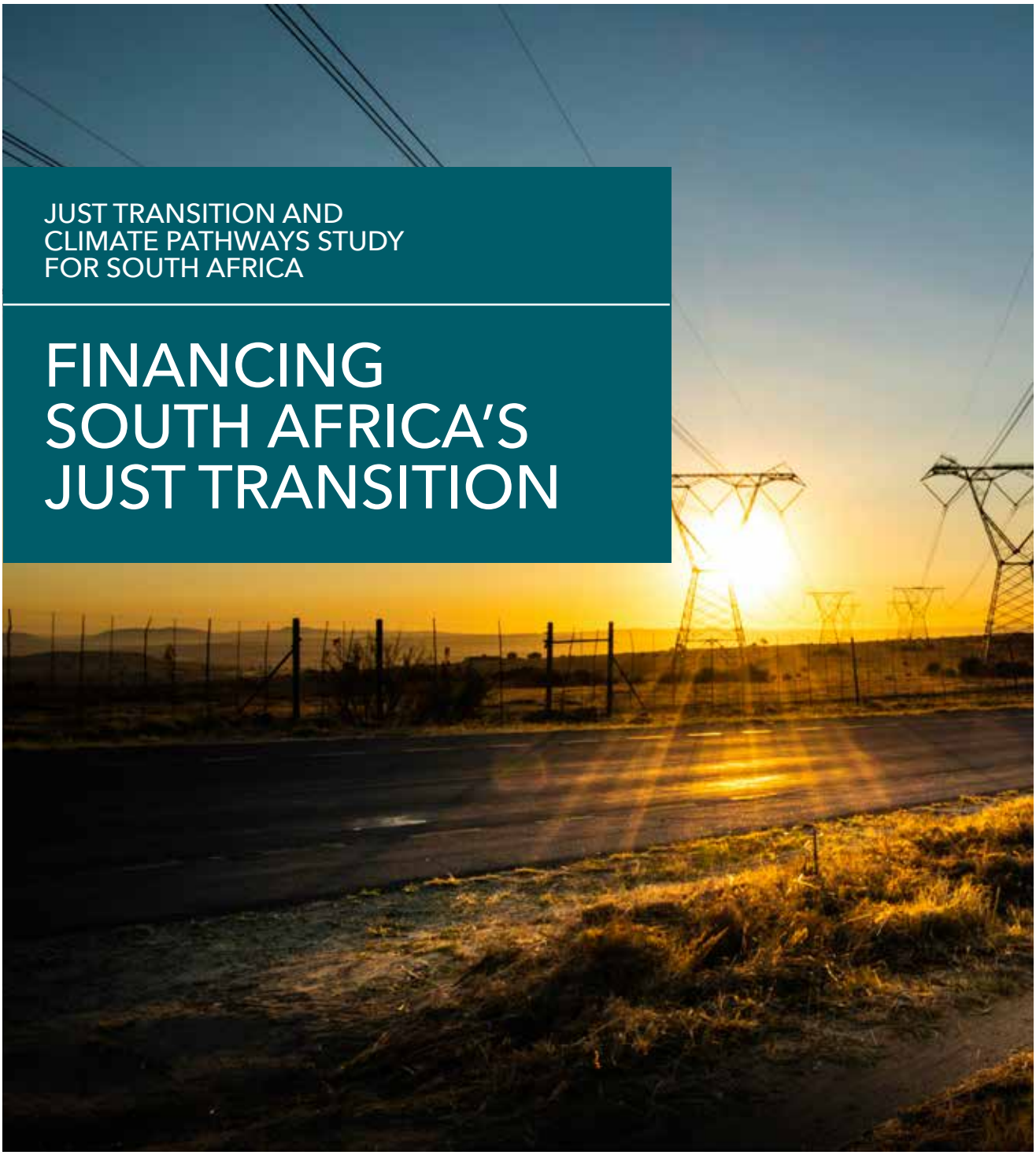
National Business Initiative



JUST TRANSITION AND
CLIMATE PATHWAYS STUDY
FOR SOUTH AFRICA

FINANCING SOUTH AFRICA'S JUST TRANSITION

CHAPTER 09

IN PARTNERSHIP WITH

BUSA
BUSINESS UNITY SOUTH AFRICA

BCG BOSTON CONSULTING GROUP

ACKNOWLEDGEMENTS

PARTNERS

National Business Initiative

At the National Business Initiative (NBI), we believe in collective action and collaboration to effect change; building a South African society and economy that is inclusive, resilient, sustainable and based on trust. We are an independent business movement of around 80 of South Africa's largest companies and institutions committed to the vision of a thriving country and society. The NBI works with our members to enhance their capacity for change, leverage the power of our collective, build trust in the role of business in society, enable action by business to transform society and create investment opportunities.

Business Unity South Africa

BUSA, formed in October 2003, is the first representative and unified organisation for business in South Africa. Through its extensive membership base, BUSA represents the private sector, being the largest federation of business organisations in terms of GDP and employment contribution. BUSA's work is largely focused around influencing policy and legislative development for an enabling environment for inclusive growth and employment.

Boston Consulting Group

BCG partners with leaders in business and society to tackle their most important challenges and capture their greatest opportunities. BCG, the pioneer in business strategy when it was founded in 1963, today works closely with clients to embrace a transformational approach aimed at benefitting all stakeholders – empowering organisations to grow, build sustainable competitive advantage, and drive positive societal impact. Their diverse global teams are passionate about unlocking potential and making change happen, and delivering integrated solutions.

RESEARCH SUPPORTED BY

Banking Association South Africa: The Banking Association South Africa (BASA) advances the interests of the industry with its regulators, legislators, and stakeholders, to make banking sustainable, profitable and better able to contribute to the social and economic development and transformation of the country. As the national association of domestic and international banks operating in South Africa, BASA advocates the views of the banks on legislation, regulation, social, and economic issues that affect the industry.

UK PACT South Africa: UK PACT has partnered with South Africa to support action on Just Transition pathways and a low-carbon economic recovery. As the third largest economy in Africa, South Africa plays a critical role in economic and policy priority setting at a continental level and across the Southern Africa region. South Africa's long-standing participation in the United Nations Framework Convention on Climate Change (UNFCCC) processes creates a solid platform for an impactful and transformational UK PACT partnership. Moreover, UK PACT seeks to support climate action that will contribute to the realisation of other development imperatives in South Africa, such as job creation and poverty alleviation. Priority areas of focus for UK PACT in South Africa are aligned with key national priorities in the just energy transition, renewable energy, energy efficiency, sustainable transport, and sustainable finance. UK PACT projects can contribute to addressing industry-wide constraints, common metropolitan challenges, and bringing city, provincial and national level public and private partners together to address climate priorities.

We Mean Business: This is a global coalition of nonprofit organisations working with the world's most influential businesses to take action on climate change. The coalition brings together seven organisations: BSR, CDP, Ceres, The B Team, The Climate Group, The Prince of Wales's Corporate Leaders Group and the World Business Council for Sustainable Development. Together we catalyze business action to drive policy ambition and accelerate the transition to a zero-carbon economy. NBI has been a regional network partner to WMB since the beginning of 2015.

Supported by:

Federal Ministry for the Environment, Nature Conservation and Nuclear Safety

of the Federal Republic of Germany

Strategic Partnerships for the Implementation of the Paris Agreement (SPIPA): Climate change is a global threat that requires a decisive and confident response from all communities, particularly from major economies that represent roughly 80% of global greenhouse gas emissions. The 2015 Paris Agreement, complemented by the 2018 Katowice climate package, provides the essential framework governing global action to deal with climate change and steers the worldwide transition towards climate-neutrality and climate-resilience. In this context, policy practitioners are keen to use various platforms to learn from one another and accelerate the dissemination of good practices.

To improve a geopolitical landscape that has become more turbulent, the EU set out in 2017 to redouble its climate diplomacy efforts and policy collaborations with major emitters outside Europe in order to promote the implementation of the Paris Agreement. This resulted in the establishment of the SPIPA programme in order to mobilise European know-how to support peer-to-peer learning. The programme builds upon and complements climate policy dialogues and cooperation with major EU economies.

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Confederation of Danish Industry: DI is Denmark's largest, most representative and most influential business and employers' organisation, covering manufacturing as well as service industries. DI works with employer and business membership organisations all over the world to reach the UN's Sustainable Development Goals and make their vision of a world with economic opportunities for everyone come alive.

CONTENTS

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

SERIES INCLUDES:

TERMINOLOGIES

AFOLU	Agriculture, Forestry and Other Land Use
BEV	Battery Electric Vehicle
bn	Billion
BASA	Banking Association of South Africa
BEC	Breakthrough Energy Catalyst
BRT	Bus Rapid Transit
BAT	Best available technology
BUSA	Business Unity South Africa
c	Cents (in South African Rands)
CapEx	Capital Expenditure
Carbon budget	A quantity of greenhouse gas emissions that can be emitted cumulatively over a time period.
CCGT	Closed Cycle Gas Turbine
CCUS	Carbon Capture Utilisation and Storage: A suite of technologies that involve capturing CO_2 from large point sources (e.g. power generation, industry) or from the atmosphere. If the captured CO_2 is not used on-site, the CO_2 is compressed and transported to be used in a range of applications or permanently stored in geological formations.
CfD	Contracts for Differences set a specific off-take price for a product upfront, with lower prices triggering subsidization from the concessional funder,and higher prices being allocated to the concessional funder and recycled.
CO_2	Carbon dioxide
CO_2e	Carbon dioxide equivalent
Commercial capital	Funding provided at market rates, including debt and equity capital.
Concessional capital	Funding provided at below market rates, such as low-interest debt or grant funding.
COP27	UN Climate Change Conference of the Parties
Debt	Funding provided with the expectation of repayment, typically with interest.
DFI	Development Finance Institution
EIA	United States Energy Information Administration
EU	European Union
EV	Electric Vehicle
FCEV	Fuel Cell Electric Vehicle
Forex	Foreign exchange
GDP	Gross Domestic Product
GHG	Greenhouse gas
GHGI	Greenhouse Gas National Inventory
GJ	Gigajoule
Green hydrogen	Hydrogen produced from renewable energy resources and water.
Green steel	Steel produced from iron ore with green hydrogen as the reductant
Gt	Gigatonne (1 thousand million tonnes)
GTP	Gas-to-power
GW	Gigawatt
H_2	Hydrogen
ICE	Internal Combustion Engine
IEA	International Energy Agency
IPCC	Intergovernmental Panel on Climate Change
IRP	Integrated Resource Plan
ISMO	Independent System and Market Operator
JETP	Just Energy Transition Partnership
k	Thousand
kg	Kilogram
KZN	KwaZulu-Natal
LNG	Liquified Natural Gas
mn	Million
Mt	Megatonne (1 million tonnes)
Mt p.a.	Megatonne per annum
MW	Megawatt
n/a	Not Applicable
NDC	Nationally Determined Contribution: Commitments by countries to reduce national emissions and adapt to the impacts of climate change, under the Paris Agreement.
net-zero	Net-zero CO_2 emissions
NIP	National Infrastructure Plan
NPC	National Planning Commission
NPV	Net Present Value
OCGT	Open Cycle Gas Turbines
OPEX	Operational Expenditure
PCC	Presidential Climate Commission
PCFTT	Presidential Climate Finance Task Team

Peaking GTP	Use of gas to handle peaks in power demand.
PGMs	Platinum Group Metals
PJ	Petajoule
PJ/a	Petajoule per annum
PV	Photovoltaic solar energy
RE	Renewable Energy
REIPPPP	Renewable Energy Independent Power Producer Procurement Programme
SA	South Africa
SMR	Small Modular Reactor
Synfuels	Synthetic fuels
TCO	Total cost of ownership
tn	Trillion
TWh	Terawatt-hours
UNFCCC	United Nations Framework Convention on Climate Change
US	United States
US$	United States Dollar
WACC	Weighted Average Cost of Capital
WC	Western Cape
ZAR	South African Rand

OVERVIEW OF CEO CHAMPIONS

Onboarding of additional CEOs ongoing

Joanne Yawitch
NBI CEO

Cas Coovadia
BUSA CEO

Paul Hanratty
Sanlam CEO

Shirley Machaba
PwC CEO

Lungisa Fuzile
Standard Bank South Africa CEO

Leila Fourie
JSE Group CEO

André de Ruyter
Eskom CEO

Arrie Rautenbach
ABSA CEO

Ian Williamson
Old Mutual CEO

Alan Pullinger
First Rand CEO

Portia Derby
Transnet CEO

Stuart Kent
Aurex Constructors CEO

Mark Dytor
AECI CEO

Nolitha Fakude
Anglo American SA Chairperson

Taelo Mojapelo
BP Southern Africa CEO

Deidré Penfold
CAIA Exec Director

Theo Boschoff
AgBiz CEO

Seelan Naidoo
Engen MD and CEO

Mohammed Akoojee
Imperial Logistics CEO

Stuart Mckensie
Ethos CEO

Nombasa Tsengwa
Exxaro CEO

Gavin Hudson
Tongaat Hulett CEO

Nyimpini Mabunda
GE SA CEO

Bertina Engelbrecht
Clicks Group CEO

CLICKS GROUP LIMITED

Tshokolo TP Nchocho
IDC CEO

IDC
Industrial Development Corporation

Hloniphizwe Mtolo
Shell SA CEO

Vivien McMenamin
Mondi SA CEO

mondi

Andrew Robinson
Norton Rose Fulbright CEO

NORTON ROSE FULBRIGHT

Roland van Wijnen
PPC Africa CEO

PPC

Njombo Lekula
PPC MD SA Cement and Materials

PPC

Alex Thiel
SAPPI CEO

sappi

Fleetwood Grobler
Sasol CEO

sasol

1. FOREWORD

JUST TRANSITION AND CLIMATE PATHWAYS STUDY FOR SOUTH AFRICA

South Africa is a signatory to the United Nations Framework Convention on Climate Change (UNFCCC) and to the Paris Agreement. As an energy and emissions intensive middle-income developing country, it recognises the need for it to contribute its fair share to the global effort to move towards net-zero carbon emissions by 2050, taking into account the principle of common but differentiated responsibilities and the need for recognition of its capabilities and national circumstances.

South Africa is highly vulnerable to the impacts of climate change and will need significant international support to transition its economy and to decarbonise. Furthermore, given the country's high rate of inequality, poverty and unemployment and the extent of dependence on a fossil fuel-based energy system and economy, this transition must take place in a way that is just, that leaves no-one behind and that sets the country onto a new, more equitable and sustainable development path; one which builds new local industries and value chains.

In response to the above imperatives, the National Business Initiative, together with Business Unity South Africa and the Boston Consulting Group has worked with corporate leaders to assess whether the pathways exist for the country's economic sectors to decarbonise by 2050, and whether this can be done in such a way as to build resilience to the impacts of climate change and to put the country onto a new, low emissions development path.

The work done by the business community has interrogated the energy, liquid fuels, mining, chemicals, AFOLU (Agriculture, Forestry and Other Land Use), transport and heavy industrial sectors. The results of the modelling and analytical work have been informed by numerous industry experts, academics and scientists. The results demonstrate that these pathways do exist and that even a country with an economy that is structurally embedded in an energy-intensive production system can shift.

The results of this work to date have shown that to realise these pathways, efforts must begin now. Timing is of the essence and the business community is of the view that there is no time like the present to create the regulatory and policy environment that would support transitioning the economy.

Accordingly, business can commit unequivocally to supporting South Africa's commitment to find ways to transition to a net-zero emissions economy by 2050.

Furthermore, in November 2022, South Africa tabled its revised Nationally Determined Contribution (NDC) to the UNFCCC. Business recognises the need for greater ambition to position the country as an attractive investment destination and increase the chances of accessing green economic stimulus and funding packages. Specifically, business would support a level of ambition that would see the country committing to a range of 420–350 Mt CO_2e by 2030. This is significantly more ambitious than the NDC put out for public comment, and would require greater levels of support with regard to means of implementation from the international community than is currently the case. It is also consistent with international assessments of South Africa's fair share contribution to the global effort, and it would further ensure that the no-regret decisions, that would put South Africa onto a net-zero 2050 emissions trajectory, would be implemented sooner.

While South Africa has leveraged a degree of climate finance from the international community, the scale and depth of the transition envisaged will require substantial investments over an extended period of time. Critically, social costs and Just Transition costs must be factored in. Significant financial, technological, and capacity support will be required to support the decarbonisation of hard to abate sectors. Early interventions in these sectors will be critical.

Upington, Northern Cape. Photo: scatec.com/locations/south-africa

Business sees the support of the international community as essential for the country to achieve its climate objectives. For this reason, business believes that a more ambitious NDC, and one that would place the country firmly on a net-zero emissions by 2050 trajectory, would have to be conditional on the provision of the requisite means of support by the international community. In this light the business community will play its part to develop a portfolio of fundable adaptation and mitigation projects that would build resilience and achieve deep decarbonisation.

Despite the depth of the challenge, South African business stands ready to play its part in this historical endeavour. Business is committed to working with government and other social partners, with our employees, our stakeholders, and the international community, to embark on a deep decarbonisation path towards net-zero and to build the resilience to the impacts of climate change that will ensure that our country contributes its fair share to the global climate effort.

2. INTRODUCTION

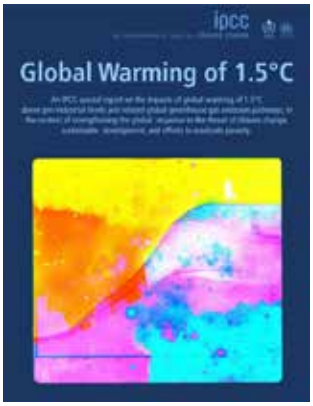
2.1 THE PURPOSE OF THIS REPORT

This report is part of the Just Transition and Climate Pathways study for South Africa. It focuses on the financing of the decarbonisation of South Africa's economy, and is part of a series of reports that are being released. These reports are intended to leverage further engagement between sector experts and key stakeholders, beyond the extensive stakeholder engagement that was undertaken since August 2020 within the respective technical working groups of the project. We hope this will foster continued dialogue as we work towards a final report that will collate the individual sector findings and provide collective insight.

2.2 THE CASE FOR CHANGE

2.2.1 CLIMATE CHANGE AND THE RACE TO GLOBAL NET-ZERO EMISSIONS BY 2050

Climate change is the defining challenge of our time. Anthropogenic climate change poses an existential threat to humanity. To avoid catastrophic climate change and irreversible 'tipping points', the Intergovernmental Panel on Climate Change (IPCC) stresses the need to stabilise global warming at 1.5 °C above pre-industrial levels. For a 66% chance of limiting warming by 2100 to 1.5 °C, this would require the world to stay within a total carbon budget estimated by the IPCC to be between 420 to 570 gigatonnes (Gt) of CO_2, to reduce net anthropogenic emission of CO_2 by ~45% of 2010 levels by 2030, and to then reach net-zero around 2050.[1]



Hence, mitigating the worst impacts of climate change requires all countries to decarbonise their economies. In the 2019 World Meteorological Organization report, 'Statement on the State of the Global Climate', the United Nations (UN) Secretary-General urged: "Time is fast running out for us to avert the worst impacts of climate disruption and protect our societies from the inevitable impacts to come."

South Africa, in order to contribute its fair share to the global decarbonisation drive, bearing in mind the principle of 'common but differentiated responsibilities and respective capabilities', should similarly set a target of reaching net-zero emissions by 2050, **and also keep it within a fair share of the global carbon budget allocated, estimated to be between 7 and 9 Gt CO_2e**.[2]

Even if global warming is limited to 1.5 °C, the world will face significantly increased risks to natural and human systems. For example, 2019 was already 1.1 °C warmer than pre-industrial temperatures, and with extreme weather events that have increased in frequency over the past decades, the consequences are already apparent.[3]

1 IPCC. 2018. *Special Report on Global Warming of 1.5°C*.
2 Extrapolation of the medians of various methodologies described by Climate Action Tracker. The full range is 4–11 Gt CO_2e.
3 World Meteorological Organization. 2019. 'Statement on the State of the Global Climate'.

More severe and frequent floods, droughts and tropical storms, dangerous heatwaves, runaway fires, and rising sea levels are already threatening lives and livelihoods across the planet.

South Africa will be among the countries at greatest physical risk from climate change. It is already a semi-arid country and a global average temperature increase of 1.5 °C above pre-industrial levels translates to an average 3 °C increase for Southern Africa, with the central interior and north-eastern periphery regions of South Africa likely to experience some of the highest increases.[4] Research shows that a regional average temperature increase of over 1.5 °C for South Africa translates to a greater variability in rainfall patterns. Models show the central and western interiors of the country trending towards warmer and drier conditions, and the eastern coastal and escarpment regions of the country experiencing greater variability in rainfall as well as an increased risk of extreme weather events.

Rising temperatures and increased aridity and rainfall variability will have severe consequences for South Africa's agricultural systems, particularly on the country's ability to irrigate, grow and ensure the quality of fruit and grain crops; and on the health of livestock, such as sheep and cattle. The agricultural system will see decreased productivity and declining health at temperature thresholds. Parasites tend to flourish in warmer conditions, threatening people as well as livestock and crops. Increasing temperatures and rainfall variability threaten South Africa's status as a mega-biodiverse country. Severe climate change and temperature increases will shift biome distribution, resulting in land degradation and erosion. The most notable risk is the impact on the grassland biome, essential for the health of South Africa's water catchments, combined with the risk of prolonged drought.

Finally, rising ambient temperatures, due to climate change and the urban heat effect, threaten the health of people, particularly those living in cramped urban conditions and engaging in hard manual labour, as higher temperatures result in increased risk of heat stress and

4 Department of Environmental Affairs, Republic of South Africa. 2018. *South Africa's Third National Communication Under the United Nations Framework Convention on Climate Change.*

a reduction in productivity. Therefore, limiting global climate change and adapting to inevitable changes in the local climate will be critical to limit the direct, physical risks to South Africa. Like many developing countries, South Africa has the task of balancing the urgent need for a just economic transition and growth, while ensuring environmental resources are sustainably used and consumed, and responding to the local physical impacts of climate change.[5] While South Africa is highly vulnerable to the physical impacts of climate change, its economy is also vulnerable to a range of transition risks posed by the global economic trend toward a low-carbon future, such as those from changing markets and technologies, and from regulations.

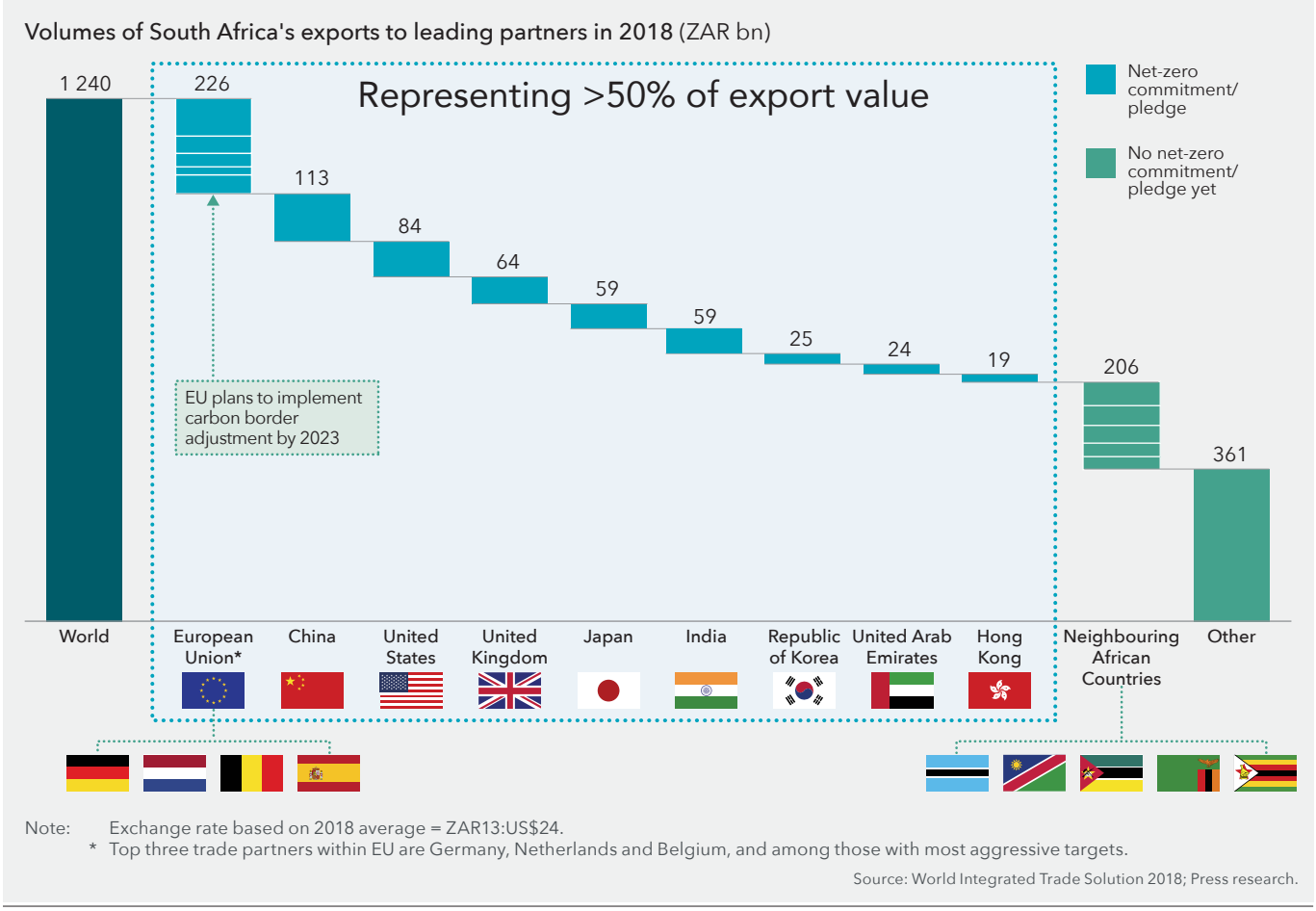
South Africa is also facing a significant trade risk. It ranks in the top 20 most carbon-intensive global economies on an emissions per Gross Domestic Product (GDP) basis, and in the top five countries with GDP in excess of US$100 billion per annum. The economy will face mounting trade pressure as trade partners implement their low-carbon commitments. South Africa has predominantly coal-based power generation, with the coal-to-liquid (CTL) process in the liquid fuels sector, and a coal-reliant industrial sector.

