The State of Climate Action in South Africa

Priorities for Action for the Government of National Unity

The First Assessment from the Presidential Climate Commission

This report is the Presidential Climate Commission's first assessment of climate action in South Africa. It presents a snapshot of South Africa's progress toward reducing emissions, enhancing climate resilience, and improving the lives and livelihoods of all South Africans—particularly those most impacted in the climate transition.

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About the Presidential Climate Commission

The Presidential Climate Commission (PCC) is a multistakeholder body established by the President of the Republic of South Africa. The PCC advises on the country's climate change response and supports a just transition to a low-carbon, climate-resilient economy and society.

The PCC produces recommendations to government based on research and evidence and facilitates dialogue between social partners—ultimately aiming to define the type of economy and society we want to achieve and detailed pathways for how to get there.

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FOREWORD

We have recently witnessed the inauguration of President Ramaphosa for a second term in office as head of the 7th Administration. A free and fair democracy is something we used to dream about during our struggle against apartheid, where the people of our country are free to choose their own leaders, are free to vote without any pressure on them, and without any intimidation. This week we witnessed political parties working together to form the new Government of National Unity.

During his inauguration address, the President highlighted several priorities for this new government. One of these is accelerating the response to tackling climate change, which is one of our greatest threat multipliers—exacerbating South Africa's burden of poverty, unemployment, and inequality.

Our country continues to face significant climatic risks and impacts. Floods and droughts have ravaged different parts of our country in recent months, with the impacts affecting the poorest and most vulnerable communities the most. These events reflect a worrying and increasing trend of climatic incidents, harming people, their homes, their communities, and impacting their livelihoods. The President has said that the government will not rest in addressing the climate crisis and has vowed to tackle these challenges in a manner that is ambitious, just, and inclusive—not only for this generation but those that follow.

The President formed the Presidential Climate Commission in 2020 to facilitate and oversee this ambitious, just, and inclusive response to climate change to a climate-resilient green economy. The Commission is also tasked with advising government on the efficacy of its response to climate change.

In this context, despite the sobering findings, it is my great pleasure to present the Commission's first independent assessment of the state of climate action in South Africa, which we have prepared to coincide with the start of this 7th Administration. This report presents a comprehensive overview of how climate change is impacting South Africa, the measures that different groups are taking in response, and the gaps where further progress is needed. The report stands on the shoulders of years daily testimonies and experiences of many South Africans, of evidence and data collection in the country and complements the important climate tracking work undertaken by the Department of Forestry, Fisheries and Environment and many others.

The report is yet another clarion call for climate action and is unequivocal in its findings: South Africa has strong commitments to addressing climate change, but needs to accelerate implementation efforts, particularly in areas of governance, financing, and market reform. The report clearly highlights areas where step changes are required, which we advise the new administration to implement with urgency.

This report calls for measures to be put in place to reduce emissions and improve resilience, highlighting and prioritising four sectors, water, agriculture. energy, and transport, to usher in into low-carbon economy that is more resilient and strengthen our global competitiveness, while addressing the triple challenges of poverty, inequality, and unemployment.

Let's get to work, together.

VALLI MOOSA

Deputy Chair
Presidential Climate Commission
June 2024

EXECUTIVE SUMMARY

South Africa is already experiencing the impacts of climate change, and detrimental climate impacts and risks are predicted to increase rapidly as we move toward the end of the 2020s and into the next decade. In response, South Africa has set ambitious goals for climate action: reduce the greenhouse gas (GHG) emissions that drive global warming and adapt to the impacts of climate change.

The just transition is central to South Africa's response to climate change—putting the lives and livelihoods of people at the heart of its climate response to ensure that the most vulnerable and impacted are protected, supported, and empowered in the transition. A just transition to a low-carbon and resilient economy will strengthen South Africa's global competitiveness and create opportunities to reduce poverty, inequality and unemployment. South Africa's just transition aims to be inclusive, taking all South Africans forward into a more prosperous future.

South Africa is now entering a new and more challenging phase of climate action. The focus is not only on setting targets but also on achieving those targets. Strong government policies must drive a rapid response to climate change in a just manner that recognises, protects, and realises human rights and is supported by all stakeholders—businesses, civil society, labour unions, communities, and citizens. The work of building a just transition should adhere to the three principles underpinning the just transition as established in the country's Just Transition Framework: procedural justice, distributive justice, and restorative justice.

How can we be confident that the necessary progress will be delivered at the pace and scale required? It is the role of the Presidential Climate Commission (PCC) to track and offer an independent view of that challenge. To meet this mandate, the PCC focuses on real and resolute progress in building a just transition, measured through indicators of early and continued action by government and other major stakeholders. The focus is on not only progress in key economic sectors and regions but also on important cross-cutting themes such as stakeholder engagement, governance, and finance.

In this context, this report presents the PCC's first independent and evidence-based assessment of climate action in South Africa. In preparing this report, the PCC has taken the following actions:

- Assessed progress toward multiple priority indicators of change—encompassing mitigation, adaptation, finance, and the just transition—reviewing available data up until the end of 2023
- Interviewed more than a dozen experts on this progress to substantiate findings and provide broader context
- Studied the environment in which climate policy is made in South Africa, looking at the political, development, and economic factors that are enabling or preventing progress
- Conducted the first nationally representative survey on the just transition, together with the Human Sciences Research Council (HSRC), surveying more than 3,000 South Africans on their perceptions, attitudes, and support for climate action and the just transition

The key finding from this work is that although South Africa has strong commitments and public support for tackling climate change and facilitating a just transition, progress is not happening at the pace and scale required to tackle a crisis of such proportion. Key barriers hindering progress include incoherent policies, weak governance structures, insufficient finance, and inconsistent actions by the government and other stakeholders. From these analyses, we are beginning to identify the immediate actions that must be effected to realise South Africa's vision for the just transition and overcome these barriers.

Looking ahead, the PCC will continue to scrutinise and monitor implementation progress in detail—focusing on what is working, what is not, for whom, and why. The intention is to produce a biennial State of Climate Action in South Africa report so that all social partners—government, business, civil society, and labour, among others—have the most comprehensive, accurate, and up-to-date information to enable change. This will complete other related but separate tracking efforts, especially those prepared by the Department of Forestry, Fisheries and Environment (DFFE), such as the biennial transparency reports and annual climate change reports.

