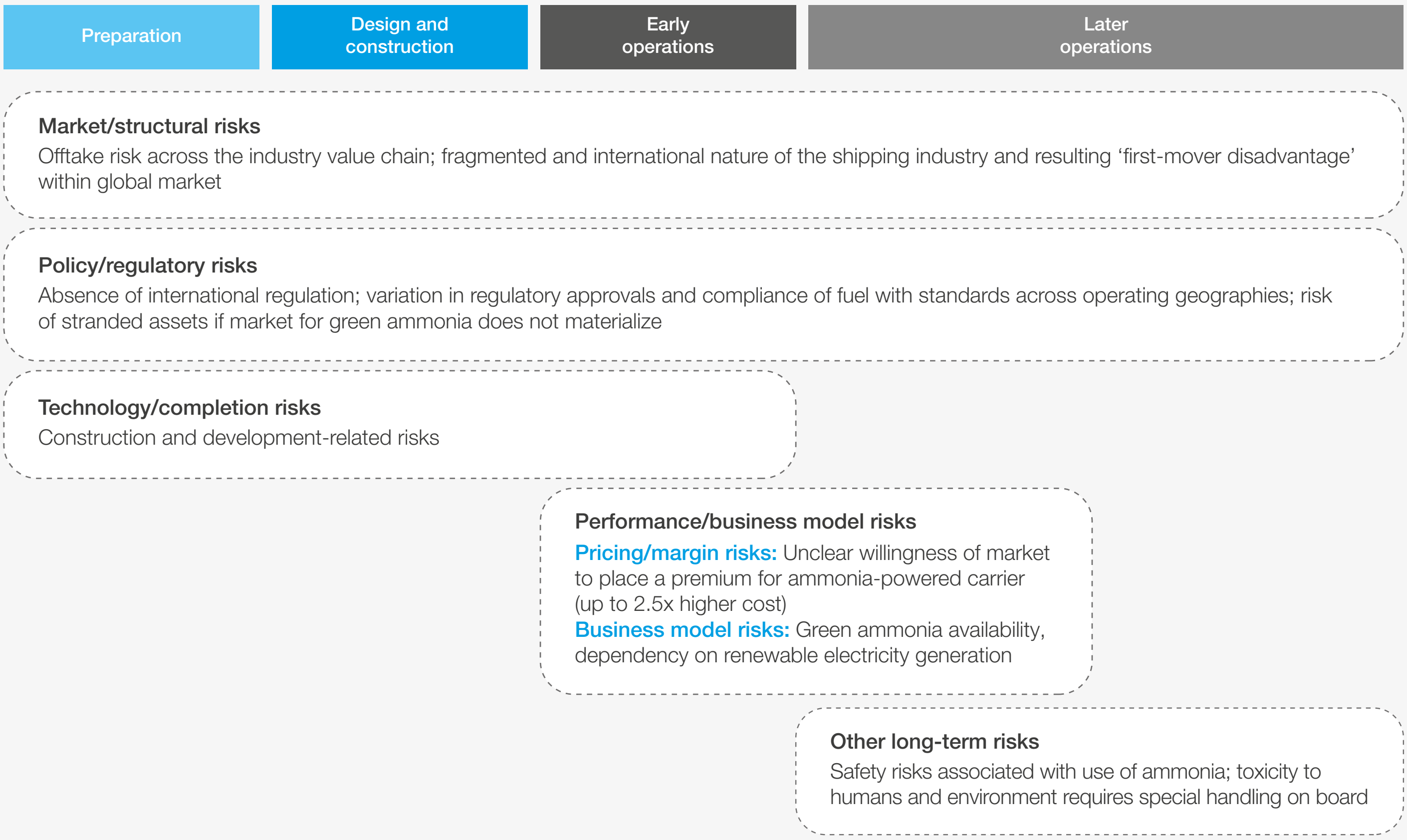
However, shipping's transition to net zero faces several challenges. With respect to financing, current vessels – with a lifespan of 25 to 35 years – operating on high-emission fuels must be written off as sunk costs for owners and investors.

Furthermore, private lending to the sector has declined steadily since the 2008 financial crisis, creating a growing investment gap.

At a solution level, a high cost differential exists between carbon-based fuels and potential green alternatives. While cargo liners have a predetermined route, other vessels, such as trampers, do not operate on a fixed schedule or regular route, raising the risk of incompatibility between the vessel and the bunkering infrastructure at the next port of call.

