

Decarbonizing South Africa's Shipping and Trucking Sectors

WHITE PAPER

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Preface

South Africa's abundant natural resources provide it with the opportunity to become a global leader in renewable energy and green hydrogen production. Its unique geography, astride major shipping lanes connecting Asia with the western hemisphere, positions it as an ideal hub for producing, bunkering and exporting zero-emission shipping fuels. These global opportunities could power the country away from fossil fuels, transform the nation's economy, create employment opportunities in new sectors and improve the lives of its people.

Decarbonizing energy production is a climate imperative for the planet and South Africa's contribution is enshrined in its commitment to reach net zero by 2050. It would deliver the secure, reliable and affordable electricity supply that the country urgently needs. Last year, load-shedding broke new records, affecting all levels of society and industry. A clean energy and industrial mix would also protect South Africa from the near-term risk to its export economy posed by the carbon taxes of its largest trading partners.

Looking to the future, an economy based on renewables and green hydrogen could provide the foundation for the country to produce and export zero-carbon molecules such as clean ammonia and methanol, essential for decarbonizing global transportation and heavy industrial processes. This transition could add close to 6% in GDP and 2 million new jobs, in a country where tackling unsustainable levels of joblessness, poverty and inequality dominate political discourse.

These opportunities featured prominently in presentations and discussions during a three-day workshop organized by the First Movers Coalition in Cape Town in March 2024, which attracted 70 participants from a wide range of public and private sector organizations. The coalition combined shipping and trucking into one workshop to spark cross-sector insights and highlight synergies – given that both sectors face similar challenges and enablers around financing, infrastructure and competitiveness.

There are encouraging signs of progress. The government has enacted climate-forward policies aimed at decarbonizing transport, commercializing green hydrogen and developing the value chain for renewable energy. It has framed an investment plan for the just energy transition, targeting a budget of nearly ZAR 1.5 trillion. The World Bank has completed pre-feasibility studies into several major green hydrogen projects. Workshop participants agreed that combining forces across shipping and trucking could strengthen the demand and supply signals for the zero-emission technologies that hold the key to decarbonizing both sectors.

The transition of South Africa's energy and transportation sectors is not in the hands of its government alone. The private sector, multilateral development banks and industrialized countries all have critical roles to play – to aggregate demand for low-carbon solutions and de-risk the finance needed for huge investments in new infrastructure. It will take the collaboration of all these actors to connect global demand and financial resources with a domestic pipeline of projects ready to deliver the future fuels that South Africa is so well-poised to produce.

Executive summary

Challenges

As a major contributor to the global economy, South Africa faces increasing political and economic pressure to decarbonize. However, the country is already challenged by an energy crisis costing the country 2-3% of GDP growth. Balancing the need to decarbonize with job security, community impact and social equity remains a complex challenge.

As the country's leading trade partners implement policies including carbon border taxes to achieve their net-zero targets, up to 35% of the country's export value could be at risk if decarbonization is not pursued.

Meanwhile, the state of the electricity grid – operating at little more than 50% capacity – as well as the need for infrastructure upgrades to road, rail and port networks limit the feasibility of low-carbon technology development. Financial barriers such as high interest rates, low internal rates of return and insufficient capital structures create major barriers to projects getting financed.

Opportunities

South Africa has the opportunity to become a leader in clean technology and a role model for a just energy transition in emerging markets. With its high renewable energy potential and strategic position in global maritime trade, South Africa is poised to be a leader in green hydrogen (GH₂) including:

- Transforming ports into green bunkering hubs for international shipping.
- Developing the infrastructure to utilize GH₂ for domestic commercial road transport.
- Exporting GH₂ derivative products to service increasing global demand.

Additionally, South Africa can leverage development finance and explore novel financial instruments to accelerate project development and make offtake bankable.

Trucking decarbonization

Trucking is the backbone of commerce in South Africa: the auto-manufacturing sector provides ~5% of the country's GDP and employs more than 500,000 people, with over 50% of production exported.

Key barriers:

- Lack of charging infrastructure needed for widespread adoption of zero-emission trucks (ZETs), as well as accompanying grid infrastructure and charging stations.
- Factors that limit demand for ZETs, including: cost, lack of confidence in government action, import duties on finished trucks.
- Absence of policies to provide: incentives for production or adoption of ZETs, allowances for increased weight and dimensions of ZETs, common standards or a plan to deploy necessary infrastructure.

Key solutions:

- Public-private partnerships to promote opportunities such as green corridor development, public procurement and other infrastructure.
- Support for a just transition through improving grid capacity and resilience, while providing incentives for and removing barriers to procuring ZETs.

Shipping decarbonization

With its favourable geography and immense potential for green hydrogen, South Africa has the opportunity not only to develop green bunkering hubs, but also to export green hydrogen and derivatives (e.g. e-ammonia and e-methanol) to supply a growing demand from global shipping for zero-emission fuels.

Key barriers:

- Global demand for zero-emission fuels and ongoing evolution of regulation.
- High cost of e-fuels preventing projects from securing offtake or reaching final investment decision, amplified by the high cost of project financing in South Africa.
- Existing port infrastructure issues (e.g. stability, reliability, ease of bunkering) and the need to invest in new facilities to bunker future fuels.

Key solutions:

- Development of port infrastructure, incentives to produce green hydrogen, and supportive international regulations (e.g. through International Maritime Organization).

- Financing from institutional finance, multilateral development banks (MDBs) and private financiers, to accelerate project development of hydrogen production and derivatives.
- Continued collaboration on integrated green fuel value chains across clusters (e.g. Boegoebaai Port, Freeport Saldanha), along with efforts to scale-up global offtake.

Finance as a vital enabler to accelerate low-carbon technologies

Securing finance is critical for scaling-up and commercializing low-carbon technologies, especially in emerging markets where costs of capital and interest rates are notably high. South Africa will need to explore non-traditional and novel financing instruments to fund the transition, including project development for zero-emission fuels, manufacture of zero-emission trucks, upgrading port and road freight infrastructure, and improving and expanding the grid.

Key barriers:

- High interest rates and cost of capital in South Africa (as high as 18%) make energy projects less attractive to financiers.

- Traditional capital structures are inadequate, with no clear guidance on where concessionary capital can plug in.
- Typical offtake agreements are only 1-5 years, but new projects need longer agreements to ensure bankability.
- Lack of transparency and standards make it challenging for financiers and buyers to assess projects.

Key solutions:

- Governments can explore combined public-private funding with MDBs and private financiers to provide more early-stage financing mechanisms.
- Development banks and project developers can work together to clarify and streamline the deployment of concessionary capital.
- Private sector actors can continue to partner across the value chain to deploy strategic capital and accelerate project development.

1 Role of renewable energy and green hydrogen in the transition

Domestic generation of renewables and green hydrogen could tackle the decarbonization challenge and turbocharge a just transition.



1.1 Renewable energy – the key to hitting net zero

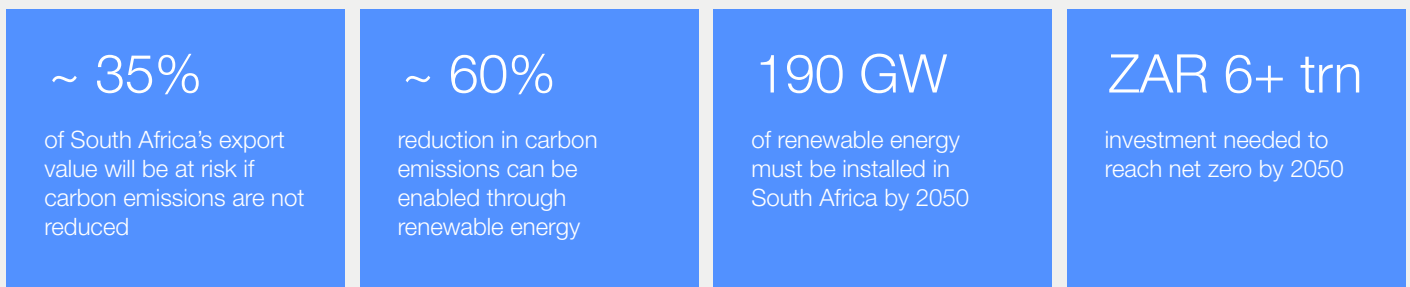
South Africa's geography, space and abundance of wind, sun and water offer enormous potential for the country to become a global hub for clean, renewable energy. With an estimated 920 GW of wind and solar resources,¹ South Africa has the opportunity to accelerate its rollout of renewables to deliver more affordable, reliable power to its people while safeguarding the country's recent commitment to achieving net zero by 2050. However, as the world's 15th largest emitter globally, with over 80% of its electricity mix relying on an ageing fleet of coal-fired power stations,² there are challenges to overcome to realize this opportunity.

An energy system rooted in renewables would mitigate the trade risks posed by the transition of more industrialized nations. With South Africa's leading trade partners moving to implement policies such as carbon border taxes to achieve their net-zero targets, up to 35% of the country's export value could be at risk if decarbonization is not pursued.³

A thriving renewables sector could also fuel new opportunities such as green hydrogen production and the manufacture of zero-emission fuels (ZEF), which would not only support decarbonization of the country's heavy industries but also increase the competitiveness of its exports and its entire economy.

The numbers are ambitious, yet achievable. South Africa can reach net zero by 2050 by installing 190 GW of renewable energy, leading to a reduction of approximately 60% in carbon emissions. This requires installing 6-7 GW of renewable capacity every year by 2030⁴ – a considerable challenge given the country has installed just 6.1 GW in total over the past decade. Nevertheless, roughly 20 GW of capacity is in the pipeline, amounting to about one-third of the 60-70 GW needed by 2030 to achieve the low end of the target in its 2030 Nationally Determined Contribution (NDC).

FIGURE 1: South Africa's transition – an overview in data



Sources: South African Reserve Bank,⁵ National Business Initiative.⁶

ZAR 3 trillion needed to decarbonize power sector

The total investment needed for South Africa to hit net zero by 2050 runs to over ZAR 6 trillion, of which roughly half is needed in the power sector. The good news is that, of the ZAR 310 billion of investment in renewable energy needed by 2030, about 60% is sufficiently bankable and mature to be funded mainly from private sector sources, according to analysis by Boston Consulting Group (BCG).⁷ International development finance will be needed to fund “non-bankable” investments (e.g. social costs, reskilling) and to support the development of the green hydrogen industry.

To accommodate this amount of new energy capacity, major investment is needed to expand, strengthen and modernize South Africa's creaking electricity grid, which one workshop participant noted is “about the size of Western Europe”. Given the grid's current capacity, only about 30 GW of renewables could be added⁸ – well short of the 190 GW needed for the power system by 2050. By 2030, an extra 30 GW of capacity needs to be built, with coastal areas being the optimal sources for renewable energy. At least 14,000 km of new power lines will be required to transmit the additional renewable capacity.



A renewable power system can result in net-positive job creation of 2.4 million cumulative job years by 2050 if elements of the renewable energy value chain are localized.

Boston Consulting Group⁹

Stabilizing energy security and reliability with decentralized renewables

In the face of worsening load-shedding during 2023, workshop participants discussed the urgent need to stabilize energy security and reliability.

One participant highlighted the “huge potential for decentralized solar generation”, particularly on the residential side, with an “absolute bonanza of solar power batteries” coming into the country, contributing to a total installed capacity in 2023 of 6.164 GW of solar power.¹⁰ He also noted the role of mining companies in generating their own renewable power locally.

BOX 1: Key policies supporting renewables and green hydrogen

July 2023: [South African Renewable Energy Masterplan \(SAREM\)](#)

December 2022: [Green Hydrogen \(GH₂\) Commercialisation Strategy](#)

October 2021: [Hydrogen Society Roadmap for South Africa](#)

1.2 Green hydrogen – a 7 million tonne/year opportunity by 2050

Workshop participants highlighted that South Africa’s opportunity to power the transition reaches far beyond renewables. The real opportunity is to use the country’s solar, wind and hydro assets to develop green hydrogen and its derivatives – a process which starts with renewable-powered electrolysis to split either freshwater or sea water into hydrogen and oxygen, and ends by compressing the gas for a wide range of commercial and industrial use-cases.

Given that South Africa is already the biggest producer of grey hydrogen in the world, a new green hydrogen masterplan could become a cornerstone of the country’s post-fossil economy. With major economies moving towards net zero, the global market for green hydrogen is expected to grow and South Africa’s existing export relationships with the EU, Japan and UK position it well to exploit this opportunity.

Hydrogen use-cases

The FMC’s in-country workshop heard from a variety of sources on South Africa’s opportunity to produce green hydrogen. The applications of hydrogen technology cover many different sectors of the transition, for example:

Industry:

- Production of ammonia and methanol as feedstocks (e.g. for chemicals, fertilizers, refrigeration).
- Direct reduction of iron for green steel.
- Direct combustion for high-temperature industrial processes.

Mobility:

- Production of e-ammonia and e-methanol to power ocean-going shipping.
- Hydrogen fuel-cell technology offers the possibility of powering road vehicles and rail transport.
- Aviation and ocean-going shipping could, if technology matures, be powered by direct hydrogen combustion in the future.

Power and heat:

- Hydrogen fuel cells can be used to store power and heat.
- Fuel cells or direct hydrogen combustion can be used to power turbines.

Having produced the hydrogen, one of the key challenges will be compression to 350-700 bar, to enable the gas to be transported for use in industry or used as a fuel for H₂ internal combustion engines or fuel-cell electric vehicles. Another application is to use fuel-cell battery technology to provide electricity to the grid – a use-case known as “power to power”.

Workshop participants also highlighted the opportunity of combining the twin needs of shipping and trucking for ZEF such as green methanol and ammonia into a single, powerful demand signal for South Africa’s nascent green hydrogen production sector.

Potential benefits to South Africa

Developing South Africa's green hydrogen capability could bring huge benefits to the economy, the country's quest to decarbonize, the employment market and the development of infrastructure:

GDP boost of 5.9%

- The GH₂ value chain can drive the industrialization of South Africa's heavy manufacturing (e.g. green steel) and petrochemicals sector (e.g. sustainable aviation fuel, green methanol, PtX) to drive economic growth.
- This could increase GDP by around 5.9% or ZAR 500 billion by 2050, according to the World Bank.¹¹

Decarbonize hard-to-abate industries

- GH₂ can cost-effectively drive 10-15% emissions reductions in sectors where electrification is unfeasible (e.g. heavy manufacturing, long-distance aviation and shipping, petrochemicals) to ensure competitiveness in net-zero world.¹²

Up to 1.8 million new jobs

- The GH₂ value chain can drive long-term net job creation in new green jobs, as well as preserving jobs in at-risk industries (e.g. heavy manufacturing, petrochemicals).
- In scenarios with GH₂ exports and associated industries, up to 1.8 million more jobs could be created economy-wide by 2050 than in scenarios without GH₂ exports and use.¹³

Enable infrastructure investment

- GH₂ projects will serve as anchor demand to justify shared infrastructure investment, including Boegoebaai port, the Northern Cape grid expansion, reskilling initiatives etc.