The text that follows summarises the key messages from the PCC's first independent analysis of the state of climate action.

The context for acting on climate change in South Africa

South Africa is in a part of the world that is severely impacted by climate variability. The country frequently experiences droughts, floods, heat waves, and other extreme weather events, with evidence that the frequency and intensity of such events are increasing because of climate change. At 1.25°C of warming above preindustrial levels today, these events have already caused enormous damage to infrastructure, ecosystems, lives, and livelihoods, displacing thousands of people. They have also disproportionately impacted vulnerable groups, including women and young people, older people, the unemployed, historically marginalised groups, and those living in informal settlements.

Climate change exacerbates South Africa's triple challenges of poverty, unemployment, and inequality. South Africa is one of the most unequal countries in the world; the divide between the rich and the poor is larger than ever, and the current unemployment rate is at a record level. The health impacts from pollution caused by burning fossil fuels—a major driver of climate change—are acutely suffered by poorer communities, exacerbating these inequities.

Addressing climate change means strengthening adaptation measures to improve the resilience to immediate events (e.g., extreme weather, disasters) as well as long-term climatic shifts that impact water availability, food security, and human health. Efforts to build climate resilience should more meaningfully engage all stakeholders, especially vulnerable groups, to ensure that the benefits and burden of adaptation are equitably distributed. Addressing climate change and adjusting to a rapidly decarbonising global economy also necessitates concurrent and sharp reductions in GHG emissions—the harmful pollutants that drive climate change. The scale of the challenge demands an effective and well-equipped state that enables trust and action among all stakeholders.

The just transition imperative

South Africa has increasingly prioritised a just transition, with this agenda taking off at scale over the past five years. In recent years, the just transition agenda has become a top priority of government, civil society, and business. The National Planning Commission in 2017–19 aimed to coalesce the country around shared goals for the just transition, and the DFFE commissioned work to better understand the jobs and sectors at risk in the transition and how to build resilience in these sectors. In 2020, the President created the PCC to oversee and facilitate a just transition in the country and to forge consensus between all major stakeholder groups. In 2020–21, working with the National Business Initiative, major businesses examined the changes that will be required in specific sectors to reach net zero emissions by the middle of the century. In 2022, the cabinet adopted the country's first national Just Transition Framework, which set out a unifying vision for a just transition, alongside principles and actions to guide this transition.

The PCC and the HSRC's national survey shows that there is broad public support for acting on climate change and the just transition. More than half of South Africans believe that the transition could alleviate load shedding. Additionally, more than 40 percent of South Africans think a shift to cleaner forms of energy like renewables will help to reduce electricity costs and help the economy grow. South Africans are also generally in favour of enacting stronger policies to support a just transition, including those related to economic diversification, education, training, reskilling, and targeted employment opportunities for vulnerable groups.

The mismatch between commitments and action

Although there is strong public support and policy commitments for acting on climate change and driving a just transition in South Africa, there is a notable disparity between policy ambitions and practical outcomes. South Africa is often generally described as a policy-rich, implementation-poor country—and this is equally true for climate action. There are three main drivers for the mismatch between commitments and action:

- **Contradictory public policies and positions, particularly regarding the future of the energy sector, as government wrestles with immediate trade-offs between energy security, economic growth, the health impacts of pollution from fossil fuels, and climate commitments.** The lack of consensus about the pace of the coal phaseout is delaying the implementation of necessary policy measures to prepare for and enable the transition,

such as the draft 2023 integrated resources plan (IRP), the integrated energy plan, and the South African Renewable Energy Masterplan.

- **Inadequate technical and financial capacity constrains the role of local governments as the frontline responders to climate change and the just transition.** According to government reports, more than 60 percent of local municipalities are classified as dysfunctional due to resource constraints, structural challenges, poor governance, ineffective and sometimes corrupt financial and administrative management, and poor planning and service delivery. At the same time, these municipalities are the front-end responders to climate impacts, playing a critical role in implementing and managing adaptation projects to improve community resilience, including disaster risk management strategies and early warning systems.
- **Limited investments in the just transition, from public, private, international, and domestic sources.** Although climate and just transition finance flows have grown significantly in recent years, these still fall short of South Africa's annual need, especially for adaptation. Tracked annual climate finance reached R131 billion per annum on average in 2019–21, an all-time high, but still far from the average annual estimated needs of R334–R535 billion per annum.

The race to build climate resilience

South Africa's vulnerability to climate change has steadily increased. According to recent data, the country's food and water sectors are the most vulnerable to climate change due to projected changes in its cereal yields, low capacity to acquire and deploy agriculture technology, existing water scarcity, and limited dam storage capacity per capita. South Africa's readiness to leverage public and private investments for adaptation action has decreased due to high and persistent social inequality, a comparatively complex business environment, and declining state capacity.

Considering the significant risks South Africa faces because of climate change (floods, droughts, heat waves, other extreme weather events), national policies and commitments have set out a comprehensive approach to building climate resilience. The implementation of these commitments has, however, been sluggish. For example, only 28 of the 95 actions outlined by the National Climate Change Adaptation Strategy are listed as fully implemented or currently being implemented.

The broader systemic issues that hamper progress in the just transition also hamper progress on building climate resilience. Within the existing policy framework, the institutional mandates and responsibilities to address climate change are not always clear, and coordination between actors is inadequate despite regular communications among at least some of the relevant government departments. Many municipal officials also tend to still view building climate resilience as additional to, rather than a fundamental element of, their core responsibilities, which hinders the uptake of municipal climate change plans and strategies. In addition, constrained municipal budgets impede the implementation of adaptation and resilience-building initiatives. More broadly, finance for climate adaptation lags significantly behind finance channelled toward mitigation (12 percent to adaptation compared with 88 percent to mitigation). As a result, adaptation projects are unevenly distributed across South Africa, with most concentrated in the Western Cape and KwaZulu-Natal provinces according to a recent study.

The race to reduce GHG emissions

South Africa is currently the 14th-largest GHG emitter in the world, and the largest emitter on the African continent. The production of coal-based electricity is the largest contributor to South Africa's emissions, accounting for more than half of the country's emissions. South Africa's GHG emissions increased during the 2000s, peaking in 2009 before decreasing during the 2010s. According to the latest data, in 2022 South Africa emitted an estimated 479 million tons of carbon dioxide equivalent ($MtCO_2e$) (excluding forestry and other land-use changes), slightly lower than the emissions levels of 2000.