The highly fragmented, international nature of the shipping industry exacerbates challenges. Piecemeal policy intervention will be ineffective. While the EU's recent proposal to add shipping to the EU ETS is a step in the right direction, requirements and incentives must be implemented at a global scale to be effective. Further, carbon trading schemes are associated with price volatility, generating uncertainty for investors. These challenges, among other risks (Figure 13), have resulted in an investment gap that will need to be largely plugged by public capital.

FIGURE 13 **Key risks – Green ammonia-powered carrier**



Source: World Economic Forum and Oliver Wyman.

Capital

A majority of the financing required for green ammonia-powered carriers stems from fuel production costs. Co-investment across the shipping value chain is therefore a promising approach to produce cost efficiencies and improve business model economics. Potential co-investment structures could involve equipment providers, vessel manufacturers, cargo owners and fuel developers. This approach would allocate risk and costs across multiple stakeholders. For example, in the case of the Nordic Green Ammonia-Powered Ship (NoGAPS) project, the vessel is both powered by and transporting ammonia. The cargo owner is also the fuel supplier. By establishing what amounts to an offtake agreement for both the fuel and the vessel's services, this arrangement reduces the risk incurred by the vessel owner and the ship financier significantly.

Public-private investment frameworks are especially important for shipping's transition. ECAs have become an increasingly significant source of financing for the shipping sector since the 2008 crisis and will play a critical role in funding the next generation of ships. Applying a precedent from the renewables space, MDBs could provide project financing through an ECA. In this structure, ECAs can take on risk, resulting in cheaper financing for the vessel owner.

In comparison to previously discussed technologies, challenges associated with financing do not stem from the financing needs of the vessel itself. Given that a green ammonia-powered carrier is not expected to be significantly more capital intensive than existing ships, the solution does not lie in deal structuring. Rather, the key barriers to expanding the technology are fuel availability and price. To address these challenges and improve business model economics, de-risking measures and demand-side support (e.g. fuel mandates) are crucial.

Contracts

Demand: Uncertainty over green fuel offtake needs to be addressed through the stimulation of demand.[31] Long-term offtake agreements need to be established across the value chain, beginning with cargo owners accepting green premiums with potential pass-throughs to end customers. Similarly, vessel owners could enter into long-term chartering agreements (e.g. 15+ years) with cargo owners, with a built-in green premium.

Supply: Critical to the business model is a steady supply of green ammonia at a steady price. Since renewable electricity is a significant dependency for fuel production, driving 70% of production costs, securing an uninterrupted and affordable supply will enable solutions to be reliably adopted. Additionally, EPC firms can be brought in to oversee the engine development process, ensuring that vessel performance will be up to standards.