Future green hydrogen production hubs

The South African government's green hydrogen programme includes 19 projects worth over ZAR 300 billion,¹⁴ of which the Department of Public Works and Infrastructure (DPWI) has selected nine "strategic integrated projects" (SIPs) for expedited approval processes (see Figure 2).

Among these fast-tracked projects, the workshop focused on three major strategic opportunities to develop hydrogen production hubs – Durban-Richards Bay, Saldanha Bay and Boegoebaai. Each project aims to support the just transition, by growing local green jobs and in some cases offering alternative employment to fossil jobs.

Participants at the workshop were updated on these opportunities in a presentation by the Global Maritime Forum, which with the World Economic Forum and Friends of Ocean Action has created the P4G Getting to Zero Coalition Partnership that recently published [South Africa: fuelling the future of shipping: South Africa's role in the transformation of global shipping through green hydrogen-derived fuels](#).¹⁵



FIGURE 2: | Nine green hydrogen mega-projects fast-tracked



1 Prieska Power Reserve
Product: Ammonia
Size: 70+ kt NH₃/yr
Exp. date: 2026/30

2 Ubuntu Green Energy H₂ Project
Product: Ammonia
Size: 73kt NH₃/yr
Exp. date: N/A

3 Boegoebaai Green H₂ Programme
Product: H₂
Size: 400kt H₂/yr
Exp. date: 2025

4 Atlanthia Green H₂
Product: H₂
Size: N/A
Exp. date: N/A

5 Upilanga Solar and Green H₂ Park
Product: H₂
Size: N/A
Exp. date: N/A

6 Sasolburg Green H₂ Programme
Product: H₂
Size: 1.8kt H₂/yr
Exp. date: 2023

7 SASOL HySHiFT
Product: SAF
Size: 15kt/yr (up to 2.5Mt/yr)
Exp. date: 2023/40

8 HIVE Ammonia
Product: Ammonia
Size: 780kt NH₃
Exp. date: 2025/26

9 Anglo-American Mogalakwena Mine
Product: H₂
Size: 3.5MW electrolyser
Exp. date: 2022

Awaiting information for ISA registration

10 Enertrag Indigen Methanol Project

11 Enertrag Postmasburg Ammonia Project

12 Mainstream Renewable Energy H₂

13 AMSA Saldanha Steel H₂ project

14 HDF Energy, IPM 1, H₂-to-power

15 Isondo Fuel Cell MEAs Mnfg.

16 Saldanha Bay Green H₂ Project

17 Project Phoenix fuel cells–Mitochondria

18 Cape Stack Fuel Cells

19 Bambili Hyplat Fuel Cell Mnfg.

Note: H₂ = hydrogen, MeOH = methanol, SAF = sustainable aviation fuel.

Source: BCG

Durban-Richards Bay hydrogen valley

This project aims to develop a “hydrogen valley” along South Africa’s northeast coastline, based on a hub from Durban to Richards Bay. It seeks to aggregate demand to kickstart hydrogen production and leverage economies of scale in South Africa.

Saldanha Bay

Saldanha Bay Industrial Development Zone (IDZ) is being promoted as a hub to produce zero- and low-carbon fuels and goods – for domestic use, to refuel vessels that call at the port and for export to the global market. Synergies with local industry could lead to economic growth and new jobs in the production of green steel and zero-carbon shipping routes for bulkers carrying iron ore. The project could produce 50,000 tonnes of GH₂ per annum, generating around 280,000 tonnes of green ammonia (see Box 4).¹⁶

Boegoebaai

Boegoebaai, located in Northern Cape Province, has the potential to become a deep-sea commercial hub that exports zero-carbon bunker fuels and commodities. This port, rail and infrastructure project would transport mining,

agricultural and other products while generating jobs and economic development through the production of green hydrogen and ammonia.

Regional opportunities between South Africa and Namibia

Analysis by the World Bank and Hyphen (a \$10 billion solar, wind and green ammonia project in Namibia) points to the possibility of a green corridor between the two countries to promote zero-emission fuels. According to the Bank, Namibia has at least nine green hydrogen projects in preparation, with applications including green steel, hydrogen trains and hydrogen storage, as well as ammonia for shipping fuel, fertilizers and other industrial applications.

A workshop participant noted that the future of hydrogen supply is decentralized, with many production points serving many demand centres, especially for maritime applications. A green corridor linking Southern Africa’s coastal ports would therefore enhance the connectivity of supply and demand. Collaboration between regional governments could be a key enabler.

1.3 Financing challenges for renewables and green hydrogen projects

The workshop heard that, during 2023, the World Bank had approved \$1.65 billion in concessional financing to ramp-up the deployment of clean hydrogen projects in emerging markets.¹⁷ The current pipeline exceeds \$5 billion and other multilateral development banks are ramping up their hydrogen financing. For example, the International Finance Corporation (IFC) has become involved in nearly a dozen green hydrogen projects worldwide, totalling over \$10 billion in potential investments.¹⁸

However, despite the huge potential of both renewable energy and green hydrogen, such clean

energy projects face challenges across the world in reaching final investment decision, often through lack of demonstrable demand. This is also true in South Africa, where the cost of capital for energy projects can be as high as 18%.¹⁹

One workshop participant noted that the need to compete with the cost of capital globally is “a big issue in South Africa and on the continent, especially regarding hydrogen.” Project developers face challenges from foreign exchange risk and the high cost of debt, currently up to 12% in South Africa. The green premium is still too high without greater incentives, said the participant.



At some stage governments and offtakers will have to think carefully about incentives to industry – unless they do this, there will be no traction.

Workshop participant

2 Shipping

South Africa has great potential as a production and bunkering hub for zero-emission shipping fuels – but it needs global demand to get the ball rolling.



2.1 Sector overview

Shipping serves a critical role in transporting over 80% of world trade²⁰ and global demand for sea freight is forecast to triple by mid-century.²¹ As the low-carbon transition gathers pace, consumer goods companies, mindful of their scope 3 emissions targets, are shifting their freight from planes to ships. However, while shipping may be a less polluting way to move goods around the planet compared to the alternatives, it still emitted 1.1 billion tonnes of greenhouse gases (GHG) in 2018, accounting for nearly 3% of all GHG emissions.²²

In July 2023, the International Maritime Organization (IMO)²³ adopted a historic ambition of achieving net-zero GHG emissions for international shipping by or around 2050. This was a game-changing moment for the industry's decarbonization journey, especially given international shipping was omitted from the Kyoto Protocol and the Paris Agreement. To achieve net zero, the industry needs to abandon the fossil-based bunker fuel that powers 99% of commercial shipping²⁴ and chart a course towards full decarbonization.

Two low-carbon fuels that can power big vessels²⁵ stand out: methanol offers a viable short-term pathway, while ammonia could

become commercially viable later this decade. For these breakthrough fuels to be zero-emissions, production technologies and feedstocks such as renewable energy and green hydrogen are required. Hydrogen as a direct shipping fuel is yet to be fully explored – it may prove viable for specific situations (e.g. short-haul ferry routes), though this would not be relevant for international shipping.

South Africa sees the highest volume of maritime traffic in Sub-Saharan Africa. Its strategic location, abundant natural resources and export economy have made the country a long-standing hub of international trade.²⁶ Maritime imports and exports accounted for ~90% of all South African trade volume in 2023.²⁷

The FMC's in-country workshop explored opportunities for South Africa to become a production and bunkering hub for fuels that can decarbonize the shipping sector. This is a key objective of the FMC's "surfacing supply workstream" and complements demand-side commitments made by shipping sector members to shift to zero-emission fuels (ZEF), as either carriers or cargo owners, in line with the criteria in Box 2.



South Africa's shipping sector creates over 300,000 jobs, with the potential to reach more than 1 million jobs by 2033.²⁸

This chapter analyses the status of technologies, opportunities, challenges and solutions in relation to decarbonizing shipping in South Africa and globally

For more detail on finance and policy measures necessary to support the low-carbon transition of the country's heavy industries, see Chapters 4 and 5.

BOX 2: FMC's targets for zero-emission shipping

Carriers:

"At least 5% (on an energy basis) of our deep-sea shipping will be powered by zero-emission fuels* by 2030"

Cargo owners:

"At least 10% of the volume of our goods shipped via deep-sea shipping will be on ships using zero-emission fuels by 2030, reaching 100% by 2040"

*FMC definition:

Zero-emission fuels are those that reduce well-to-wake GHG emissions by 80% or more compared to fossil heavy fuel oil²⁹

- Current list of fuels includes: ammonia, methanol, hydrogen, battery
- These commitments do not include biofuels, liquid natural gas, carbon offsets or efficiency improvements

Full details of the commitment can be found [here](#).

2.2 Status of technologies, supply and demand

South Africa is strategically positioned astride major global shipping lanes from Asia around the Cape of Good Hope to Europe and the continents of North and South America. As the transition to a low-carbon economy gathers pace, vessels will need to refuel more often, given that zero-emission fuels are about half the energy density of fossil fuels. This makes South Africa's location midway between eastern and western hemispheres a potentially ideal bunkering stop-off.

The country's plan to develop a hydrogen economy positions it at the centre of global efforts to decarbonize shipping. The two leading ZEF (e-methanol and e-ammonia) are both derived from green hydrogen, so South Africa has the potential to become both a shipping fuel producer and exporter. For more detail on the country's green hydrogen ambitions, see Chapter 1.

Workshop participants discussed the relative merits of e-methanol and e-ammonia. Due to the technological readiness of methanol, green methanol is considered the most viable near-term ZEF for shipping. Its added advantage is that vessels can be – and are being – fitted with dual-fuel engines that run on either green methanol or conventional bunker fuel, reducing the capital risks of investing in new technology.

Ammonia is also being tested as a shipping fuel in various demonstration projects. The market has seen a strong uptick, especially over the past year, in orders for ammonia-powered dual-fuel vessels. Recent breakthroughs in testing and commercializing ammonia-powered engines mean that ammonia-based fuels could be market-ready by the second half of this decade. Concerns still exist around the safety of handling ammonia, but these are being addressed and tested.

2.3 Opportunities

South Africa's great opportunity lies in the country's potential supply landscape of domestic ZEF production – enabled by a wind- and solar-powered hydrogen economy – combined with the global shipping industry's demand for ZEF. However, this will only materialize if the country can address a range of domestic challenges. The opportunity is not simply to produce future fuels for global supply chains, but to create a win-win situation in which South Africa's global

role enables it to grow its domestic economy, decarbonize its industries and generate jobs through a just transition.

Mette Asmussen, who leads Maritime Sector Initiatives for the World Economic Forum, explains the close relationship between international and local markets: "What is happening globally will also impact whether the opportunity in South Africa can be realized."



While global policy certainty can make up for local uncertainty, if there is no global switch to green fuels, there will be no domestic switch either.

Mette Asmussen, Lead, Maritime Sector Initiatives, World Economic Forum

Workshop participants highlighted some key opportunities in the South African context that could help accelerate the adoption of zero-emission shipping, outlined below. These revolve around the possibility of manufacturing green hydrogen to produce e-methanol or e-ammonia, which in turn create new opportunities for the country, such as bunkering, green corridors and shipping offtake through fuel exports.

Green hydrogen for e-methanol and e-ammonia

Green hydrogen production offers South Africa numerous opportunities, both for domestic production of zero-emission shipping fuels and for the export of green hydrogen and its derivatives

to other markets. Given its volume and volatility, hydrogen is a notoriously challenging element to transport, requiring either high pressure or cryogenic storage. Consequently, hydrogen export would need to find different carrier molecules or energy vectors, such as e-methanol and e-ammonia. These synthetic molecules are made using clean hydrogen, combined with sustainable carbon or nitrogen.

The World Bank has estimated international shipping's demand for South African hydrogen could total 182,000 tonnes a year by 2030 and 2 million tonnes (Mt) a year by 2050 (including demand in ports and from by-pass traffic). This opportunity may be particularly attractive in the near-term as shipping operators search for ZEF and green hydrogen producers look for reliable and significant volumes of offtake to make projects bankable.



International shipping's demand for South African hydrogen could total 182,000 tonnes a year by 2030 and 2 million tonnes a year by 2050.

The World Bank

Shipping offtake – bringing global demand to local supply

Globally, more than 200 dual-fuel methanol vessels have been ordered, requiring over 20 Mt of e-methanol fuel per annum to achieve 100% zero-emission operability.³⁰ However, fuel availability at that scale is expected to be challenged until at least 2030-35.³¹ This demand creates an opportunity for South African producers to secure early customers and sign advance offtake agreements, providing certainty for new projects and improving investment prospects.

Ammonia also brings advantages as a ZEF, such as high carbon-emission savings, unlimited feedstock (nitrogen) availability and existing logistical infrastructure around the globe. While ammonia engines will reach the market from 2025 at the earliest, major carriers like Trafigura and BHP are already placing orders for dual-fuel ammonia vessels. It is clear that ammonia is projected to grow as one of the top fuel choices to achieve net zero.

The World Bank has conducted a pre-feasibility study on establishing green shipping fuel value chains at the ports of Boegoebaai and Saldanha Bay.³² The study identifies ammonia as the preferred ZEF production choice for South Africa, due to the scarcity of biogenic carbon dioxide to produce methanol. Most of the fuel's cost comes from hydrogen feedstock – but by leveraging abundant wind and solar supply, the two ports will be able to generate renewable electricity at scale to produce competitive green hydrogen for local industry use (e.g. green steel) and to produce green ammonia for export to the global shipping industry.

Geographically well-positioned bunkering hub and green corridors

Political disturbance and security risks in the Red Sea during 2023-24 forced many shipping operators to abandon the Suez Canal and re-route

their cargo around the Cape of Good Hope. Even without those risks, operators shipping lower-value or less time-critical cargo may use the Cape route rather than the more expensive Suez Canal, adding two weeks to a ship's voyage time from Asia to Europe. This extra travel time – plus the lower density of zero-emission fuels – could compel vessels running on ZEF to bunker in South Africa before reaching Europe. Access to zero-emission fuels therefore opens up the possibility of South African ports positioning themselves as bunkering hubs to supply passing shipping traffic.