In the mining sector, three of the four most significant minerals in South Africa's commodity footprint are at risk, given the global efforts to curb emissions: thermal coal, Platinum Group Metals (PGMs), iron ore and gold.

The bulk of South Africa's exports comprise carbon-intensive commodities from the mining, manufacturing, and agricultural sectors which will become less competitive in markets in a future decarbonised world. These sectors also provide the majority of employment of unskilled labour at a regional level.

The carbon-intensity of the South African economy, key sectors, and export commodities must be seen against the backdrop of the country's key trading partners committing to ambitious decarbonisation goals. By October 2022, countries representing 83% of global carbon dioxide emissions and 91% of the world's economy have made ambitious commitments to carbon-neutrality. Many of South Africa's key export markets have set net-zero targets, including the European Union (EU), China, the United States, the United Kingdom, Japan, India, United Arab Emirates (UAE), and South Korea (see Figure 1).[6]

Figure 1: Trade-related risks pose additional threats to South Africa's economy if it does not transition



Note: Exchange rate based on 2018 average = ZAR13:US$24.
* Top three trade partners within EU are Germany, Netherlands and Belgium, and among those with most aggressive targets.

Source: World Integrated Trade Solution 2018; Press research.

5 Department of Environmental Affairs, Republic of South Africa. 2016. *South Africa's Second Annual Climate Change Report.*
6 https://zerotracker.net/

As part of the Glasgow Climate Pact at the UN Climate Change Conference of the Parties (COP26) in November 2021, countries were requested to "revisit and strengthen" their 2030 emissions-reduction targets – known as "nationally determined contributions" or NDCs – by the end of 2022 to better align with the Paris Agreement's goal of limiting global temperature rise to 1.5 °C.

Over and above this, certain regions like the EU are considering carbon border taxes which could impact future trade. Such taxes would be applied on the carbon content of imports to the EU. It is therefore essential to consider how South Africa's competitiveness in global markets, and hence the viability of its industries, will be affected should key trading partners start taking steps to protect their net-zero commitments and enable their net-zero carbon growth trajectories. South Africa will need to address the risks and seize the opportunities presented by climate change.

South Africa will have the chance to tap into new opportunities. Goldman Sachs estimate that around 35% of the decarbonisation of global anthropogenic greenhouse gas emissions is reliant on access to clean power generation, and that lower-carbon hydrogen and clean fuels will be required for hard-to-decarbonise sectors.[7] South Africa has key strategic advantages which can be leveraged to tap into such emerging opportunities. It has a number of significant assets including sun, wind and space. Renewables-dominated energy systems and local manufacturing are key. South Africa's coal assets are aged, and decommissioning coal plants can be done within the carbon budget and with minimal stranded asset risk. Its motor vehicle manufacturing expertise could be transitioned to electric vehicle production. The country's stable and well-regulated financial services sector, among the most competitive in the world, would make a strong base for green finance for the continent. The combination of wind and solar enables the right kind of conditions for Green hydrogen, setting the stage for South Africa to be a net exporter. The role of PGMs in hydrogen and fuel cell technology and the increased demand for certain mined commodities, like copper for use in green technology, could bolster the minerals sector. South Africa's experience with the Fischer–Tropsch process positions it to be one of the world leaders in carbon-neutral fuels, and other innovations are waiting to be unlocked.

The imperative is clear: South Africa must decarbonise its economy in the next three decades and transform it into a low-carbon, climate-resilient, and innovative economy. This transition also needs to take place in a manner that is just and simultaneously addresses inequality, poverty and unemployment to ensure that no-one is left behind and that the future economy is also socially resilient and inclusive.

7 Goldman Sachs. 2020. *Carbonomics: Innovation, Deflation and Affordable De-carbonisation.*

2.2.2 THE NEED FOR A JUST TRANSITION

With a Gini coefficient of 0.63, South Africa is one of the most unequal societies in the world today.[8] A recent study shows that the top 10% of South Africa's population owns 86% of aggregate wealth and the top 0.1% close to one-third. Since the onset of the COVID-19 pandemic, levels of poverty have further increased and have likely shifted beyond 55% of the population. In July 2020, a record 30.8% of the population was unemployed.[9] Exacerbating this are levels of youth unemployment that are amongst the highest in the world.[10]

As South Africa grapples with the economic recession accompanying the pandemic, and copes with the need to rebuild the capacity of the State and its institutions following a decade of state capture, it must start rebuilding and transforming its economy to make it resilient and relevant in a decarbonised world. However, while a transition towards a net-zero economy will create new economic opportunities for South Africa, it is also a transition away from coal, which without careful planning and new investments will put many jobs and value chains at risk in the short-term, and exacerbate current socio-economic challenges.

Today, the coal mining sector provides almost 0.4 million jobs in the broader economy, with ~80 k direct jobs and ~200 k to 300 k indirect and induced jobs in the broader coal value chain and economy. The impact is even broader when it is taken into account that, on average, each mine worker supports 5 to 10 dependents. This implies a total of ~2 to 4 million livelihoods.[11] The low-carbon transition must do more than simply address what is directly at risk from decarbonisation. The transition must also address the broader economic concern of stalled GDP growth of ~1% for the last five years, rising unemployment with ~3% increase over the last five years,[12] a deteriorating debt to GDP ratio, and the consistently negative balance of trade.[13]

These challenges are more severe given further deterioration during the COVID-19 pandemic. It is therefore critical that South Africa's transition is designed and pursued in a way that is just; meaning that it reduces inequality, maintains and strengthens social cohesion, eradicates poverty, ensures participation in a new economy for all, and creates a socio-economic and environmental context which builds resilience against the physical impacts of climate change.

This transition requires action, coordination, and collaboration at all levels. Within sectors, action will need to be taken on closures or the repurposing of single assets. Job losses must also be addressed with initiatives like early retirement and reskilling programmes, with the latter having the potential for integration with topics like skills inventories and shared infrastructure planning and development. A national, coordinated effort to enable the Just Transition will also be crucial to address the education system and conduct national workforce planning. In order to implement its Just Transition, South Africa will need to leverage global support in the form of preferential green funding, capacity-building, technology-sharing, skills development, and trade cooperation.

To move towards this net-zero vision for the economy by 2050, South Africa must mitigate rather than exacerbate existing socio-economic challenges and seize emerging opportunities to support its socio-economic development agenda. How to ensure a Just Transition towards net-zero and to advance South Africa's socio-economic context is therefore the key guiding principle of this study.

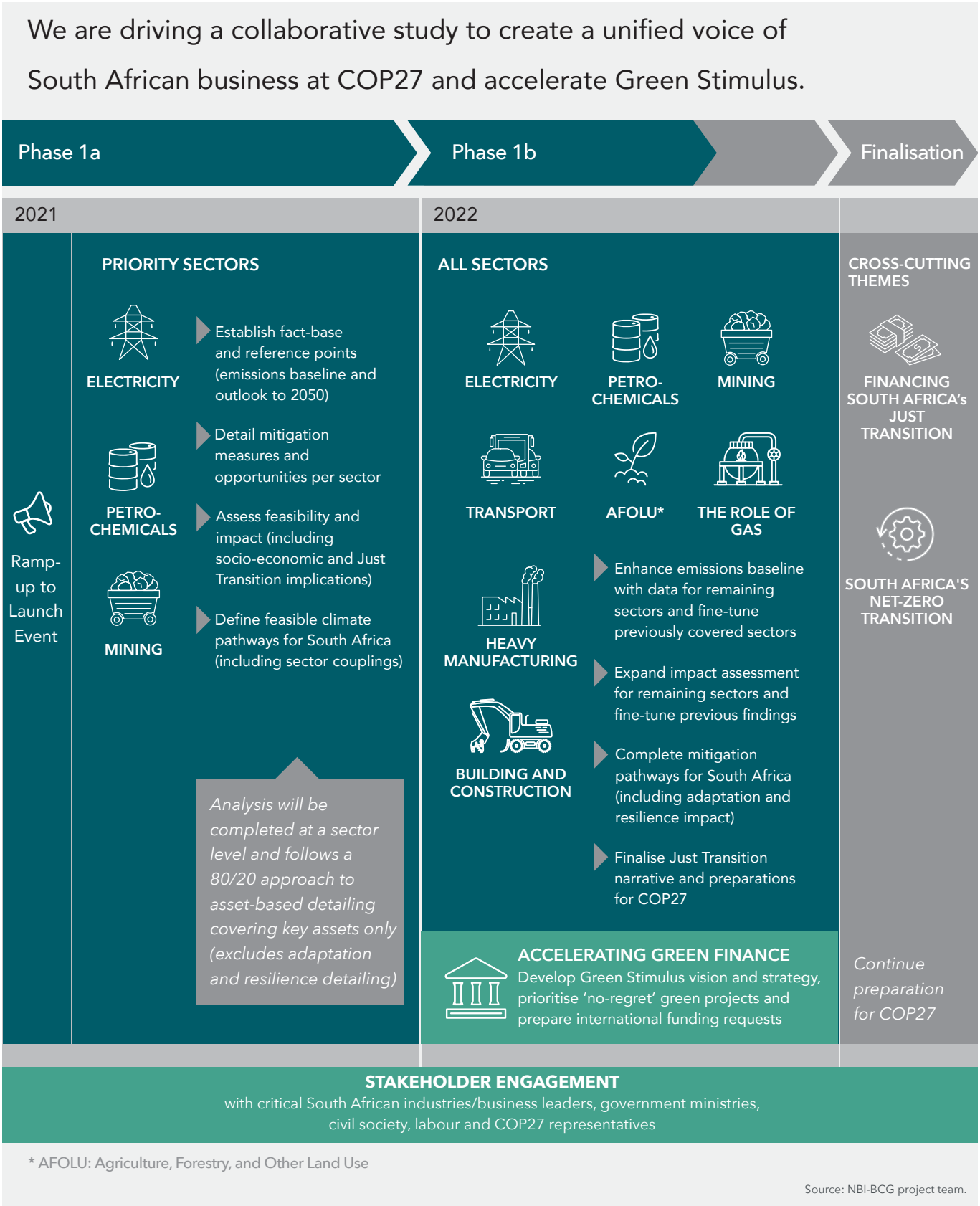
2.3 OBJECTIVES AND APPROACH OF THE OVERALL STUDY

Key objectives. Achieving net-zero emissions in South Africa by 2050, whilst ensuring a Just Transition, is a complex and unique challenge. Extensive studies examining how a Just Transition towards a lower-carbon economy can be achieved in South Africa have already been conducted or are currently underway. There are many different views on what defines a Just Transition in South Africa, which decarbonisation ambitions South Africa is able to pursue and commit to, and how a transition towards a lower-carbon economy can be achieved.

This study is not advocating a particular position. It is not setting ambitions around levels and timelines for South Africa's emission reduction. Nor is it prescribing sector- or company-specific emission reduction targets.

8 The World Bank. 2021. 'South Africa Overview'.
9 StatsSA. 2017. *Poverty Trends in South Africa. An examination of absolute poverty between 2006 and 2015*.
10 Chatterjee, A., et al. 2020. *Estimating the Distribution of Household Wealth in South Africa*.
11 Minerals Council of South Africa. 2020. 'Facts and Figures'.
12 Department of Statistics, Republic of South Africa. 2021.
13 South African Reserve Bank. 2021.

Figure 2: Approach of the overall study



* AFOLU: Agriculture, Forestry, and Other Land Use

Source: NBI-BCG project team.

The study does aim to develop the necessary technical and socio-economic pathways research and analysis to support decision-making and bolster a coordinated and coherent effort among national and international stakeholders. This research is anchored around three key questions:

- What is the cost of inaction for South Africa should it fail to respond to critical global economic drivers stemming from global climate action?
- What would it take, from a technical perspective, to transition each of South Africa's economic sectors to net-zero emissions by 2050?
- What are the social and economic implications for South Africa in reaching net-zero emissions by 2050?

Approach. To understand how a transition of the South African economy towards net-zero emissions can be achieved, the study assessed each sector and intersectoral interdependencies in detail. Our analysis is structured along the understanding of what the decarbonisation pathways could be for key heavy emitting sectors, namely: electricity, petrochemicals and chemicals, mining, metals and minerals, manufacturing, transport and AFOLU (Agriculture, Forestry and Other Land Use) (see Figure 2). Given this is a multi-year project, a preliminary report is being released as each sector study is completed. Towards the end of the study, each sector analysis will be further refined on the basis of a better understanding of interlinkages. For example, insights gained from the transport sector analysis around the impact of electric vehicles on electricity demand will be leveraged for further refinement of the electricity sector analysis.

The first phase of the study focused on today's key drivers of South Africa's emissions: electricity and the petrochemicals and chemicals sectors which make up more than 60% of the country's total emissions. Given the socio-economic implications of decarbonising South Africa's energy landscape, particularly impacting coal mining regions and the mining workforce, the mining sector was included and assessed as part of the project's first phase.

The second phase of the study focused on the transport and AFOLU sectors.

The study also provided a view on the role of natural gas.

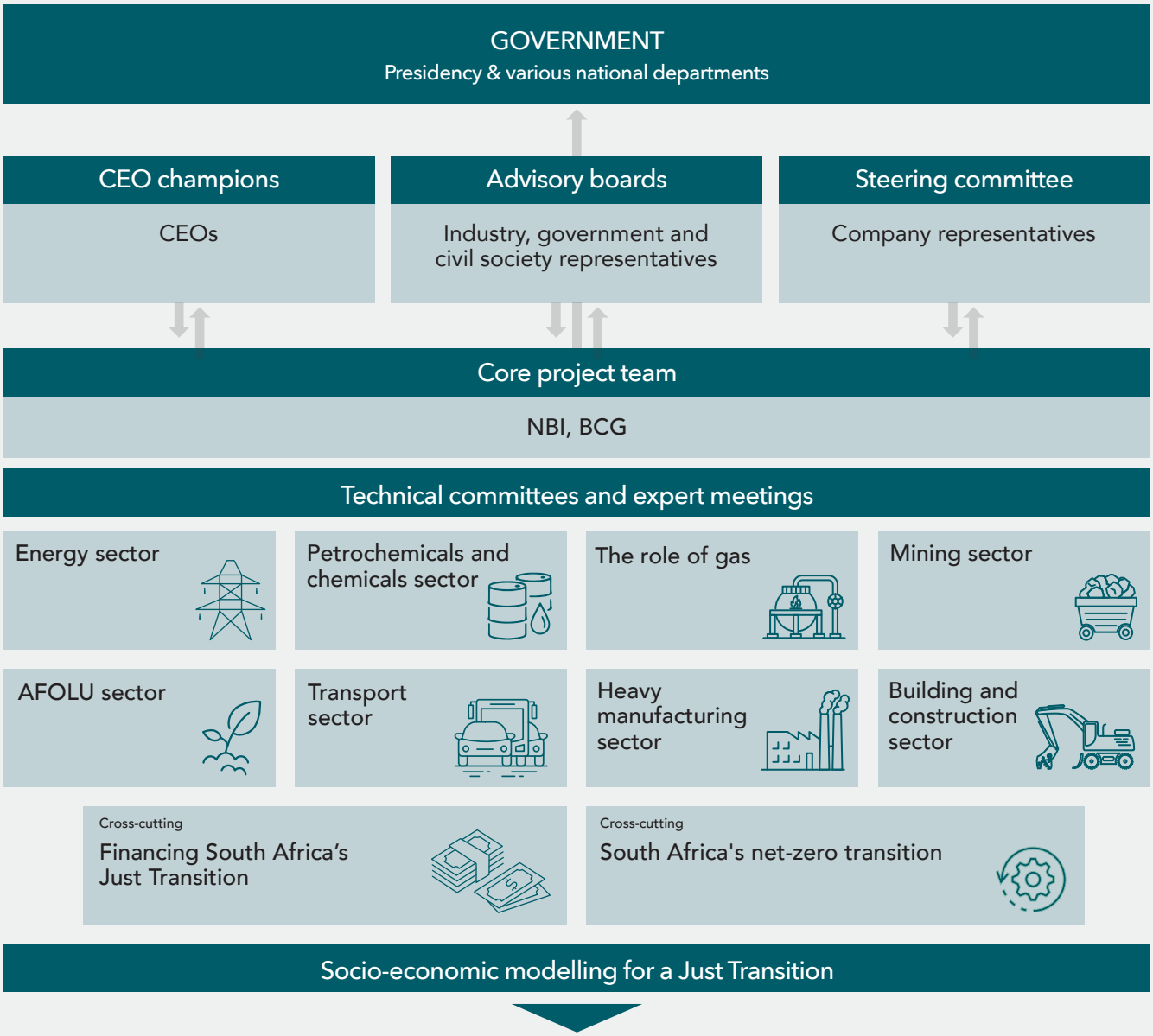
Eventually, the study will provide a comprehensive view of the South African economy, its potential future net-zero economy and the pathways that can lead to this future economy as informed by various key stakeholders.

The study is a collaborative effort, aiming to create a unified voice of South African business on the country's needs, opportunities, and challenges in achieving a net-zero economy, involving multiple stakeholders from all sectors. The governance arrangement that has overseen this work is key to enabling this collaborative, multi-stakeholder approach: across multiple levels, key stakeholders are involved in the content development.

The sector assessments were conducted within technical committees which included South African and international experts and stakeholders from private and public sectors, as well as civil society and academia. An advisory board consisting of high-profile representatives from various sectors including industry, government, labour, civil society, and academia; and a steering committee consisting of selected private and public sector representatives provided continuous direction on content development. In addition, a group of 30 CEOs from across the private sector endorsed and guided the study development (see Figure 3).

Figure 3: Governance set-up of the study

To ensure representative, balanced and fact-based content, a comprehensive governance structure is in place.



2.4 APPROACH TO THIS FINANCING REPORT

The report begins with the premise that South Africa requires transformation toward climate sustainability and social justice (See Figure 4). It must make significant investments to transform its economy, with these investments encompassing climate sustainability and social justice.

The work was based on preceding investigations within the NBI-BUSA-BCG Climate Pathways and Just Transition study. These investigations had developed detailed pathways to net-zero for the heavy emitting sectors of the South African economy, covering roughly 95% of the country's emissions. Robust data was generated to understand what mitigation initiatives were required, per sector, which in turn drove calculations to quantify the CapEx of the required technical interventions to bring South Africa in line with its 2050 net-zero target.

We aimed to understand how South Africa could finance its transition, through four key questions:

1. How much funding does South Africa require to transition to net-zero by 2050, and how is this spending divided among investment areas and over time?
2. What is the current landscape of climate finance in South Africa, and what funding sources can be leveraged to satisfy the need for specific investment areas?
3. How can climate finance be unlocked to enable South Africa's transition, especially for high-priority investment areas?
4. What are the key next steps in the immediate-term for priority investment areas, and what are the respective responsibilities of private and public sector economic stakeholders?

The report has greater depth on the mitigation component of a Just Transition, than on the social aspects (e.g. reskilling, inclusion, and early retirement), and on the adaptation needs in South Africa (see Figure 5). Further robust analysis is required to better understand what needs to be achieved in these areas.

An exchange rate of US$ 1.00 = ZAR 15.00 was assumed throughout the calculations

Figure 4: South Africa's status quo is already socio-economically unsustainable, and requires significant change towards climate sustainability and social justice

South Africa is the most carbon intensive major economy.

- South Africa's economy is heavily reliant on coal, with 86% of power being coal-based.
- With a carbon intensity of 0.6kgCO_2/$ PPP GDP, South Africa is the most carbon-intensive major economy.*
- South Africa is the largest emitter in Africa, driving 40% of the continent's emissions.

South Africa is today the most unequal country in the world.

- The top 10% of South Africa's population owns 86% of aggregate wealth and the top 0.1% close to one third.
- Over 30% of South Africans are unemployed, with youth unemployment reaching a record of 65.5% in 2021.
- 55% of South Africans live in poverty, with more than 10% living in extreme poverty.

South Africa's economy is extremely weak.

- Economic growth has stalled over recent years, with ~1% GDP growth for the last 5 years, and an overall decline of ~-0.2% in 2010-2020.
- The debt to GDP ratio is increasingly growing with a CAGR of 8% between 2016 (47.13%) and 2021 (68.83%), constraining South Africa financially.

Note: * Major economy = GDP in excess of US$100 billion per annum.

Source: The World Bank.

Figure 5: Mitigation, Just Transition and adaptation investments are all critically important, but this report approaches each with different levels of detail

Note: * For adaptation and social topics, approaches to unlock funding will be unpacked for the topic, rather than for individual investments.

Source: NBI-BCG project team.

3. KEY FINDINGS OF THE FINANCING ANALYSIS

Key questions to understand on how South Africa can finance its transition to net-zero by 2050:

1. *How much funding does South Africa require to transition to net-zero by 2050, and how is this spending divided among investment areas and over time?*
2. *What is the current landscape of climate finance in South Africa, and what funding sources can be leveraged to satisfy the need for specific investment areas?*
3. *How can climate finance be unlocked to enable South Africa's transition, especially for high-priority investment areas?*
4. *What are the key next steps in the immediate-term for priority investment areas, and what are the respective responsibilities of private and public sector economic stakeholders?*

10 key findings of the financing analysis

1. *~ZAR1 tn is required by 2030, and ~ZAR5.9 tn is needed by 2050 to fund the net-zero transition, but many of these investments are commercially viable and will reduce existing expenditure on fossil fuel procurement.*

2. *The power sector is the top priority for immediate investment, requiring ~70% of the economy's 2020s net-zero transitions investment and contributing ~50% of South Africa's total annual emissions.*

3. *~ZAR70 bn p.a. has already been mobilised, however an average gap of ~ZAR140 bn p.a. must be closed to fund the technical mitigation investment in the transition to 2050.*

4. *~40% (~ZAR50 bn p.a.) of investments needed by 2030 are not commercially bankable without the catalytic role of blended finance.*

5. *Concessional funding can crowd-in commercial funding through blended finance with multiples as high as 3x–9x based on project and concessional funding characteristics.*

6. *While the ~US$8.5 bn (~ZAR135 bn) JET Partnership is a step forward for climate finance in South Africa, total funding impact will depend on the percent of funds from concessional sources and the blended finance ratios achieved.*

7. *Currently a minor investor (contributing ~10% of total funding) in adaptation and social components of a Just Transition, the commercial finance sector must adopt a mindset shift from a focus on core business operations towards strengthening their resilience, their supply chains, and communities.*

8. *Funding for the net-zero transition is limited by lack of policy and strategic alignment, high perceived investment risk, limited shovel-ready project pipeline, insufficient blended finance, and inconsistent green standards.*

9. *Near-term priority investment areas include Green hydrogen, Green power, gas, grid expansion, EVs, and social and adaptation activities.*

10. *Ownership of risk through the transition to net-zero should be based on which entity is best positioned to mitigate risk and evolve toward increasing corporate risk ownership, based on improving the economic viability of each technology.*

3.1 FUNDING AND RATE OF SPENDING REQUIRED

Question 1: How much funding does South Africa require to transition to net-zero by 2050, and how is this spending divided among investment areas and over time?

~ZAR1 tn is required by 2030, and ~ZAR5.9 tn is needed by 2050 to fund the net-zero transition, but many of these investments are commercially viable and will reduce existing expenditure on fossil fuel procurement.