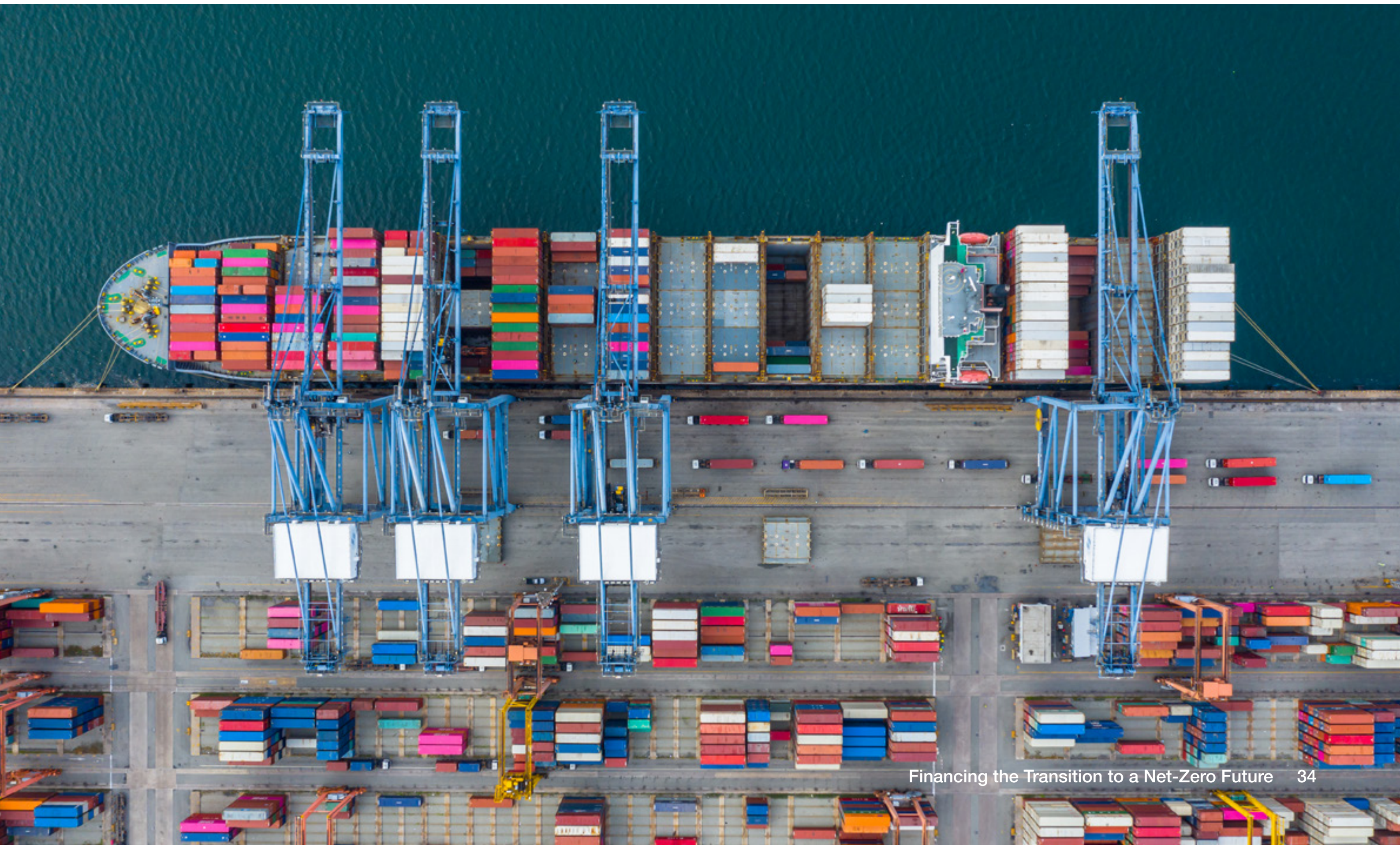
> ECAs are required to play a crucial role in closing the investment gap and providing credit enhancements to unlock private debt financing.

De-risking measures

ECAs are required to play a crucial role in closing the investment gap and providing credit enhancements to unlock private debt financing. They have become an increasingly significant source of financing for the shipping sector since the 2008 crisis and will play a critical role in funding the next generation of ships. Applying a precedent from the renewables space, MDBs could provide project financing through an ECA. In this structure, ECAs are able to take on the risk, resulting in cheaper financing for the vessel owner.