Furthermore, the potential for South Africa to produce e-methanol and e-ammonia has triggered plans to develop “green corridors” – effectively routes connecting ports for vessels to sail on ZEF. A consortium convened by the Global Maritime Forum – including Anglo American, Tata Steel, CMB, VUKA Marine, Freeport Saldanha and Engie – is exploring the development of a green corridor between South Africa and Europe.³³ The consortium has identified four South African locations as potential facilitators: Boegoebaai, Saldanha Bay, Ngqura Port and a hydrogen valley corridor stretching from Durban to Richards Bay.

National engine for growth and employment

High priority must also be given to ensuring that decarbonization brings a just transition. South Africa, as an emerging economy, has seen unemployment rise to over 30%. So the role of the green economy in delivering more jobs is a key concern for the government.³⁴

South Africa's shipping sector and its ports – in conjunction with the development of the hydrogen economy – can make a meaningful contribution to the country's economic growth, creating employment opportunities in new sectors and skilled jobs in export industries. However, concerted efforts are required to engage key stakeholders in the development of zero-emission shipping fuels.

2.4 Challenges

Several challenges are big enough to delay or diminish the opportunities described above. Leading up to the workshop, BCG analysed two

possible “failure cases” and associated barriers: insufficient hydrogen production and a failure to develop ZEF (see Box 3).

BOX 3: Potential failure cases and associated barriers

Failure case	Specific barriers
Hydrogen production projects stall development before final investment decision (FID)	<ul style="list-style-type: none"> – Lack of renewable power supply for green hydrogen production – Uncertainty on government support and regulation to develop market – Insufficient and unprepared project pipeline to attract investment – Lack of downstream offtakers prevents project financing – Technology risk prevents financing even with offtakers – Lack of capacity and skills for production beyond feasibility
Zero-emissions fuels (ZEF) not developed for shipping in South Africa	<ul style="list-style-type: none"> – Lack of green hydrogen feedstock due to factors above – Shipping operators unwilling to pay price premiums for ZEF – E-ammonia stays 2030+ fuel due to near-term adoption barriers – E-methanol projects fail to develop due to lack of shipping offtake and challenging sustainable CO₂ availability – Relevant ports not engaged to build out bunkering infrastructure

Source: BCG

Workshop participants reflected on these challenges and others, as detailed below.

Lack of renewable power supply for green hydrogen production

Lack of green hydrogen feedstock is a challenge, because it depends on a secure supply of renewable energy. South Africa’s power outages are well-known, with its unstable grid operating at little over 50% capacity. Available power must be prioritized to maintain the business-as-usual economy. So a lack of renewable power will undermine the country’s capacity to produce green hydrogen feedstock. Put simply, the country needs to fix and decarbonize its electricity grid before surplus renewables can spill into producing green hydrogen and other zero-carbon fuels.

Looked at it from a perspective of opportunity, global demand for green hydrogen and ZEF could be a positive catalyst to transform South Africa’s grid, if synergies between stabilizing the grid for multiple purposes are realized.

Low domestic demand for ZEF due to high green premium

Shipping companies tend to purchase conventional fuel through the market based on short-term demand, so they consider long-term commitments (e.g. offtake agreements) to be a risky proposition. In South Africa, there is little evidence of domestic demand for ZEF, partly due to the limited willingness of buyers to pay the green premiums for future fuels. This increases the dependence of future domestic ZEF production on global demand.

The workshop heard from industry participants that offtake agreements signed to date put the price of e-methanol at three or four times higher than conventional fuels. Additionally, it can take four times longer to finalize these new agreements, because they are longer duration than deals for conventional fuel and are consequently more strategic buying options than traditional procurement based on volume and price.



The green premium and who is going to pay is a challenge. Everyone in the supply chain thinks it shouldn’t be themselves.

Workshop participant

Port infrastructure needs investment in world-class bunkering

South Africa is not a preferred bunkering hub for the global shipping industry. Operators lack confidence in the country's ports, facilities and infrastructure to deliver as consistent or reliable a service as other ports, even for conventional fuels. The World Bank ranked South African ports at the bottom of global container port performance in 2021, lower than all other countries in Africa.³⁵

Given the high cost of chartering vessels, time in port costs money. So it is critical that ships are guaranteed rapid and efficient refuelling within a short time-window. South Africa's port infrastructure needs major investment to upgrade facilities, ensure reliable and stable fuel supplies, and build new bunkering infrastructure for ZEF.

Moreover, the South African ports used today for conventional refuelling are not involved in projects shifting to green fuels. Similarly the ports looking to advance green fuels do not have much bunkering infrastructure today.

Shipping-related policy challenges

Support and regulation will be needed from the government to develop the country's ZEF economy. The opportunity presented by producing future

fuels is balanced by an equal risk of falling behind in the global transition. With leading trade partners moving towards policies such as carbon border taxes to achieve net-zero targets, up to 35% of South Africa's export value could be at risk if decarbonization is not pursued.³⁶

While decarbonizing shipping can increase the costs of transport and trade in the short term, it is important to remain focused on the opportunities to South Africa's shipping sector and wider economy provided by the transition, particularly in the context of tightening global regulation.

Shipping-related finance challenges

An insufficient and unprepared project pipeline, combined with technology risk, deters investment in the country's nascent ZEF sector. These challenges are not unique to South Africa – they are seen across the supply-side landscape globally. However, financial risks are amplified when the cost of financing is as high as in South Africa and other emerging markets.

Workshop participants heard from FMC Shipping Sector Project Fellow Takahiro Furusaki, who presented the findings of the Coalition's recent Insight Report, [Fuelling the Future of Shipping: Key Barriers to Scaling Zero-Emission Fuel Supply](#), which identifies the top 10 barriers limiting ZEF projects from securing final investment decisions (see Figure 3).

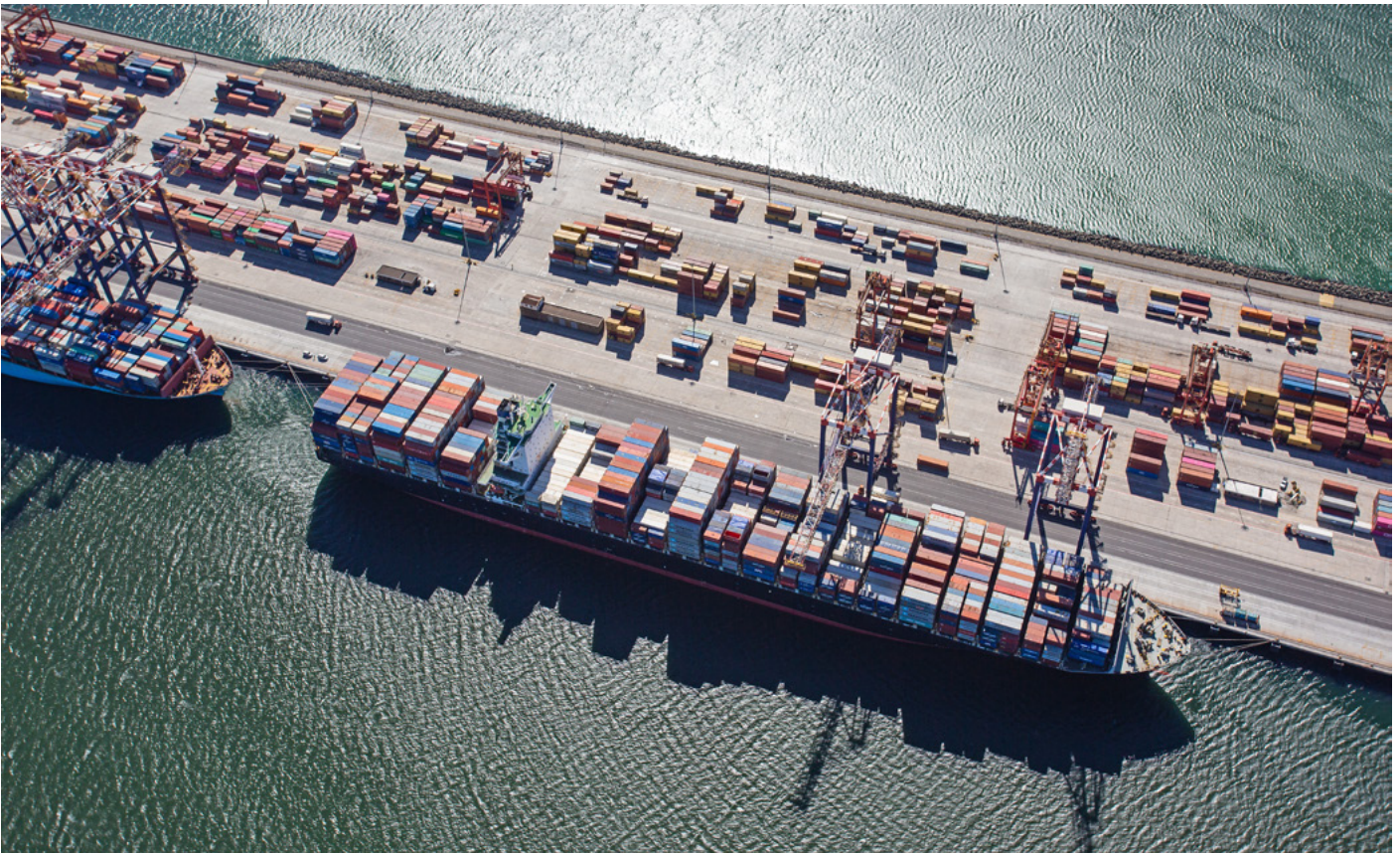


FIGURE 3: 10 barriers limiting ZEF projects from securing final investment decision



Source: BCG

2.5 Solutions

Potential solutions and innovative ideas identified by workshop participants for pathways to accelerate South Africa’s role in decarbonizing both domestic and global shipping are outlined below.

Global demand as a catalyst for domestic supply and bunkering of ZEF

A clear demand signal for bunkering ZEF in selected South African ports will be needed to realize the country’s opportunity to become a global hotspot for zero-emission shipping. As local demand may take some years to build up, certainty from global demand will play a key role. It is also important to

assess different uses for hydrogen beyond maritime fuel, to determine how multi-sectoral offtake can improve the business case for potential project developers.

Major private sector players and organizations such as FMC have a key role to play in surfacing global demand for ZEF to build a case for investing in South Africa’s domestic green hydrogen production. As well as demonstrating demand for ZEF, shipping companies need to clarify *where* that demand will arise, given the need to produce and bunker it at specific locations.

The idea of piloting and scaling-up green corridors could provide “geography-specific demand signals”, which combined with corporate demand signals of

major companies, including FMC members, could create the market conditions needed to make domestic ZEF production a reality.

South Africa is already active in developing green corridors and could benefit from collaborating

with global shipping actors and governments in export markets to identify the country's role in such ventures. Based around key South African ports, green corridors could link the global demand signal for ZEF with the local geography of domestic ZEF production, supply and bunkering.



There is already a bunkering market in South Africa – how can we leverage this opportunity further?

Takahiro Furusaki, Project Fellow, Shipping Sector, First Movers Coalition

Procurement of fuels will be undergoing a significant shift from spontaneous buying towards more strategic long-term agreements. This means that domestic sellers or suppliers need to collaborate with buyers and carriers so they can be reassured of reliable last-mile fuel delivery to their vessels. In the South African context, there are no offtake agreements for ZEF from global operators at all yet, so the supply side needs building out first.

Investment in port facilities to create stable, reliable, modern ZEF bunkering

The World Bank's low ranking of South African ports is a hard challenge to ignore. Considerable investment is needed by the private sector, government or other combination of financing mechanisms to boost the efficiency of port infrastructure, before the country's ports are ready as hubs for ZEF bunkering and supply to global shipping. Electrification of ports is also a priority. There is already movement by public-private collaborations to develop port infrastructure and operations, for example at Freeport Saldanha (see Box 4).

The aim is to create an attractive bunkering solution for ship operators, so that refuelling in South Africa is considered not out of necessity, but as a preferred or regular stop-off. To that end, the country could consider whether certain segments of the shipping sector would be more suitable for refuelling in South African ports, given that container ships, bulk carriers and tankers may require different kinds of infrastructure. With the above in mind, a national port strategy could help prioritize and coordinate efforts in the coming years.

Export of ZEF production to global hubs

Beyond domestic bunkering, South Africa could address the limitations around its ports by exporting its ZEF production to bunkering hubs in Asia or Europe. High bunker-demand ports (e.g. Singapore,

Rotterdam), which will be among the first to accommodate ZEF, will rely on importing green fuels from competitive renewable energy countries like South Africa.

There will be synergies between exporting and bunkering hub infrastructure – such as storage and jetties – that make investments more feasible and provide clarity to last-mile logistics, as well as potentially reducing bunkering costs for shipping companies considering future offtake in South Africa. For this to be a true opportunity, and one that brings broader socio-economic benefits to South Africa, it will be important to export value-added maritime fuel and not lower-value hydrogen or feedstock.

Relationships with export partners

Trade and shipping will always be closely interlinked and policies for trade will have an impact on shipping. Trade policies and bilateral agreements between South Africa and key trade partners could be used as policy tools to support the transition and lower the green premium. South Africa can leverage existing relationships with top export markets that are leading the way in green technology (for example, though not exclusively, the EU, United Kingdom and Japan). This is already an area being explored, such as South Africa's declaration with Germany pledging to create a taskforce to meet international demand for green hydrogen, while exploring available funding mechanisms.

Standards and certifications

The role of standards and certifications is important. The nascent stage of ZEF means the product is yet to be fully defined and this is hampering uptake. As ZEF becomes a standardized product or even commodity, its definition will need to keep pace with new policies and regulations. The development of a fuel standard by the IMO is an important enabler in this regard.

BOX 4: Freeport Saldanha Industrial Development Zone

The workshop heard from Freeport Saldanha Industrial Development Zone (IDZ), which aims to create South Africa's first duty-free special economic zone located in a port.

The aim of the IDZ is to build a maritime green hydrogen production, bunkering and export hub on 356 hectares of industrial land around the deep-water port of Saldanha Bay in the Western Cape, approximately 110km from Cape Town and one of the largest ore-exporting ports in Africa.