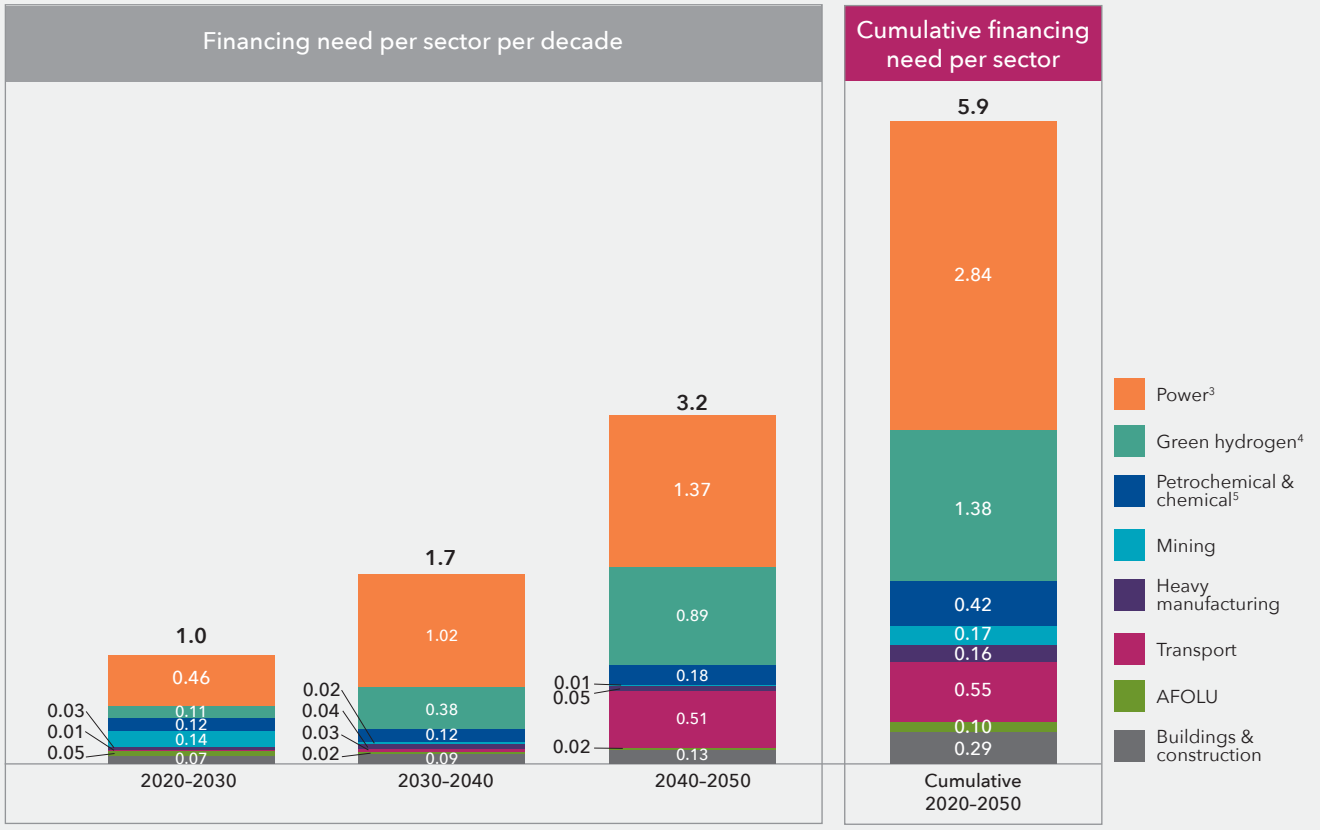
The scale of funding needed for South Africa to transition to net-zero and ensure compliance with its Nationally Determined Contribution (NDC) of ~350–420 Mt p.a. in 2030 is significant. ~ZAR1 tn is required for investments by 2030, and ~ZAR5.9 tn is needed cumulatively by 2050, as shown in Figure 6. These investments will be critical for South Africa to achieve its 2030 NDC and reach net-zero by 2050 within a cumulative carbon budget of ~9–10 Gt.

Approximately ZAR5.9 tn by 2050 requires that South Africa make investments of ~ZAR100 bn annually in the 2020s, growing to ~ZAR300 bn annually in the 2040s. Assuming historical GDP growth rate of 2.4%, these investments are equal to ~1.5% of GDP in the 2020s and

Figure 6: South Africa's transition to net-zero by 2050 could cost over ~ZAR5.9 tn for mitigation investments alone

Near-term costs primarily in power sector, with Green hydrogen and transport scaling up towards 2050.

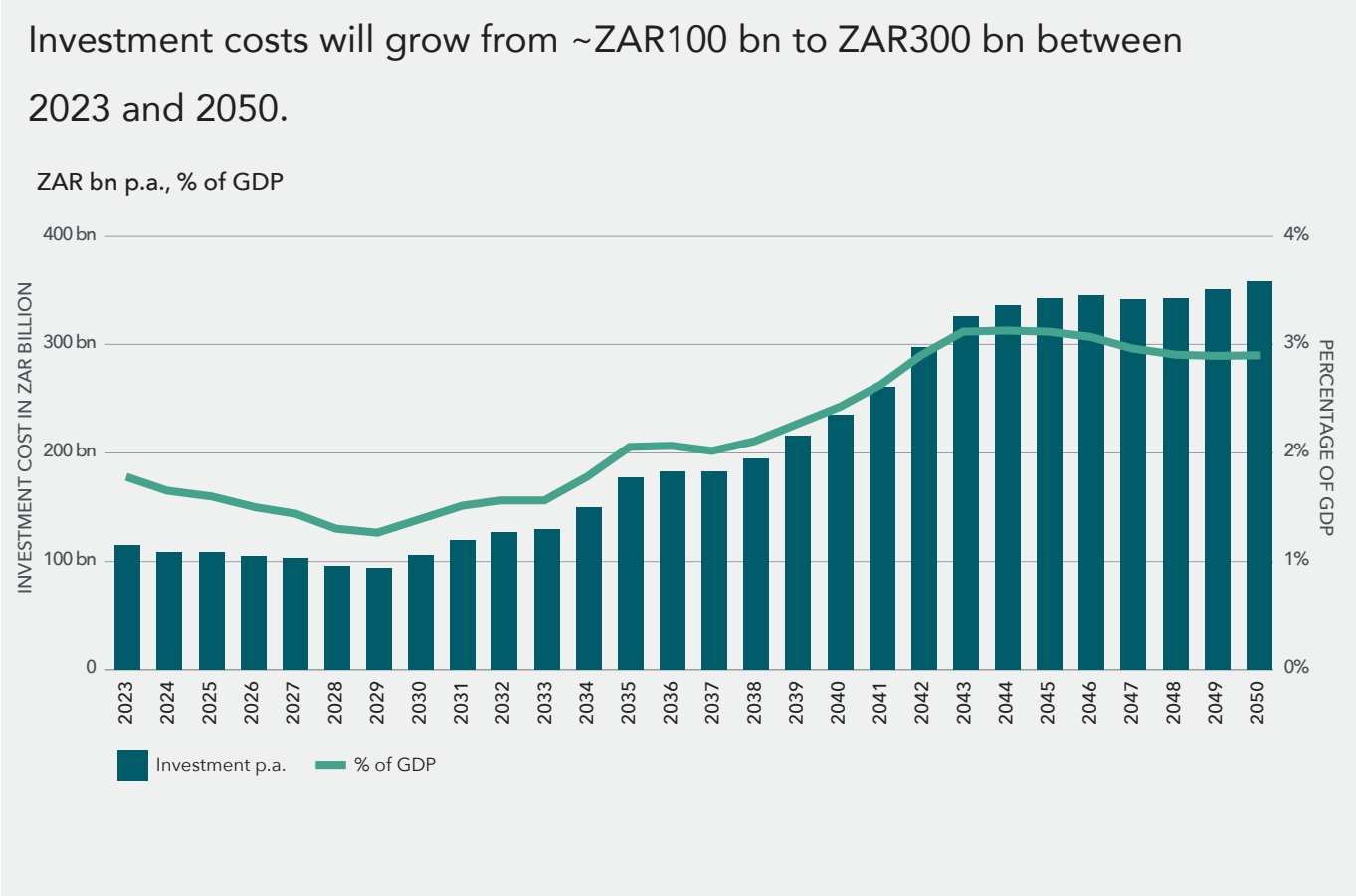
CapEx to 2050 by sector in ZAR bn p.a.[1, 2]



Notes:
1. Focus on mitigation investments across sectors. Just Transition and adaptation financing need is not quantitatively assessed.
2. Data expresses total CapEx requirements based on NBI Climate Pathways work on mitigation spend per sector which is required to align South Africa to a 1.5 °C pathway.
3. Power includes both generation and grid expansion costs.
4. Green hydrogen here assumes ~3.7 Mt p.a. local demand and includes ~4 Mt p.a. H_2 for export but does not include Green H_2 to convert existing synfuels assets to green assets, which is incorporated in the petrochemicals figure (assumed as an additional ~1.5 Mt p.a. of H_2 by 2050).
5. Petrochem includes additional costs for gas infrastructure.

Source: NBI-BCG project team.

Figure 7: Annual investment required to transition to net-zero grows from ~100 bn to 300 bn between 2023 and 2050



~3% of GDP by 2050, as shown in Figure 7. In the long term, as the transition drives more affordable and reliable electricity supply, and a new Green hydrogen value chain is established, target GDP growth should exceed the historical average of 2.4% p.a. In later years, post 2040, this could further reduce the total investment required as a percentage of GDP.

While significant, the investment in infrastructure towards net-zero is a small subset of target infrastructure spend in the country. The National Planning Commission (NPC) estimates that between 2012 and 2019, public and private infrastructure investment equaled ~19.6% of GDP, with roughly one third coming from the public sector. The NPC has set a target that, by 2030, this rate of investment should rise to 30% of GDP.

Every country has a unique mitigation cost profile. According to the World Economic Forum (WEF), South Africa's mitigation costs compare favourably against India's at ~60% of the total cost, but are ~150% of Brazil's. Country variations depend on industry make-up and geographic features. For example, Brazil has significant hydro-electric capacity and a substantial ethanol-based liquid fuels sector, and hence has lower mitigation investment requirements. However, while it enjoys lower mitigation costs, Brazil faces significant adaptation risks if rates of rainfall change. As investment requirements vary by country, it is important to take a country-specific bottom-up approach to understand the true costs and steps required to reach net-zero and ensure a Just Transition.

The investments in South Africa's infrastructure that will structurally change the economic system, include: funding ~190 GW of renewable energy (RE) capacity by 2050,[14] retiring 70% of coal-generating capacity by 2040, satisfying demand of ~9 Mt p.a. of Green hydrogen (requiring an additional ~190 GW of renewables), and electrifying transport and other sectors. The transition also rests on behavioural changes that are harder to quantify, such as a drastic reduction in red meat consumption by 2030 (as some studies suggest[15]), and a large-scale shift toward electric vehicles (EVs), and public transport.

Fundamentally altering the structure of South Africa's economy, the ~ZAR5.9 tn needed by 2050 will require

14 This includes embedded renewables generation in the mining and AFOLU sectors.

15 The *Commission Food in The Anthropocene:the EAT-Lancet Commission on Healthy Diets From Sustainable Food Systems* argues that global consumptions of red meat will have to be reduced by more than 50% by 2050 to meet sustainability targets. See also our sector report, *Decarbonising the Agriculture, Forestry and Land Use Sector in South Africa* for multiple dietary scenarios towards 2050 climate goals.

significant private and public spending. However, investment in the green transition can be cheaper than the status quo, in the long run.

For example, in the power sector, ~ZAR120 bn p.a. is currently spent on primary energy costs, mostly in coal procurement, which is greater than the ~ZAR100 bn annualised spend needed in capital expenditure by 2050 to transition the entire power sector to a renewables-dominated, net-zero system (See Figure 8).[16]

The contrast in cost of the transition versus the status quo can be further captured by modeling an Eskom As Is scenario against this study's Renewable Energy pathway. The Eskom As Is scenario is a conservative view on the costs of continuing with the current energy mix. It scales CapEx[17] and OPEX[18] based on projected kWh growth, but does not include a growth in fuel price or a bump in CapEx when several coal plants reach end of life in the 2030s. While the challenge facing South Africa is complex, the transition is both technically feasible and commercially viable.

The power sector is the top priority for immediate investment, requiring ~70% of the economy's 2020s net-zero transitions investment and contributing ~50% of South Africa's total annual emissions.

Investments in power systems will require ~70% (~ZAR700 bn) of total investments before 2030, as shown in Figure 9. This includes infrastructure in the power sector plus additional investments in embedded renewables generation in the mining (~ZAR130 bn) and AFOLU (~ZAR40 bn) sectors. Excluding embedded generation, the power sector still requires the most funding, at ~50% (~ZAR460 bn) in the 2020s.[19] Additionally, the power sector contributes the most of any sector to South Africa's emissions baseline, at ~50% of total annual emissions.

The power sector offers the greatest opportunity for commercially viable investments. Driven by technological innovation and economies of scale, the cost of PV solar and wind has fallen dramatically over the last 20 years. Successive REIPPPP rounds have seen average solar electricity costs reduce by 85% and wind energy costs reduce by 64%, as illustrated in Figure 10.

These costs are also favourable when considered against electricity from fossil fuel sources, with plans to procure an additional 1 500 MW of coal costing ~ZAR23 bn more than a least-cost, renewables-dominated path according to analysis from the Energy Systems Research Group at the University of Cape Town.

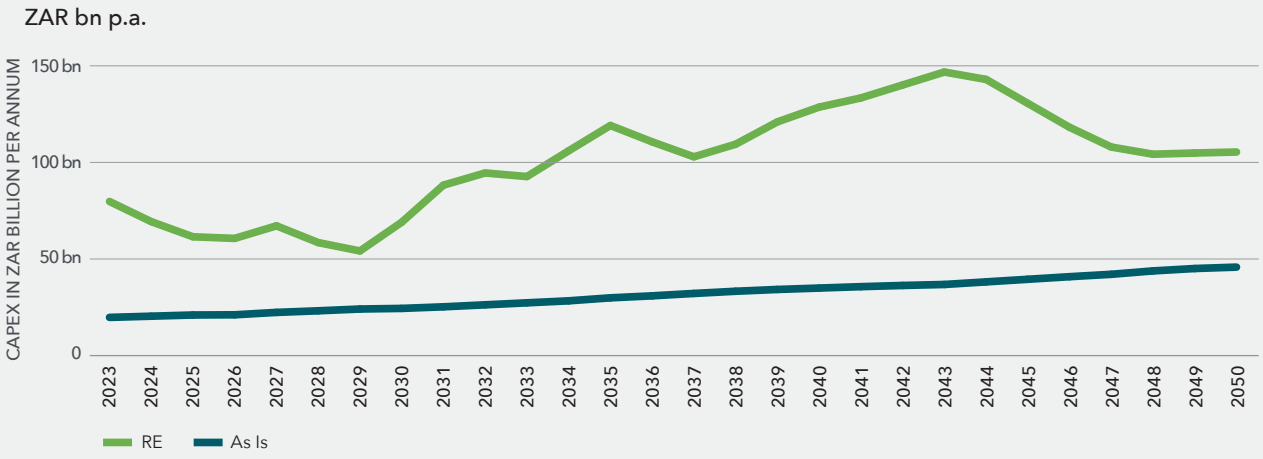
There is however a risk that, as the rest of the world starts to accelerate investments in renewable energy (RE) generation to adhere to their respective NDCs, key inputs for RE investments may become scarcer and more expensive as demand rises. Input components, such as solar panels and lithium ion batteries are taking a larger percentage of total cost. For example, according to International Energy Agency (IEA), the cathode materials (i.e. lithium, cobalt, nickel, and manganese) in lithium-ion batteries have quadrupled as a percentage of cost, rising from 5% to 20%. As lithium costs have risen amidst high demand, the total cost of lithium-ion batteries grew 5% year-over-year in 2021. If raw material costs continue to rise as demand for key minerals grows, investment is essential now to capture the current low costs per megawatt (MW) of renewables.

Investments in the power sector are not only required in RE generation. Currently, South Africa's grid infrastructure has extremely limited capacity in regions where RE potential is the highest, such as the Northern Cape (an area with high solar radiation) and Eastern Cape provinces (an area with high wind). Additionally, the grid will need to be modernised to reflect the needs of a renewable energy-dominated electricity generation system.[20] Grid expansion will require ~ZAR170 bn in the 2020s (~24% of the power sector's required investment in the 2020s). Completion of existing coal projects (Medupi and Kusile) will cost an additional ~ZAR80 bn, and investments in new gas-to-power (GTP) generation for seasonal balancing in the renewables-dominated grid will require ~ZAR80 bn. While the GTP investments are in fossil fuel-based generation capacity, they are important enablers to both the transition to net-zero and security of electricity supply.

16 This includes investments in extending grid infrastructure and building future Green hydrogen peaking generation capacity.
17 Based on Eskom FY21 'Acquisition of property, plant and equipment, and intangible assets'.
18 Based on Eskom FY21 Revenue Earnings Before Interest, Tax Depreciation and Amortisation (EBITDA).
19 For the funding needs of each sector over time disaggregated into investment areas, see Appendix A.
20 Costs of grid modernisation have not been estimated in this study.

Figure 8: While CapEx costs are greater on a Renewable Energy pathway, the total costs of a status quo far outpace Renewable Energy in the long run

Estimated CapEx 2023–2050 comparison between 'Eskom As Is' and Renewable Energy Scenarios.



Estimated CapEx + OPEX to 2023–2050 comparison between 'Eskom As Is' and Renewable Energy scenarios.

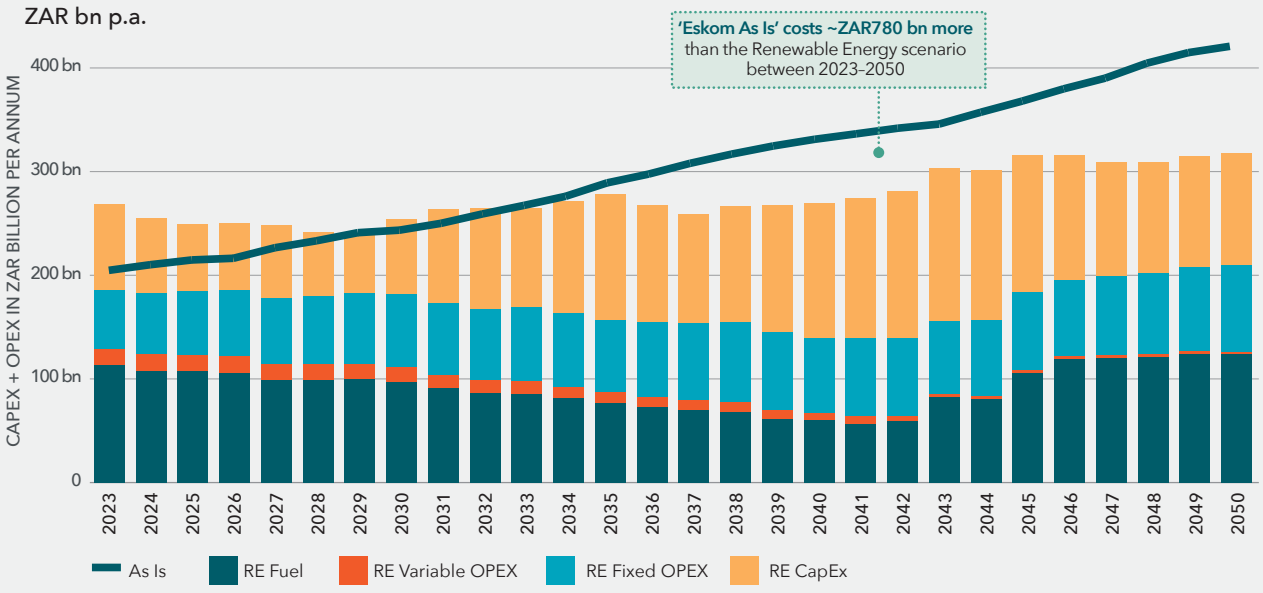


Figure 9: Investments in power systems are especially critical in the 2020s

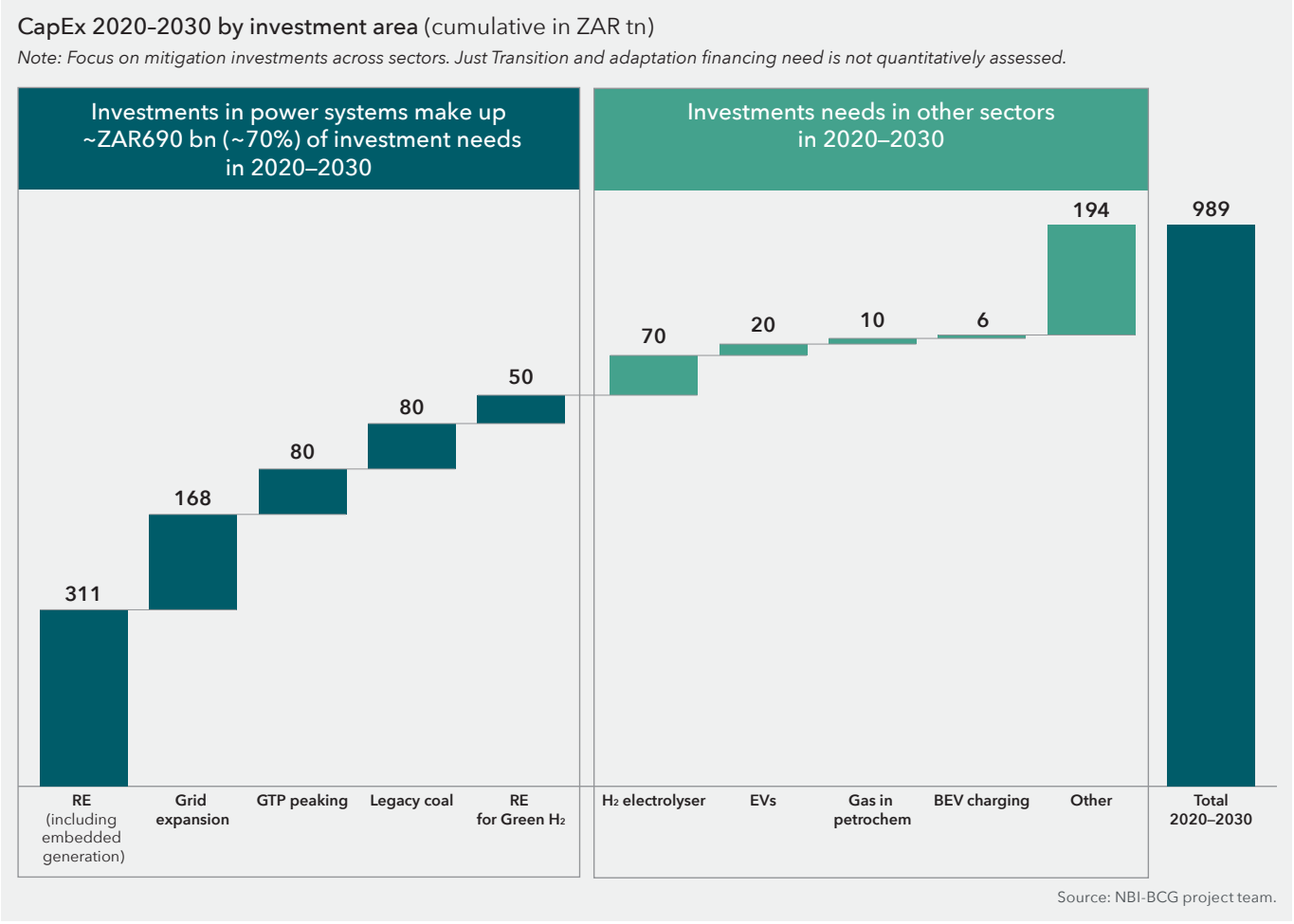
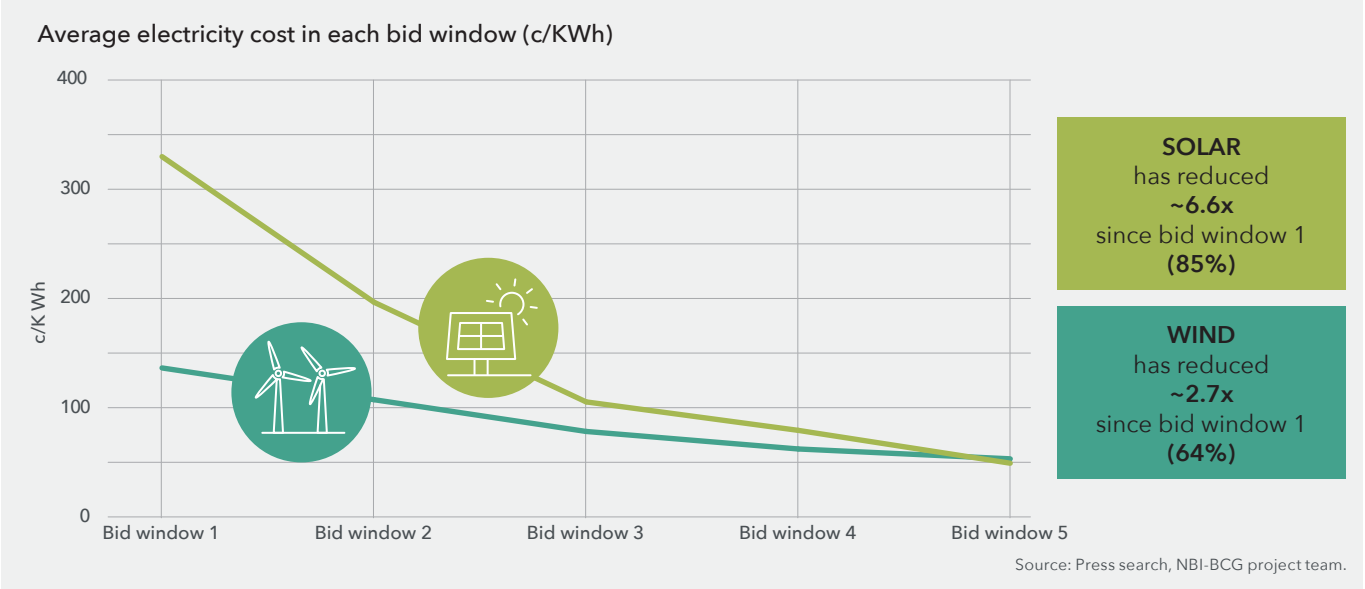


Figure 10: Successive REIPPPP rounds have seen solar energy costs reduced 6.6x and wind energy costs reduced 2.7x



Wind farm near Matjiesfontein in the Karoo.