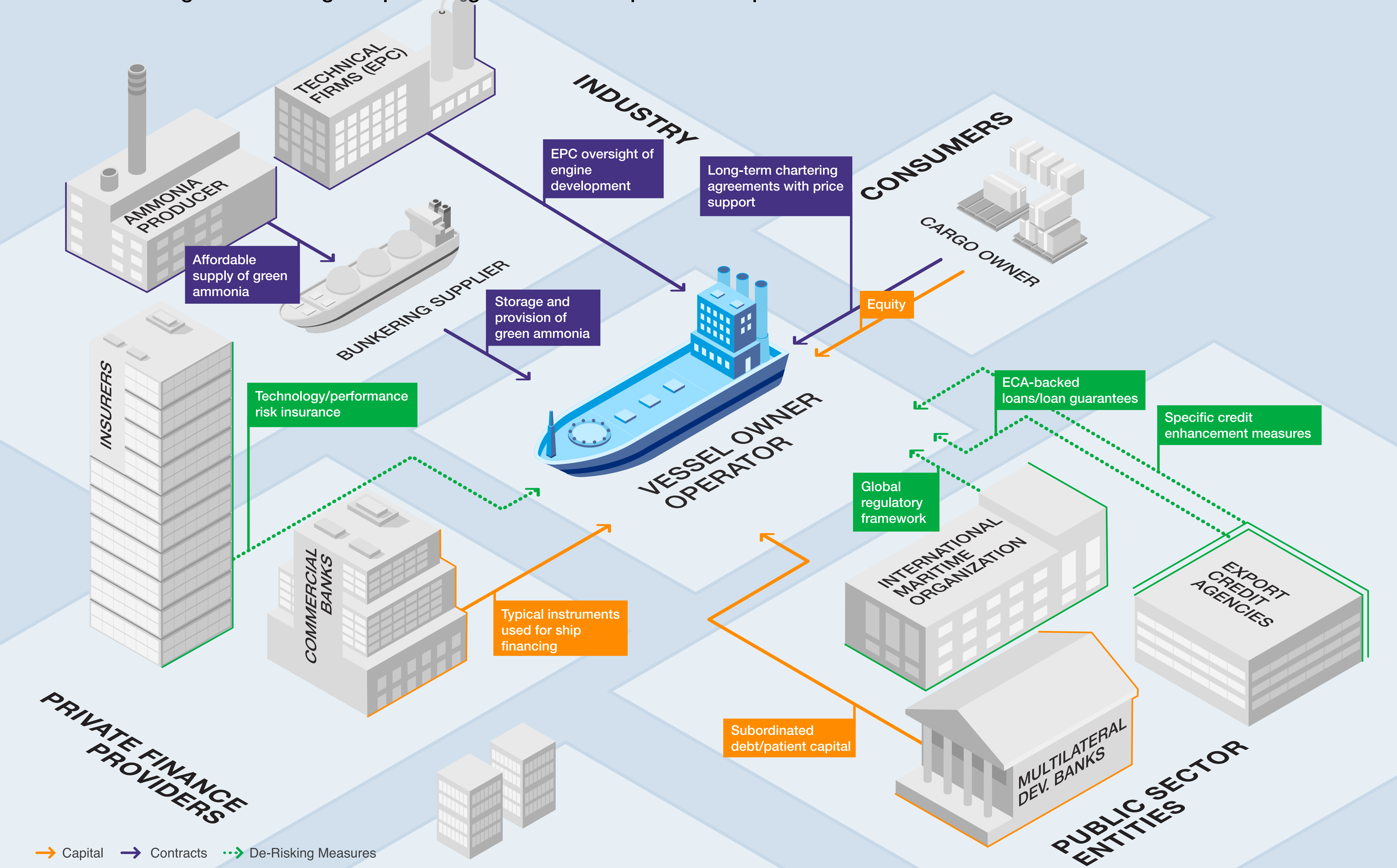
Given the highly fragmented, international nature of the shipping industry, policy intervention cannot take a piecemeal approach. While the EU's recent proposal to add shipping to the EU ETS is a step in the right direction, requirements and incentives must be implemented at a global scale to be effective. Further, carbon trading schemes are associated with price volatility, generating uncertainty for investors. The IMO has a significant role to play in setting a level playing field for the global shipping industry by establishing consistent guidelines and standards that apply to all vessels, regardless of geographic origin. Establishing safety and fuel handling regulations could signal to investors ammonia's viability as a solution. Creating a global regulatory framework can also help mitigate concerns regarding competitiveness.

Within the private sector, insurers can support risk mitigation through a dedicated product offering. The vessel owner/operator, too, can mitigate performance risks by utilizing a dual-fuel engine to decrease the potential exposure to risks associated with the supply of ammonia.



ENABLING SHIPPING DECARBONIZATION

Deal structuring and financing blueprint for green ammonia-powered ship



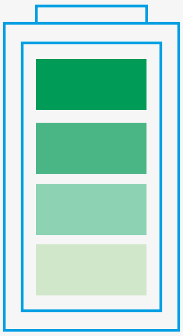
Source: World Economic Forum and Oliver Wyman, based on industry input

3 Public intervention to accelerate progress

The financial sector's ability to scale investment multifold under existing covenant, environmental and risk constraints has very real limits. The problem requires policy-makers to correct for the market failure. Intervention is necessary to establish de-risking measures, incentivize early movers and encourage MDBs to provide clear stewardship as anchor investors.

The private sector can make progress on the financing of early-stage breakthrough technologies, but this progress must be accelerated. This section outlines four thematic recommendations (Figure 14) and a set of underlying actions that policy-makers should consider to create an enabling environment and energize private capital flows.