In its pre-feasibility study, the World Bank modelled the Freeport's potential production and supply of green marine fuel as follows:

- 50,000 tonnes of green hydrogen per annum ≈ 280,000 tonnes of green ammonia (energy to fuel 40 Handysize bulk carriers)
- 1.6 GW renewables (40/60 wind/solar), 500 MW electrolyser capacity
- Estimated capital investments ≈ \$2 billion

Policy measures

Policy measures discussed by participants during the workshop include the following priorities for the government to consider:

- **Legislation and regulation:** Support the transport and bunkering of ZEF in ports, as well as ensuring laws are updated to keep pace with future requirements. Safety is particularly important and South Africa could benefit from partnerships with pioneering ports with experience on other continents. Such initiatives could play a role in connecting green corridors and could also be national partnerships with a strong bunkering location.
- **National port strategy:** Create a national strategy to plan for and coordinate port readiness for green bunkering in ways that utilize current strengths and close gaps. This strategy could be a cross-department effort that takes into account infrastructure, electrification, trade regulation, energy and collaboration with other demand sectors.
- **International regulation:** Progress at the global policy level will have an impact on South Africa's capacity to benefit from opportunities presented by the IMO's emerging rules and regulations for the global shipping industry. Participants raised the issue of a "guarantee of origin" scheme and "green requirements" for green hydrogen and derivatives for international trade.
- **Incentives and finance:** Incentives are needed to keep sustainable sources of CO₂ for e-methanol within the country. Blended combinations of government and non-governmental finance could help get feasibility studies for the green hydrogen value chain off the ground.
- **Global pricing mechanism for carbon:** Negotiations for an economic mechanism within the IMO include a potential "polluter pays" element that would see tax levied on emissions. The money raised could capitalize a fund that finances the development and production of zero-emission fuels, especially in emerging markets. It could therefore be to South Africa's benefit to work proactively towards realizing such an opportunity.



If done in the right way, global carbon pricing can unlock massive industries locally, like green hydrogen.

Workshop participant

3 Trucking

Trucks account for 63% of South Africa's transport emissions. Tackling this means reimagining the whole sustainable logistics supply chain.



3.1 Sector overview

Eighty-nine percent of all freight in South Africa travels by road.³⁷ One workshop participant put it like this: “Trucks are the backbone of our commerce and the lifeline for our economies.” As a crucial logistic entry point for the region, South Africa has the opportunity to attract the growing capital allocated to decarbonize scope 3 emissions from global actors by transitioning its trucking fleet to zero-emission alternatives.

The country has a thriving domestic automotive manufacturing sector that provided 5.7% of GDP and employed over 500,000 people in 2020. While it produces around half a million vehicles each year, fewer than 6% are medium- and heavy-duty vehicles,³⁸ yet they account for 63% of the country’s transport emissions and 7% of total emissions.³⁹

Heavy reliance on the export of internal combustion engine (ICE) vehicles puts South Africa’s automotive industry at risk of emerging climate-related bans in key export markets, such as the EU’s Carbon Border Adjustment Mechanism (CBAM), due to enter into force by 2026, and the EU’s CO₂ emissions targets for trucks. Decarbonizing trucking is therefore a high priority for South Africa. The government has set a goal in its National Determined Contribution (NDC) of shifting up to 800,000 passenger vehicles and 190,000 commercial vehicles from ICE to zero-emission vehicles.⁴⁰

Given its abundant mineral resources crucial for local or global battery production, coupled with its extensive green energy potential, South Africa is well-positioned to engage in and reap the benefits of the zero-emission truck transition.

However, challenges such as high total cost of ownership and limited charging infrastructure hinder widespread adoption. Significant support from public and private sectors will be needed to build charging stations and provide financial support, including subsidies, for purchasing battery-electric vehicles (BEVs). Additionally, commitments to purchase zero-emission technologies and services can play a role in incentivizing manufacturers to invest in production and innovation, as well as encouraging logistic services to operate zero-emission trucks (ZETs), thereby fostering confidence among other demand players.

This chapter analyses the status of technologies, opportunities, challenges and solutions in relation to decarbonizing trucking in South Africa, drawing on insights from participants at the FMC’s in-country workshop in March 2024. For more detail on finance and policy measures necessary to support the low-carbon transition of the country’s heavy industries, see Chapters 4 and 5.



Decarbonizing trucking is not just about swapping diesel for batteries but about re-imagining sustainable logistics.

Workshop participant

BOX 5: FMC’s targets for near-zero emission trucking

Trucking owners & operators:

“At least 30% of our heavy-duty and 100% of our medium-duty new truck purchases are zero-emission trucks* by 2030.”

Retailers & manufacturers:

“We require our trucking service providers to meet the commitment that at least 30% of heavy-duty and 100% of medium-duty new truck purchases will be zero-emission trucks* by 2030.”

*In-scope vehicles include: battery electric vehicles (BEVs), fuel-cell electric vehicles (hydrogen – FCEVs) and zero tail-pipe emissions technologies.

Full details of the commitment can be found [here](#).

3.2 Status of technologies, supply and demand

Transitional solutions

The current emissions standards for heavy-duty vehicles in South Africa are equivalent to Euro II, a level that falls behind the more stringent standards adopted by all other G20 members. Many of these nations have transitioned to or are in the process of adopting Euro VI standards.⁴¹ Diesel engines lacking modern emission control systems emit significant quantities of PM2.5, soot, nitrogen oxides (NOX) and other pollutants.

In 2015, it was estimated that transportation activities accounted for approximately 7% of deaths related to exposure to PM2.5 and ozone in South Africa. Of these fatalities, 48% are attributed to on-road diesel vehicles.⁴² Both truck manufacturers and logistics services are taking steps to address emissions, introducing Euro V technologies and embarking on various biodiesel projects aimed at reducing CO₂ emissions while improving air quality.

Battery-electric vehicles (BEVs)

Globally, trucking logistics providers are increasingly betting on BEVs, despite energy density challenges for the heavy-duty trucking segment. This is driven primarily by the availability of BEVs as an option

today, as well as the increasingly favourable total cost of ownership (TCO) for these vehicles.

In South Africa, several pioneers are piloting BEVs: Shoprite Group, South Africa's largest retailer, is testing Scania's refrigerated electric truck equipped with solar panels for local deliveries, while KDG Logistics has procured two Volvo electric truck tractors for port-to-factory operations.⁴³

Fuel-cell electric vehicles (FCEVs)

FCEVs are typically powered by hydrogen. However, they remain more nascent than BEVs, due to the availability and cost of fuel-cell technology and green hydrogen. Despite this, South Africa is actively investing in hydrogen fuel cells. The government has piloted the operationalization of FCEVs in pre-determined corridors and through investments in companies such as Isondo, Mitochondria Energy and CHEM Energy to support the development of fuel cells for stationary and mobility applications.⁴⁴

The private sector is also investing in FCEV technologies, for example Anglo American's deployment of a 510-tonne FCEV truck at one of its platinum mines,⁴⁵ and Toyota and Sasol's partnership to build a hydrogen mobility ecosystem.⁴⁶

3.3 Opportunities

South Africa abounds with opportunities to decarbonize its transport sector. The production and deployment of BEVs and FCEVs presents a unique chance to address environmental and air quality concerns, while advancing a just transition that generates jobs for local communities, supports upskilling and fosters economic growth. Additionally, investing in green truck infrastructure and technology development could position South Africa as a leader in sustainable transportation, attracting investment and driving innovation.

In light of the increasing number of original equipment manufacturers (OEMs) committed to transitioning exclusively to ZETs by 2040, alongside the tightening of global regulations like the EU's CBAM, exporting countries such as South Africa may hasten their shift towards embracing zero-emission technologies instead of transitional ones. While this could lead to economic and environmental benefits, careful planning and investment are essential to mitigate risks and ensure long-term success for local producers.

The country benefits from having many of the key actors – including mining, logistics and transport sectors – necessary to transform the entire supply chain for the production of ZETs and the energy required to fuel them. Global players, whose international decarbonization commitments need to be realized regionally, are also present in South Africa.

Green hydrogen, which can power both zero-emission trucks and ships, presents a significant opportunity for South Africa. With the publication in November 2022 of its *Green Hydrogen Commercialization Strategy*,⁴⁷ the government declared its ambition to be a leader in this technology. For more information, see Chapter 1.

The country has plentiful supplies of some of the rare earth metals (e.g. manganese) needed in batteries⁴⁸ and is already making advances in domestic battery manufacturing, such as Afrivolt's planned 1.5 GWh lithium-ion cell factory in Cape Town.⁴⁹ South Africa is also the world's largest producer of platinum group metals (PGMs),⁵⁰ an

important catalyst used in the production of certain fuel cell technologies. However there is some uncertainty around which technologies will become most widely adopted and how relevant PGMs will remain.⁵¹

These opportunities are recognized by both public and private sectors and are beginning to materialize through pilot projects for green trucking corridors and green industrial clusters around major ports and mines.



Africa is in a pivotal position to take advantage of its opportunities – but it’s only an advantage if we seize it.

Workshop participant

3.4 Challenges

In terms of the challenges that the decarbonization of trucking in South Africa is facing, BCG analysed two possible “failure cases” and associated barriers in the lead-up to the workshop. These relate to insufficient renewable energy and a lack

of market penetration for zero-emission trucks (see Box 6). Workshop participants reflected on these challenges and others in greater detail, as captured below.

BOX 6: Potential failure cases and associated barriers

Failure case	Specific barriers
Renewable energy (RE) capacity and grid infrastructure not scaled sufficiently rapidly	<ul style="list-style-type: none"> – Insufficient grid capacity to build out required renewables – Lack of alignment between strategy and enacted policy – Insufficient capital focused on renewables and grid infrastructure – Inability to secure supply chain for renewables components – Lack of capacity among developers to scale operations
Zero-emission trucks (ZETs) fail to penetrate meaningfully in South Africa	<ul style="list-style-type: none"> – Trucking operators unwilling to pay total cost of ownership (TCO) premium for ZETs – Lack of clarity on infrastructure prevents ZET purchases – Trucking operators lack financing tools to defray high initial cost – ZET production and supply chain fails to materialize due to lack of supportive policies and know-how – Import levies and weight limitations increase cost difference in landed South African cost of EVs vs. ICE

Source: BCG

Demand and confidence

There are numerous pilot projects underway with local and global actors in the ZET sector that show promise and the establishment of green corridors demonstrates progress. However, many initiatives remain at an experimental stage and do not yet represent a significant demand signal which could effectively drive the transition.

The lack of demand for ZETs remains a major challenge. One workshop participant noted: “When you interact with OEMs, they are reluctant to bring these products into the market because demand is close to zero.” Several factors explain this, including the cost of these technologies, inadequate infrastructure and power instability. There is also market scepticism around the capacity of electric trucks to run the long distances that operators require.

Total cost of ownership (TCO)

The cost disparity between green and fossil fuel trucks poses a significant barrier to widespread adoption. ZETs generally come with higher initial expenses but boast lower operating costs compared to ICE trucks – the upfront cost for BEVs is typically two to three times higher than for ICE trucks.⁵² Those costs are exacerbated by import duties, which range from 12-20% on clean technology in South Africa.

To achieve TCO parity with diesel vehicles and offset initial costs, the operational energy expenses for ZETs must be significantly lower than those for diesel. However, while electricity costs are anticipated to remain low, uncertainties persist around the price of hydrogen. As one participant pointed out, “The pricing differential is significant: diesel is ZAR 26 per litre, grey

hydrogen is ZAR 110 and green hydrogen is ZAR 160 – and the domestic market for green hydrogen in South Africa may not be large enough to drive down these prices.”

The TCO is also influenced by the weight and dimensions of these vehicles, particularly since

batteries tend to be voluminous and heavy. In the road transport sector, where profit margins are thin, maximizing payload capacity is essential for cost-effectiveness. Without allowances within the regulations for additional weight and dimensions, adopting ZETs could potentially limit payload capacity, impacting profitability.



In road transport, the profit margin is maximum 5%, so if you're transporting 20 tonnes of cargo and you have to lose 1 tonne because of weight limits, that loss in profit can make or break the scalability of new technology vehicles.

Workshop participant

Energy infrastructure

Nascent demand for ZETs is impeded by a lack of infrastructure to deliver the power needed. Support for charging infrastructure will be an essential component in transitioning to zero- and low-emission vehicles. To instil confidence in the market, the government needs to roll out 30,000-45,000 new public charging units per annum, according to the latest analysis by BCG. If hydrogen technologies are adopted, then appropriate refuelling infrastructure will be needed for long-distance freight routes.

Significant private investments are required at owned-facilities and trucking depots, but owners

and operators may be reluctant to invest until the government demonstrates credible plans for infrastructure build-out with clear processes, timelines and regulatory guidance.

Moreover, load-shedding has been a major ongoing problem for South Africa's energy sector in recent years. The energy availability factor plummeted from 100% in 2006 to around 50% last year, though there are signs it is beginning to pick up again.⁵³ Without progress in upgrading the capacity of the country's national grid, it is unlikely the government will be able to provide the renewable power necessary to meet its EV targets to support the decarbonization of the transport sector.

3.5 Solutions

Creating a market for emerging technologies is often likened to a “chicken and egg” situation, where demand and supply need to align simultaneously. In the trucking sector, investment in charging and refuelling infrastructure depends on the adoption of ZETs, but the uptake of ZETs relies on the availability of adequate infrastructure. Addressing this challenge requires collaboration between stakeholders across sectors, as well as government intervention, to establish an enabling environment for the widespread adoption of green technologies.

Workshop participants discussed and identified many solutions to decarbonize the sector, while ensuring its prosperity, detailed below.

National infrastructure rollout plan

To support the installation of new public charging units and hydrogen refuelling stations along key long-distance freight routes, South Africa could greatly benefit from establishing a national rollout plan in consultation with private operators to ensure the strategic placement of these facilities.

However, with the electricity grid operating at little more than half capacity, several participants described plans to generate their own power for EVs. Shoprite has invested in a solar PV programme to address its energy security issues.⁵⁴ The company recently deployed its first Scania BEV on a pilot basis with a rooftop solar system to recharge the truck's batteries.

Given ongoing load-shedding, all available electricity is required for existing domestic and industrial applications. The trucking sector needs to be sensitive to the impact that BEVs could have on the country's electricity grid and the availability of power for ordinary people. This can be managed by treating truck charging as an incremental load for which additional capacity needs to be built.

Additionally, charging – especially at locations like depots, terminals and logistics hubs – could be paired with behind-the-meter energy generation or localized grid reinforcement. One participant said: “The way you need to roll out these vehicles is a phased approach and over a number of years. Through that you have infrastructure following the trucks and can solve the problem.”

Given the challenges in delivering a secure supply of renewable power, several participants highlighted the role of green hydrogen to fill the gap. The government, with industry stakeholders, is spearheading initiatives to establish hydrogen valleys to jump-start the hydrogen economy and accelerate production. Three green hydrogen hubs have been identified in Johannesburg, Durban/Richards Bay and Mogalakwena/Limpopo. These hubs are poised to host fuel-cell electric mining trucks and heavy-duty trucks along the N3 corridor, showcasing South Africa's commitment to embracing hydrogen technology.⁵⁵ For a more detailed discussion of South Africa's nascent green hydrogen industry, see Chapter 1.