As a Party to the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC) (along with 194 other countries), South Africa is committed to the global goal of reducing GHG emissions to limit warming to well below 2°C while making best efforts to meet 1.5°C. South Africa has set targets for reducing GHG emissions through 2030. The country's revised nationally determined contribution (NDC), which was submitted to the UNFCCC in 2021, sets a commitment for national GHG emissions to be in the range of 398–510 $MtCO_2e$ in 2025 and 350–420 $MtCO_2e$ in 2030. External analysis shows that the lower end of the mitigation target in 2030 (i.e., 350 $MtCO_2e$) almost aligns with a global trajectory of limiting warming to 1.5°C. South Africa has also set an aspirational goal for

reaching net zero CO_2 emissions by 2050, as articulated in its Low Emissions Development Strategy and the national Just Transition Framework. South Africa aims to submit an updated NDC to the UNFCCC in 2025 in line with global agreements, setting updated and strengthened targets for 2030 and 2035. Strengthened emissions reduction targets will align with global imperatives for collectively reducing emissions while maximizing local opportunities around a measured and planned transition at a pace and scale South Africa can afford.

South Africa is on track to meet its 2025 GHG emissions target and, according to the government's draft Sectoral Emissions Target (SET) Report, the low target of the 2030 NDC (350 $MtCO_2e$) could be achieved with more ambitious actions in the electricity and transport sectors. The report cautions, however, that if key policies—such as the 2019 IRP with its prescribed electricity build and decommissioning plans—are not achieved, the 2030 target in the NDC may not be achieved. This is pertinent given Eskom's recent decision to further delay the decommissioning of three of its oldest coal-fired power plants (Camden, Grootvlei, and Hendrina).

Four necessary sectoral transitions to address climate change and achieve a just transition

The report examines four sectors and the needed transitions to address climate change and achieve a just transition in South Africa. These sectors were selected because of their vulnerability amidst a changing climate (agriculture and water) and due to their outsized role in driving GHG emissions (energy supply and transport).

Agriculture

South Africa's climate and development policy framework enshrines small-scale agriculture as a key entry point for action that furthers climate resilience, livelihoods, and household food security in rural areas. Although South Africa has been food secure at the national level for decades, many South Africans rely on subsistence or small-scale agriculture to combat household food insecurity, which affects one-fifth of households. Agriculture is also the primary economic activity in rural areas, where poverty is disproportionately prevalent. The productivity of South Africa's agriculture sector, however, has fluctuated over the past decade due in part to increasing climate change impacts, and production practices contribute to the challenge.

Entrenched spatial, racial, and gender inequality hinders the capacity of South Africa's estimated 2 million small-scale farmers to mitigate and manage the impacts of climate change. Small-scale farmers face limited participation and ownership in agricultural activities: around 70 percent of all agricultural income is earned by less than 7 percent of farmers. This is especially true for black and female small-scale farmers: black South Africans are estimated to represent just a quarter of all formal farm owners, and women are still required by most tribal authorities to acquire land through their husbands or male relatives. Whereas commercial farmers have marshalled the resources required to invest in drip irrigation, more resilient crop varieties, and other technologies to adapt to climate change, small-scale farmers largely require tailored government support and financial incentives to do so in a way that addresses their diverse needs.

More efficient water usage, meaningful land reform efforts, and accelerated uptake of climate-smart agriculture (CSA) practices are key to South Africa's realisation of a more equal and climate-resilient agriculture sector. However, land reform efforts, which have largely failed to meaningfully change landholding patterns, will only prove an effective lever to

address climate, development, and agricultural challenges with more transparent, efficient, and equitable processes. The adoption of CSA practices by small-scale farmers, which has varied across the country, could also be accelerated by strengthening the capacity of agricultural extension agents; building partnerships between extension agents and farmers, both small-scale and commercial; improving small-scale farmers' access to capital; and enhancing the design of CSA technologies to better meet farmers' diverse needs.

Concurrent transformative shifts are also needed to ensure that South Africa's agricultural production system is prepared to withstand the more severe climate impacts that are projected over the coming decades. This includes diversifying crops to include those that can better withstand extreme conditions and ensuring vulnerable groups, especially black and female farmers operating at a small scale, can design and implement the adaptation measures that work best in their communities.

Water

The water sector is extremely sensitive to climate change. Changes in rainfall, temperature, and extreme weather events brought on by climate change may worsen many water sector issues, including water quantity and quality challenges. Climate change is anticipated to increase existing water scarcity in South Africa, making it more challenging to close the existing gaps in water and sanitation access currently facing millions of people in the country. Poor and marginalised groups face disproportionately high levels of inadequate water and sanitation access. South Africa's old and poorly maintained water and sanitation infrastructure results in significant water loss and does not adequately treat water and wastewater. Further, water allocation is highly unequal, with most of the country's water allocated to white farmers and businesses. These challenges all have implications for human health, the environment, and the economy.

To adapt to climate change and ensure a just transition for the water sector, several key shifts are required. One key shift will be the transition from conventional planning and engineering solutions to adaptive and flexible planning that produces cobenefits while providing institutional stability. Integration of grey and green infrastructure, incorporation of "no regrets" strategies that yield benefits in any future climate scenario, and finalising the catchment management authorities would help enable this shift. A second and related shift is required around the way water resources and infrastructure are managed to foster an integrated management approach that improves resilience and ecosystem health. Supportive strategies under this shift include using an adaptive integrated water resources management approach, leveraging ecological infrastructure, protection of strategic water resource areas, and repairing and upgrading existing infrastructure.

Third, achieving the goal of universal water and sanitation access will require building the human resource, financial, and technical capacity of service providers while also looking for innovative solutions for areas that are hard to reach with traditional, centralised water and sanitation. This shift will require both improving and maintaining existing services by addressing the challenges currently facing water and sanitation service providers and extending service provision to places that currently lack adequate service, especially informal settlements and rural/traditional areas. Finally, shifts are also needed to ensure that water is allocated in the most efficient and equitable manner, which can be enabled through better water conservation and demand management, water supply augmentation, and reallocation among users. Greater investment is needed in the sector to support these shifts.

Energy supply

South Africa is facing severe electricity security challenges, with load shedding increasing year on year, causing widespread social and economic impacts. Despite the country having one of the highest rates of electrification in sub-Saharan Africa, millions of people are not connected to the grid or are energy poor, leading to a reliance on unsafe energy sources in these households. Additionally, air pollution from activities along the coal value chain has significant detrimental health and economic impacts.