FIGURE 14 **Recommended policy enablers to catalyse private finance**



- **A. Improve the risk-return profile of breakthrough decarbonization projects**
- **B. Coalesce a multistakeholder ecosystem for collective action**
- **C. Establish clear pathways, standards and mandates globally**
- **D. Design away perverse incentives and outcomes**

Source: World Economic Forum and Oliver Wyman, based on *Financing the Transition to a Net-Zero Future* initiative insights

Green investments environment framework

In 2012, the World Bank developed a framework for a "green investment climate", which it defines as an "investment climate for environmentally friendly activities based on policies, programs, legislation, institutions, fiscal and financial interventions, and other measures designed to promote green growth of economies".[32] It is based on the argument that enabling investment climates are typically shaped by a diverse range of tools that governments use as part of their intervention strategies. This arsenal of tools is important, but it is also essential that the interventions are not implemented in a piecemeal fashion and instead are guided by an overarching framework. Figure 15 maps the four key enablers against this framework and identifies specific tools and policies needed to accelerate progress.

FIGURE 15 | **Mapping of policy enablers to the green investment climate framework**

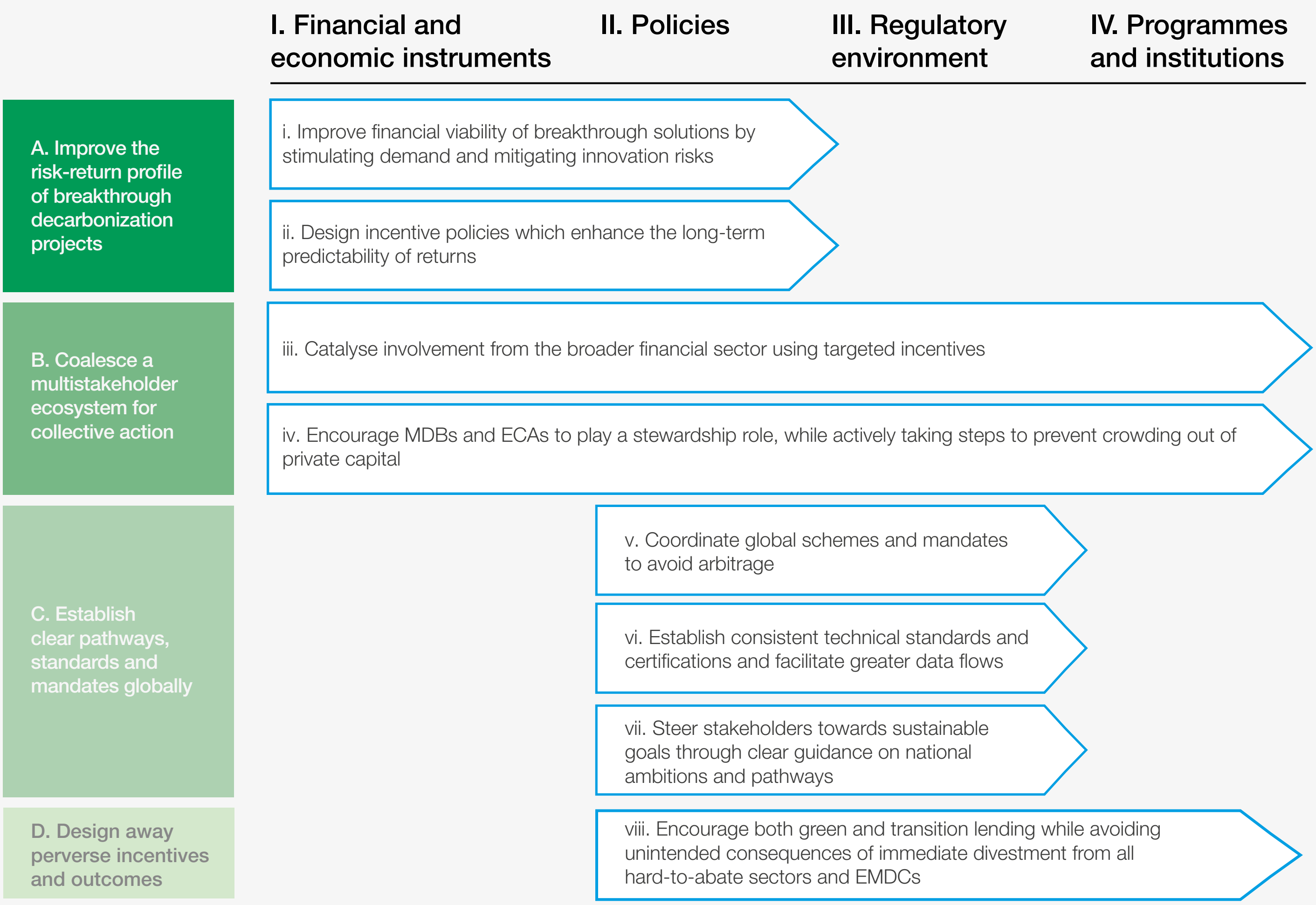
Framework	Description of component	Recommended policy	Mapping
I. Financial and economic instruments	**Fiscal incentives:** Incentives to reduce tax liabilities	– Early mover incentives (e.g. tax-equity swaps)	A, B
	Financial measures: Financial instruments, schemes, subsidy arrangements	– Contracts for difference/feed-in tariffs – Guarantees/subpar debt instruments – Capex grants – Credit insurance/enhancements	A, B
	Market-based mechanisms: Markets for carbon trading and valuation	– Tradable certificate schemes (e.g. SAFc) – Carbon pricing/rebates	A, B
II. Policies	**Policies, targets, and legislation:** Policies, specific legislation, and information availability-related initiatives to implement objectives	– Public procurement agreements – Green/blending mandates – Information availability-related initiatives (e.g., mandating transition plans)	A, B, C, D
III. Regulatory environment	**Procedures and mechanisms:** Specifications, standards, verifiable indicators to regulate green investments	– Green standards, certifications, labels – Corrective action to ensure regulatory compliance – Emission monitoring and verification	B, C, D
	Regulatory agencies: Institutions that create and maintain the regulatory environment	– Inclusion of climate related activities in mandates	B, C, D
IV. Programmes and institutions	**Programmes:** Initiatives implemented to promote green investing	– R&D funding, technical assistance – Catalytic capital through pooled investment vehicles – Investable pipeline development	B, D
	Institutions: Institutions involved in the country/regions programmes	– Structured engagement to co-design solutions and capital steering mechanisms	B, D