Fostering partnerships

Piloting is crucial for understanding cost-reduction opportunities, optimizing operations at scale and identifying policy loopholes that hinder the transition. One participant argued that while it is important to learn lessons from other markets, it is also essential to learn by doing. "We are doing a lot of talking and planning," they said, "but until we see assets on the ground and learn from that, we will never solve these problems."

However, the challenge lies in effectively scaling-up these projects. Many of the solutions mentioned above require collaboration between public and private sectors. Participants from both sectors at the workshop acknowledged the need for concerted efforts to develop partnerships between the government, OEMs, utilities and financiers.

Public-private partnerships play a critical role in facilitating blended finance – a mix of public and private funding, grants, subsidies and innovative financing models – essential to overcome financial barriers and incentivize investment in ZETs. According to one participant, the problem is not the availability of de-risked capital, but the availability of bankable projects. He called on the private sector to collaborate more closely with the government on pilot projects to decarbonize trucking, adding that "infrastructure-led investment is what leads to growth".

Policy measures

Policy measures discussed by participants during the workshop include the following priorities for the government to consider:

- **Government action plan:** In December 2023, the government unveiled its *Electric Vehicles White Paper*,⁵⁶ aimed at regulating

the manufacturing, sale and utilization of EVs. Recognizing the global trend toward zero-emission vehicles as a potential challenge to the country's automotive industry, the white paper introduced a comprehensive action plan to steer the sector towards EV and EV component production.

- **Incentives and subsidies:** The government has incentivized domestic automobile production for several decades through, for example, the Automotive Production and Development Programme (APDP).⁵⁷ As part of its EV white paper, the government acknowledged the need for higher levels of funding to catalyse EV investment in automotive assembly and component manufacturing. In February 2024, the Minister of Finance announced a new investment allowance, complementary to the APDP, that will enable businesses involved in EV production to claim 150% of qualifying investment spending in the first year. The new allowance will commence in March 2026. The government has also reprioritized ZAR 964 million to support the transition to EVs.
- **Trade policy reform:** The government currently imposes up to 20% import duty on finished or CBU (completely built-up unit) trucks, including BEVs. Given South Africa does not manufacture BEVs, this duty will need to be reconsidered if the trucking sector is to decarbonize in the near term. In its EV white paper, the government acknowledges the need to temporarily reduce import duties for batteries in vehicles produced and sold in the domestic market. It also underlines the need for duty-free export market access for vehicles and components produced in South Africa to support the resilience of the industry. Combined, these measures could incentivize local manufacturing, potentially leading to export opportunities once domestic demand is established.
- **Government procurement:** In 2018, the government published its Green Transport Strategy up to 2050.⁵⁸ The strategy's EV industry roadmap planned to introduce a policy to ensure that 5% of total annual fleet requirements by both state and state-owned enterprises comprise EVs by 2025.
- **Adjusting permitted gross vehicle weight:** To offset the impact of battery weight and dimensions on payload capacity and profitability, the government could adopt allowances similar to those in the EU, which would enhance the total cost of ownership (TCO) for these vehicles. Currently, such allowances are not included in the South African legislative framework.



Getting import duty lifted is imperative, as the impact of bringing one electric truck onto the road is the same as 100 electric cars.

Workshop participant

4

Financial measures to accelerate the transition

The financing challenges facing South Africa's low-carbon transition require public-private-philanthropic partnerships – and greater commitments from the Global North.



4.1 Focus of FMC's Finance Pillar

The Cape Town workshop included finance participants from banks, asset managers, development banks, government entities, stock exchanges and project developers. The FMC's Finance Pillar aims to address the following questions:

1. How can financial institutions (e.g. banks, asset owners, insurers) act upon their net-zero targets, enabling the transition for hard-to-abate sectors?
2. How can effective de-risking solutions, incentives, public-private-philanthropic partnerships and innovative financing mechanisms be replicated at scale, including in emerging economies?
3. What systemic change and new financial architecture interventions are needed across private financial institutions, development finance institutions and policy-makers to scale-up financing for the transition?

Finance lead Eneida Licaj highlighted the work of the FMC's Finance Pillar in bringing together different sources of private and public capital into a "capital stack" that can help develop and scale-up breakthrough technologies during the pilot project and early deployment stage – which sits between the R&D phase and commercial deployment.

According to the pillar's newly published report, [Scaling Clean Technology Offtakes: A Corporate Playbook for Net Zero](#),⁶⁹ the success of early-stage projects in reaching final investment decisions (FID) depends fundamentally on sufficient demand. To amplify this demand, it is essential that middle-market companies – as well as first movers – pre-buy ZEF and green hydrogen to aggregate demand for project developers.



It is essential to have first movers but also fast followers – a surge of middle-market companies to engage in offtakes and propel the demand for clean commodities.

Eneida Licaj, Lead, Finance Pillar, First Movers Coalition

This chapter addresses some of the key macro-economic risks, financial risks, opportunities and solutions in relation to funding South Africa's industry and energy transition, proposed and discussed by workshop participants during the three-day meeting.

If there were one overall message to emerge from the workshop, it is that the challenge is far too large for one entity to take on. Only through a collaboration between governments (in Southern Africa and the Global North), private financial institutions, development banks and philanthropic donors can the major infrastructure projects needed to drive the transition in the region get off the ground.

4.2 Macro-economic risks

Load-shedding energy crisis disrupts industrial operations

South Africa's decarbonization goals face a significant challenge due to the recurring load-shedding noted in earlier chapters. Electricity cuts averaged eight hours per day in 2022, costing 2-3% of GDP growth. Industries reliant on continuous power face increased production costs and operational disruptions, hindering efforts to transition to cleaner energy. Load-shedding also undermines investor confidence in the reliability of energy supply. Urgent investment is needed in renewable energy infrastructure, grid modernization and energy storage solutions to enhance energy security and stability.

Port and rail infrastructure unable to meet increasing energy needs

South Africa's port and rail infrastructure is critical for transporting energy resources and facilitating industrial activities. However, the existing infrastructure faces challenges in meeting growing energy demands of heavy industries and supporting the transition to cleaner energy sources.

Insufficient capacity, ageing infrastructure and inefficiencies in logistics contribute to delays and bottlenecks, impeding decarbonization efforts. Closing the infrastructure gap requires significant investment in port expansions, rail upgrades and logistics optimization to ensure reliable and efficient energy supply chains.

The just transition is a sensitive issue

Achieving a just energy transition poses a complex challenge, particularly in South Africa, where heavy industries – such as the country's 78 operating coal mines – play a significant role in both employment and the economy. Balancing

the need for decarbonization with socio-economic considerations, such as job losses, community impacts and social equity, requires careful planning and stakeholder engagement. Implementing policies and programmes that prioritize workforce development, retraining and support for affected communities can facilitate a smoother transition to a low-carbon economy, while ensuring social inclusivity and equity.



We have seen the extractive nature of capital before, below ground, and we cannot let that happen on our continent when it comes to our above-ground capital.

Workshop participant

There is also a risk that extraction is replaced by protectionism. Moves by key trading partners to boost their own domestic energy transitions – such as the European Union's Green Deal and CBAM, or the US Government's Inflation Reduction Act (IRA) – could be viewed as

protectionist from the perspective of the Global South. This raises an important global question – How can developed economies address the unintended consequences of positive policy initiatives designed to accelerate progress towards net zero?

4.3 Financial risks

High interest rates and capital costs, low returns

Interest rates of roughly 12% and the resultant high capital costs present hurdles for investing in the decarbonization of South Africa's shipping and trucking sectors. These costs make capital-intensive projects, such as production facilities for green hydrogen and ammonia or upgrading infrastructure, financially burdensome. Given the extended payback periods (~10-15 years) and smaller internal rates of return compared to traditional fossil fuel investments, participants voiced concern around the risk-return profile of green investments. Furthermore, the risk profile associated with first-of-kind technology projects may not align with state funding pools, such as tax revenue or pension funds.

Moreover, as the technology advances, the optimal capital structure in projects as they approach FID remains unclear among developers who are championing the first projects in-country. Financing decisions are made on a case-by-case basis, without a standardized playbook for leveraging upstream and downstream subsidies across the value chain.

Inadequate capital structure throughout project development

Infrastructure investors currently tend to overlook project finance and focus on large-scale platforms that can catalyse new investments. This creates a significant opportunity for development finance institutions (DFIs) to step in. However, even DFIs lack clarity around the necessary level of concessionality to attract private investment.

Discrepancy between timing and volume of commitments

While the shipping industry, as an example from the transport sector, currently operates through short-term fuel purchases, developers of ZEF require long-term offtake agreements spanning more than 10 years to ensure bankability. However, depending on market dynamics, the minimum duration for these agreements could be significantly shorter, posing challenges for fuel providers to confidently invest in markets with low liquidity.

Simultaneously, offtakers face uncertainties regarding the availability, location, volume and cost of the desired fuel, as well as the willingness of their customers to cover these expenses. The acceptance of higher costs and risks associated with clean fuel largely depends on the nature of the customer involved.

Lack of consensus on “green” standards exposes investors to regulatory risks

While FMC has made clear its own criteria for the ZEF that can deliver the deep decarbonization of shipping, the term “zero-emission fuel” lacks clear definition in the market.⁶⁰

This lack of clarity and standardization poses challenges in determining what exactly is being bought and sold. This in turn can expose investors to regulatory risks and penalties if their investments are found non-compliant with new or existing environmental regulations.

Financing gap for South Africa’s just energy transition

Forged at COP26 in November 2021, the Just Energy Transition Partnership (JETP) between South Africa and France, Germany, the United Kingdom, United States and European Union, saw the mobilization of \$8.5 billion of grants and concessional loans. Recently raised to

\$11.9 billion, this includes \$700 million of grant funding.

In November 2022, the South African government published its five-year Just Energy Transition Investment Plan (JET IP) from 2023-2027 that determines the funding required for the country to transition to a low-carbon, climate-resilient economy. JET IP requires approximately ZAR 1.5 billion for 2023–2027, with 70% needed for the electricity sector. Public sources alone cannot provide this financing, so a range of private, local and international sources must also be utilized. The funding gap is estimated at around ZAR 700 billion for 2023–2027, according to analysis by BCG (see Figure 4).

The government has chosen to prioritize the low-carbon transition of the electricity grid, where the need is greatest due to load-shedding. One of the first investment opportunities to follow is road and rail. However, new energy vehicles (NEV) and green hydrogen have only been allocated a small fraction of this finance, leaving gaps of 78% and 89% respectively in projected funding needs.

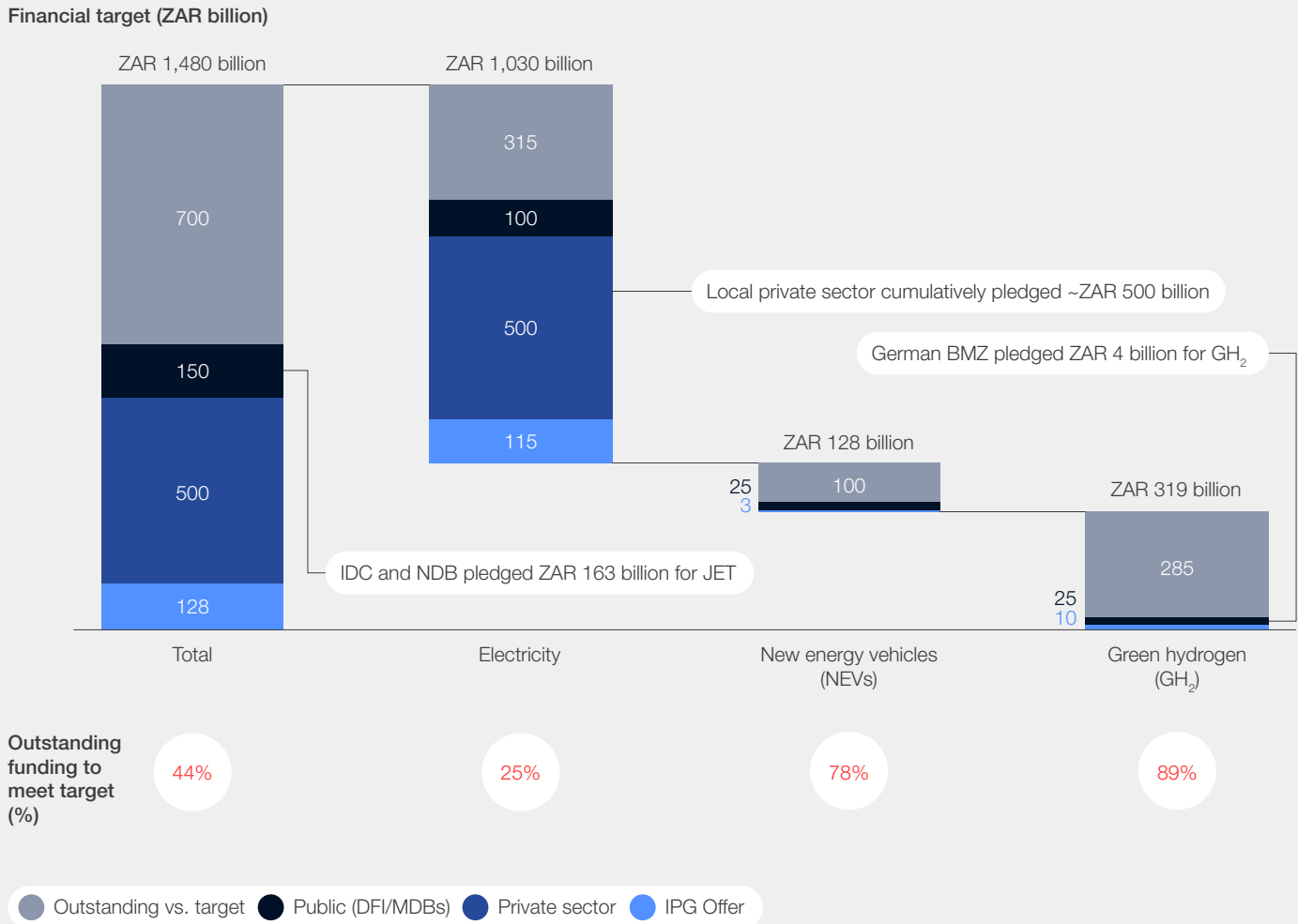
For more of a policy angle on JET IP, see section 5.3 in the Policy chapter.



The JET Partnership has leveraged \$11.9 billion of concessional finance for South Africa’s transition – including \$700 million of grant funding.



FIGURE 4: Funding gap for JET IP – projected finance needs and estimated availability, by source and sector



Notes: JET = Just Energy Transition; IPG = International Partners Group of the JET Partnership; IDC = Industrial Development Corporation of South Africa; NDB = New Development Bank, established by BRICS countries; BMZ is Germany's Federal Ministry for Economic Cooperation and Development.