Transitioning to a low emissions electricity system offers the opportunity to address these challenges by increasing energy security, access, and affordability while improving air quality and health. Energy efficiency improvements also bring quick wins for reducing emissions, creating jobs, and supporting small business development. The energy transition also poses risks, however, especially to those who depend on the coal value chain, which is geographically concentrated and accounts for roughly 150,000–200,000 jobs throughout the country. These risks must be considered and properly managed, for example, through local employment diversification, reskilling, and social and economic support for displaced workers.

To decarbonise South Africa's energy supply system, renewable energy needs to be scaled rapidly while fossil fuel reliance declines. This report tracks progress across four key indicators that will enable this transformation: renewable energy capacity, battery storage scale-up, coal power capacity, and natural gas consumption. Total renewable energy capacity in South Africa reached 10.4 gigawatts (GW) in 2022, growing roughly 1 GW per year since 2015. According to external studies, to decarbonise the energy system by 2050, between 190 and 390 GW of renewable energy capacity will be needed. This will require adding an average of 6–14 GW of renewable capacity per year, a significant increase over the historical rate. Battery storage will be needed alongside renewable energy capacity; an estimated 70 GW of battery storage will be needed by 2050, up from the current available capacity of less than 1 GW.

As renewable and battery storage capacity increase, coal capacity must decline with 6 GW of coal coming offline by 2030 and all coal plants decommissioned by 2042 to achieve decarbonisation by 2050. Eskom is behind schedule on decommissioning per the targets set in the 2019 IRP and Eskom's recent announcement that it will delay closing Camden, Grootvlei, and Hendrina will put the country even further off track under this indicator. Finally, although natural gas will be used in the medium term for peaking power, it will need to be phased out entirely by 2050 from current consumption levels of roughly 88,000 terajoules annually. Natural gas will ideally be replaced by locally produced green hydrogen as production capacity increases.

For each indicator, large gaps persist between historical trajectories and future targets aligned with South Africa's 2050 net zero CO_2 emissions target. There is, however, evidence to suggest that adoption of clean technologies, including renewable energy like wind and solar, may follow rapid, nonlinear growth trajectories when supported by effective policy and financing.

Transport and automotive

The transport and automotive sectors are key economic and employment contributors for South Africa and will be vital to the country's just transition. The public transport system is currently plagued by accessibility, affordability, and safety challenges, and its workers and infrastructure are highly exposed to climate change impacts. Addressing these challenges is made more difficult by apartheid-era spatial planning and transport policies that were used to implement and enforce racial segregation, thereby creating an inefficient and inequitable transport system. The minibus taxi industry helps to fill some of the gaps created by this system but has its own safety and affordability issues. Concurrently, the automotive sector faces significant transition risks because key export markets are set to ban the sale of internal combustion engines by 2035.

Aligning South Africa's transport and automotive sectors with the country's near- and long-term goals for mitigation and a just transition will require several key shifts while also considering the above challenges. These shifts can be categorised as increasing collective and shared transit modes and decarbonising carbon-intensive modes of transport by adopting new energy vehicles (NEVs).

Five indicators are monitored for the transport and automotive sectors in this report: number of public road transport vehicles, private ownership of vehicles, share of NEVs in light-duty vehicle sales, share of NEVs in the light-duty vehicle fleet, and number of public charging stations. To decarbonise the transport sector, the number of public road transport vehicles will need to double by 2050 from the roughly 420,000 vehicles currently in operation. To achieve this target, the rate of change over the last five years will need to accelerate by 1.9 times. Although not covered by this indicator, commercial and passenger rail will also need to increase, with demand increasingly shifting from road to rail transport through 2050. The scale up of public transport will help to replace private vehicle ownership, which will need to peak at 10 million in 2035—up from 8.2 million in 2023—and then decline to 6 million by 2050.

As private vehicle ownership peaks during the next decade, an increasing share of vehicle sales will need to be NEVs. NEVs currently represent less than half a percent of total light-duty vehicle sales but will need to reach 30 percent of sales by 2030 and 100 percent by 2035. As NEV sales increase, so will the share of NEVs in the vehicle fleet. This share will need to increase from its current value of less than half a percent to 6 percent in 2030 and 100 percent in 2050. Charging infrastructure will need to concurrently increase from an estimated 300 existing public charging stations to 30,000–45,000 by 2035.

Rapid acceleration is required across all five indicators to get on track. Fortunately, as with the energy sector, adoption of clean technologies like NEVs may grow more rapidly than expected—surpassing linear projections for growth—if supported with the requisite enabling conditions noted above.

SECTION 1.

The environment for climate action

CHAPTER 1.

SOCIAL, ECONOMIC, AND POLICY CONTEXT

South Africa faces significant economic and social challenges that impact climate action. The country faces the triple burden of high levels of poverty, unemployment, and inequality: more than half of South Africans continue to live under the poverty line (World Bank 2023b), a third of the South African workforce is unemployed (World Bank 2023b), and South Africa remains one of the most unequal countries in the world (World Bank 2022).

These triple challenges highlight the need for a just transition. Addressing the triple challenges requires that a transition to a low-carbon, climate-resilient economy improves the lives and livelihoods of South Africans, particularly those most impacted by the transition.

South Africa has been working on a just transition for several years, though this agenda has taken off at national scale in the past five years. The just transition imperative first emerged in South Africa in 1992 at the Earthlife Africa conference and more explicitly under the labour movement spearheaded by the Congress of South African Trade Unions in 2009 (Hallowes and Munnik 2023; PCC 2022b; Thorpe 1992). In recent years, the just transition agenda has also become a top priority of government, civil society, and business. South Africa agreed to an US$8.5 billion Just Energy Transition Partnership (JETP) with the United States, the European Union, France, Germany, and the United Kingdom in 2021. Following this, in 2022, South Africa adopted the country's first national Just Transition Framework, building on recommendations from the PCC, which set out a unifying vision for a just transition alongside principles and actions to guide this transition (Box 1). Most recently, South Africa has prepared an investment plan for the JETP that aims to