Image: Shutterstock

3.2 CURRENT CLIMATE FINANCE AND FUNDING SOURCES

Question 2: What is the current landscape of climate finance in South Africa, and what funding sources can be leveraged to satisfy the need for specific investment areas?

~ZAR70 bn p.a. has already been mobilised, however an average gap of ~ZAR140 bn p.a. must be closed to fund the technical mitigation investment in the transition to 2050.

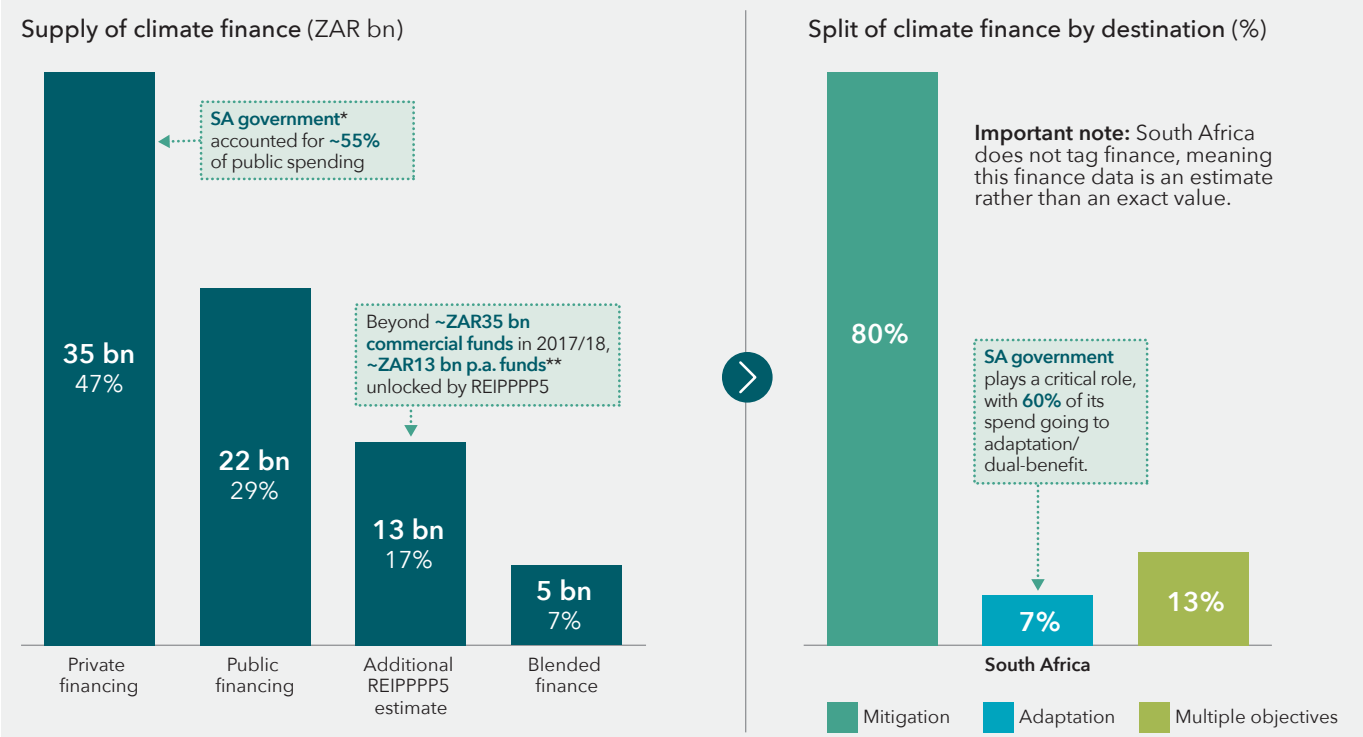
The supply of climate finance for mitigation, adaptation, and dual-objective climate investments in South Africa is estimated at ~ZAR70 bn p.a.[21] (Figure 11), with commercial finance a particularly important component of the finance landscape. This is part of a global market estimated at ~US$632 bn p.a. (~ZAR9.5 tn p.a. at exchange rate of US$1.00–ZAR15.00 in the first quarter of 2022), which has almost doubled in the last 6 years, as shown in Figure 12.

South African climate finance is mostly commercial and REIPPPP 5-associated funding at ~ZAR50 bn p.a., or about two-thirds of the domestic market. Mitigation investments account for ~80% of South Africa's total climate finance, and are especially dominant for commercial funders, where all funding went to mitigation.

South Africa requires at least ~ZAR100 bn p.a. on average until 2030, growing to ~ZAR330 bn p.a. in the 2040s to complete transition to net-zero by 2050.[22] This is an average of ~ZAR210 bn p.a. above the mobilised ~ZAR70 bn p.a., meaning that a further ZAR140 bn has to be sourced. Investment per annum in the 2020s must grow and must be targeted at key decarbonisation levers, such as renewable energy generation, grid expansion, and EV charging infrastructure, to ensure compliance with South Africa's NDC.

~40% (~ZAR50 bn p.a.) of investments needed by 2030 are not commercially bankable without the catalytic role of blended finance.

Figure 11: South Africa's climate finance market is estimated at ~ZAR70 bn p.a., a most of which is private financing



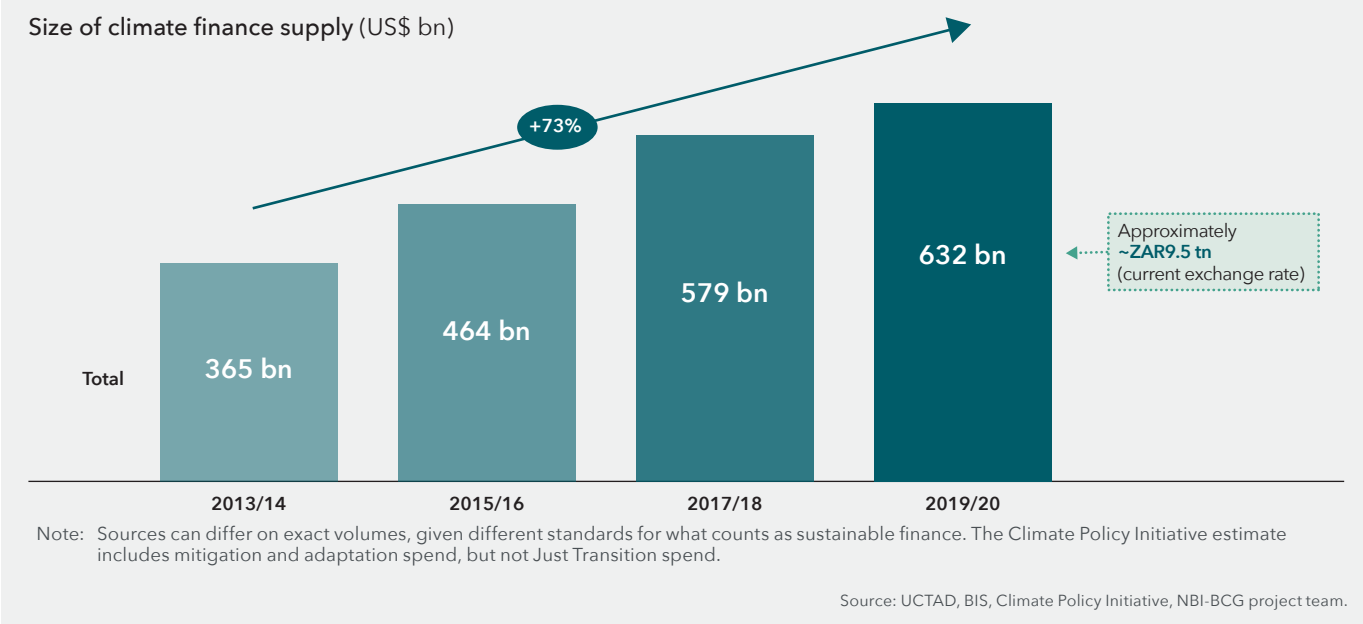
Notes: * Government budget expenditure was defined in the source as "the capital disbursements of various South African ministries and government departments".
** Based on a cumulative investment estimate of ~ZAR50 bn over ~4-year period.

Source: PV Magazine, MoneyWeb, GreenCape and Climate Policy Initiative, NBI-BCG project team.

21 This estimate is based on the most recent 'Climate Policy Initiative report on the South African climate finance landscape from 2017/18'. Given that REIPPPP5 was not announced at that stage, an additional ~ZAR12.5 bn has been added to the estimate.

22 This excludes Social and adaptation investments needed as part of the Just Transition, which will further increase this number.

Figure 12: Global climate finance supply estimated at ~US$632 bn, or ~ZAR9.5 tn



Note: Sources can differ on exact volumes, given different standards for what counts as sustainable finance. The Climate Policy Initiative estimate includes mitigation and adaptation spend, but not Just Transition spend.

Source: UCTAD, BIS, Climate Policy Initiative, NBI-BCG project team.

Approximately ZAR70 bn p.a. of South Africa's annual investment needs in the 2020s can be funded from mostly commercial sources, assuming that there is an enabling policy environment, as shown in Figures 13 and 14 on page 34.[23] This is driven by bankable opportunities in renewable energy generation, natural gas in the petrochemicals industry, and EVs in the mining and agriculture sectors.

Another ~ZAR40 bn can be funded with a mixed approach. However, concessional funding from development finance institutions (DFIs) and government will also be critical. This investment includes natural gas infrastructure and grid expansion.

A final ~ZAR10 bn p.a. in the 2020s will be required from mostly concessional sources to catalyse the initial scaling of Green hydrogen production. Grant funding and donations will also be critical, particular for study funds to ensure a pipeline of projects are initiated.

See Appendix B for a high-level view of each project type required for the transition and what funding sources will be required for each.

23 For the high-level funding approach assessments underpinning this figure, please see Appendix B.

Figure 13: Majority of technologies required in the 2020s are commercially viable, while some infrastructure and Green H^2 require concessional support

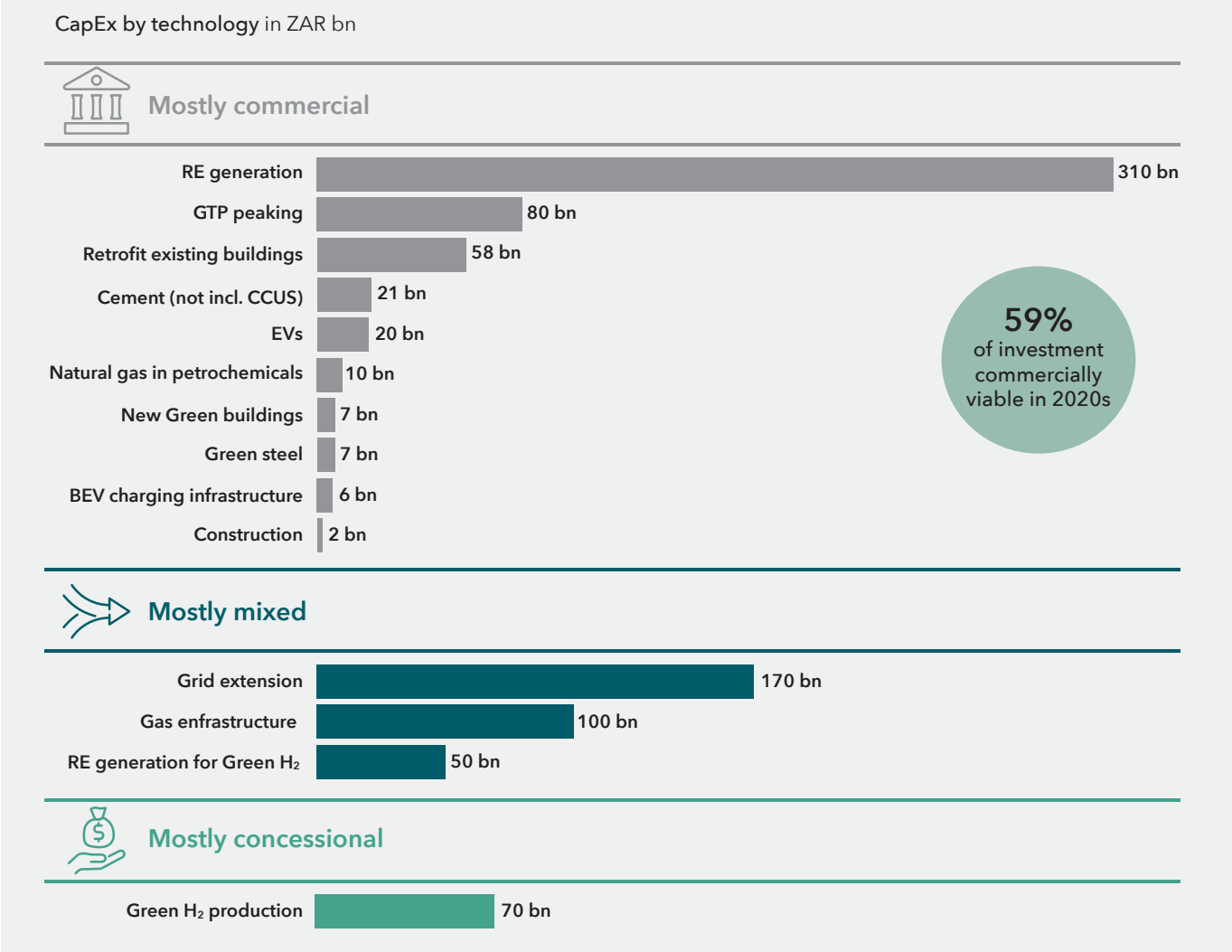
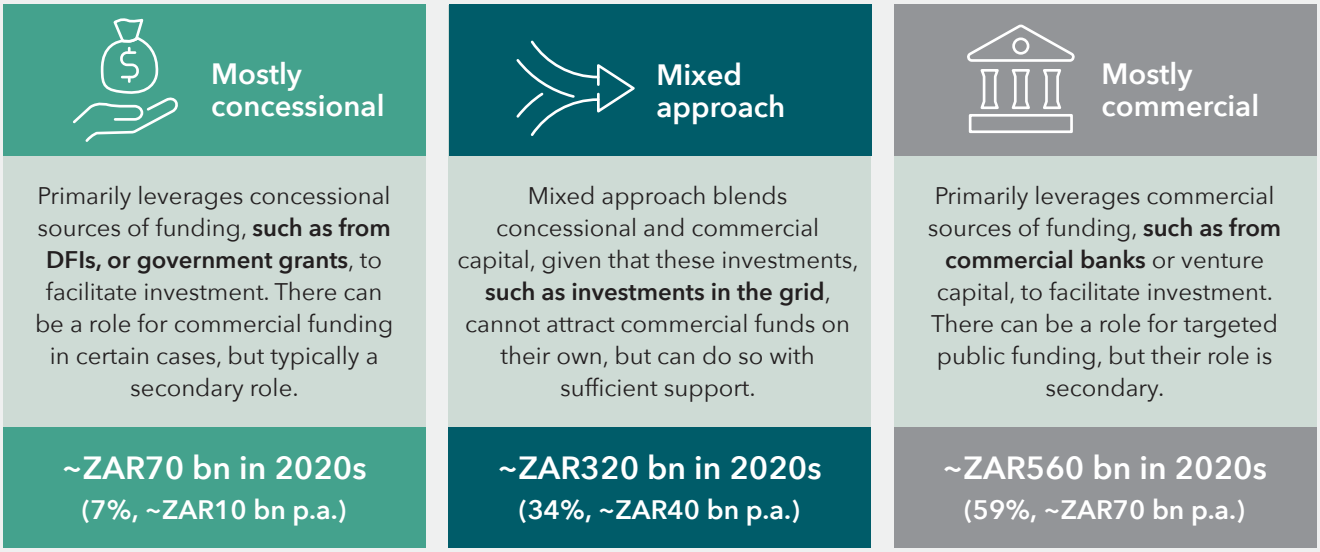


Figure 14: A majority of South Africa's short-term funding needs can be funded from mostly commercial sources



Note: Numbers here include Green hydrogen for export demand.

Source: NBI-BCG project team.

3.3 UNLOCKING CLIMATE FINANCE FOR HIGH PRIORITY AREAS

Question 3: How can climate finance be unlocked to enable South Africa's transition, especially for high-priority investment areas?

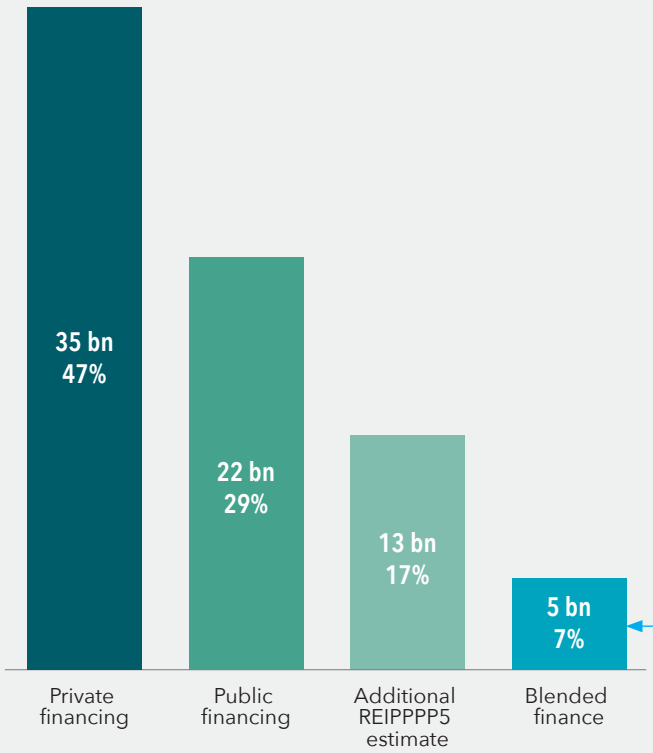
Concessional funding can crowd-in commercial funding through blended finance with multiples as high as 3x–9x based on project and concessional funding characteristics.

While concessional capital is currently a minority of South Africa's climate finance market, comprising less than 20%[24] of the tracked climate finance supply in 2017/18,[25] it can play an important role in unlocking the potential of commercial sources of funding.

The primary benefit of concessional funding is the catalytic role it plays in de-risking investments or providing additional incentives to invest, which in turn creates a crowding-in effect from commercial funders. This goes beyond pure grant funding and can include other support mechanisms such as subsidised currency hedging instruments or contracts for difference.[26] Concessional funding will need to be significantly expanded to fully unlock the potential of blending. Additionally, more than climate finance is needed to ensure climate projects are successfully executed. This support includes, technology support (e.g. the sharing of expertise, and knowledge), guarantee facilities, etc.

Blended finance currently plays a minor role in South African climate finance (see Figure 15).

Figure 15: Blended finance currently plays a minor role in South African climate finance



Only ~8% of climate finance in South Africa in 2017/18 was blended finance:

~ZAR4.9 bn p.a. of blended climate finance tracked, comprising:

- **75%** was structured using 10% public finance and 90% private finance, which demonstrates a significant multiplication effect of concessional to market-rate funds.
- **25%** was structured using 80% public concessional finance and 20% private finance, which supported an increased appetite for high-risk investments.

Several climate investments needing mixed, or even commercially-led, financing will rely on blended finance arrangements, which **must be expanded and become more effective** at crowding-in commercial capital.

South Africa can leverage additional, innovative forms of **concessional-based catalyst fund models** to boost blended finance arrangements and crowd-in commercial capital for climate investments.

Source: Climate Policy Initiative and GreenCape, expert engagements, NBI-BCG project team.

24 In this case, the ~16% concessional capital refers to grant funding made available in the reference period.

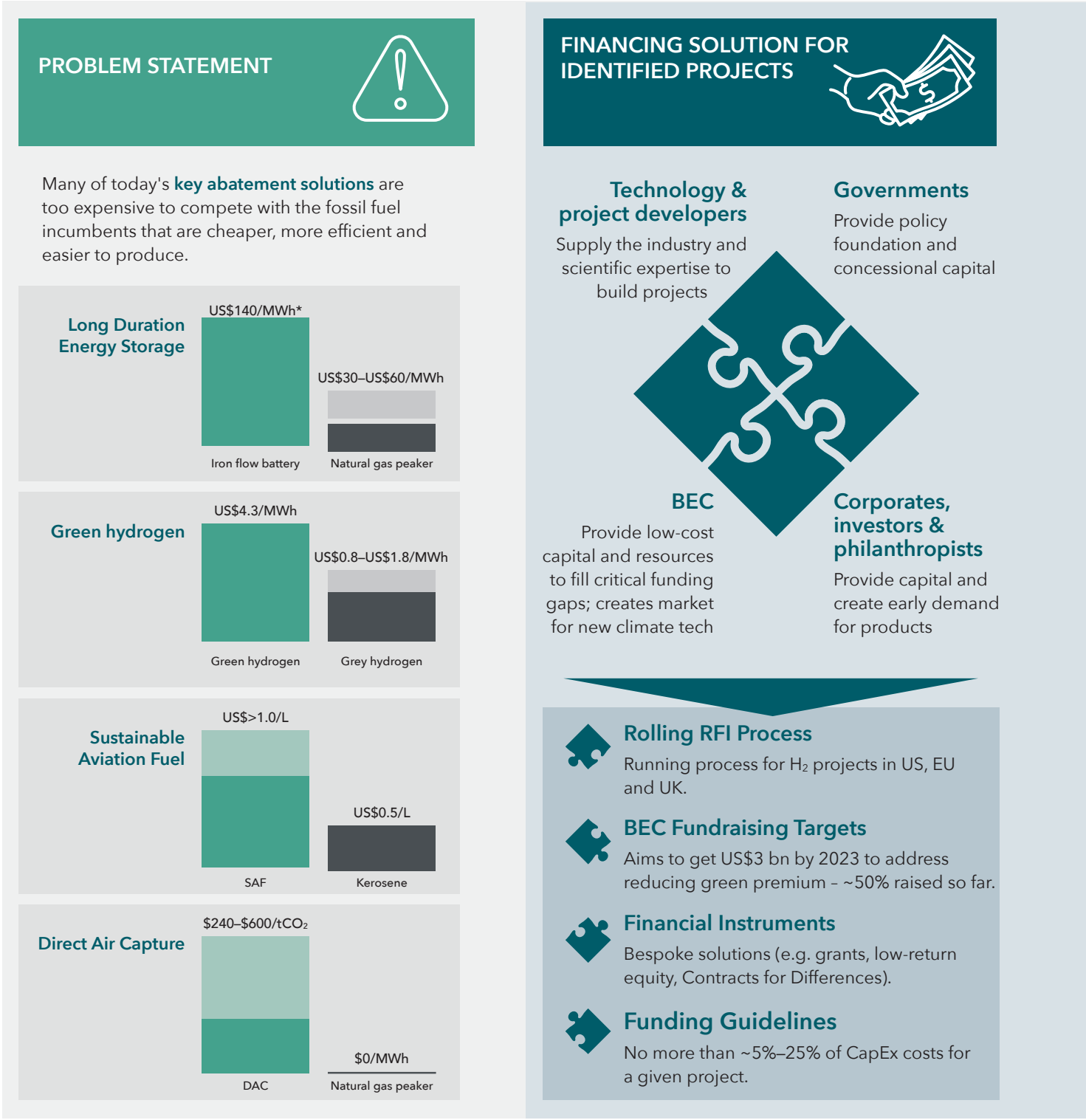
25 This share would likely shrink further when incorporating additional funding unlocked through REIPPPP5, which is predominantly commercial financing.

26 Contracts for difference (CfD) set a specific off-take price for a product upfront, with lower prices triggering subsidization from the concessional funder, and higher prices being allocated to the concessional funder and recycled.

Blended finance ratios vary by project and concessionary capital characteristics with large scale examples ranging from 3:1 to 9:1 commercial to concessional ratios. According to the 'DFI Working Group on Blended Concessional Finance for Private Sector Projects: Joint Report', Development Finance Institutions (DFIs) invested US$2.4 bn through blended concessional finance in Sub-Saharan Africa at an average ~3:1 concessional ratio in 2020. In South Africa, blended finance makes up a small portion of total climate investment but with strong concessional ratios. Approximately 75% of tracked blended finance in 2017/18 consisted of a 9:1 ratio and 25% had a 4:1 ratio. Maximising blending funding ratios is a key way to crowd-in finance towards the net-zero transition.