Source: BCG

4.4 Financial opportunities

South Africa is a green hydrogen frontrunner

South Africa is strategically positioned to emerge as a frontrunner in the green hydrogen economy. With its abundant renewable energy capacity and unique geographic location, the nation stands poised to capitalize on international maritime decarbonization efforts. For more detail on potential GH₂ projects, including Saldanha Bay, Boegoebaai and Durban/Richards Bay, as well as on the country's potential as a major exporter of GH₂ and ammonia, see Chapter 1.

Role of capital markets

Capital markets, as centralized pools of capital from various sources, are vital in advancing green projects. Initiatives such as green bond programmes and voluntary carbon markets (VCM) are gaining traction. The Johannesburg Stock Exchange (JSE) has been recognized for centralizing and pooling capital, through both its green bond programme and a new VCM initiative, where projects under development can sell credits using a national registry of carbon credits to create a marketplace for buyers.

The equity market has a value of ZAR 1 trillion and the bond market is worth ZAR 4 trillion, indicating there is ample money available. One speaker, who noted that South Africa's savings industry is sitting on ZAR 17 trillion, said: "The funding is there but the framework needs to be welcoming to capital." Nevertheless, private capital is conservative, so bringing blended capital into the early stages of major infrastructure projects remains crucial. Once financial close is reached, then private sector capital will flow in.

Role of the Development Bank of South Africa (DBSA)

DBSA is focused on creating intergenerational wealth through developing infrastructure. The bank is positioned to promote climate-resilient projects with its expertise in project finance, guarantees and concessional loans. DBSA has increased its renewable energy investment exposure, which now stands at 42% of the bank's energy portfolio and is expected to grow to 50% of the bank's total portfolio. The institution manages several green funds, further underscoring its commitment to sustainable development.

4.5 Financial solutions

Stack up demand across sectors to boost the investment case

South Africa has an opportunity to make its shipping and trucking industries work better together. For example, they could exploit synergies by using ports as places where trucks fill up on ZEF. Unconventional solutions are already emerging. These include "integrators" – organizations or platforms that coordinate and streamline activities across the supply chain to enable procurement-focused collaborations, public-private demand aggregation, and innovative contracting and finance mechanisms. Integrators help manage the flow of goods and information between different stages of the supply chain, from suppliers to manufacturers to retailers and finally consumers, in an effort to drive efficiency by reducing redundancies and optimizing operations.

Collaboration can extend across sectors, with potential demand for hydrogen-derived products spanning multiple industries and bringing many benefits. A prime example, explored further in earlier chapters, is the renewable energy sector and the shipping industry coming together to support the production of green hydrogen, used to make zero-emission ammonia and methanol. Meanwhile, combining demand for ZEF from different industry sectors can facilitate large-scale investments in production. Breakthrough technology providers will be motivated to invest in more extensive facilities knowing they have a stable, ongoing demand from diverse offtakers.

Mechanisms to address gap between producers and offtakers

Given the gap between offtakers, such as the shipping industry with its short-term fuel procurement, and fuel producers who need long-

term offtake, financial mechanisms are needed to help bridge the gap. Some solutions include:

- Better fuel demand forecasts by carriers and shipping lines, as the certainty this brings is a critical determinant for project bankability.
- Insurance products that protect fuel developers/producers from non-realization of commitments.
- Buyers' agreements on future purchases, with flexible price points that do not lock in a fixed price ahead of time.

De-risking role of industrialized nations to subsidize capex and support offtake

Finance sector participants called for greater public-private collaboration, not only to reduce the long-term risk of their investments but also to enable them to act before all risks have been eliminated. Risk-sharing mechanisms, such as guarantees,⁶¹ sovereign offtake support, grants, low-return equity and "contracts for difference"⁶² were all mentioned as important solutions.

Infrastructure projects, like Hyphen's gigawatt-scale green hydrogen and ammonia project in Namibia, are so big they need financing by global capital markets – but first they need to be made bankable. One workshop participant said: "For this whole thing to work, someone needs to subsidize the capex – because there is not sufficient balance sheet strength in the Southern African market to make these projects bankable. Who's going to pay for that? The answer from this part of the world is – the industrialized nations need to pay for it."

With the capex subsidized, the project's viability depends on not just its competitiveness, but also policy certainty in the producing country and long-

term offtake agreements with countries such as Germany or Japan committing them to buying the green ammonia at a fair price. “Sovereign offtake support is the key to bankability,” said one speaker.

Another participant emphasised the responsibility of wealthier nations to respect social equity in

their transactions: “The industrialized world needs to chart out a way that ensures producing countries such as South Africa fully benefit from projects with affordable power. It’s impossible for the Global North to support these projects in an extractive way with no benefit for host countries.”



Developed nations and current net emitters should make a contribution – it’s an affordability issue on the part of developing countries and an accountability issue on the part of developed nations.”

Workshop participant

Promote financial instruments for early-stage funding

It is essential to establish a transparent and detailed project pipeline, including initiatives to upgrade the grid to support the development of green fuel projects. However, there is growing demand for more generous grants and early-stage financing to help such projects reach financial investment decision.

South Africa lacks a venture capital sector, which makes it challenging to take projects from pilot phase through to commercialization. This funding gap needs to be filled with more innovative, risk-tolerant capital, according to one participant. The government’s Department of Trade, Industry and Competition (DTIC) has a critical infrastructure fund which companies are applying to, but it does not currently cater to EV infrastructure, for example.



In infrastructure finance the real gap is in the early phase – pre-feasibility to financial close. As we head towards net zero, it will be super important for the finance sector to unlock early stage, pre-financial-close and blended finance solutions.

Workshop participant

Mechanisms are needed to support and incentivize first movers and fast followers during critical stages of project development. These could include tax breaks, direct subsidies and priority in grant applications, aimed at reducing the financial risks and enhancing the attractiveness of first-of-kind projects. Richer countries can support Just Energy Transition (JET) initiatives through grant funding, to help de-risk projects. Grants reduce financial risk by covering some upfront costs, making projects more attractive to additional investors. Grant funding can be part of larger blended finance solutions, as public and philanthropic funds can help attract more private capital by lowering the overall risk.

Role for philanthropic funding

The workshop featured a session on philanthropic funding, moderated by Rob Johan Adriaan van Riet, Head of the First Movers Coalition. He highlighted a new World Economic Forum initiative, [Giving to Amplify Earth Action \(GAEA\)](#), which has secured \$4 billion of committed capital from its 100+ philanthropic, public and private partners. GAEA’s aim is to unlock catalytic funding at speed and scale to accelerate the shift towards climate and nature solutions.

The kinds of breakthrough technology projects that will drive the transition require a much higher proportion of public and philanthropic funding than other infrastructure projects. This led the workshop to highlight the need for “hyper-concessional financing” to crowd in finance from less risk-tolerant sources. Participants appealed to philanthropists to meet this need on a case-by-case basis.



There is not just a need for concessional financing, but a need for hyper-concessional financing.

Rob Johan Adriaan van Riet, Head, First Movers Coalition

Adopt a bias towards taking action

At such a critical time for South Africa, participants called on all actors to adopt a default bias towards taking action with speed and determination. The workshop had the following specific recommendations:

- **The government** should provide greater policy clarity to allow for capital flows into first-of-kind projects.
- **Financiers** must adopt a fresh perspective on risk assessment, while factoring in the dynamics of rival shipping hubs such as Rotterdam and Singapore.

- **Development finance institutions** (DFIs) need to streamline application and approval processes to enable quicker and more efficient financing; they also need to relax some of their requirements to make concessional lending easier.
- **Domestic stakeholders** need to craft a value proposition that is not seen as protectionist, but positions South Africa as a formidable contender in the global race to realize its full potential as a hub for clean fuel and renewable energy.

BOX 7: Recommendations from workshop participants

- Focus on industries with viable and sustainable investment opportunities.
- Enhance understanding of risk-return profiles for green investments.
- Address shortage of investment-ready projects through impact advisory and investment readiness capabilities.
- Provide guidance on project origination, structuring and execution, particularly for investments in the African continent.
- Utilize local asset management capabilities when seeking investment from international sources.
- Ensure projects and products are not perceived as exploitative or extractive.
- Explore alternative mechanisms beyond National Treasury guarantees for project funding.
- Consider ring-fencing tariffs from high-energy users to support infrastructure financing.
- Encourage richer countries to provide grant funding to de-risk projects and enable blended finance solutions.
- Propose a financial mechanism whereby early-stage financing for developing ZEF and BEV production would be provided by fossil fuel industry revenues.

5

Policy measures to accelerate the transition

The government has a critical role to play in building the infrastructure to support the transition and framing climate-friendly regulations to incentivize business.



5.1 Overview of policy environment

Given the high rates of unemployment and poverty in South Africa, the government is very focused on poverty alleviation and the just transition. Consequently, the framing of opportunities for decarbonizing the country's shipping and trucking sectors should be seen in terms of – as one participant put it – a broader agenda to re-industrialize South Africa's economy using green solutions.

The government has taken significant steps in the past decade or more to implement a range of key climate policies, including establishing a low-emission development strategy, carbon tax and just transition framework. Some highlights include the following:

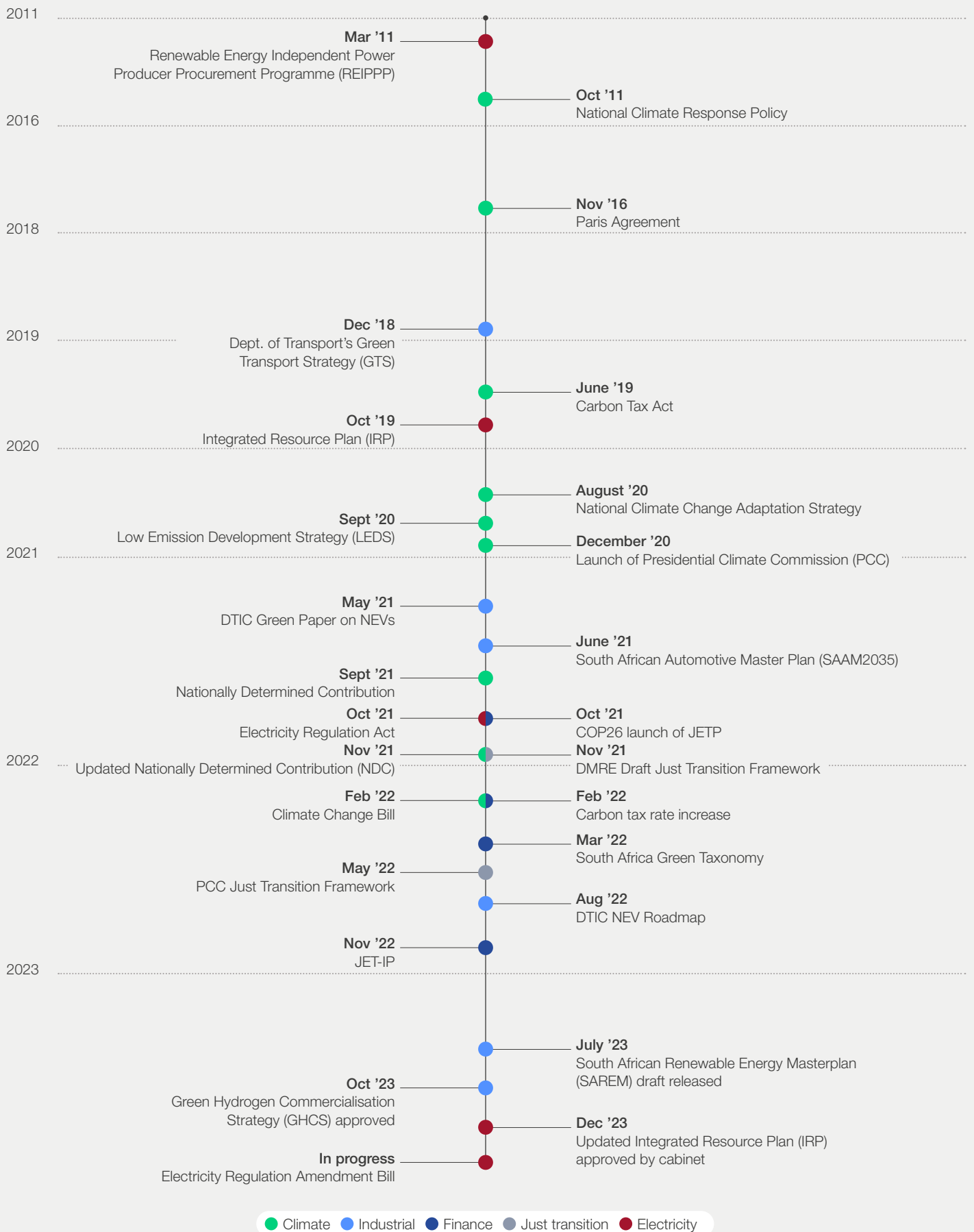
- **March 2024:** Parliament is working on an amendment to the Electricity Regulation Act, which would create a multi-market power sector based on a transmission system operator (TSO) model. This would allow competitive buying and selling of power via a market operator, which could provide a channel for the sale of excess power from green hydrogen facilities.⁶³
- **December 2023:** The Cabinet approved the country's updated [Integrated Resource Plan \(IRP\)](#), which envisages 29.3 GW of new generation capacity by 2030, including over 7 GW of new gas projects, 4.5 GW of wind, 3.6 GW of solar PV and 6.3 GW of distributed generation. Until 2030, the government anticipates a supply-demand deficit, so load-shedding is likely to continue for now.⁶⁴
- **October 2023:** The National Assembly passed the [Climate Change Bill](#), a significant piece of legislation which, if enacted, would enshrine South Africa's NDC into law and set the country on a low-carbon, climate-resilient pathway.

The Bill requires the government to set sectoral emission targets and allocate carbon budgets to significant GHG-emitting companies.⁶⁵

- **July 2023:** The draft [South African Renewable Energy Masterplan \(SAREM\)](#), which aims to develop value chains for renewable energy and storage technologies as well as creating inclusive jobs, was released for public comment.
- **December 2022:** The proposed [Green Hydrogen \(GH₂\) Commercialisation Strategy](#) was released for public comment; it builds on the [Hydrogen Society Roadmap for South Africa](#) published in 2021.
- **November 2022:** The government published its [Just Energy Transition Investment Plan \(JET IP\)](#), which envisages ZAR 1.5 trillion of investment in the low-carbon economy over five years. For more detail see section 5.3 below and the Finance chapter, section 4.3.
- **September 2021:** The government published its revised [Nationally Determined Contribution \(NDC\)](#), which commits the country to a net-zero goal by 2050, as well as a near-term 2030 target compatible with a <2°C world.⁶⁶
- **2018:** The government published its [Green Transport Strategy for South Africa \(2018-2050\)](#), which aims to decarbonize the transport sector – especially road transport, which accounts for 91% of the sector's emissions.