Box 1 • Defining a just transition for South Africa

The Just Transition Framework[a] provides a shared definition of a just transition for South Africa, building on the processes facilitated by the National Economic Development and Labour Council[b] and the National Planning Commission,[c] the definition articulated in the draft Climate Change Bill,[d] and the views expressed in the stakeholder consultations and community engagements facilitated by the Presidential Climate Commission.[e] Thus, this report follows the definition put forward by the framework, which maintains that a just transition is one that:

- aims to achieve a quality life for all South Africans, to increase the ability to adapt to the adverse impacts of climate, foster climate resilience, and reach net zero greenhouse gas emissions by 2050, in line with best available science;
- contributes to the goals of decent work for all, social inclusion, and the eradication of poverty;
- puts people at the centre of decision-making, especially those most impacted—the poor, women, people with disabilities, and the youth—empowering and equipping them for new opportunities of the future; and
- builds the resilience of the economy and people through affordable, decentralised, diversely owned renewable energy systems; conservation of natural resources; equitable access of water resources; an environment that is not harmful to one's health and well-being; and sustainable, equitable, inclusive land use for all, especially for the most vulnerable.

Moreover, the Just Transition Framework is guided by three pillars of justice drawn from literature on the just transition,[f] consultations facilitated by the PCC,[g] and international best practice guidelines[h]:

- **Distributive justice:** ensuring that both the benefits and costs of climate change and its responses are equally shared.
- **Restorative justice:** ensuring that historical damages to people, communities, and the environment are addressed, rectified, and ameliorated.
- **Procedural justice:** ensuring that all voices are at the table and heard.

Sources: a. PCC 2022b; b. NEDLAC 2020; c. NPC 2020; d. Republic of South Africa 2022; e. PCC 2022a, 2022b; f. McCauley and Heffron 2018; Cahill and Allen 2020; g. PCC 2022b; h. Olsen and La Hovary 2021.

guide the funding in a transparent and effective manner while identifying areas to bridge the investment gaps toward US$100 billion.

Figure 1.1. presents a simplified, top-down depiction of the growing movement of climate action and the just transition in South Africa, though there has been a plethora of bottom-up, subnational efforts that have led and pushed many of the listed events and milestones.

Figure 1.1 • **A simplified, top-down depiction of the growing movement of climate action and the just transition**

CLIMATE		JUST TRANSITION
	1992	The just transition imperative emerges in environmental justice discussions during the Earthlife Africa conference.
South Africa shows unequivocal commitment to the environment in the drafting of its Constitution.	**1996**	
South Africa ratifies the UNFCCC.	**1997**	
South Africa ratifies the Kyoto Protocol.	**2002**	
COP15: South Africa pledges 34% under BAU emissions by 2020 and 42% by 2025 under the Copenhagen Accord.	**2009**	Congress of South African Trade Unions (COSATU) highlights the importance of the just transition.
The **National Climate Change Response White Paper** (NCCRP) is published, which outlines South Africa's long-term climate strategy, including provisions for carbon pricing.	**2011**	The NCCRP refers to just transition, focusing on green jobs and skills.
	2013	South Africa adopts a **National Development Plan** (NDP) with a focus on environmental sustainability and charting an equitable transition to a low-carbon economy.
South Africa ratifies the Paris Agreement and submits its first intended **nationally determined contribution** (NDC), which specified peak emissions between 2020 and 2025.	**2016**	South Africa is the first (and only) country to explicitly note the just transition imperative in its first NDC.
South Africa's **Climate Change bill** (CCB), which outlines the State's emission targets and adaptation plans, is published for public comment.	**2018**	Presidential Jobs Summit establishes the Presidential Climate Change Coordinating Commission to oversee and coordinate the just transition for South Africa.
South Africa submits its long-term low-GHG emission development strategy (LT-LEDS) to the UNFCCC, and adopts the **Integrated Resource Plan**, which outlines the expansion of electricity supply. The DFFE also passes the **National Climate Change Adaptation Strategy** (NCCAS).	**2019**	
President Cyril Ramaphosa constitutes the **Presidential Climate Commission** (PCC), which would independently advise on the country's climate change response and pathways to a low-carbon, climate-resilient economy, and society.	**2020**	The PCC comprises Commissioners from all major social partners to forge consensus and partnership on the just transition, including with government ministers.
South Africa updates its **NDC** to target a range of 398 - 510 $MtCO_2e$ by 2025 and 350 – 420 $MtCO_2e$ by 2030.	**2021**	South Africa is the first country to agree to a US$8.5 billion **Just Energy Transition Partnership** (JETP) with the EU, UK and USA.
South Africa commits to **net-zero carbon emissions** by 2050 in its Long-Term Strategy, also reflected in the Just Transition Framework.	**2022**	The PCC sets out a unifying objective for a just transition in the country's first national **Just Transition Framework**. Just transition is also introduced in the CCB. In November, the Presidential Climate Finance Task Team (PCFTT) releases its **Just Energy Transition Investment Plan** (JET IP).
South Africa's National Assembly approves the CCB, which awaits further approval from the National Council of Provinces and the President.	**2023**	South Africa tables a detailed **Just Energy Transition Implementation Plan**, including with a specific focus on skills development and economic diversification for the coal-dominated Mpumalanga province.

Notes: BAU = business as usual; DFFE = Department of Forestry, Fisheries and the Environment; GHG = greenhouse gas; UNFCCC = United Nations Framework Convention on Climate Change.

CHAPTER 2.

GOVERNANCE, IMPLEMENTATION CAPACITY, AND FINANCE

Although South Africa has signalled strong commitments to addressing climate change (Chapter 1), there has been a notable disparity between policy ambitions and practical outcomes. Indeed, South Africa is often described as a policy-rich, implementation-poor country (Botha 2022). South Africa currently contends with carbon-intensive growth, socioeconomic challenges, and chronic energy insecurity, which hamper progress.

This section examines the various drivers of South Africa's political economy that either enable or challenge climate and just transition policies and their effective implementation: governance (of both national and local government), public trust, the key stakeholders, and capital flows. Specific mitigation and adaptation as well as sectoral policy implementation concerns are explored in later chapters; this chapter aims to outline the underlying conditions in which they exist and their implications for South Africa's climate and just transition goals.

Governance

A notable disparity exists between policy ambitions and practical outcomes in South Africa's approach to climate action. Improved governance structures—capable of efficiently navigating and enacting these policies into tangible results—are critically needed.