A B C D

Source: World Economic Forum and Oliver Wyman, adapted from World Bank, *Green Infrastructure Finance: Framework Report*, 2012.

The specific recommendations, while based on input received in the context of specific technology discussions, aim to holistically identify all enabling areas of public intervention. The eight recommended actions are outlined in Figure 16.

FIGURE 16 | **Organizing framework for recommended public-sector interventions**



Source: World Economic Forum and Oliver Wyman, based on *Financing the Transition to a Net-Zero Future* initiative insights.

i. Improve financial viability of breakthrough solutions by stimulating demand and mitigating innovation risks

The early mover financing and adoption of solutions can be enabled by improving risk-reward trade-offs. There are two key levers for the public sector to consider: 1) through demand enhancing measures such as green mandates (e.g. SAF blending), procurement requirements (e.g. power purchase agreements) and price support measures (e.g. carbon prices); this will stimulate demand for green products, ensuring a steady stream of revenue with adequate revenue margins;
2) through policy-makers de-risking innovation risks, thereby unlocking financing; specific measures include creating market solutions to reduce technology performance risks (e.g. equipment guarantees), establishing reliable supply chains of production inputs (e.g. municipal feedstock), and targeted grants/investments to spur bold innovation.

ii. Design incentive policies which enhance the long-term predictability of returns

Policy-makers should design incentive schemes that allow long-term predictability of financial returns. Short-dated incentive schemes will have limited impact, particularly in attracting patient capital, as financiers pursue steady returns over a longer tenor. Specifically, for breakthrough technologies, non-recourse project economics can be heavily reliant on commodity prices. While incentive schemes can encourage the buildout of production facilities, short-dated incentives limit the certainty of revenues. Extending the tenor of incentive schemes (e.g. the Low Carbon Fuel Standard for aviation fuel) and, where necessary, underwriting it in formal agreements (e.g. contracts for difference) can mitigate uncertainty, decrease the cost of capital, improve insurer willingness to underwrite investment risk and increase investor appetite.

iii. **Catalyse involvement from the broader financial sector using targeted incentives**

Tools and policies should be designed to facilitate greater participations from varied sources of capital. Insurers, asset owners, asset managers, patient capital and other sources of private capital are required to bridge the investment gap. Targeted measures are needed to elicit the involvement of these stakeholders. For example, such financial tools as tax equity incentives, tax exemptions and government capital grants towards projects can increase flows from institutional investors. Loan guarantees and concessionary capital are considered to be some of the most effective mechanisms for de-risking early-stage climate-oriented investments.[33]

iv. **Encourage MDBs and ECAs to play a stewardship role, while actively taking steps to prevent the crowding out of private capital**