Strong blended finance design has been shown to drive significant low-carbon investment.

Figure 16: Breakthrough Energy Catalyst case study of innovative blended finance



Blended finance is being deployed globally to accelerate the innovation pipeline and drive proven technologies to commercial scale. Breakthrough Energy's Catalyst (BEC) program is one such innovative blended finance arrangements tailored to incentives investment in four key abatement technologies, as show in Figure 16.

Early successes from BEC highlight three key learnings that can be applied broadly. First, projects can be accelerated by facilitating a funding ecosystem including investors, manufacturers, and off-takers. Second, bespoke concessional solutions on a project-by-project basis allows concessional funding to remove investment roadblocks, crowding-in the maximum level of commercial funding while minimising the time to market. Third, impact attribution is a material reward for investors and strong impact measurement can unlock additional investment at a given level of risk.

INCENTIVE SOLUTION FOR THE CORPORATES, INVESTORS AND PHILANTROPISTS

Quantifiable Impact

BEC collaborated with CDP* to develop the ECTF** that measures the potential impact of catalytic/ concessional financing on reducing the Green Premium and accelerating learning curves.

Three key metrics include:

Reduction in Green Premium (RGP)

The amount by which ECT and incumbent cost difference has been reduced.

Catalysed Emission Reductions (CatER)

Additional decrease in emissions due to accelerated deployment of ECT.

Impact Attribution

Measure of RGP or CatER impact that can be attributed to the funder as a function of concessional support.

KEY LEARNINGS

A funding ecosystem

A consortium of government, funders, off-takers and producers has potential to accelerate projects.

Bespoke concessional solutions

BEC designs financing solutions on a project-by-project basis.

Measuring impact

A new framework is needed to attract capital into emerging climate technologies and reward investors for risk.

Notes: ** CDP = Carbon Disclosure Project ;
*** ECTF = Emerging Climate Technology Framework.

Source: Expert engagement.

To maximise blending finance potential, South Africa should both learn from global case-studies and partner with leading organizations such as Breakthrough Energy Catalyst to build best-in-class blended finance for South Africa.

While the ~US$8.5 bn (~ZAR135 bn) JET Partnership is a step forward for climate finance in South Africa, total funding impact will depend on the percent of funds from concessional sources and the blended finance ratios achieved.

The ~US$8.5 bn (~ZAR135 bn) Just Energy Transition Partnership (JETP) announced at COP26 offers support to South Africa's transition away from an economy dependent on coal. The political declaration commits to mobilising ~8.5 bn through the next 3–5 years through a combination of grant, concessional, and commercial funding sources.

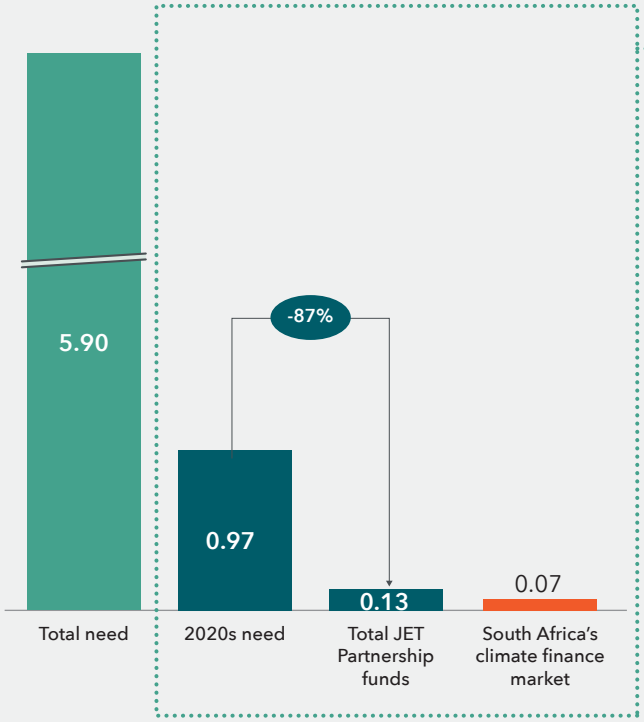
While a significant commitment, the partnership is only one piece of the puzzle to meet South Africa's funding needs. US$8.5 bn would count for ~2% of South Africa's funding needs through 2050 and ~13% of the capital required by 2030 (See Figure 17).

The level of funding crowded-in from the JETP hinges on the percentage of fundings from grant and concessional sources, and the commercial to concessional blended finance ratio achieved on this money. If only 10% is concessional funding and a 3:1 ratio is achieved, the total financial impact of the JETP will be ~US$3.4 bn, far below the initial commitment. At a rate of 10% concessional funding, a best-in-class 9:1 ratio must be achieved to bring in the 8.5 bn in committed total funding. If 20% of the value is concessional/grant funding, only a 4:1 ratio is required to crowd-in 8.5 bn, and in a stretch goal scenario where a 9:1 ratio can be achieved, this could flood in

Figure 17: The JET Partnership (JETP) must be negotiated to provide finance in a useful structure with the right terms

The JETP is insufficient, representing less than 15% of South Africa's needs in the 2020s to be NDC-compliant …

(ZAR tn)



… but tangible progress must be made to secure the full amount and potential additional funding.

Considerations for the JETP as South Africa looks towards COP27:

- **South Africa must take a leading role in shaping the agenda of JETP:** If South Africa is not clear on what it needs funding for, then that decision is made for the country by developed nations.
- **Importance of strong commitments:** The original JETP political declaration explicitly acknowledges South Africa's enhanced NDCs, and especially the lower bound of ~350 Mt p.a.
- **International partnerships aren't fully concessional:** The JETP incorporates both concessional and commercial elements in separate bilateral agreements, including both debt- and grant-based disbursement of funds.
- **Significant resources available, but they can be lost:** While JETP is a small fraction of South Africa's funding needs, it is significant, at ~2x the entire South Africa climate finance market in 2017/18, and can be lost if strong projects are not found.

Source: Expert engagements, NBI-BCG project team

~US$17 bn (~ZAR290 bn), or ~25% of the total funding required by 2030. For the JETP to crowd-in 100% of the funding required by 2030, ~78% of the funding would need to come from concessional sources together with a 9:1 blended finance ratio. These scenarios highlight the importance of both negotiating a high-level of concessional funding and deploying funding at the highest possible blended finance ratio.

In addition, the JETP has several key considerations that policy-makers must navigate as they seek to leverage the agreement. It is essential that the terms of the agreement must be shaped by South African stakeholders. If donor countries dictate the terms without clear stakeholder input, the structure of the funding made available may be challenging for South Africa to deploy. Guiding terms and maximising the concessional financing included relies on a transparent project pipeline that can ground negotiations on specific projects with measurable outcomes for decarbonisation. Additionally, the agreement rests on strong commitments from South Africa, especially in setting out to achieve the low end of its NDC. If South Africa does not reach this low end, it could result in the funding being lost, or priced at higher non-concessional rates. It is critical that the applicable conditions and criteria for funding are clarified upfront to ensure that the funding can be utilised and high debt is not incurred if certain targets are not met.

> ***Currently a minor investor (contributing ~10% of total funding) in adaptation and social components of a Just Transition, the commercial finance sector must adopt a mindset shift from a focus on core business operations towards strengthening their resilience, their supply chains, and communities.***

Adaptation and social investments will be more difficult to fund commercially, given the limited financial returns they may offer to investors. This is reflected in South Africa's climate finance landscape, where 90% of adaptation funds are from public sources. Business must play a greater role in these investments in cooperation with public financing, by understanding and quantifying their adaptation requirements, and changing their mindset towards these topics. Investment decisions on adaptation should consider value of risk mitigation and should make explicit the decision between investing now and deferring costs. This shift will enable business to invest to protect their competitive advantage, build resilient supply chains, and enhance the stability of their operating environments.

Social and adaptation investments will require substantial additional funding through 2050 and more research is required to understand the inevitable impacts of climate change. Current estimates do not capture the full cost structure. The National Adaptation Strategy estimates ~ZAR300 bn in funding needs by 2030, but has no view beyond 2030.

Focusing solely on the transition away from coal, and based on this study's projected pathway to decommissioning coal-fired power stations, an estimated ~ZAR1.2 tn[27] will be required in education, reskilling, and site decommissioning. Focusing on one component shows the vastness of the challenge but represents an incomplete picture of what is needed for a Just Transition that contributes to the transformation of South Africa's economy.

The adaptation side box that follows provides more detail on the complexities with funding adaptation investments in South Africa, and possible responses from the business sector.

27 Estimate based on the proposed renewable energy pathway in this study where 100% of coal sites are decommissioned before 2050.

Business' response to climate change adaptation

Considering the unavoidable impact of climate change on South Africa's temperatures, rainfall patterns and overall climate, businesses across the various sectors will be impacted in various ways, as illustrated in Figure 18.

In response, business must seek to holistically address these impacts in four ways:

- **Building operational resilience:** Design operationally critical processes to be resilient to impacts of extreme weather and climate change.
- **Providing workforce care:** Ensure employees are operating in a safe environment that addresses discomfort caused by climate change and provides financial and physical and mental health support post extreme events.
- **Building resilience across the value chain:** Ensure business supply chains are resilient to the impacts of climate change.
- **Participating in public protection:** Ensure the environment for the host communities remains thriving during (and post) business operations.

South Africa will need significant funding for adaptation investments. To meet these funding needs, concessional (public) funders will need to play a catalytic role to unlock commercial (private) financing. Commercial financiers also need to shift their mindset to see adaptation activities as a competitive advantage worth investing in now, rather than later.

Even with the wide range of responses available to the private sector, the Climate Policy Initiative shows that of the 7% of green finance invested in South Africa for adaptation, only 10% is from the private sector.[28] This begs the question: what challenges are causing this low participation in adaptation finance?

Building operational resilience seems to be the most natural response for businesses when considering new operations since this is seen as part of operational management. However, businesses must still guard against maladaptation, a term defined by the IPCC as: "actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future." The challenge comes when considering making existing operations more resilient due to the associated cost.[29]

The business case for workforce care is strong since it directly involves the safety and comfort of those responsible for the productivity of the business. This may be through regulation and behavioural change (e.g. adapting PPE, reducing heat output devices) or infrastructure and technology upgrades (e.g. increased ventilation, more shaded areas). The case for investing in the resilient and adaptive nature of supply chains is compelling, especially considering retained competitiveness.

Whole value chains will be impacted by climate change and the transition to net-zero. Business should understand the coming shifts in their value chain and take steps to prepare for this transition. For example, the auto industry will be reshaped by the transition to electric vehicles. According to the Presidential Climate Commission (PCC) report, 'A Framework for a Just Transition in South Africa', while 100 000 people work in automotive manufacturing, another ~380 000 work as mechanics and in petrol stations. By viewing products as part of the full value chain, investments in communities outside the walls of the company can make strategic sense, both in terms of social justice and economics. For example, by supporting auto mechanic upskilling to work on EVs, the EV ownership experience will improve, expanding the EV market for the auto company and securing jobs in the supply chain.

The last measure, investing in adaptation and resilience measures for public protection and hosting communities, is seen to be the most challenging for businesses. This type of adaptation response can be split into two types. The first would be investing in building resilience of communities to guard against climate change impacts that may be further exacerbated by business operations. To assist business to identify the scope of impactful work for adaptation in host communities, consideration should be given to what adverse impacts operations could have on surrounding communities and what adaptation measures could help both communities and businesses in those areas. Once business can acknowledge its responsibility to the community, as well as to itself, it will be possible to start making high-level statements of how public and private can work together and what the 'blended' response could look like.

28 SA Climate Finance Landscape 2020 by Climate Policy Initiative, Bertha Centre and GreenCape.
29 Task Force on Climate-related Financial Disclosures (TCFD).

Figure 18: The unavoidable impacts of climate change will be felt across industries in South Africa

Source: NBI-BCG project team.

The second type of adaptation response would be co-investing in building resilience into public social infrastructure. As an example, South Africa's minister of Public Works and Infrastructure recently gazetted the first iteration of the National Infrastructure Plan (NIP) 2050, which already identifies climate resilient measures required and cites a financing gap of ~R2 tn.[30] The current plan is to leverage public-private partnerships to close the gap, but how can the public sector tangibly attract more private finance?

Overall, a key to increasing private sector participation in adaptation is to quantify the risk and opportunity for business as well as in its broader operating context and communities in which it is embedded, and to assess how these measures can improve social and climate resilience, and long-term business sustainability. From there we may see that across sectors, some adaptation activities are well within reach of business to not only invest in, but to proactively drive as well.

30 Engineering News 16th March: NIP 2050 leans heavily on private sector to close ZAR2 tr gap.

3.4 KEY STEP FOR PRIORITY INVESTMENT AREAS

Question 4: What are the key next steps in the immediate-term for priority investment areas, and what are the respective responsibilities of private and public sector economic stakeholders?

Funding for the net-zero transition is limited by lack of policy and strategic alignment, high perceived investment risk, limited shovel-ready project pipeline, insufficient blended finance, and inconsistent green standards.

Currently, five key challenges in South Africa, illustrated in Figure 19, restrict either the supply of climate finance, or its ability to be effectively leveraged.

First, **the policy environment in South Africa can be inconsistent or limiting**. For example, an outdated Integrated Resource Plan (IRP) combined with a slow bid process in previous REIPPPP rounds, has constrained RE development, despite a strong project pipeline. Other examples include limits on licensing requirements, inability to sell into the grid surplus capacity.

Second, there is a **perception of high risk and low reward associated with climate investments** in South Africa, particularly where investment ticket[31] sizes are relatively small, and the currency is subject to significant fluctuations. This is both an industry-specific challenge for climate investments, given lower technical maturity of some technologies, as well as a structural challenge that South Africa must address to attract foreign investment.

Third, a l**imited pipeline of shovel-ready projects**, especially outside of renewable energy, means that investors can struggle to find strong projects to invest in. This is driven in part by a lack of financing for feasibility studies to investigate and build out the pipeline.

Fourth, **blended finance currently plays a minor role**, with about an 8% share of climate finance in South Africa, and most blended finance is currently from foreign sources.

Finally, **there is an inconsistent adoption of 'green' standards**. This exacerbates the risk of investments being greenwashed and can serve to limit investment altogether. For example, the lack of alignment on whether excess RE generated for Green H_2 electrolysis can be sold to the general power grid without violating the principle of

Figure 19: The five distinct challenges facing climate finance in South Africa

Climate finance challenges

1 Lack of policy and strategy alignment

- Multiple policies are not linked to provide a coherent path.
- Different agencies in government follow different strategies.
- Specific instances where policy inhibits projects.[1]

2 High risk, low perceived rewards

- Without incentives, some green projects have low return rates.
- Technologies with low maturity have greater implementation risk.
- High currency volatility in South Africa risks reducing capital available.

3 Lack of transparency on project pipeline

- Few projects of sufficient size to attract large-scale investment.
- Lack of catalytic blended finance tailored to project lifecycle.[2]
- Low project preparedness for finance.

4 Lack of blended finance

- Low levels of cooperation between commercial and concessional funders.
- Public-private blended finance in South African green projects is 100% from international sources.

5 Inconsistent standards and rules

- No global definition of 'green' for many investments.[3]
- Restrictive application of green standards.[4]
- Risk of green-washing given different green standards.

Notes: 1. For example, EV import taxes, embedded generation limits.
2. Specifically, the evolution of the target capital stack (or mix of debt, equity and grant financing) required as project matures.
3. For example, whether gas can be considered a transition fuel or not.
4. Such as restrictions on selling surplus RE electricity generated specific for Green H_2 production can be sold to the general grid.

Source: NBI-BCG project team.

31 Ticket size here refers to the value of an investment.

Figure 20: Multiple levels of actions are required to address financing challenge

		High-impact actions	Challenges* resolved
STRUCTURAL CHANGE	Innovative financing arrangements	■ Leverage innovative blended finance mechanisms where concessional funding is used as a catalyst that derisks investments, crowding-in commercial capital.	1 **2** 3 **4** 5
		■ Establish concessional mechanism providing currency hedges for climate funds.	1 **2** 3 4 5
	Policy changes	■ Open pension fund rules to make funds available for climate investments.	**1** 2 3 **4** 5
		■ Revise IRP with more aggressive pathway for renewable energy.	**1** 2 3 4 5
		■ Align gas policy approach across policy-makers, as limited-use transition fuel for short-term seasonal balancing with no upstream exploration.	**1** 2 3 4 5
	Administrative reforms	■ Establish regulatory one-stop shop to fast-track processes for climate projects.	1 2 3 4 **5**
		■ Establish forum or leverage existing forum, such as the PCC or PCFTT, to ensure private and public sector stakeholders align on project prioritisation.	**1** 2 3 4 5
PROJECT-LEVEL ACTIONS	Project-level actions	■ Establish incubator to aggregate projects and link funders, especially blended, to projects.	1 2 **3** 4 5
		■ Develop transparent, publicly accessible project pipeline, especially for investment areas with a limited project pipeline (such as the grid).	1 2 **3** 4 5

Notes: * Key to challenges:
1. Lack of policy and strategy alignment.
2. High risk, perceived low rewards.
3. Lack of transparency on project pipeline.
4. Limited blended finance.
5. Inconsistent and strict standards and rules.

Source: NBI-BCG project team.

'additionality'[32] creates uncertainty and could dampen enthusiasm in Green H_2 investments.

Unlocking the potential of South Africa's climate finance market will require action from all relevant stakeholders in society. It is essential therefore, that we address all five of these financing challenges together. A mixture of top-down actions that address structural challenges and bottom-up actions that target project-specific issues will be required to build a strong enabling environment for execution, as shown in Figure 20.

Structural changes, including new innovative financial arrangements, policy changes and administrative reforms will help address lack of policy alignment, perception of high risk/low financial reward, and unlock blended finance. For example, one top-down policy change could be to adjust import tax structure on EVs to be in line with, or below, the taxes levied on internal combustion engine (ICE) vehicles, increasing EV affordability, and stimulating EV adoption. This needs to be supported by a reliable green power supply.

Paired with structural changes, strong bottom-up project-level action will further resolve challenges. For example, more targeted support for the management of a project, such as fast-tracked licensing and bureaucratic processes and/or support provided to increase preparedness for financing requests will help to resolve the limited project pipeline, as well as clarity on financing qualification criteria being applied consistently to all applicant.

Near-term priority investment areas include Green hydrogen, green power, gas, grid expansion, EVs, social & adaptation activities.

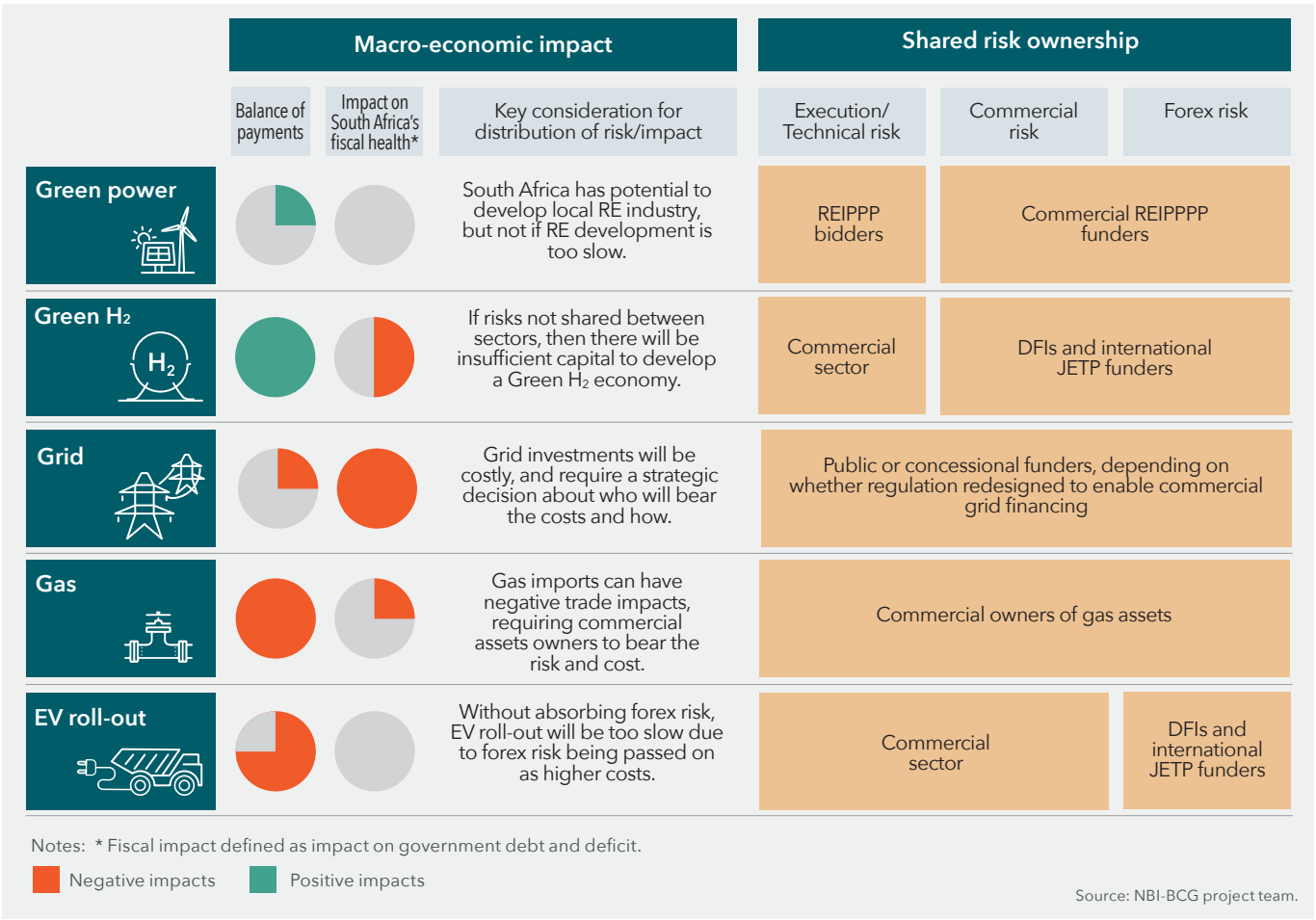
32 A tenet of the "green" hydrogen classification, the 'Additionality' principle requires that electricity used in hydrogen production be sourced from new renewable projects.

For this analysis, six priority investment areas have been selected from the greater array of potential activities for detailed analysis of required actions, based on their criticality for South Africa's transition in the short-term (See Figure 21). These priority areas are:

1. Green power (including RE generation and battery storage activities)
2. Green hydrogen
3. Grid investments in both modernisation and extension
4. Gas (incorporating gas-to-power peaking, gasification in the petrochemicals sector, and underlying gas infrastructure investments)
5. Electric vehicle (EV) roll-out of infrastructure and vehicles
6. Social and adaptation activities.