Governance and structural issues continue to impair the implementation of climate and just transition policies. Structural challenges include poor clarity on roles and responsibilities of environmental competencies within the government, government departments working in silos, a lack of support to the local sphere of government, and a poor alignment of policies and programmes (Averchenkova et al. 2019). Enhancing governance and implementation capabilities will require significant systemic changes to institutional capacity and structure. Some of the most prominent governance issues are related to nonalignment of policy priorities and disagreements over approach and definition of issues, to which capacity deficiencies contribute. Uncertainty over the direction of climate change and energy policy, exacerbated by a lack of political will and "distracted leadership," not only stymie an effective transition for South Africa but also impacts investor confidence and therefore the necessary capital flows.

Limited human and technical capacity and resources in South Africa are key obstacles to effective climate governance. There is limited understanding of climate change and its impacts across both government bodies and local communities, exacerbated by outdated climate information in integrated development plans (Sibiya et al. 2023). Inadequate technical capacity not only hampers development and implementation quality but also makes it difficult to garner political will to address climate and just transition issues (Averchenkova et al. 2019).

Fragmentation, contrasting policies, and contradictory government positions have created policy uncertainty in the country, including around the just transition. Limited public cohesion on climate action—not only between stakeholders but also between policies and government departments—has created conflicting priorities and guidance on how to achieve South Africa's climate goals. For example, there is a disconnect between the nationally determined contribution (NDC) and the 2023 integrated resource plan (IRP) because independent modelling indicates that the IRP does not adhere to NDC targets. These policies and regulations are often at odds, perhaps because the Presidency; Department of Forestry, Fisheries and the Environment (DFFE); Department of Mineral Resources and Energy (DMRE); and the National Treasury are pushing ahead with policies and frameworks without appropriate alignment between the players. Successful climate action in South Africa therefore requires explicit alignment of all policies to mitigate mixed messaging and dissent. The forthcoming Climate Change Bill, which is expected to be enacted later in 2024, aims to address this by "fostering institutional coherence and enhance climate change adaptation governance across the spheres, national and sub-national layers of government in South Africa" (Republic of South Africa 2021b).

Corruption in the public sector has left South Africa with weakened institutional conditions that impede an effective and just low-carbon transition for the country. Specifically, the impacts of state capture[1] have

materialised in recent climate-related disaster events. The abuse of public funds has exhausted current capital reserves (Masuku 2019) that could have been invested in stronger adaptation measures (see Chapter 5) or used to help mitigate impacts of environmental hazards, such as the landslide damage from the recent KwaZulu-Natal (KZN) floods (Evans 2022b). Although chasing down corrupt or captured officials and leaders is necessary, it is still insufficient for effective and accountable governance (Makgetla 2021a; Masuku 2019). Effective solutions require systemic changes to block illegitimate influences on government decision-making and implementation processes.

A more robust monitoring, evaluation, and learning framework could help to track the effectiveness of policy implementation and its contribution to achieving climate and just transition goals. Additionally, bolstering political will across government tiers and aligning local initiatives with national directives—as will be covered in the following section—are imperative for coherent policy execution.

Local government action

Local governments are tasked with providing basic services to communities in South Africa, but they face challenges in discharging their mandates, with implications for climate action. Thus, they are a critical sphere of government in ensuring climate action, including responding to climate-related disasters, local economic development, implementing adaptation plans and activities, providing infrastructure, and land-use planning and management. However, local governments face many challenges in discharging their mandate—some of which stem from the national level, and others that are self-inflicted. There are also structural problems. As such, local government has had inconsistent success in climate initiatives and action. This is problematic for climate action given that many environmental duties lie at the local level (Glasser and Wright 2020).

The misalignment between local initiatives and national directives is significant. A disconnect exists between policymaking and implementation (particularly when implementers are required to fund policies that they did not develop) (Low 2022). National economic

policy and local economic development and planning are also disjointed because national strategies and investments are generally not pursued in consultation with metropolitan municipalities and often do not consider local development plans (CoGTA 2016).

There are structural issues in the way spheres of government are arranged, and local governments generally lack support. Constitutionally, local governments are equal but autonomous partners to national and provincial governments. However, due to political arrangements and party structures, which are hierarchical by their nature, there has been a general weakening of the voice of local governments, with more importance given to provincial (rather than local) leaders and officials (SACN 2022)—especially in terms of project and financial management—which exacerbates existing problems with budget spending and service delivery. Local governments also lack support from national and provincial governments. Specifically for climate change action at a local level, some local government departments are unaware of how to select, prioritise, and implement climate actions (Pers. Comm. 2024c). There is a need for a single repository of climate information as well as likely benefits to building a community of practice among local officials from across the country who are grappling with similar challenges (Pers. Comm. 2024c).

Local governments' potential contributions to the climate response are constrained by a lack of financial resources. The financial model used for local government is inherently unsustainable. Municipalities rely mainly on revenue collection to operate effectively, through tariffs for basic services, and receive the smallest proportion of funding from the state compared with other spheres of government—approximately 10 percent (National Treasury 2023). If municipalities are unable to generate sufficient income through revenue collection for municipal services, there is a limited budget for all local-level services, even as the need to make such services climate resilient is increasing. The South African Cities Network reports that due to a deteriorating economic outlook, the COVID pandemic, austerity measures, and other poor economic conditions, fewer households are paying their service delivery bills, leading to increased service debt (SACN 2022). Additional funding is provided to local government through conditional grants, but due to capacity constraints and poor financial management and oversight, these grants can often go unspent (Kruuse 2023). With additional climate-related responsibilities, local governments are under increased pressure to provide services that do not have a budget allocation—a provision that is not stipulated in the Climate Change Bill.

Local governments are also constrained in terms of local capacity. Local governments often lack technical expertise and skills, including softer skills that enable them to build relationships and partnerships within government, the private sector, and the broader community (Pers. Comm. 2024c; SACN 2022). Capacity challenges also include positions being filled based on political allegiance (not skills) and the lack of skilled financial officers, especially in smaller municipalities and rural areas (SACN 2022). Gaps in capacity and skills are more glaring in smaller municipalities.

Chronic capacity constraints and insufficient budget allocations also lead to an endless cycle of funding shortages. The Department of Water and Sanitation (DWS), for example, is forced to repeatedly provide underperforming municipalities with grants to repair water services infrastructure due to poor maintenance and operation by municipalities. Municipalities are losing about 1.66 billion/cubic meter (m^3) per year through nonrevenue water (i.e., water lost through leaks and similar issues), at an approximate cost of R6/m^3, which amounts to R9.9 billion each year (DWS 2018).