Public capital providers, such as MDBs and ECAs, should look to use their financing abilities to serve as anchor investors. MDBs should create capacity in the system, lead on origination breakthrough technology-based projects and provide technical assistance on expanding innovative opportunities to corporates and partner financial institutions. They can better leverage public capital through blended finance and insurance instruments.[34] Both MDBs and ECAs have a critical role to play in providing the financial sector with a clear line of sight on national ambition, forthcoming initiatives and available programmes. ECAs, which to date have played a limited role in financing transition efforts, can finance SMEs and corporates on their transition journeys through the provision of climate focused loans, guarantees and insurance products. Export financing strategies will be needed, especially for hard-to-abate sectors, where the financial sector may have limited appetite to increase the scale of financing for historical reasons (e.g. capital constraints for lending in the shipping sector).

v. **Coordinate global schemes and mandates to avoid arbitrage**

Localized, fragmented regulatory activities and public-sector schemes will likely result in limited effectiveness. A coordinated global response across sectors and technologies is required to create a level playing field and ensure that green solutions are able to compete in the marketplace. For example, the decarbonization of the aviation sector is most likely to be successful through consistent global blending mandates for SAF (e.g. 10% blending) rather than localized/country-specific blending mandates. The latter will put the impacted airlines at a competitive disadvantage and slow down the expansion of global production and the distribution networks for SAF.

vi. **Establish consistent technical standards and certifications and facilitate greater data flows**

Policy-makers should aid the development of green standards, measurements, certification and verification frameworks to reduce the risk of greenwashing. This includes the use of green principles to promote consistency and transparency across international financial markets. Where progress is already being made by multilateral institutions and private-sector and mission-based organizations, policy signals can help provide credibility to appropriate efforts. Examples where this has been done effectively include the International Capital Market Association Green Bond Principles[35] and the Loan Market Association Green Loan Principles.[36] Additionally, policy-makers can address market inefficiencies caused by limited data by coordinating national reference data collection and sharing. For example, public institutions can share detailed data on own investments (e.g. loan guarantees by use of proceeds, insurance coverage) in addition to facilitating the creation of national data hubs for climate data.

vii. **Steer stakeholders towards sustainable goals through clear guidance on national ambitions and pathways**

Engaging in dialogue with financiers to set expectations, communicate national priorities and give credibility to low-carbon pathways reflecting country/regional specificities is key. This would help drive "conviction" and "convergence" on pathways most likely to support the country's transition to net zero while preventing the proliferation of misaligned efforts. It would also steer and focus capital in areas with the greatest need and impact. The communication of priority sectors supported by detailed roadmaps, for example, will ensure alignment and certainty on the way forward. It also allows the prioritization of limited production inputs (e.g. municipal waste) and the scaling up of common inputs (e.g. hydrogen).

viii. **Encourage both green and transition lending while avoiding unintended consequences of immediate divestment from all hard-to-abate sectors and EMDCs**

Strong and clear signals must be sent encouraging investment in the "greening" of brown, hard-to-abate sectors. If climate policies are not carefully considered and designed, financiers may inadvertently be incentivized to divest from important activities of the economy rather than to help them transition. For example, the narrow design of key performance indicators and incentives for "green assets" rather than for the "greening of assets and activities" can cut off financing to essential activities. Similarly, regulatory actions and developed country policies may inadvertently hinder climate finance flows to EMDCs if not carefully considered, which would not be consistent with the goals of a "just transition".[37]

Conclusion

The challenge ahead is significant, but not insurmountable. If executed thoughtfully, the mobilization of finance to breakthrough technologies presents a tremendous investment opportunity. More importantly, solving the climate crisis as a global community is the only viable path forward to avoid irreversible damage to the planet. It is imperative to capitalize on this growing opportunity and work together to achieve net-zero ambitions and avoid a climate catastrophe.

It is imperative that innovation across technologies and financing structures, and policy and cooperation across the stakeholder ecosystem, be enabled and encouraged to successfully catalyse system-level change. To support this effort, the *Financing the Transition to a Net-Zero Future* initiative will work towards elevating policy and MDB dialogue, further developing frameworks for financing and de-risking solutions tailored to emerging markets, identify specific lighthouse projects to be piloted and, more broadly, continue to identify areas for collaboration to mobilize finance towards fighting climate change.

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