The cumulative capital expenditure of these projects to 2030 is ~ZAR700 bn, or ~70% of South Africa's total infrastructure investment needs in the 2020s (illustrated in Figure 22). Almost half of that is in RE, including embedded generation for the mining and AFOLU sector (~ZAR311 bn), demonstrating the immediate-term importance of decarbonised electricity. This figure swells further when incorporating additional[33] renewable generation required for production of Green H_2, which requires ~ZAR50 bn. Investments in grid expansion, which must increase at roughly four times the current rate and are a critical enabler to further renewables development,[34] will require an additional ~ZAR170 bn. Lighthouse projects in Green H_2 and investments in EVs are relatively small but offer considerable environmental and socio-economic potential. They are also critical in ensuring that South Africa can retain and grow its industrial base and continue

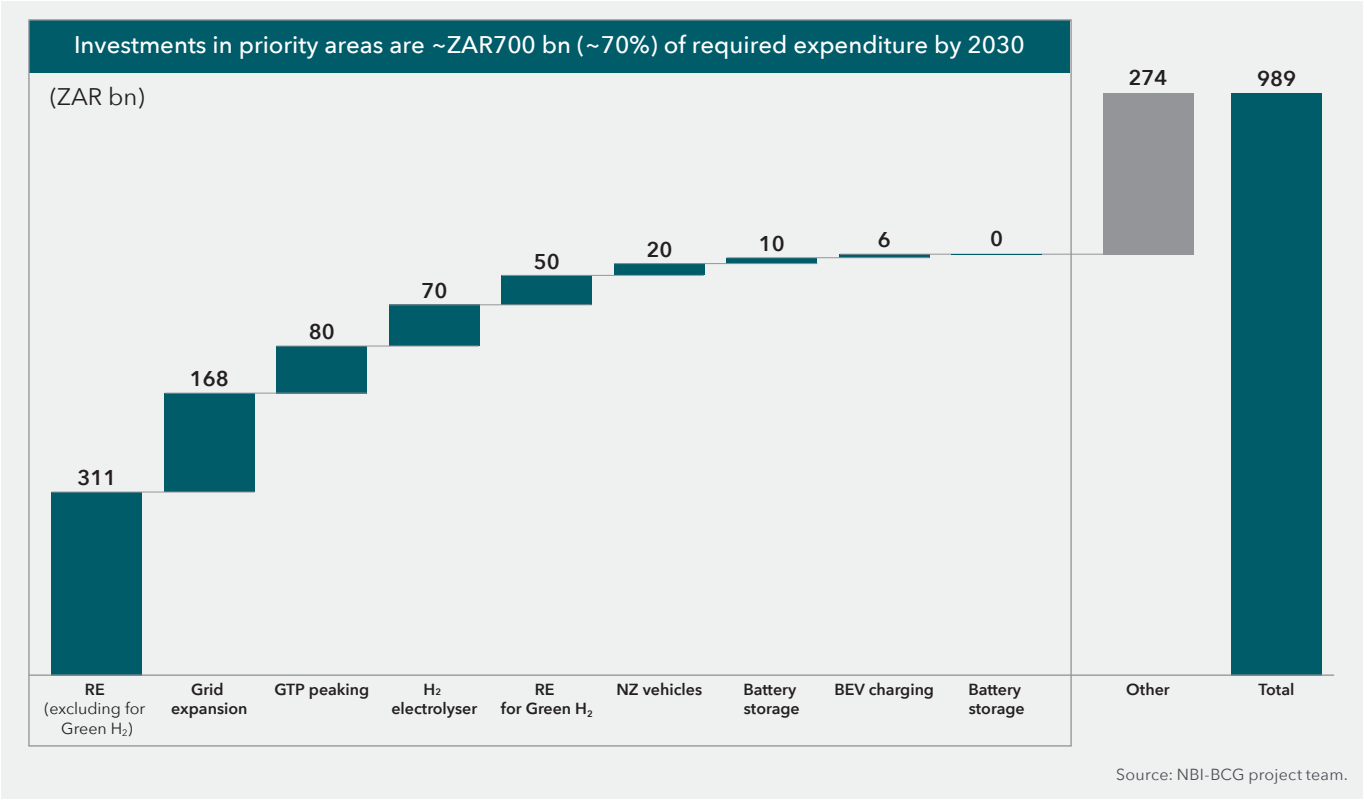
Figure 21: Risk ownership of priority investments must be shared across the economy, with commercial funders bearing more risk in bankable, mature investments



33 Due to the rule of 'additionality' governing Green H_2 production, Green H_2 facilities cannot draw green electricity from the general grid to prevent cannibalisation of renewable electricity from other purposes.

34 In the Northern Cape for example, where solar potential is some of the world's highest, grid capacity is particularly constrained, with no capacity for additional grid connections. Therefore, decarbonisation of South Africa's power supply cannot happen without grid infrastructure investments.

Figure 22: Priority investments for the short-term account for ~70% of spending by 2030



Source: NBI-BCG project team.

to trade in goods that will not be subject to border tax adjustments, due to the reduction in embedded carbon from using Green H_2.

South Africa must prioritise these short-term investments to ensure it adheres to the 2030 NDC and achieves net-zero by 2050 with a cumulative carbon budget of ~9–10 Gt CO_2. This prioritisation is based on the strong enabling environmental impact, socio-economic potential, and ease of implementation of these investments. The criticality of investments in renewables and grid infrastructure cannot be understated, given the size of the power sector's emissions contribution in South Africa's emissions baseline (~50%), and with limited grid infrastructure acting as a bottleneck to renewables development – these investments can kick-start South Africa's Just Transition. On the other hand, lighthouse projects for Green H_2 will not directly drive decarbonisation in this decade but will offer the potential to kick-start the development of a Green H_2 economy, with considerable long-term environmental, industrial, trade, and socio-economic benefits. In addition, EV roll-out spending may be small in the 2020s but increasing the share of EVs in South Africa's vehicle parc is an enabler to the development of domestic EV manufacturing capabilities. Decarbonising road transport by increasing the share of EVs in the vehicle parc in turn also relies on a strong EV charging network.

As shown in Figure 23, not every challenge applies to all investment areas. For example, challenges in renewable power include limited policy alignment, perceived high risk/low reward, and insufficient shovel-ready projects. Gas infrastructure, in contrast, is not limited by insufficient shovel-ready projects, but instead is limited by inconsistent 'green' standards. Figures 24–29 show the blueprints to unlock funding across for the highlighted investment areas, based on the challenges identified as being relevant for each investment. With investment unlocked, the private sector will have a significant role to crowding-in finance and executing projects.

Figure 23: Six priority investment areas have been selected for more detailed analysis

	Activity	Challenges	Assessed	
Energy	RE generation (excluding for Green H_2)	1 2 3 4 5	✓	Green power
	GTP peaking	1 2 3 4 5	✓	Gas
	Green H_2 turbines			
	Battery storage	1 2 3 4 5	✓	Green power
	Grid extension	1 2 3 4 5	✓	Grid
	Grid modernisation			
	Natural gas in petrochemicals	1 2 3 4 5	✓	Gas
	Biomass			
	RE generation (for H_2 production)	1 2 3 4 5	✓	Green H_2
	Green H_2 production			
Transport and logistics	Net-zero vehicles	1 2 3 4 5	✓	EV roll-out
	EV charging infrastructure			
	Commercial rail expansion			
	Passenger rail expansion			
	Bus Rapid Transit (BRT)			
Just Transition and economic infrastructure	Gas infrastructure	1 2 3 4 5	✓	Gas
	Water infrastructure			
	New green buildings			
	Retrofit existing			
	Construction			
Land and agriculture	Agriculture and othe land sinks			
	Sustainable land management			
	Waste management			
Manufacturing	Mining exploration			
	Green steel (2 Mt/a)			
	Cement (fuel switch, BAT)			
Other	Sustainable diets			
	CCUS			
	Just Transition investment (as a whole)	1 2 3 4 5	✓	Just Transition, Adaptation
	Adaptation (as a whole)			

Note: Only maximum of two instruments highlighted, unbolded instruments may be used to bolster primary instruments for activity.

Source: NBI-BCG project team.

Figure 24: Funding blueprint for green power (including renewables and battery storage)

Challenges	Specific challenge to resolve	Proposed solution to address challenge
1 Lack of integrated policy and alignment	**RE and battery storage:** Lack of speed on legislation around unbundling, combined with lack of transparency on wheeling framework and charges associated with wheeling through the grid and limits on embedded generation, reducing ability to invest.	**Policy change:** Government must prioritise legislative procedures for unbundling electricity sector and specific legislation regulating wheeling in South Africa, including setting up a transparent repayment structure. The private sector must cooperate in this process and provide inputs as needed. Speed is also needed on future REIPPPP process, 100 MW self-generation limit must be lifted, and IRP must be updated (RE and battery storage).
	RE and battery storage: Restrictive rules on usage of pension fund capital.	**Policy change:** Open rules on usage of pension fund capital for climate investments.
2 High risk, low perceived reward	**Battery storage:** Attractiveness of battery storage investments currently low, exacerbated by high upfront capital costs and perceived risk causing a mismatch between demand and supply of battery storage.	**Innovative financing mechanism:** Blended finance arrangements that employ concessional capital to de-risk projects, and thereby crowd-in commercial capital, such as first loss provision or Contracts for Difference, can support battery storage investments early in the project lifecycle, when financial support is most needed.
	RE and battery storage: High perceived risk of investments in South Africa for international finance sources, limiting funding inflows.	**Innovative financing mechanism:** Establish concessional mechanism providing currency hedges for climate funds, such as done by Development Bank in India, reducing the high costs associated with hedges.
3 Limited shovel-ready project pipeline	**Battery storage:** Limited transparency on project pipeline for battery storage.	**Policy change:** Project incubator to be established to increase transparency on projects, linking to funders.
	RE: While a strong project pipeline exists for REIPPPP5, slowness in previous rounds of REIPPPP bidding, coupled with the outdated IRP, reduces clarity on future RE development, which is critical for the development of a domestic RE industrial base.	**Policy change:** Government must revise the IRP with a more aggressive build-up of renewables and specific commitments on future bid window scheduling for the REIPPPP, with voices of community stakeholders and the private sector considered in this process.
4 Lack of local blended finance	N/A	N/A
5 Inconsistent adoption of green standards	N/A	N/A

Source: Expert engagements, NBI-BCG project team.

Figure 25: Funding blueprint for Green hydrogen

Challenges	Specific challenge to resolve	Proposed solution to address challenge
1 Lack of integrated policy and alignment	**Green hydrogen:** No bilateral trade cooperation from government to derisk off-take with potential import partners (e.g. Germany) and enable hydrogen IP transfer.	**Policy change:** Private sector to lobby government to engage with trade partners (e.g. the EU) on future trade agreements and an IP transfer agreement, with the private sector to provide inputs in this process.
	Green hydrogen: Slow bureaucratic approval processes that could cause South Africa to miss out on export opportunity offered by Green H_2.	**Administrative action:** Improve and streamline permitting and licensing processes, private sector to lobby for 'one-stop shop' in government to facilitate regulatory clearance for climate projects, especially in Green H_2.
2 High risk, low perceived reward	**Green hydrogen:** Supply-demand mismatch, with large economic gap to bridge before Green H_2 reaches parity with fossil fuels, along with high perceived risk due to low technical maturity.	**Innovative finance mechanism:** Concessional finance can provide CfDs,* risk guarantees, sponsored currency hedges, and other support to derisk hydrogen investments. This capital can be efficiently recycled for future projects, as evidenced by Breakthrough Energy Catalyst and Climate Investor One.
	Green hydrogen: Rules requiring off-take before funding is made available for project development, which itself is a typically required for off-take agreement.	**Policy change:** Concessional funds can sponsor required studies for off-take agreements, using concessional finance to support the project in the early stage of the project lifecycle to crowd-in commercial capital.
3 Limited shovel-ready project pipeline	**Green hydrogen:** Lack of transparency on what Green H_2 projects are available to be funded, with limited pipeline of public projects that are well-prepared for funding requests and can attract commercial capital.	**Project-level action:** Create pipeline of projects, potentially through digital marketplace, which creates transparency on what is available, as well as providing technical assistance to projects that lack preparedness to attract commercial capital.
	Green hydrogen: Projects are typically small by international standards, limiting attractiveness for foreign investors.	**Innovative finance mechanism:** Establish agency/entity to incubate projects and reduce issues associated with small project sizes.
4 Lack of local blended finance	**Green hydrogen:** Lack of coordination on projects to prioritise for concessional finance, diminishing catalytic power of concessional funds from economies of scale.	**Administrative action:** Establish forum, or leverage existing forum, such as the PCC or PCFTT, to ensure private and public sector stakeholders share knowledge and align on project prioritisation.
	Green hydrogen: Limited grant funding and strict rules regarding its use, e.g. projects typically can't receive funding from several concessional facilities, like H_2 Global or KfW, limiting their ability to capitalise on concessional capital.	**Policy change:** Open up rules on use of concessional finance and commercial sources like pension funds, to better allow concessional funders to cooperate (such as the KfW and IDC cooperation in South Africa), and increase grant funding as early-stage catalyst, leveraging synergies to catalyse commercial capital for Green H_2 projects.
5 Inconsistent adoption of green standards	**Green hydrogen:** Difficulties aligning to EU green standards that govern if hydrogen can be 'green', which must be negotiated. For example, projects can't sell surplus electricity from embedded RE generation due to EU requirement of additionality for Green H_2.	**Policy change:** Private sector and government co-oporation to engage with trade partners, e.g. Germany, on future trade agreements and the rules governing Green H_2 in Europe. For example, establish common sense rule that permit hydrogen installations to wheel surplus electricity through the grid.
	Green hydrogen: No clarity currently on what constitutes 'green' carbon feedstock for Green H_2 production.	**Administrative action:** Finalise green taxonomy and clarify instrument rules to increase efficiency, reduce greenwashing, including with international partners, like in the EU.

Note: * Contracts for Difference (CfD) are a derisking tool stipulating that the purchaser will pay the supplier the difference between an existing price (e.g. for oil-based fuel) and the price of the product sold (e.g. green fuels).

Source: Expert engagements, NBI-BCG project team.

Figure 26: Funding blueprint for grid infrastructure, including modernisation and extension

Challenges	Specific challenge to resolve	Proposed solution to address challenge
1 Lack of integrated policy and alignment	**Grid:** Lack of clarity on how public-private partnerships can play a role in funding the grid, with no regulatory framework or repayment structure currently designed to enable private participation in the grid.	**Policy change:** Create a framework for the private sector to provide supporting finance for grid investments by completing the Eskom unbundling and through grid infrastructure auctions, where grid segments are auctioned off with transparent repayment structure to encourage private investment.
	Grid: restrictive rules on usage of pension fund capital.	**Policy change:** Open rules on usage of pension fund capital for climate investments.
	Grid: Unclear policy pathway for grid development.	**Policy change:** Revise IRP with more aggressive grid expansion plans, especially in Northern Cape REDZ.
2 High risk, low perceived reward	**Grid:** High perceived risk of investments in South Africa for international finance sources limiting funding inflows.	**Innovative financing mechanism:** Establish concessional mechanism providing currency hedges for climate funds, such as done by Development Bank in India, reducing the high costs associated with hedges.
3 Limited shovel-ready project pipeline	N/A	N/A
4 Lack of local blended finance	**Grid:** Lack of appetite from development finance to fund grid investments, and limited funding available from government due to balance sheet constraints, which is exacerbated by the slow movement on electricity sector unbundling.	**Policy change:** If commercial investments in the grid are not enabled, then the newly-created Independent System and Market Operator (ISMO) through the electricity sector unbundling process must be sufficiently enabled to accrue debt capital to invest in grid expansion and modernisation.
5 Inconsistent adoption of green standards	**Grid:** Some investors not considering grid investments to be 'green', limiting investment available, despite the critical enabling role of expanded and modernised grid infrastructure. Concessional finance from international sources, for example, can be strictly limited to specific types of investments.	**Administrative action:** Concessional and commercial investors must update their priority 'green' investments to include grid infrastructure, and clear instrument rules based on the green finance taxonomy should be established and monitored. In addition, rules strictly earmarking international concessional capital for specific investments should be renegotiated and relaxed.

Source: Expert engagements, NBI-BCG project team.

Figure 27: Funding blueprint for gas, including gas infrastructure

Challenges	Specific challenge to resolve	Proposed solution to address challenge
1 Lack of integrated policy and alignment	**Gas:** Lack of clarity on what demand for gas will be required, which is critical for any investment in gas supply infrastructure.	**Policy change:** Clarity on the role of gas must be created, with a clear roadmap delineating the narrow role of gas in a renewables-dominated grid.
	Gas: Slow bureaucratic processes surrounding planned peaking projects and decommissioning of coal plants in favour of gas peaking capacity.	**Administrative action:** Fast-track G2P concession in Richard's Bay for low-utilisation peaking production, and explore public-private partnerships for operating plants at decommissioned coal plants.
2 High risk, low perceived reward	**Gas:** High perceived risk of investments in South Africa for international finance sources, limiting funding inflows.	**Innovative financing mechanism:** Establish concessional mechanism providing currency hedges for climate funds, such as done by Development Bank in India, reducing the high costs associated with hedges.
3 Limited shovel-ready project pipeline	N/A	N/A
4 Lack of local blended finance	N/A	N/A
5 Inconsistent adoption of green standards	**Gas:** Policy-makers not yet aligned on the role of gas in South Africa's transition, and whether gas is considered a transition fuel. If gas is to play a short-term transitionary role, then this is an enabler for short-term gas infrastructure investments.	**Administrative action:** Government must align across policy-makers on the role of gas in the transition, through an evidence-based approach, with input from civil society and business. In addition, clear instrument rules based on the green taxonomy should be developed and published.

Source: Expert engagements, NBI-BCG project team.

Figure 28: Funding blueprint for EV roll-out, including charging infrastructure and vehicles

Challenges	Specific challenge to resolve	Proposed solution to address challenge
1 Lack of integrated policy and alignment	**Net-zero vehicles and EV charging:** Luxury tax on the import of electric vehicles (EVs) increases their cost and lengthens the time to Total Cost of Ownership (TCO) parity with equivalent ICE vehicles.	**Policy change:** Taxes on EVs to be at least normalised to those levied on ICE vehicles, with taxes on EVs ideally levied lower than those on ICE vehicles, or ICE vehicles cross-subsidise EVs in early stages, to increase EV affordability and stimulate the domestic market for EVs (Net-zero vehicles and EV charging).
2 High risk, low perceived reward	**Net-zero vehicles:** Affordability issues for price-sensitive consumers, which limit the attractiveness of these vehicles.	**Policy change or administrative action:** Lenders can reduce set preferential interest rates for EV car loans, improving affordability for consumers. This can also be incentivised or regulated by government policy.
	Charging infrastructure: High perceived risk of charging investments, given limited current off-take and upfront capital expenditure.	**Innovative financing mechanism:** Blended finance arrangements can be employed to derisk investments in EV charging, especially through patient upfront finance.
	Net-zero vehicles: Currency fluctuations impacting importation of technology.	**Innovative financing mechanism:** Establish concessional mechanism to provide currency hedges.
3 Limited shovel-ready project pipeline	**Charging infrastructure:** Limited pipeline of strong EV charging projects that are prepared for commercial financing.	**Project-level action:** Project pipeline can be strengthened by project incubator and project-level partnerships to strengthen creditworthiness and preparedness for financing, with incubator linking funders to projects.
4 Lack of local blended finance	N/A	N/A
5 Inconsistent adoption of green standards	N/A	N/A

Source: Expert engagements, NBI-BCG project team.

Figure 29: Funding blueprint for social and adaptation activities

Challenges	Specific challenge to resolve	Proposed solution to address challenge
1 Lack of integrated policy and alignment	**Just Transition:** Just Transition Framework from PCC exists as alignment tool, but specific implementation details (such as a strategic workforce plan) are needed.	**Policy change:** Government should run dedicated, data-driven study to develop a strategic workforce plan in South Africa to guide investments, as well as other implementation plans based on the PCC framework (**Just Transition**).
	Adaptation: South Africa recently had the NIP 2050 (National Infrastructure Plan) gazetted, but we must ensure that the national budget and National Climate Change Adaptation Strategy are in alignment with it.	**Administrative action:** Run alignment and review exercise ensuring all budgets, policies, regulations and incentives enable the national adaptation and resilience objectives for the country, e.g. plans for future infrastructure investment (**adaptation**).
2 High risk, low perceived reward	**Just Transition and adaptation:** Private sector hesitant to invest in adaptation or resilience of existing assets due to additional cost, and of public/social infrastructure – seen as a public sector responsibility.	**Policy change and administrative action:** Private sector to undergo a mindset shift to think of investment into social infrastructure (e.g. transport infrastructure) as an investment in competitive advantage and undisrupted operations. Leverage the TCFD Framework to quantify the cost of climate risks on the business to build a strong business case, which can also be required by national regulation if needed (**Just Transition and adaptation**).
3 Limited shovel-ready project pipeline	**Just Transition and adaptation:** Private sector does not have a consolidated view of South Africa's social investment and adaptation needs and the impact of each project, making it hard to judge which impactful projects to invest in.	**Policy change:** Perform analysis on a national level to identify highly vulnerable regions (e.g. coal belt) and sub-regions (e.g. Gert Sibande District Municipality) in South Africa, design adaptation and resilience projects to mitigate vulnerability, and define project impact in terms of socio-economic factors (e.g. lives saved, jobs created, the value of property damage avoided, etc.) (**Just Transition and adaptation**).
4 Lack of local blended finance	**Adaptation:** Only 10% of adaptation projects were funded by blended finance in 2018, and limited overall blended finance in South Africa, suggesting low collaborative spirit between private and public sector on using blended finance approaches, which are especially critical for social and adaptation investments.	**Policy change ad project-level actions:** The public sector should leverage a long list of projects whose socio-economic impact has been quantified and seek funding early on from the private sector for the most impactful ones. Also, engage technical experts early on to give private sector assurance of project success. Government can also leverage regulatory requirements to incentivise investments in social and adaptation investments (**Just Transition and adaptation**).
5 Inconsistent adoption of green standards	**Just Transition:** Limited standards governing what is considered social transition expenditure, with no tagging performed in analyses of climate finance.	**Just Transition:** Clear taxonomy to be developed on social transition expenditure, based on PCC Just Transition Framework.
	Adaptation: Although statistics show private sector is only involved in the 10% blended finance of adaptation, it is possible that some funds have been missed due to differences in tagging adaptation finance in the private sector.	**Adaptation:** Design consistent methodologies of identifying adaptation finance in company financials to create ease of tracking funds.

Source: Expert engagements, NBI-BCG project team.

Olifantshoek, a mining town in the Northern Cape.

Image: Shutterstock

Ownership of risk through the transition to net-zero should be based on which entity is best positioned to mitigate risk, and evolve toward increasing corporate risk ownerships based on improving economic viability of each technology.

Transition risks affect all actors in the green economy and successful risk mitigation will benefit the full ecosystem.

Private and public sector stakeholders in South Africa have a shared responsibility for the transition to net-zero, but with accountability for different actions. The focus of the public sector will be on creating an enabling environment for finance and judiciously stimulating investment through the leverage of government balance sheets, revenue and other fiscal measures. This includes negotiating the specific terms of the JETP, maximising the concessional finance available to the country, and reviewing the regulatory environment, such as for the transport and buildings sectors, to unlock climate investments. The private sector must take a proactive role in stimulating the climate finance market in South Africa. This includes actively developing new partnerships and blended finance mechanisms, developing project pipelines, and providing inputs to government on which regulations are restrictive and what policies will further stimulate climate investment.

The transition will fundamentally alter the structure of South Africa's economy, impacting the country's short-term balance of payments and fiscal health,[35] and presenting considerable technical risks, especially for technologies that are less mature. These transition risks will need to be shouldered by various economic stakeholders, not just the government. Despite these potential issues, it is essential to implement these investments to be compliant with the 2030 NDC.[36] It is important to understand which economic stakeholders bear the brunt of the risk for specific investments, to ensure shared accountability for South Africa's transition.

Which stakeholders shoulder the risk burden depends on two primary factors: the ability of commercial finance to fund the specific investment (based on bankability and technical maturity), and which stakeholders are best placed to manage a specific risk. For example in EVs, where the key technology is currently imported and investments are exposed to foreign exchange fluctuations, support may be needed from concessional finance, such as DFIs, to limit the impact of foreign exchange fluctuations, with a similar principle applying to Green H_2 technology imports.

These principles imply that projects that can be funded from mostly commercial sources, such as Renewable Energy, can see the private sector (specifically, REIPPP bidders and project managers) take relatively more risk. On the other hand, for risks that stem from less bankable or mature investments, additional support is needed from concessional sources. An example of this would be investments in Green H_2, which needs more risk guarantees and concessional support from concessional funders to blunt the associated commercial and foreign exchange risks, as demonstrated in Figure 21 on page 44.

Without coordinated risk management among economic stakeholders, there will be rippling impacts on other elements of South Africa's climate finance strategy, as shown in Figure 30. South Africa's government currently has limited ability to bear large-scale risks on its constrained balance sheets. Additional liabilities would require increased taxation to fund repayment, reducing the attractiveness of private investment. For this reason, there is a clear need for coordination on risk ownership in South Africa's transition, whether through an existing forum such as the Presidential Climate Commission (PCC), or some other forum that links public and private sector stakeholders.