Local government actions are stymied by poor management and a lack of enforcement mechanisms for service delivery. In early 2023, the Presidency stated that 163 out of 257 municipalities were dysfunctional due to poor governance, ineffective and sometimes corrupt financial and administrative management, and poor service delivery and planning (Presidency of the Republic of South Africa 2023). The number of municipalities that need state intervention continues to grow (AGSA 2022; Thusi and Selepe 2023). According to Cooperative Governance and Traditional Affairs, in 2023, a total of R1.7 billion was withheld from 15 municipalities across seven provinces due to the failure of municipalities to adhere to budgetary regulations (CoGTA 2023).

System and process deficiencies also impact service delivery at the local government level. Corruption and cadre deployment,[2] which are much more prevalent in local rather than national government (Xolani et al. 2022), are often strong indicators of governance failure and are primary drivers for depleting the funding required for effective service delivery (Ndevu and Muller 2018). Following record-breaking rainfall and flooding in 2022, the Auditor-General of South Africa found that failure to embed preventative controls, a lack of effective leadership, and restricted human and financial resources slowed disaster response and relief provision to communities in KZN and the Eastern Cape (AGSA 2022).

Despite these challenges, there are innovative examples of successful climate response strategies at the local level. Some local governments have adopted customised responses to climate change that are a better fit for their specific type of municipality. This assists with resource constraints and provides tailored solutions to a complex problem. Some municipalities have developed myriad strategies to deal with various aspects of climate change and developed task teams and partnerships with organisations and companies to assist with resourcing and response planning. Greater support from national and provincial governments is required to assist all local governments to overcome the diagnosed challenges and effectively mitigate and adapt to climate change.

Trust in public institutions

Public support and trust in public institutions are important pillars in facilitating just and equitable climate action, though levels of trust in government are currently low. Trust in institutions is an important prerequisite to implement climate change adaptation and mitigation policies (Dirksmeier et al. 2023). Moreover, social injustices arising from low-carbon transitions can be detected from public opinions, especially from those who are directly affected (Wang and Lo 2021).

Several surveys indicate low levels of trust in government to oversee and facilitate a just transition. In a recent PCC/Human Sciences Research Council (HSRC) survey (elaborated further in Chapter 3), respondents assigned greater responsibility for preventing climate change from worsening to environmental groups and large companies over the national government. Respondents also assigned individuals more responsibility than local and foreign governments, which could indicate that South Africans largely distrust public institutions to address the climate crisis. Moreover, according to the *2023 Edelman Trust Barometer*, South Africans generally trust business and nongovernmental organisations (NGOs) more than government. Two-thirds of respondents from the Edelman study felt that government was a source of misleading information as opposed to business (25 percent) and NGOs (23 percent). Only one-third of South Africans in the study indicated that they trusted the government to do what is right in terms of climate change, and less than half felt the same about business (Edelman 2023). The latest in a series of repeated surveys conducted by Afrobarometer found that the trust of South Africans in public institutions is the lowest since the study began in 2006 and was declining (Moosa and Hofmeyr 2021). Only media broadcasters and the Department of Health had a trust proportion of above 50 percent of respondents. Trust in the President, ruling party, and state institutions and departments were well below 50 precent, and trust in courts of law and the Public Protector were at 43 percent and 42 percent, respectively (Moosa and Hofmeyr 2021).

Climate change remains a low public priority and is not often top of mind in the country's political consciousness, though energy issues remain at the forefront. Thus, there is little public pressure and few political costs for misalignment with climate ambition (Calland 2023). Both top-down and bottom-up communication of climate and just transitions concerns suffer from a lack of discourse on the topic, which has dampened progress on South Africa's ability to implement effective transition interventions. Essential to building public trust in national directives to address climate and transition-related issues is to engage the key actors identified in Section 2.5.

Key actors accelerating or hampering progress on climate change and a just transition

Stakeholders in the South African policy landscape—including those who represent affected communities (e.g., forums, associations, councillors, etc.); NGOs and civil society organisations (CSOs); and district, regional, and national government representatives—by and large acknowledge the threat of climate change and need for climate action (PCC 2022a). However, many within these various groups maintain their own agendas or those of their respective constituencies, which leads to competing priorities in the country's transition to a more just, low-carbon economy. Stakeholders of the transition, therefore, essentially fall in two camps: those who drive (or delay) the policy and those who are affected by policy changes. In some cases, these groups overlap. But often the former neglects the needs of the latter. For example, though some South African companies and industry associations endorse advancing policies that enable renewable energy growth, major industry players continue to oppose key climate policies and have yet to begin transition planning (InfluenceMap 2023).

It is thus important to highlight the key players who affect the drivers of change in South African climate and just transition policy development. Table A-1 in Appendix A provides a full list of relevant actors involved in South Africa's policy landscape based on several existing stakeholder maps, notably those put together by the Presidential Climate Commission

(PCC) and Climate Investment Funds (CIF). Table A-1 seeks mainly to identify the key players in climate and just transition policy decision-making as well as the communities affected by such decisions. It does not chart out the power dynamics of these actors at this time, but this may be adopted in future iterations of this exercise, informed by consultations with relevant stakeholders.

A handful of key industry players continue to command much of the resource development and distribution, political discourse, and policy influence in South Africa. Historically, South Africa's economy has been driven largely by sectoral interlinkages and policy relationships between public and private economic actors in the energy and extractive (mining and minerals) industries, often referred to as the minerals-energy complex (MEC) (Fine and Rustomjee 1996). The influence of the MEC enabled an economic dependence on coal through strong political alliances with state actors such as the DMRE, which tends to not provide the enabling environment necessary to support widespread adoption of renewable energy. Additionally, lenient lobbying regulations enable companies to avoid disclosing their activities and their access to "non-public engagement pathways" to influence policy, limiting transparency (Mathe et al. 2023).

The presence and power of the MEC has, however, dwindled considerably in recent years. Beyond a shift in national direction toward net zero emissions, decreasing costs of renewables against rising and volatile costs for coal have shifted private investment toward cleaner alternatives while also weakening the economic significance of the coal value chain (Baker and Burton 2023). Following a legacy of corruption and state capture, many of the relationships that were central to the MEC have also come undone. Yet the low-carbon transition will require key minerals (e.g., copper, manganese, and rare earth minerals) that are abundant in South Africa to support the development of clean technological alternatives. Thus, the MEC will remain a relevant and significant player in the South African economy even after fossil fuels are transitioned out, albeit one that is more decarbonised.