Meanwhile, the [Presidential Climate Commission \(PCC\)](#) has called for a full phase-out of coal and recommends renewables and battery storage as least-cost alternatives, although the role of fossil gas remains an option. For significant policy initiatives dating back to 2011, see Figure 5.

FIGURE 5. | South African government's key policy milestones



Notes: JETP = Just Energy Transition Partnership; DTIC = Department of Trade, Industry and Competition; NEV = New energy vehicle; DMRE = Department of Mineral Resources and Energy.

Source: BCG

5.2 Policy-related risks

Energy crisis and reliance on coal

South Africa's economy is structurally embedded in an energy-intensive, fossil fuel-based production system, which presents major hurdles to the country's transition to a low-carbon economy. Among G20 countries, South Africa has had the highest share of coal generation in its grid since 2015, with well over 80% of electricity generated by coal in 2022.⁶⁷ It is the largest emitter in Africa, driving 40% of the continent's emissions.

Export markets' net-zero targets

The economic and social cost of inaction is massive. According to the South African Reserve Bank, up to 35% of the country's export value will be at risk if it does not reduce its carbon emissions.⁶⁸ This is because most of its key export markets have set net-zero targets, including the EU, US, China, United Kingdom, Japan, India, United Arab Emirates (UAE) and South Korea.⁶⁹ The EU has followed up with its CBAM, which poses a

significant challenge for South Africa's ICE-based automotive sector that exports half its production to Europe and the UK.

Poverty and inequality

South Africa has the highest income inequality in the world, with a Gini coefficient of around 0.67. For comparison, the US scores 0.41, the highest among developed countries, while Scandinavian countries score around 0.25.⁷⁰ The top 10% of South Africa's population owns 86% of the wealth, while 55% live in poverty. Unemployment is over 30%, rising to a record 65% among young people in 2021.⁷¹

Policy-makers are therefore very focused on a just transition, to ensure the country's response to climate change delivers economic competitiveness and reduces the high levels of structural inequality, poverty and unemployment. Investors and export partners need to be mindful of these socio-economic challenges and the high priority placed on them by both public and private actors in South Africa.

5.3 Policy-related solutions

Just Energy Transition Investment Plan (JET IP)

The government's JET IP provides a roadmap from 2023-2027 to decarbonize the economy based on the following priorities, summarized by the Presidential Climate Commission as follows:⁷²

- **Creating quality jobs** in new sectors like electric vehicles, green hydrogen, renewable energy, and manufacturing
- **Increasing our energy security** and ending load shedding through a massive rollout of new, sustainable energy sources

- **Addressing the risks of climate change** and positioning South Africa to be an important global player in the green economy of the future
- **Boosting economic growth** through more than ZAR 1 trillion of new investment in the South African economy

The government is prioritizing JET resources to finance the transition of the power sector away from its reliance on coal, along with support for coal workers whose jobs are at risk. Social equity and inclusion are key concerns for policy-makers and public sector financiers.



How do we bring economic activities to places where people are living with unemployment? How do we link the mainstream economy to marginalized groups – what about townships?

Workshop participant

Workshop participants included members of the recently established JET project management unit (PMU), tasked with overseeing the implementation

of the JET IP. Given the plan's focus on stabilizing electricity supplies, the PMU has identified grid transmission projects as an urgent priority.⁷³

While green hydrogen forms part of JET’s focus, industry participants called on the government to address private sector uncertainty around its commitment to accelerating the green hydrogen market through incentives and supportive regulations.

For more detail on the financing gap between JET IP’s goal and currently committed finance, see Finance chapter, section 4.3. For more analysis of South Africa’s renewable energy and green hydrogen opportunities, see Chapter 1.

Policy support for rail, shipping and trucking sectors and infrastructure

Upgrading the efficiency of South Africa’s infrastructure – whether the electricity grid, roads and charging networks, rail connections or port development – is a critical enabler for progress.

The next priority for JET financing after electricity will be road and rail, with the government planning to improve rail infrastructure to relieve the burden of freight that falls on the road transport sector. For example, copper is currently carried from Zambia to South Africa by truck, because of a lack of rail infrastructure. One workshop attendee suggested the government might consider asking the private sector to bid for time on the rail network.

Trucking industry participants called on the government to provide supportive policies and financial incentives to develop domestic zero-emission vehicle manufacturing, essential to ensure that ZETs can compete against ICE-powered trucks on price. The requested measures include:

- Review of the government’s import levies, which increase the landed cost of EVs compared to incumbent ICE-powered vehicles
- Modification of existing regulatory restrictions on truck length and weight, which currently put ZETs, with their heavy batteries, at a commercial disadvantage compared to their fossil-fuelled rivals

In April 2024, the Department of Transport held a ministerial roundtable on maritime decarbonization. The department is working on a roadmap for the shipping sector with the South African Maritime Safety Authority (SAMSA) and the Council for Scientific and Industrial Research (CSIR), as well as participating in negotiations in the IMO.

Greater collaboration needed between government, industry and financial institutions

One of the key benefits of FMC’s in-country workshop was the multi-stakeholder convening approach that allowed policy-makers, industry and other actors to discuss ways of collaborating. When asked how industry could support government, one participant highlighted the need for greater cooperation in blending finance in line with the demands of the capital stack. He added that the problem is not so much the availability of de-risked capital as a lack of bankable projects; and he emphasized the importance of collaboration with the trucking industry in deciding where to place EV charging infrastructure.



How to eat an elephant one bite at a time? We should start to initiate a lot more collaborative projects with the private sector.

Workshop participant

The critical role of industry in driving innovation was a common theme at the workshop. One participant said that evidence is needed from the private sector that pilot projects are viable, before the government can structure an enabling environment around new technology. Participants agreed that a dynamic relationship between policy-making and pilot projects could be mutually beneficial; but South Africa currently has too few pilots, which makes recovery difficult after failure.

Meanwhile, one attendee reflected on the lack of government platforms to foster multi-stakeholder partnerships, especially when it comes to attracting international investment. “The government is stretched thin, but we need to make a concerted effort to develop partnerships with financial institutions to enable piloting and to move towards solutions,” he said, identifying the International

Development Corporation of South Africa as “a great place to start”.

Localization of opportunities

The importance of ensuring that the low-carbon transition benefits ordinary South Africans, including those out of work or living in poverty, was a recurrent theme during the workshop. A senior official spoke of the need to define a green industrialization strategy for South Africa, which could both mitigate the external risks to the transition in order to bring down the capex, and enhance opportunities to produce low-carbon fuels, materials and products locally.

BOX 8: Summary of policy-related solutions to accelerate South Africa’s transition

Lever	Potential interventions
Policy and regulation	<ul style="list-style-type: none"> – Align policies and regulation, such as IRP and NEA, to government strategies outlined in the JET and NDCs, including setting clear targets and standards, and accelerating permitting and licencing processes for green technologies. – Develop codes and standards for fuelling with ZEF in ships and vehicles. – Establish guarantee of origin scheme and “green” requirements for green hydrogen and derivatives for international trade. – Update climate change goals to include the use of ZEF for shipping decarbonization with policy to incentivize or mandate such fuel blending. – Update legislation and regulation to support the transport and bunkering of ZEF in ports and keep pace with future operational requirements. – Disincentivize ICE vehicles with scrappage incentives, emissions reduction targets and excise duties/taxes based on emissions and engine capacity. – Reduce or rebate import duties and VAT on electrolyzers. – Reduce import tariffs and adjust weight restrictions on ZEVs.
Financing	<ul style="list-style-type: none"> – Establish tax incentives, carbon tax revenue recycling and preferential funding for green initiatives. – With private financial institutions, set up a programme for government-backed green bonds. – Establish trade agreements and trade corridors with international partners to secure offtake. – Set ZEV incentives to develop trucking supply chain, local production and demand. – Create incentives to keep sustainable CO₂ sources for e-methanol in-country. – With NGOs, finance feasibility studies along the green hydrogen value chain.
Supporting infrastructure and supply chain	<ul style="list-style-type: none"> – Enable the competitive localization of manufacturing value chains (e.g. to enable the development of renewable energy). – Negotiate trade agreements for supply chain imports (e.g. batteries, PVs). – Coordinate shared infrastructure (e.g. charging, ports) and supply chain development plan for ZEF and ZETs. – Identify process and support for trucking corridor and loading area infrastructure planning. – With the private sector, invest in port modernization and ZEF bunkering.
Skills and knowledge-sharing	<ul style="list-style-type: none"> – With the private sector, identify key skill gaps to develop upskilling/reskilling programmes for developing renewables, ZEF and ZEVs, and localizing supply chains. – Establish international partnerships for technology transfer and standards alignment. – Develop global e-ammonia rules and regulations with IMO.

Source: BCG

Conclusion

The three-day workshop organized by the First Movers Coalition in Cape Town in March 2024 focused on the decarbonization of South Africa's shipping and trucking sectors, as well as its potential to become a powerhouse for renewable energy and green hydrogen production.

Participants highlighted the many risks and challenges facing the country's transition. South Africa's electricity grid – currently experiencing up to eight hours of load-shedding a day – urgently needs upgrading and strengthening before it can absorb the additional renewable capacity the country is targeting. Major investments are also required for the nation's ports to provide reliable bunkering options for the zero-emission fuels needed by global shipping. Additionally, the lack of charging infrastructure is a major barrier to the roll-out of battery-electric trucks.

On the finance side, there is a funding gap of around ZAR 700 billion between the government's just energy transition target budget and the resources available. The cost of capital for energy projects in South Africa is many times higher than in more developed markets, due to multiple political, regulatory, currency, technology and transmission risks. The pipeline of potential new projects is not providing enough investment-ready opportunities, with many struggling to attract final investment decisions.

However there are also many signs of promising progress in tackling these many obstacles. The government has fast-tracked nine strategically significant green hydrogen mega-projects for expedited approvals, several of which have already completed World Bank-funded pre-feasibility studies. The International Maritime Organization is actively working on economic mechanisms penalizing consumption of fossil fuels, while revenues from any tax raised could be allocated to fund the production of green fuels in emerging economies. Industry players from shipping and trucking – including members of the First Movers Coalition – are aggregating their demand signals for zero-emission fuels and technologies, given global demand will be essential in the absence of clear local demand.

The South African government must create an enabling environment for the green economy. Industrialized nations and multilateral development banks need to provide concessionary finance to underwrite the capital expenditures of major infrastructure projects. In the private sector, a combination of first movers and fast followers must demonstrate commitment to the transition through offtake agreements for zero-emission technologies. The FMC's workshop brought together 70 participants from government, finance and the private sector. Progress now rests on each set of actors playing their part.

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Endnotes

- 1 National Business Initiative (NBI), It all hinges on Renewables, 2022, https://www.nbi.org.za/wp-content/uploads/2023/09/It-all-hinges-on-Renewables_5th-Sept.pdf.
- 2 Sources:
 - United States Agency for International Development (USAID), South Africa Climate Change Country Profile, November 2022, <https://www.usaid.gov/climate/country-profiles/south-africa>.
 - Ember, Global Electricity Review 2023, <https://ember-climate.org/insights/research/global-electricity-review-2023/#supporting-material>.
- 3 South African Reserve Bank (SARB), SARB Occasional Bulletin of Economic Notes, April 2024, <https://www.resbank.co.za/content/dam/sarb/publications/occasional-bulletin-of-economic-notes/2024/occasional-bulletin-of-economic-notes-combined-2401-01.pdf>.
- 4 National Business Initiative (NBI), South Africa's Net-Zero Transition, December 2022, <https://www.nbi.org.za/report/south-africas-net-zero-transition/>.
- 5 South African Reserve Bank (SARB), SARB Occasional Bulletin of Economic Notes, April 2024, <https://www.resbank.co.za/content/dam/sarb/publications/occasional-bulletin-of-economic-notes/2024/occasional-bulletin-of-economic-notes-combined-2401-01.pdf>.
- 6 National Business Initiative (NBI), South Africa's Net-Zero Transition, December 2022, <https://www.nbi.org.za/report/south-africas-net-zero-transition/>.
- 7 Boston Consulting Group, Net-Zero South Africa – It All Hinges on Renewables, 20 July 2022, <https://www.bcg.com/publications/2022/net-zero-south-africa-report>.
- 8 Ibid.
- 9 Ibid.
- 10 International Renewable Energy Agency (IRENA), Renewable Capacity Statistics 2024, 2024, https://mc-cd8320d4-36a1-40ac-83cc-3389-cdn-endpoint.azureedge.net/-/media/Files/IRENA/Agency/Publication/2024/Mar/IRENA_RE_Capacity_Statistics_2024.pdf?rev=a587503ac9a2435c8d13e40081d2ec34.
- 11 World Bank Group, South Africa – Country Climate and Development Report, October 2022, <https://openknowledge.worldbank.org/server/api/core/bitstreams/52409ffd-96f7-58d4-be7f-c8114abbd4c5/content>.
- 12 National Business Initiative (NBI), It all hinges on Renewables, 2022, https://www.nbi.org.za/wp-content/uploads/2023/09/It-all-hinges-on-Renewables_5th-Sept.pdf.
- 13 The Presidency, Republic of South Africa, South Africa's Just Energy Transition Investment Plan (JET IP), 2022, <https://pcccommissionflo.imgix.net/uploads/images/South-Africas-Just-Energy-Transition-Investment-Plan-JET-IP-2023-2027-FINAL.pdf>.
- 14 South African Government, Minister Patricia de Lille gazettes infrastructure projects of significant importance to country as strategic integrated projects (SIPs), December 2022, <https://www.gov.za/speeches/minister-patricia-de-lille-gazettes-infrastructure-projects-significant-importance-country>.
- 15 P4G Getting to Zero Coalition Partnership, South Africa: fuelling the future of shipping: South Africa's role in the transformation of global shipping through green hydrogen-derived fuels, June 2021, https://www3.weforum.org/docs/South_Africa_fueling_the_future_of_shipping.pdf.
- 16 Salgmann, R., Weidenhammer, M. and Englert, D., Green shipping fuels made in South Africa, World Bank Blogs, 29 November 2023, <https://blogs.worldbank.org/en/transport/green-shipping-fuels-made-south-africa>.
- 17 The World Bank, World Bank Proposes 10 GW Clean Hydrogen Initiative to Boost Adoption of Low-Carbon Energy, 17 November 2023, <https://www.worldbank.org/en/news/press-release/2023/11/17/world-bank-proposes-10-GW-clean-hydrogen-initiative-to-boost-adoption-of-low-carbon-energy>.
- 18 International Finance Corporation (IFC), Clean Hydrogen: Scaling Up to Meet Net Zero Emissions Targets, <https://www.ifc.org/en/what-we-do/sector-expertise/manufacturing/decarbonization/clean-hydrogen>.
- 19 International Energy Agency (IEA), Cost of Capital Observatory, 6 December 2022, <https://www.iea.org/data-and-statistics/data-tools/cost-of-capital-observatory>.
- 20 UN Trade and Development (UNCTAD), Review of Maritime Transport 2022: Navigating stormy waters, <https://unctad.org/rmt2022>.
- 21 The Organisation for Economic Co-operation and Development (OECD), The Ocean, Ocean shipping and shipbuilding, <https://www.oecd.org/ocean/topics/ocean-shipping/#:~:text=The%20main%20transport%20mode%20for,can%20create%20economic%20value%20added>.