As South Africa looks towards the transition to net-zero, the scale of the challenge is clearly immense. However, the journey must be started in the immediate-term, with four key next steps laying the groundwork for success pre-COP27 and beyond:

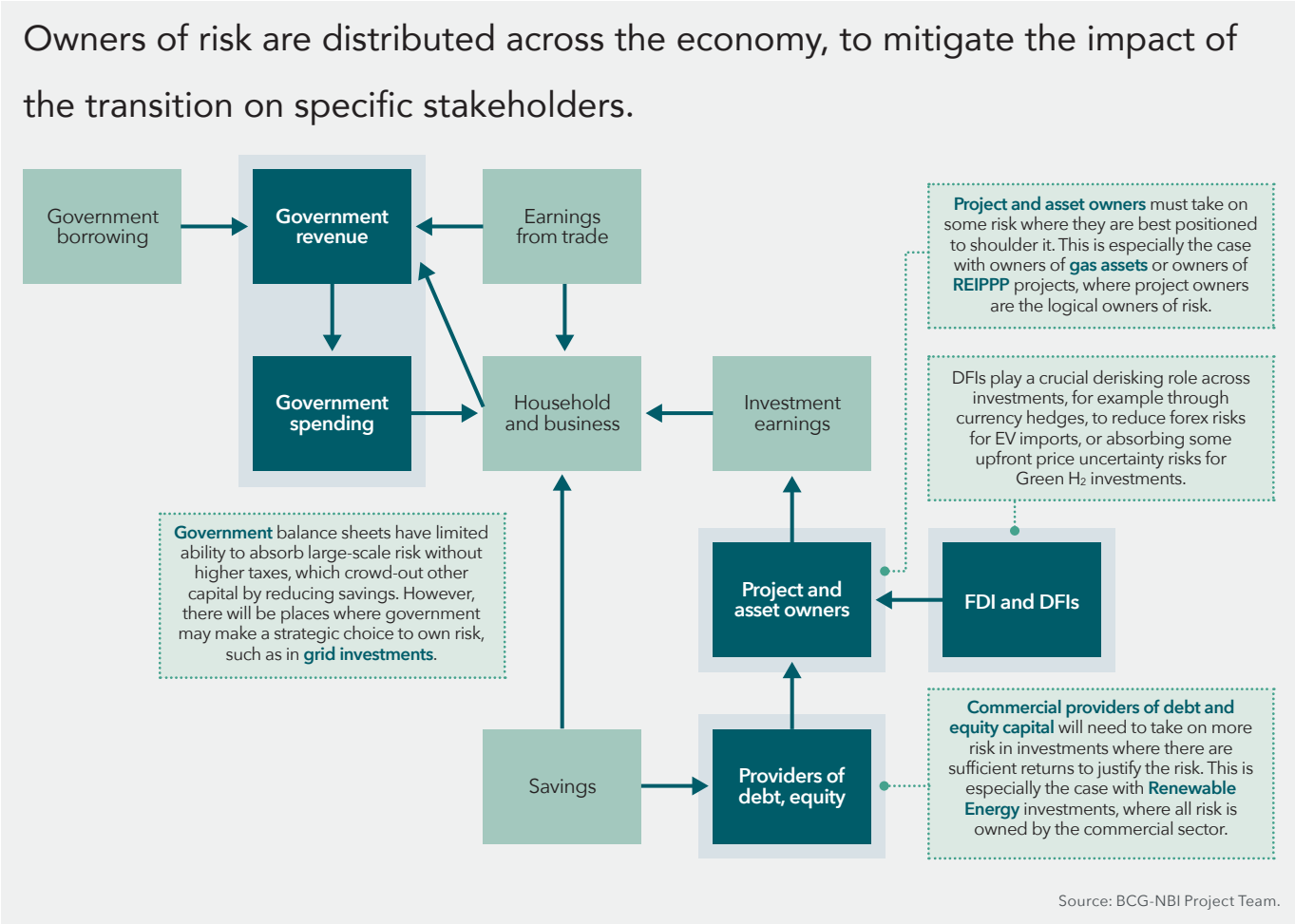
1. Align on priority projects and investment areas across private and public stakeholders, using existing structures, such as the PCC.
2. Build transparent, granular project pipeline, such as specific grid expansion projects.
3. Establish a collaborative working group, or leverage an existing forum, to coordinate investments and distribute implementation risks.
4. Initiate a fast-tracked process to update the IRP with a more aggressive RE development pathway, and more rapid investments in grid infrastructure,[37] that is consistent with South Africa's NDC and a renewables-dominated future power system.

35 Fiscal health is defined as the ratio of South Africa's debt and deficit to its GDP.

36 Among other issues, or South Africa risks losing JET Partnership funds, which were negotiated on the basis of the low NDC target of ~350 Mt p.a.

37 Underpinning this will be a strategic decision by the government about the role of the private sector in funding the grid. Either government can decide to continue centrally funding and managing the grid or can decide to auction grid expansion projects to private bidders, who then own and operate the infrastructure. This report takes no view on which of these options is preferable, but a decision will need to be made as to which funding solution is leveraged which acknowledges that current investments in the grid are insufficient.

Figure 30: Implementation risks have knock-on effects in the circular economy, emphasising need for risks to be mitigated by multiple stakeholders



Understanding what next steps are needed is critical. However, it is also important that there is clear accountability for these actions among relevant stakeholders in South Africa's economy. For example, the private sector cannot change the rules governing embedded generation, in the same way that government has limited tools to single-handedly expand the project pipeline. This is the shared responsibility of private and public sector stakeholders, with different economic players managing transition risks based on what they are best positioned to manage.

The imperative is clear that unified action is required from the private and public sectors to transition towards net-zero. It is critical that action is taken now to create a solid foundation for the net-zero transition. First movers on climate investments will likely get preferred access to capital and avoid potential cost increases as future investments ramp-up. Initial moves will also generate learnings for further developments, which is especially significant given the ambition for South Africa to become a leader on Green hydrogen.

South Africa faces a critical moment in its transition to net-zero, where it can make a decisive first step towards decarbonisation and lay the foundation for a sustainable, economically prosperous path to net-zero. Action is required by all stakeholders in the green economy and only by working in collaboration can the full required investment be mobilised. The window to reach net-zero by 2050 is still open, but rapidly closing unless decisive action is taken immediately.

4. OUTLOOK

As was stated in the foreword of this report, South African business commits unequivocally to supporting South Africa's commitment to find ways to transition to a net-zero emission economy by 2050. Furthermore, business would support an enhanced level of ambition in the NDC that would see the country committing to a range of 420–350 Mt CO_2e by 2030. However, this enhanced ambition would have to be conditional on the provision of the requisite means of support by the international community. In this light, the business community will play its part to work with international and local partners to develop a portfolio of fundable adaptation and mitigation projects that would build resilience and achieve deep decarbonisation.

A managed Just Transition is important, and such a transition is impossible without a broad multi-stakeholder effort. National government, through the Presidential Climate Commission and the National Planning Commission, and supported by key government ministries, is leading this effort.

In support of this national programme, the NBI membership together with BCG and BUSA are running a multi-year project to understand net-zero decarbonisation pathways, sector by sector. This will provide a solid input into national and local dialogues, as well as identify critical investment areas. Furthermore, this level of detail enables policy frameworks and engagement with providers of international support to maximise the potential to leverage concessional finance and trade support to attract local public and private finance.

This work is ongoing and is intended as a basis for further consultation and a foundation for future work. The work on each sector will be released in stages as it is completed and will form a basis on which others can build. Ultimately a final body of work of the combined sector content will be made up of reports on:

- An introduction to the project and to a managed Just Transition, including analysis from our economic modelling
- Electricity
- Petrochemicals and chemicals
- The role of gas
- The role of Green H_2
- Mining
- Transport
- Agriculture, Forestry and Other Land Use
- Construction
- Heavy industry
- A concluding chapter highlighting key investment opportunities and no-regret decisions.

Each of these reports will be published via our Just Transitions Web Hub. Please monitor this website for the latest report versions, supporting data and presentation material, as well as news of other Just Transition initiatives and a wide range of current opinion and podcasts on a Just Transition for South Africa.

We invite you to engage with us and to provide comment and critique of any of our publications via info@nbi.org.za.

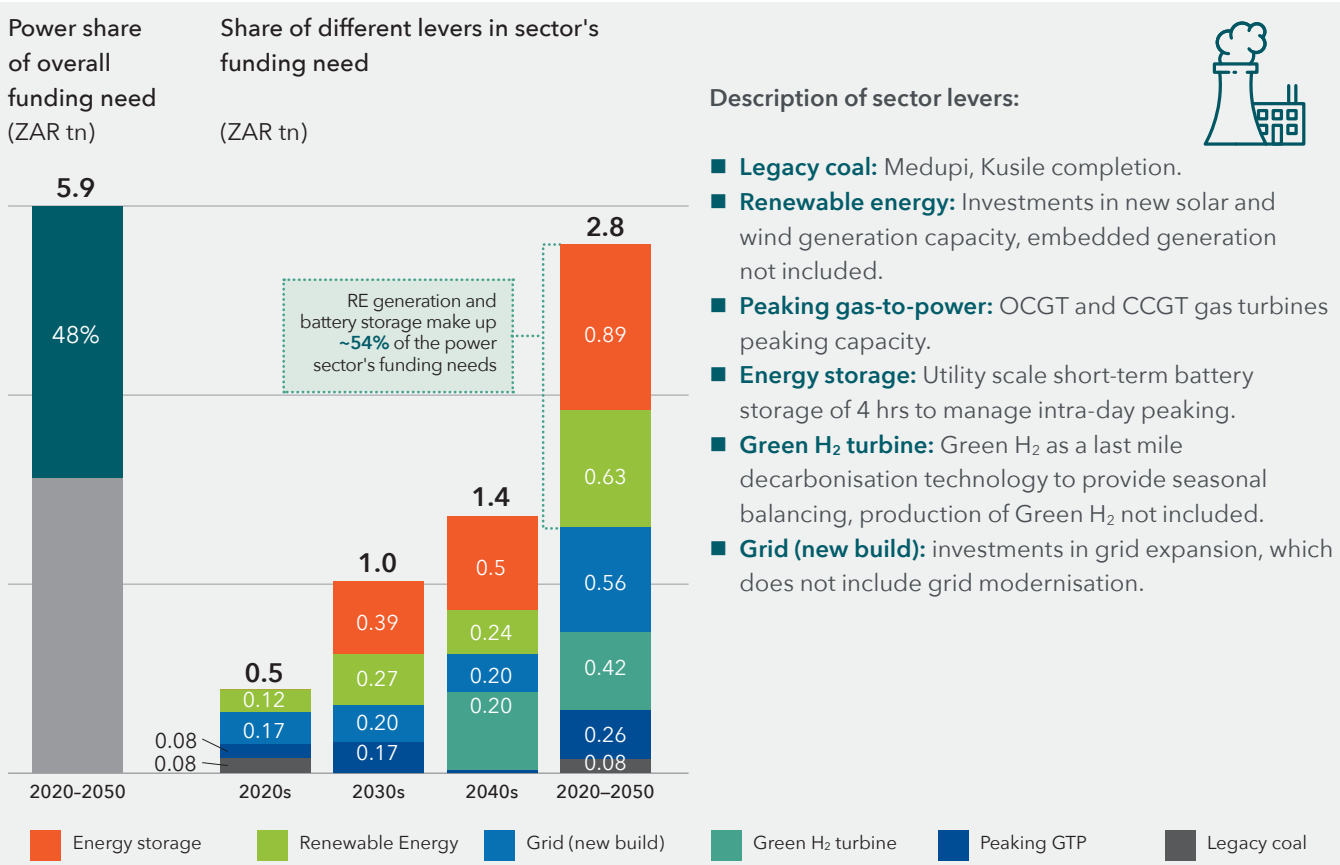
Image: Shutterstock

APPENDIX A

Mitigation investment needs by sector in this analysis

Appendix A contains the funding requirements by investment area for each sector detailed in the NBI Climate Pathways work in descending order based on the size of the sector's total funding requirements. Each sector report was built bottom-up through a collaborative, multi-stakeholder process including a diverse advisory board, steering committee, and 30 CEO Champions, representing a cross-section of South Africa's economy and civil society. Further details included in sector specific publications.

Figure 31: Funding requirements in the power sector



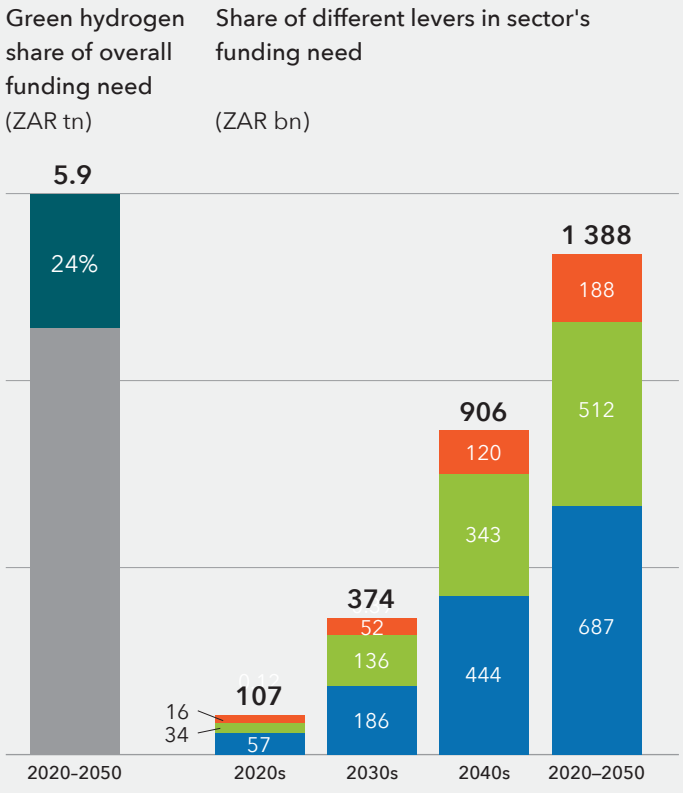
Description of sector levers:

- **Legacy coal:** Medupi, Kusile completion.
- **Renewable energy:** Investments in new solar and wind generation capacity, embedded generation not included.
- **Peaking gas-to-power:** OCGT and CCGT gas turbines peaking capacity.
- **Energy storage:** Utility scale short-term battery storage of 4 hrs to manage intra-day peaking.
- **Green H_2 turbine:** Green H_2 as a last mile decarbonisation technology to provide seasonal balancing, production of Green H_2 not included.
- **Grid (new build):** investments in grid expansion, which does not include grid modernisation.

Note: Analysis reflects annual demand based on IRP 2019 low demand profile, adjusted for electrification across sectors, which sees an increase in total demand of ~100 TWh on the initial analysis. The 2017 hourly load demand profile from UCT ERC was used in Plexos model. Plexos model ensured that the system was balanced at an hourly resolution with coal retired early by 2042.

Source: NBI-BCG project team.

Figure 32: Funding requirements in the Green hydrogen sector



Description of sector levers:

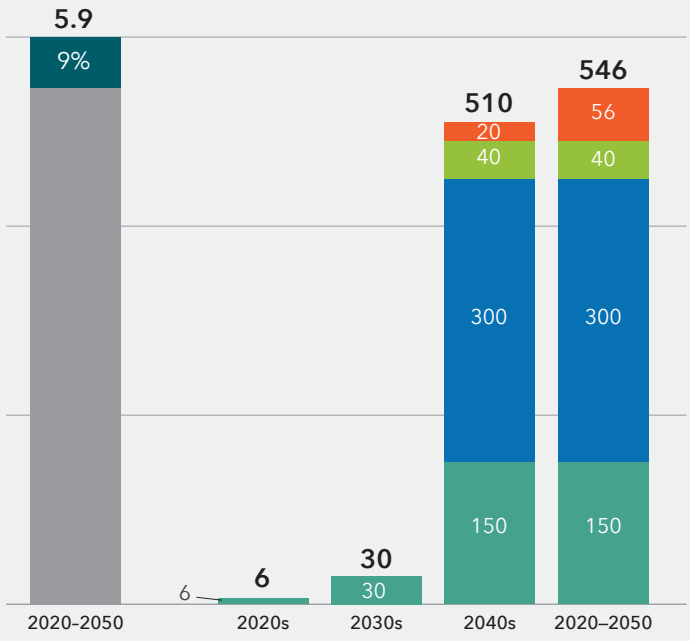
- **Solar generation:** Investments in new solar generation capacity specifically to produce Green H_2.
- **Wind generation:** Investments in new wind generation capacity specifically to produce Green H_2.
- **Electrolysers:** Investments in electrolyser capacity to produce hydrogen.
- **Does not include:** Green H_2 distribution infrastructure, such as pipelines and storage, or grid connection, wheeling and transmission costs. These figures do not include costing of Green H_2 for the petrochemicals sector, which is included in the petrochemicals estimate.

Note: Sector analysis is based on various assumptions, reflecting a 50–50 split in installed renewable capacity between solar and wind – 60% electrolyser utilisation; 65% electrolyser efficiency; 1 MW solar PV & 1 MW wind required for 1 MW electrolyser. This estimate includes the high estimate for Green H_2 exports (~4 Mt p.a. by 2050).

Solar generation · Wind generation · Electrolysers

Source: NBI-BCG project team.

Figure 33: Funding requirements in the transport sector



Description of sector levers:

- **EV charging infrastructure:** Investment required to build public charging units and surrounding infrastructure to enable public access to EV charging.
- **Commercial/passenger rail expansion:** Investment required to build additional track for the rail network.
- **Bus Rapid Transit:** Investment required to build road infrastructure to enable BRT (e.g., lane demarcation, transit curb, etc.). Not based on specific corridors, estimate is based on global average cost of BRT infrastructure.
- **Not included:** Delivery and installation cost of locomotives or cost to improve utilisation of existing rail network (thus a minimum estimate).

Note: Sector analysis is based on various assumptions, reflecting EV charger to EV ratio of 0,15 by 2030, 0,13 by 2040, and 0,10 by 2050, and maximum of 8 m EVs on the road by 2050, assumes a flat 75 M/km of rail infrastructure required.

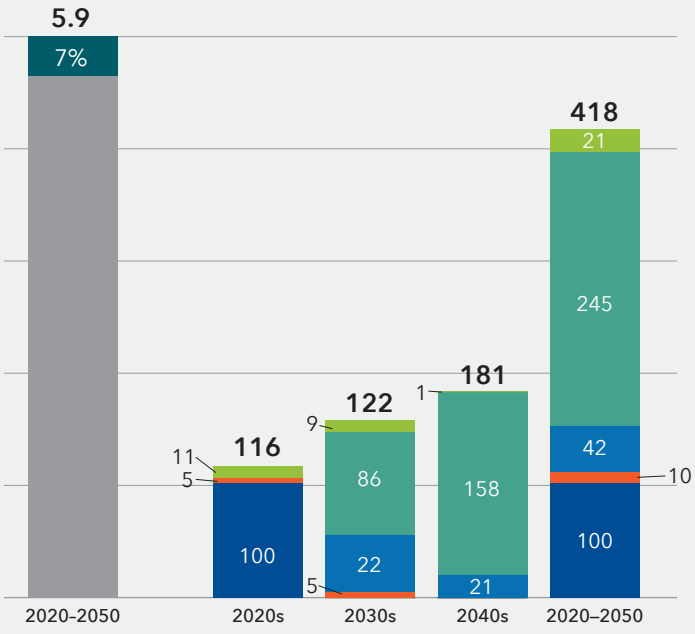
EV charging infrastructure · Commercial rail expansion · Passenger rail expansion · Bus Rapid Transit

Source: NBI-BCG project team.

Figure 34: Funding requirements in the petrochemicals sector

Petrochemicals share of overall funding need (ZAR tn)

Share of different levers in sector's funding need (ZAR bn)



Description of sector levers:

- **Renewable Energy:** Solar PV and wind as embedded generation.
- **Green hydrogen:** This includes spending on electrolyser capacity to produce Green H_2, as well as additional investments in RE capacity to supply the electrolysers.
- **Biomass:** Processing units for Power to Liquid (PtL), with sustainable biomass as a feedstock.
- **Gas:** Gas processing units as part of the synfuels assets to displace coal as a feedstock.
- **Gas supply infrastructure:** Floating Storage Regasification Unit (FSRU) and inland pipeline cost from Richards' Bay.

Note: Sector analysis is based on various assumptions, reflecting total production from synfuels constant through to 2050; 1.2 GW RE as communicated by Sasol; gas infrastructure for peak national gas demand of ~350 PJ/a.

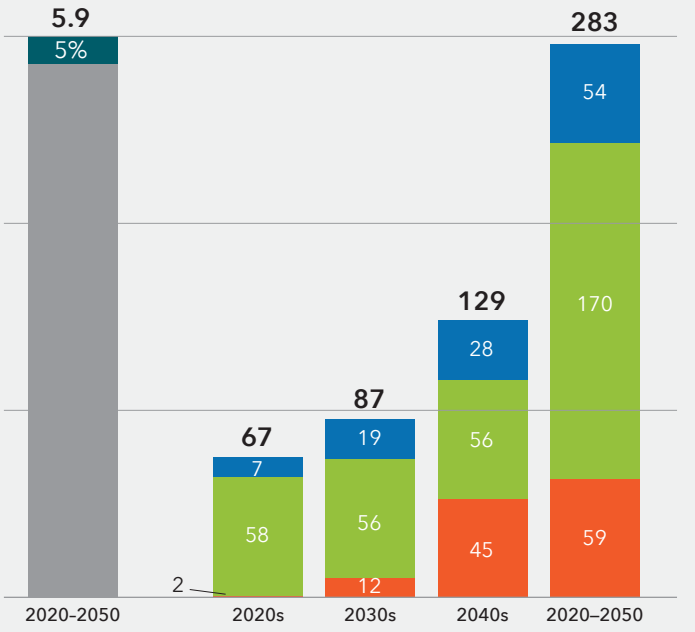
Renewable Energy | Green hydrogen | Biomass | Gas | Gas infrastructure

Source: NBI-BCG project team.

Figure 35: Funding requirements in the building and construction sector

Buildings and construction share of overall funding need (ZAR tn)

Share of different levers in sector's funding need (ZAR bn)



Description of sector levers:

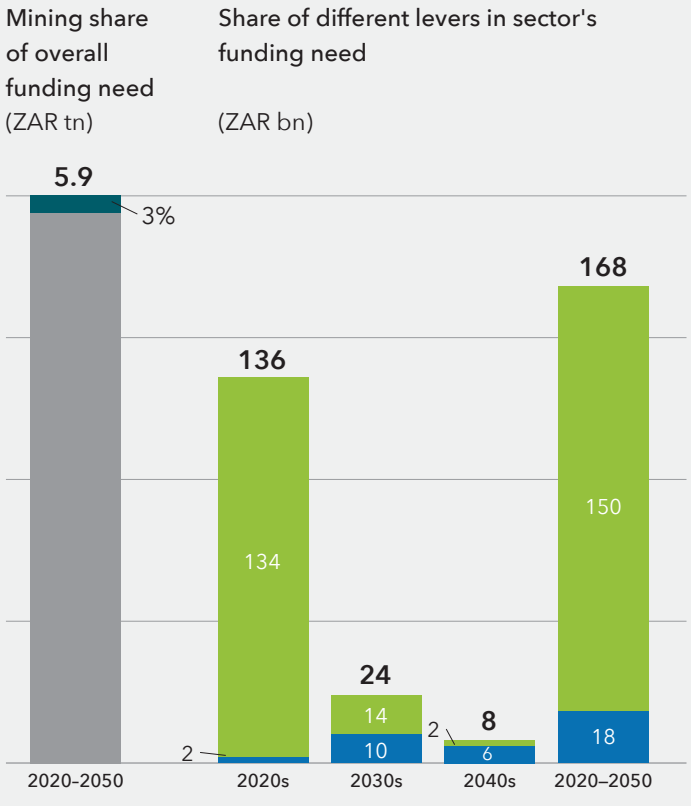
- **New buildings:** Build smaller, energy efficient buildings that are electrified (net-zero once green power available).
- **Retrofit existing buildings:** Electrify all energy use and improve efficiency in existing buildings (larger than new buildings, due to lost benefit building smaller, more efficient buildings, and existing stock with >50% of built environment in 2050, in most ambitious development scenario).
- **Construction:** Electrify existing vehicles and stationary equipment (also increases efficiency) – high given electrification costs.
- **Not included:** Total cost of building, only incremental cost of greening buildings.

Note: Sector analysis is based on various assumptions, including building energy efficiencies: 50% reduction for retrofits, 70% reduction for new builds (from today's average); building stock will increase by 125% (driven by economic and population growth, and filling the existing housing gap); the average size of dwellings built will reduce by ~30%, and the average cost by ~75% (relative to 2017 average).

New buildings | Retrofit existing | Construction

Source: NBI-BCG project team.

Figure 36: Funding requirements in the mining sector



Description of sector levers:

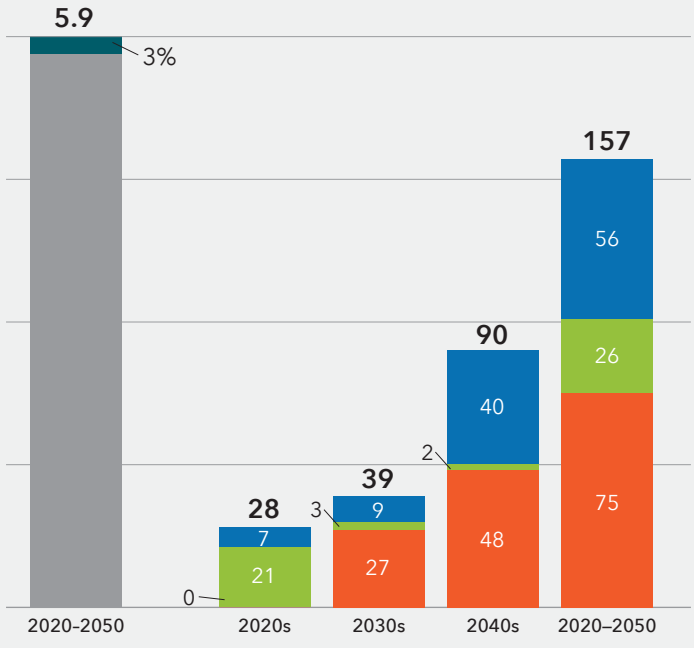
- **Renewable generation:** Embedded RE generation at mining sites to provide power to supplement power purchased from grid (hybrid model).
- **EVs:** Transition of mining vehicle fleet towards net-zero technologies, such as battery EVs and fuel-cell EVs.
- **Not included:** Green H_2 for the mining sector is considered as part of the Green H_2 sector.

Note: Sector analysis is based on various assumptions: Constant grid tariff of US$65/MWh assumed; diesel and coal prices of US$75/MWh and US$4/MWh assumed for 2019 and scaled with EIA projections to 2050; electricity costs based on REIPPP5 procurement costs.

Renewable Energy EVs

Source: NBI-BCG project team.

Figure 37: Funding requirements in the heavy manufacturing sector



Description of sector levers:

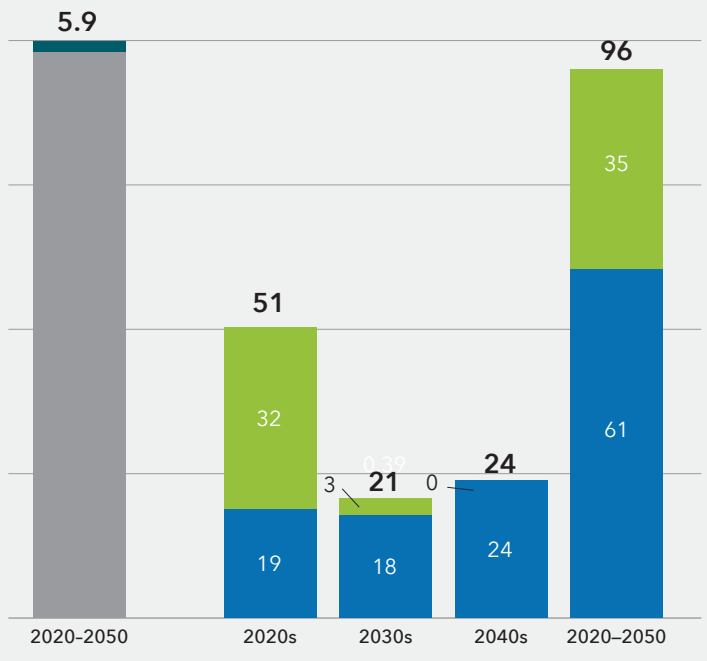
- **Green steel:** CapEx to build DRI-EAF plants that use Green H_2.
- **Other cement (fuel switch, BAT):** CapEx to replace aged manufacturing assets with best available technology and to build processing, storage and transportation facilities for alternative fuels (e.g., waste processing plant).
- **CCUS:** CapEx to build/retrofit carbon capture technology with transportation and storage infrastructure.
- **Not included:** OPEX costs or savings, RE generation CapEx, cost of transitioning the remaining heavy manufacturing sectors (incl. aluminium, glass, pulp and paper, etc.)

Note: Sector analysis is based on various assumptions: Steel production capacity reaches 13 Mt p.a. by 2050; up to 10 Mt of carbon is captured by 2050; power decarbonisation assumed to follow grid decarbonisation.

CCUS Other cement (fuel switch, BAT) Green steel

Source: NBI-BCG project team.

Figure 38: Funding requirements in the AFOLU sector



Description of sector levers:

- **Renewable generation:** Embedded RE generation at AFOLU sites to provide power and to supplement power purchased from the grid (hybrid model).
- **EVs:** Transition of AFOLU vehicle fleet towards net-zero technologies, such as battery EVs and fuel-cell EVs.
- **Not included:** Cost not estimated for diet switch or sustainable land management, which will be key decarbonisation levers.

Note: Sector analysis is based on various assumptions, including assumption of electricity costs equivalent to REIPPPP5 procurement costs.

EVs | Renewable Energy

Source: NBI-BCG project team.

Franschhoek winelands, Wester Cape.

Image: Shutterstock

APPENDIX B

High-level funding approaches for mitigation investments

Appendix B contains the high-level funding approach assessments for each investment area based on their respective technical maturity and commercial bankability, which together dictate the attractiveness of an investment for commercial funders. The assessment is only performed for the 2020s, given that the technical maturity and commercial bankability of investment areas is likely to evolve with time, especially in nascent sectors, such as Green hydrogen.

Figure 39: Summary of 2020s funding approaches for mitigation

	Activity	Source	Instruments		
			Debt	Equity	Grant
Energy	RE generation (excluding for Green H_2)	Mostly commercial	●	●	○
	GTP peaking	Mostly commercial	●	●	○
	Green H_2 turbines	Mostly concessional	○	●	●
	Battery storage	Mostly concessional	●	●	○
	Grid extension	Mixed	●	○	●
	Grid modernisation	Mixed	●	○	●
	Natural gas in petrochemicals	Mostly commercial	●	●	○
	Biomass	Mostly commercial	●	●	○
	RE generation (for H_2 production)	Mixed	●	●	○
	Green H_2 production	Mostly concessional	○	●	●
Transport and logistics	EVs	Mostly commercial	●	●	○
	EV charging infrastructure	Mostly commercial	●	●	○
	Commercial rail expansion	Mostly commercial	●	●	○
	Passenger rail expansion	Mostly commercial	●	●	○
	Bus Rapid Transit (BRT)	Mixed	●	○	●
Just Transition and economic infrastructure	Gas infrastructure	Mixed	●	●	○
	Water infrastructure	Mostly concessional	○	○	●
	New green buildings	Mostly commercial	●	●	○
	Retrofit existing	Mostly commercial	●	●	○
	Construction	Mostly commercial	●	●	○
Land and agriculture	Agriculture and other land sinks	*(Not assessed)*	○	○	○
	Sustainable land management	*(Not assessed)*	○	○	○
	Waste management	*(Not assessed)*	○	○	○
Manufacturing	Mining exploration	Mostly commercial	●	○	○
	Green steel (2 Mt/a)	Mostly commercial	●	●	○
	Cement (fuel switch, BAT)	Mostly commercial	●	●	○
Other	Sustainable diets	*(Not assessed)*	○	○	○
	CCUS	Mostly concessional	○	●	●

Key: ○ Not relevant ● Relevant

Note: Only maximum of two instruments highlighted, unbolded instruments may be used to bolster primary instruments for activity.

Source: NBI-BCG project team, WEF.

Figure 40: Funding approach assesments (1)

ENERGY *(Note: Qualitative assessment is for 2020s only.)*

POWER

RE generation (excluding for Green H_2)

CAPEX[1] (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~310 bn	~290 bn	~240 bn	Bankability ● Maturity ●

QUALITATIVE ASSESSMENT	**Mostly commercial funding approach**, with the commercial private sector, especially commercial banks, able to provide almost all funding requirements (mostly through market-rate debt) with the right enabling policy and regulatory environment, such as cost-reflective pricing in PPAs. RE generation has proven bankable use-cases, such as through the REIPPPP.	POLICY NEED	Regulatory reform (e.g. tariff structure)

GTP peaking

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~80 bn	~170 bn	~20 bn	Bankability ●* ** depends on regulatory environment* Maturity ●

QUALITATIVE ASSESSMENT	**Mostly commercial funding approach**, with the commercial private sector able to provide a significant majority of funds needed assuming the right enabling policy and regulatory environment (e.g. structuring of off-take contracts), as well as investment incentivisation.	POLICY NEED	Regulatory reform (off-take contracts)

Green H_2 generation (including peaking)

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~0 bn	~0 bn	~420 bn	Bankability ● Maturity ●

QUALITATIVE ASSESSMENT	**Mostly concessional funding approach**, with the commercial private sector able to provide some funding, especially with project-level equity capital, but only with enabling policy/ regulatory environment, significant direct incentivisation, and some concessional seed capital. Currently, technical risk associated with projects is quite high, necessitating risk guarantees and hedges.	POLICY NEED	Incentives, blended finance, risk mitigation

Battery storage

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~0 bn	~390 bn	~500 bn	Bankability ● Maturity ●

QUALITATIVE ASSESSMENT	**Mostly concessional funding approach**, with the commercial private sector able to provide some funding needs, but only with enabling policy/regulatory environment, significant direct incentivisation, and some concessional seed capital. Some additional technology development and better materials are required for utility-scale storage, necessitating stimulation of R&D spend.	POLICY NEED	Incentives or blended finance

Key: ● High ● Medium ● Low

Grid extension

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
~170 bn	~200 bn	~200 bn

Bankability: Medium *
* depends on regulatory environment
Maturity: High

QUALITATIVE ASSESSMENT

Mixed funding approach, with the public sector needing to provide a sufficient enabling and regulatory environment to ensure private investors can recoup invested capital, e.g. through a proper tariff structure, allowing newly-established ISMO[2] to borrow from private capital markets, or potentially through auctioning infrastructure segments to private investors.

POLICY NEED

Regulatory reform (e.g. tariff structure)

Grid modernisation

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
Not assessed		

Bankability: Medium
Maturity: High

QUALITATIVE ASSESSMENT

Mixed funding approach, with the public sector needing to provide a sufficient enabling and regulatory environment to ensure private investors can recoup invested capital, e.g. through a proper tariff structure, allowing newly-established ISMO[2] to borrow from private capital markets, or potentially through auctioning infrastructure segments to private investors.

POLICY NEED

Regulatory reform (e.g. tariff structure)

GAS

Natural gas in petrochemicals

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
~10 bn	~0 bn	~0 bn

Bankability: High
Maturity: High

QUALITATIVE ASSESSMENT

Mostly commercial funding approach, with the commercial private sector, especially commercial banks, able to provide almost all funding requirements (mostly through market-rate debt). Scope for public sector involvement should be limited here, given that further natural gas developments should be bankable for petrochemicals businesses. However, to ensure capital can be accessed, the public sector should ensure that no regulatory or policy roadblocks impede access to finance.

POLICY NEED

Enabling policy environment

LIQUID FUELS

Biomass

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
~0 bn	~18 bn	~24 bn

Bankability: High
Maturity: Low *
* not at scale

QUALITATIVE ASSESSMENT

Mostly commercial funding approach, with the commercial private sector, especially owners of existing synfuels plants, able to cover costs of converting plants to produce sustainable fuels, although some concessional capital may be needed to derisk and incentivise investments.

POLICY NEED

Risk mitigation support

Key: High Medium Low

GREEN HYDROGEN

RE generation (for local and high export production[3])

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
~50 bn	~230 bn	~520 bn

Bankability ● *
* not at scale
Maturity ●

QUALITATIVE ASSESSMENT	POLICY NEED
Mixed funding approach, with the commercial private sector, especially commercial banks, able to provide significant funding (mostly through market-rate debt), assuming that the other elements of Green H_2 production projects are funded. However, RE generation for H_2 projects is more complex, given the challenge of funding the broader H_2 project.	Regulatory reform

Green H_2 production[4] (electrolysers)

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
~70 bn	~230 bn	~510 bn

Bankability ●
Maturity ●

QUALITATIVE ASSESSMENT	POLICY NEED
Mostly concessional funding approach, with concessional funders, especially domestic and international DFIs, providing the bulk of catalytic start-up capital to these projects to stimulate access to additional private funding as projects mature. In early stages, these projects will rely on concessional debt and equity finance, moving to more commercial debt as the project matures.	Incentives, blended finance, risk mitigation

Key: ● High ● Medium ● Low

Notes: 1. Cumulative CapEx
2. Independent System and Market Operator.
3. & 4. Assumes 9.1 Mtpa H_2 consumption by 2050 in South Africa across sectors, incl. high estimate for exports of ~4 Mt p.a. (includes Green H_2 exports and use in petrochemicals sector).

Source: Press search, NBI-BCG project peam.

Figure 41: Funding approach assesments (2)

TRANSPORT AND LOGISTICS *(Note: Qualitative assessment is for 2020s only.)*

TRANSPORT MODES

EVs[1]

CAPEX[2] (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~20 bn	~30 bn	~30 bn	Bankability ● Maturity ●

QUALITATIVE ASSESSMENT

Mostly commercial funding approach, with the commercial private sector able to provide a majority of funding needs for BEV infrastructure, but only with enabling policy/regulatory environment, and potentially some incentivisation, concessional seed capital, or risk guarantees.

POLICY NEED

Regulatory reform (e.g. trade restriction)

BEV charging infrastructure

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~6 bn	~30 bn	~20 bn	Bankability ● Maturity ●

QUALITATIVE ASSESSMENT

Mostly commercial funding approach, with the public sector needing to provide most of the required investment, most likely through fully concessional grant systems, as well as creating an enabling environment for complementary private sector funding. This is especially true given the 'public good' nature of water.

POLICY NEED

Regulatory reform (e.g. price regulation)

TRANSPORT INFRASTRUCTURE

Commercial rail expansion

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~0 bn	~40 bn	~0 bn	Bankability ●* ** depends on regulatory environment* Maturity ●

QUALITATIVE ASSESSMENT

Mostly commercial funding approach, with the commercial private sector able to provide almost all funding requirements with the right enabling policy and regulatory environment, with potential for some public sector incentivisation. The policy environment must be designed to overcome challenges with network infrastructure investments, such as through infrastructure concessions.[3]

POLICY NEED

Regulatory reform (e.g. tariff structure)

Passenger rail expansion (including HSR[4])

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~0 bn	~0 bn	~300 bn	Bankability ●* ** depends on regulatory environment* Maturity ●

QUALITATIVE ASSESSMENT

Mostly commercial funding approach, with the commercial private sector able to provide almost all funding requirements with the right enabling policy and regulatory environment, with potential for some public sector incentivisation. The p olicy environment must be designed to overcome challenges with network infrastructure investments, such as through infrastructure concessions.

POLICY NEED

Regulatory reform (e.g. tariff structure)

TRANSPORT SYSTEMS

Bus Rapid Transit (BRT)

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
~0 bn	~0 bn	~150 bn

Bankability ● *
** depends on regulatory environment*
Maturity ●

QUALITATIVE ASSESSMENT	POLICY NEED
Mixed funding approach, with the commercial private sector and the public sector needing to cooperate to fund public transport to ensure it is sufficiently attractive for private investment, potentially with subsidisation in early phases.	Regulatory reform (e.g. price structure)

Key: ● High ● Medium ● Low

Logic for need assessment based on relative bankability and maturity of projects in a category.

Notes:
1. Net-zero vehicles includes requirements for vehicle electrification in the mining and AFOLU sectors, but not the net-zero vehicles that will be purchased in the private automotive market by individual consumers.
2. Cumulative CapEx.
3. Infrastructure auctions allow a private sector operator to collect revenues from infrastructure segment for use to invest in building and maintaining the infrastructure.

Source: NBI-BCG project peam.

Figure 42: Funding approach assesments (3)

SOCIAL AND ECONOMIC INFRASTRUCTURE *(Note: Qualitative assessment is for 2020s only.)*

SUPPORTING INFRASTRUCTURE

Gas infrastructure

CAPEX[1] (2020s)	CAPEX (2030s)	CAPEX (2040s)
~100 bn	~0 bn	~0 bn

Bankability 🟠*
** depends on regulatory environment*
Maturity 🟢

QUALITATIVE ASSESSMENT	POLICY NEED
Mixed funding approach, with the commercial private sector able to provide a majority of funding needed for gas infrastructure. Given the high degree of maturity of gas infrastructure technology, risk guarantees are unlikely to be needed. Additionally, if regulatory framework around GTP peaking is well designed, gas infrastructure should be bankable enough for the private sector. Otherwise, significant incentivisation, and some concessional seed capital may be required.	Regulatory reform (e.g. tariff structure)

Water infrastructure[2]

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
Not assessed		

Bankability 🔴
Maturity 🟢

QUALITATIVE ASSESSMENT	POLICY NEED
Mostly concessional funding approach, with the public sector needing to provide most of the required investment, most likely through fully concessional grant systems, as well as creating an enabling environment for complementary private sector funding. This is especially true given the "public good" nature of water.	Incentives or government-led blended finance

BUILDING AND CONSTRUCTION

New green buildings

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
~7 bn	~20 bn	~30 bn

Bankability 🟢
Maturity 🟢

QUALITATIVE ASSESSMENT	POLICY NEED
Mostly commercial funding approach, with the commercial private sector able to provide almost all funding requirements with the right enabling policy and regulatory environment. However, the problem of a vicious cycle in construction will need to be overcome, where buyers, builders and investors say that other parties are not interested in bearing the costs of sustainability. Shifting investors to a Total Cost of Ownership (TCO) mentality will support this transition, as these investments are Net Present Value (NPV)-positive.	Regulatory reform

Retrofit existing buildings

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)
~58 bn	~56 bn	~56 bn

Bankability 🟢
Maturity 🟢

QUALITATIVE ASSESSMENT	POLICY NEED
Mostly commercial funding approach, with the commercial private sector able to provide almost all funding requirements with the right enabling policy and regulatory environment. Investments in retrofitting have a strong bankability case, given they are NPV-positive due to savings on energy costs. However, low-income housing may need some capital assistance, potentially in the form of low-interest or concessional debt, while the remainder of funding can be commercially-based.	Regulatory reform

Construction

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~2 bn	~13 bn	~45 bn	Bankability ● Maturity ●

QUALITATIVE ASSESSMENT		POLICY NEED	
	Mostly commercial funding approach, with the commercial private sector able to provide almost all funding requirements with the right enabling policy and regulatory environment. However, the problem of a vicious cycle in construction will need to be overcome, where buyers, builders and investors say that other parties are not interested in bearing the costs of sustainability. Shifting investors to a TCO mentality will support this transition, as these investments are NPV-positive.		Policy and incentive reform

Key: ● High ● Medium ● Low

Logic for need assessment based on relative bankability and maturity of projects in a category.

Notes: 1 Cumulative CapEx.
2 Estimate from National Treasury is ~ZAR670 bn by 2030.

Source: SA Sustainable Finance Handbook, Treasury, Expert engagements, NBI-BCG project peam.

Figure 43: Funding approach assesments (4)

AFOLU *(Note: Qualitative assessment is for 2020s only.)*

AGRICULTURE

Sustainable land management

CAPEX[1] (2020s)	CAPEX (2030s)	CAPEX (2040s)	
Not assessed			Bankability N/A Maturity N/A

QUALITATIVE ASSESSMENT	POLICY NEED
N/A funding approach, given that sustainable land management practices are mostly behavioural changes.	N/A

Agriculture and other land use sinks

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
Not assessed			Bankability 🔴 Maturity 🟠

QUALITATIVE ASSESSMENT	POLICY NEED
Mostly concessional funding approach, with the public sector needing to provide most of the required investment, most likely through fully concessional grant systems, as well as creating an enabling environment for complementary private sector funding. If an incentive structure can be designed based on carbon credits, though, the bankability of AFOLU sinks can be given a boost.	Incentives or government-led blended finance

Waste management

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
Not assessed			Bankability 🔴 Maturity 🟠

QUALITATIVE ASSESSMENT	POLICY NEED
Mostly concessional funding approach, with the public sector needing to provide most of the required investment, most likely through fully concessional grant systems, as well as creating an enabling environment for complementary private sector funding. This is especially true given the 'public service' nature of waste management.	Incentives or government-led blended finance

Key: 🟢 High 🟠 Medium 🔴 Low

Note: 1. Cumulative CapEx.

Source: SA Sustainable Finance Handbook, Expert engagements, NBI-BCG project team.

MANUFACTURING *(Note: Qualitative assessment is for 2020s only.)*

METALS, MINERALS AND MINING

Mining exploration

CAPEX[1] (2020s)	CAPEX (2030s)	CAPEX (2040s)	
Not assessed			Bankability ● Maturity ●

QUALITATIVE ASSESSMENT	POLICY NEED
Mostly commercial funding approach, given that mining companies will be able to generate revenue from new exploration activities, which will allow sufficient investment, assuming maturity-associated technical risk can be resolved and the regulatory and policy environment enables and incentivises the deployment of new technologies.	Technical maturation and R&D support

Green steel (2 Mt/a)

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~7 bn	~9 bn	~40 bn	Bankability ● Maturity ●

QUALITATIVE ASSESSMENT	POLICY NEED
Mostly commercial funding approach, with the commercial private sector able to provide almost all funding requirements with the right enabling policy and regulatory environment, with potential for some public sector incentivisation or regulatory requirements for switching.	Regulatory reform, e.g. policy certainty

Other cement (fuel switch, best available technology)

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~21 bn	~3 bn	~2 bn	Bankability ● Maturity ●

QUALITATIVE ASSESSMENT	POLICY NEED
Mostly commercial funding approach, with the commercial private sector able to provide almost all funding requirements with the right enabling policy and regulatory environment, with potential for some public sector incentivisation or regulatory requirements for switching.	Regulatory reform, e.g. policy certainty

Key: ● High ● Medium ● Low

Note: 1. Cumulative CapEx.

Source: SA Sustainable Finance Handbook, Expert engagements, NBI-BCG project team.

RESEARCH AND TECHNOLOGY *(Note: Qualitative assessment is for 2020s only.)*

OTHER

Sustainable diets

CAPEX[1] (2020s)	CAPEX (2030s)	CAPEX (2040s)	
Not assessed			Bankability 🟠 Maturity 🔴

QUALITATIVE ASSESSMENT	POLICY NEED
N/A funding approach, given that sustainable dieting practices are mostly behavioural changes.	Technical maturation and R&D support

CCUS for cement

CAPEX (2020s)	CAPEX (2030s)	CAPEX (2040s)	
~0 bn	~27 bn	~50 bn	Bankability 🟠 Maturity 🔴

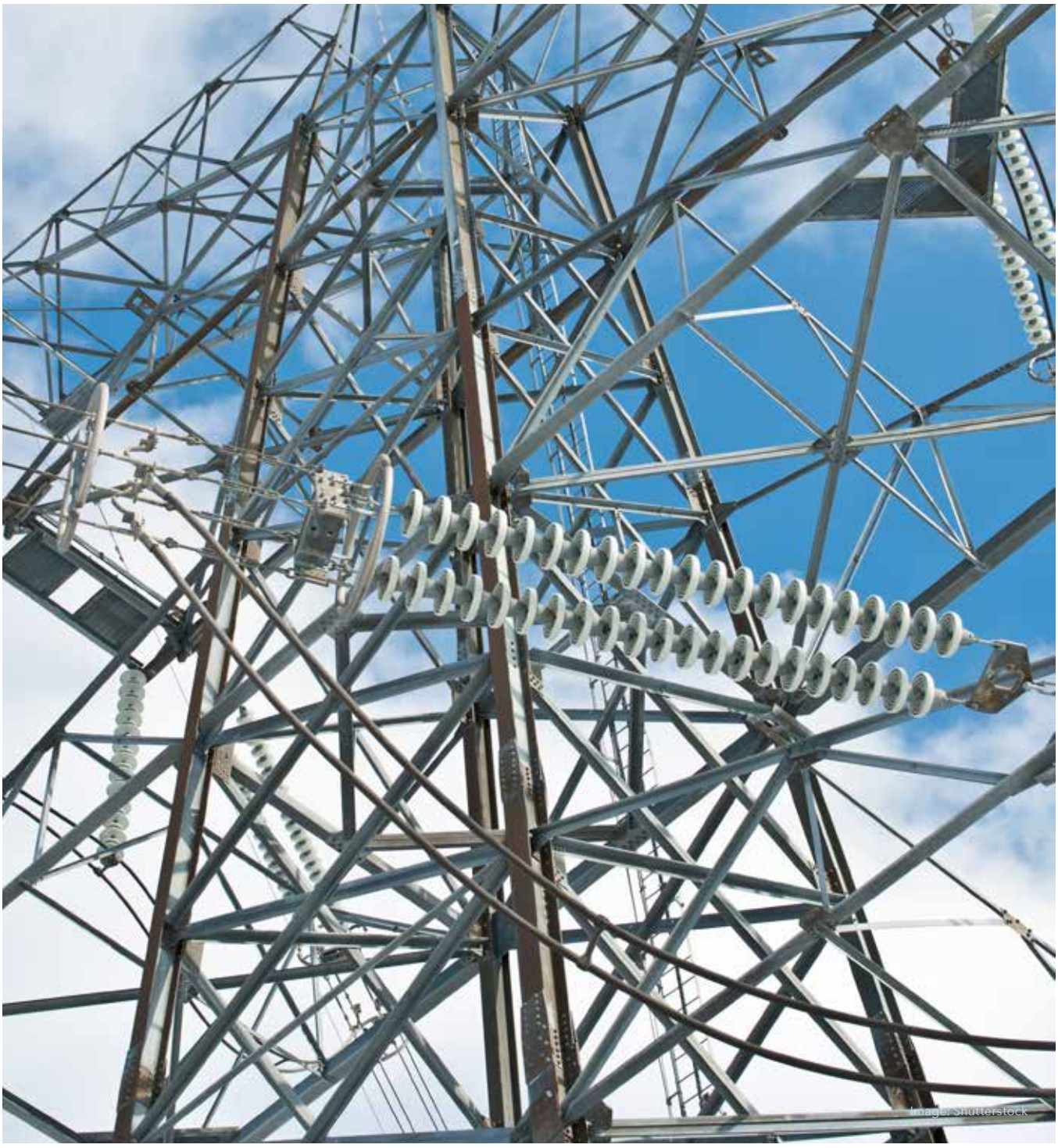
QUALITATIVE ASSESSMENT	POLICY NEED
Mostly concessional funding approach, with the public sector needing to design the policy and regulatory landscape (e.g. with carbon credits) in such a way to ensure that investments are commercially bankable, as well as to stimulate R&D investment to improve the technology and increase its maturity.	Technical maturation and R&D support

Key: 🟢 High 🟠 Medium 🔴 Low

Note: 1. Cumulative CapEx.

Source: SA Sustainable Finance Handbook, Expert engagements, NBI-BCG project team.

National Business Initiative



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