- 22 International Maritime Organization (IMO), Fourth IMO Greenhouse Gas Study 2020, 2021, <https://wwwcdn.imo.org/localresources/en/OurWork/Environment/Documents/Fourth%20IMO%20GHG%20Study%202020%20-%20Full%20report%20and%20annexes.pdf>.
- 23 International Maritime Organization (IMO), Revised GHG reduction strategy for global shipping adopted, 7 July 2023, <https://www.imo.org/en/MediaCentre/PressBriefings/pages/Revised-GHG-reduction-strategy-for-global-shipping-adopted-.aspx>.
- 24 International Energy Agency (IEA), International Shipping, <https://www.iea.org/energy-system/transport/international-shipping>.
- 25 World Economic Forum, Why zero-emission fuel offtake is key to global shipping's transition, 17 January 2023, <https://www.weforum.org/agenda/2023/01/davos-2023-zero-emission-fuel-offtake-global-shipping-transition/>.
- 26 Ricardo and Environmental Defense Fund for the P4G Getting to Zero Partnership, South Africa: fueling the future of shipping, June 2021, https://www3.weforum.org/docs/South_Africa_fueling_the_future_of_shipping.pdf.
- 27 S&P Global, Global Trade Atlas Forecasting South Africa Seaborne Trade Volume, 2024, cited in BCG's situational analysis, March 2024.
- 28 Ibid.
- 29 FMC will assess and align with IMO's lifecycle analysis methodologies, standards and overall guidance once it is released, likely in 2025. Also, technologies considered in scope will be reviewed over the course of the 2020s and potentially be updated based on new evidence. The review of new fuels will consider lifecycle emissions and scalability as well as the availability/supply of new fuels and the quantum of the commitment for different actors. The current list assumes in-scope fuels are used in accordance with generally accepted safe handling/use standards and assumes mitigation of other potentially negative environmental and social impacts. In some cases, such standards are under development. FMC allows book and claim when available for cargo owners as long as it occurs on the same carrier. FMC also encourages the continued development of a book and claim framework for the transition period. Sources: S&P Global Platts; UMAS; Getting to Zero Coalition; Cargo Owners for Zero Emission Vessels; Energy Transitions Commission; Mission Possible Project; BCG analysis.
- 30 World Economic Forum, Boston Consulting Group, Fuelling the Future of Shipping: Key Barriers to Scaling Zero-Emission Fuel Supply, December 2023, https://www3.weforum.org/docs/WEF_Fuelling_the_Future_of_Shipping_2023.pdf.
- 31 Source: Boston Consulting Group, 2024.
- 32 Salgmann, R., Weidenhammer, M. and Englert, D., Green shipping fuels made in South Africa, World Bank Blogs, 29 November 2023, <https://blogs.worldbank.org/en/transport/green-shipping-fuels-made-south-africa>.
- 33 Global Maritime Forum, Maritime, mining, steel, and energy industry leaders join forces to develop first-ever concept for a green corridor between South Africa and Europe, March 2023, <https://www.globalmaritimeforum.org/press/maritime-mining-steel-and-energy-industry-leaders-join-forces-to-develop-first-ever-concept-for-a-green-corridor-between-south-africa-and-europe>.
- 34 Morisset, J., To reduce South Africa's unemployment, make work more attractive, World Bank Blogs, 23 October 2023, <https://blogs.worldbank.org/en/africacan/reduce-south-africas-unemployment-make-work-more-attractive>.
- 35 Western Cape Government, World Bank report ranks SA ports, including Cape Town, at bottom of the list, 25 May 2021, <https://www.westerncape.gov.za/news/world-bank-report-ranks-sa-ports-including-cape-town-bottom-list>.
- 36 South African Reserve Bank (SARB), SARB Occasional Bulletin of Economic Notes, April 2024, <https://www.resbank.co.za/content/dam/sarb/publications/occasional-bulletin-of-economic-notes/2024/occasional-bulletin-of-economic-notes-combined-2401-01.pdf>.
- 37 PwC, Transportation and logistics, South Africa, <https://www.pwc.com/gx/en/transportation-logistics/publications/africa-infrastructure-investment/assets/south-africa.pdf>.
- 38 Birguid, SA Heavy Commercial Vehicle Market Analysis, Executive Summary, November 2023, https://birguid.co.za/wp-content/uploads/2023/12/Birguid_SA-Heavy-Commercial-Vehicle-Executive-Summary_November-2023.pdf.
- 39 National Business Initiative (NBI), Decarbonising The South African Transport Sector, March 2023, https://www.nbi.org.za/wp-content/uploads/2023/03/Decarbonising-the-South-African-Transport-Sector_Final_17March_023.pdf.
- 40 Ibid.
- 41 Yihao Xie, Francisco Posada, Arijit Sen, International Council on Clean Transportation, Soot-free road transport in South Africa: A cost-benefit analysis of Euro VI heavy-duty vehicle standards, December 2022, <https://theicct.org/wp-content/uploads/2022/12/Soot-working-paper-26-A4-v4.pdf>.
- 42 Anenberg, S. C. et al., International Council on Clean Transportation, A Global Snapshot of the Air Pollution-Related Health Impacts of Transportation Sector Emissions in 2010 and 2015, February 2019, <https://theicct.org/publication/a-global-snapshot-of-the-air-pollution-related-health-impacts-of-transportation-sector-emissions-in-2010-and-2015/>.
- 43 CleanTechnica, Volvo Trucks South Africa Takes Its First Extra Heavy Electric Truck On A 600km Road Trip From Durban To Johannesburg, April 2023, <https://cleantechnica.com/2023/04/12/volvo-trucks-south-africa-takes-its-first-extra-heavy-electric-truck-on-a-600km-road-trip-from-durban-to-johannesburg/>.
- 44 Sasol, Sasol and Toyota South Africa Motors form green hydrogen mobility partnership, April 2021, <https://www.sasol.com/media-centre/media-releases/sasol-and-toyota-south-africa-motors-form-green-hydrogen-mobility>.

- 45 Anglo American, Anglo American unveils a prototype of the world's largest hydrogen-powered mine haul truck - a vital step towards reducing carbon emissions over time, May 2022, <https://www.angloamerican.com/media/press-releases/2022/06-05-2022>.
- 46 Sasol, Sasol and Toyota South Africa Motors form green hydrogen mobility partnership, April 2021, <https://www.sasol.com/media-centre/media-releases/sasol-and-toyota-south-africa-motors-form-green-hydrogen-mobility>.
- 47 Government of South Africa, Department of Trade, Industry and Competition, Green Hydrogen Commercialisation Strategy for South Africa, 30 November 2022, <https://www.thedtic.gov.za/wp-content/uploads/Full-Report-Green-Hydrogen-Commercialisation-Strategy.pdf>.
- 48 Government of South Africa, Department of Trade, Industry and Competition (DTIC), Electric Vehicles White Paper, November 2023, p.34, <https://www.thedtic.gov.za/wp-content/uploads/EV-White-Paper.pdf>.
- 49 Engineering News, Aqora becomes Afrivolt, aims for battery cell manufacturing in Cape Town, 24 January 2024, <https://www.engineeringnews.co.za/article/aqora-becomes-afrivolt-aims-for-battery-cell-manufacturing-in-cape-town-2024-01-24>.
- 50 Mining Technology, Platinum production in South Africa and major projects, 4 July 2023, <https://www.mining-technology.com/data-insights/platinum-in-south-africa/>.
- 51 World Trade Organization, Information note on trade in intermediate goods: trade in platinum group metals in 2020, September 2021, https://www.wto.org/english/res_e/statis_e/miwi_e/info_note_pgms_e.pdf.
- 52 Wiedenhoff, P. et al., What the Shift to Zero-Emission Vehicles Means for Commercial Transportation, Boston Consulting Group, 22 March 2022, <https://www.bcg.com/publications/2022/what-the-shift-to-zero-emission-vehicles-means-for-commercial-transportation>.
- 53 Daphne Mokwena, Energy (EAF Progress), Government of South Africa, 20 February 2024, [https://www.gov.za/blog/energy-eaf-progress#:~:text=Our%20Energy%20Availability%20Factor%20\(EAF,also%20contributes%20to%20the%20EAF](https://www.gov.za/blog/energy-eaf-progress#:~:text=Our%20Energy%20Availability%20Factor%20(EAF,also%20contributes%20to%20the%20EAF).
- 54 Clean Technica, South Africa's Shoprite Group Has Doubled The Amount Of Renewable Energy Used In Its Operations In Just 1 Year!, January 2024, <https://cleantechnica.com/2023/12/19/south-africas-shoprite-group-has-doubled-the-amount-of-renewable-energy-used-in-its-operations-in-just-1-year/>.
- 55 Department of Science and Innovation with Engie Impact, South Africa Hydrogen Valley, October 2021, https://www.dst.gov.za/images/2021/Hydrogen_Valley_Feasibility_Study_Report_Final_Version.pdf.
- 56 Government of South Africa, Department of Trade, Industry and Competition (DTIC), Electric Vehicles White Paper, November 2023, <https://www.thedtic.gov.za/wp-content/uploads/EV-White-Paper.pdf>.
- 57 South African Revenue Service, Automotive Production and Development Programme (APDP), <https://www.sars.gov.za/customs-and-excise/registration-licensing-and-accreditation/automotive-production-and-development-programme-apdp/>.
- 58 Department of Transport, Republic of South Africa, Green Transport Strategy for South Africa: (2018-2050), https://www.changing-transport.org/wp-content/uploads/I_K_Green-Transport-Strategy_South-Africa_2018_EN.pdf.
- 59 World Economic Forum, Scaling Clean Technology Offtakes: A Corporate Playbook for Net Zero, May 2024, <https://www.weforum.org/publications/scaling-clean-technology-offtakes-a-corporate-playbook-for-net-zero/>.
- 60 The FMC's definition for zero-emission fuels for shipping is as follows:
 "Zero-emission fuels are those that reduce well-to-wake GHG emissions by 80% or more compared to fossil heavy fuel oil
 – Current list of fuels includes: ammonia, methanol, hydrogen, battery
 – These commitments do not include biofuels, liquid natural gas, carbon offsets or efficiency improvements."
- 61 Guarantees are commitments provided by parties involved to ensure that certain aspects of a project are fulfilled financially and operationally. These are crucial for reducing the risks associated with large-scale projects, especially in sectors like infrastructure, energy or construction, where investments are substantial and the payback periods are long. Guarantees typically seen in project finance include:
 – Performance guarantees: these are provided by suppliers or contractors, ensuring that equipment and systems installed function as required. If the performance falls below specified standards, the guarantor will rectify deficiencies or compensate the project company.
 – Payment guarantees: these assure that payments under a contract will be made. For instance, a supplier might require a payment guarantee from a third party covering the project owner's obligations. If the project owner fails to pay, the guarantor will cover the payments.
- 62 Contracts for difference (CfD) were introduced by the UK Government in 2014, with the purpose to incentivize investments in new low-carbon electricity generation in the UK by providing stability and predictability to future revenue streams. CfD is a long-term contract between an electricity generator and a low carbon contracts company (LCCC). The contract enables the generator to stabilize its revenues at a pre-agreed level (the strike price) for the duration of the contract. Under the CfD, when the market price for electricity generated by a CfD generator (the reference price) is below the strike price set out in the contract, payments are made by the LCCC to the CfD generator to make up the difference. However, when the reference price is above the strike price, the CfD generator pays the LCCC the difference. Source: <https://www.emrsettlement.co.uk/about-emr/contracts-for-difference/>.

- 63 Parliament of the Republic of South Africa, Electricity Regulation Amendment Bill (B23-2023), <https://www.parliament.gov.za/bill/2314467>.
- 64 Enerdata, South Africa unveils its draft Integrated Resource Plan to 2030 and 2050, 9 January 2024, <https://www.enerdata.net/publications/daily-energy-news/south-africa-unveils-its-draft-integrated-resource-plan-2030-and-2050.html>.
- 65 Ibid.
- 66 Climate Action Tracker, South Africa, 23 November 2023, <https://climateactiontracker.org/countries/south-africa/>.
- 67 Ember, Global Electricity Review 2023, <https://ember-climate.org/insights/research/global-electricity-review-2023/#supporting-material>.
- 68 South African Reserve Bank (SARB), SARB Occasional Bulletin of Economic Notes, April 2024, <https://www.resbank.co.za/content/dam/sarb/publications/occasional-bulletin-of-economic-notes/2024/occasional-bulletin-of-economic-notes-combined-2401-01.pdf>.
- 69 National Business Initiative, Decarbonising the South African Transport Sector, March 2023, https://www.nbi.org.za/wp-content/uploads/2023/03/Decarbonising-the-SA-Transport-Sector_PressRelease_22March_023.pdf.
- 70 Valodia, I., South Africa can't crack the inequality curse. Why, and what can be done, 15 September 2023, University of the Witwatersrand, Johannesburg, <https://www.wits.ac.za/news/latest-news/opinion/2023/2023-09/south-africa-cant-crack-the-inequality-curse-why-and-what-can-be-done.html#:~:text=According%20to%20the%20most%20recent,value%20between%200%20and%201>.
- 71 Boston Consulting Group, Net-Zero South Africa – It All Hinges on Renewables, 20 July 2022, <https://www.bcg.com/publications/2022/net-zero-south-africa-report>.
- 72 Presidential Climate Commission, South Africa's Just Energy Transition Investment Plan (JET-IP), <https://www.climatecommission.org.za/south-africas-jet-ip>.
- 73 Creamer, T., Settling on funding solutions for expedited grid infrastructure set as a Just Energy Transition Investment Plan priority, Engineering News, 27 February 2024, <https://www.engineeringnews.co.za/article/settling-on-funding-solutions-for-expedited-grid-infrastructure-set-as-a-just-energy-transition-investment-plan-priority-2024-02-27>.



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