Two of the major players in the MEC are Eskom (the state-owned electricity utility) and Sasol (the major petrochemicals company). These two companies are the largest greenhouse gas (GHG) emitters in South Africa, and both recently have committed to achieving net zero emissions by 2050 (Bega 2021; Lenferna 2021). However, the World Benchmarking Alliance found that both companies still have room for improvement in aligning company policy and further advancing credible transition plans to showcase how they will achieve net zero by 2050 (WBA 2021). This includes setting interim emissions reduction targets, supporting suppliers in reducing their GHG emissions, and having management-level expertise on climate while ensuring incentives are decoupled from fossil fuel growth.

Despite the PCC and other governmental efforts to be more inclusive of stakeholders, private corporations have had more say in the nature and pace of change whereas affected communities and civil society voices are often sidelined (Mathe et al. 2023). Nongovernment stakeholders and CSOs play an essential role in holding the state accountable to its own legislation, policies, and targets while representing communities, creating public awareness of climate change and actions by the state to deal with climate change, and ensuring the needs of their constituencies are considered (Amansure 2022). Exclusion of such groups exacerbates the disenfranchisement that communities already feel. Consequently, a present lack of funding for these organisations is further hindering meaningful participation in a full democratic process.

Moreover, many listed and private companies are directly impacted by the transition from fossil fuels, with only a proportion undertaking medium- to long-term planning to adapt to the transition (WBA 2021). There remains a gap in private companies' just transition planning processes to minimise transition risk and negative impacts and to promote the competitiveness of South African companies in the low-carbon economy. However, this is not entirely the fault of the individual enterprises themselves; as discussed in Section 2.1, policy uncertainty and lack of political consensus at the national level makes planning for the transition difficult.

Though workers in these industries and the communities that rely on them generally agree that climate change is increasing vulnerabilities and that rising emissions need to be addressed, some also find that the transition and climate action are being deployed too hastily (PCC 2022a). Some feel that international pressure is prompting the South African government to act fast rather than carefully, and many important stakeholders are often not consulted, leaving these communities feeling disenfranchised. Following the Komati Power Station closure, for example, the impacts on the workers and surrounding communities created tensions and highlights the need to involve the stakeholders and communities that are directly affected by the transition (see Section 8.1. for the just transition lessons learned from Komati). Global experiences with coal closures indicate that giving fair warning of closures, several years at least, is key to the process and to letting people manage their lives; however,

the government's refusal to commit to timelines for closures impedes effective planning for training and redeployment. Ensuring affected communities and workers are not just heard and accounted for but are also part of the policy design and decision-making process is required to foster the procedural justice principles under the Just Transition Framework.

Finance

Finance for climate change and a just transition currently fall short of South Africa's needs. The climate transition will require considerable financial resources from multiple sources. The estimated total cost of decarbonisation, adaptation, and just transition measures until 2050 is approximately R8.5 trillion (World Bank 2022).

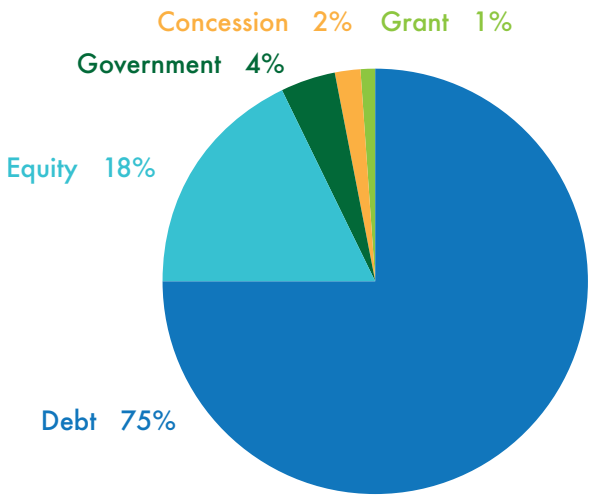
Climate finance flows have grown significantly in recent years but still fall short of what South Africa requires annually to reach its climate targets (de Aragão Fernandes et al. 2023). Tracked annual climate finance reached R131 billion per annum on average in 2019–21, an all-time high, but still far from the average annual estimated needs of R334–R535 billion per annum.

The majority of tracked climate finance (2019–21) came from domestic sources, with only 9 percent from international sources. Most funding came from private actors, including commercial sources, corporations, philanthropists or donors, NGOs, and households (de Aragão Fernandes et al. 2023). Of private finance, 98 percent was domestic. Most financial flows were through debt instruments with a borrowing cost of between 10 percent and 12 percent (see Figure 2.1 for a breakdown of finance sources). Other finance flows were through tracked equity finance, government expenditure, concessional debt, and grants (de Aragão Fernandes et al. 2023).

The overwhelming majority of funding was allocated to mitigation projects versus adaptation projects. Figure 2.2 provides a breakdown of funding allocations by project type.

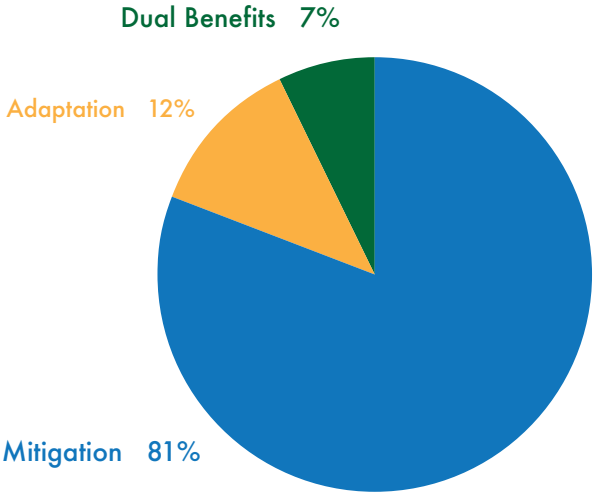
Most private and public sector spending was directed at clean energy projects. Climate finance for agriculture, forestry, and other land use as well as for water (wastewater and drought) expanded over the last two years. There was a reduction in the tracked climate finance for low-carbon transport (de Aragão Fernandes et al. 2023). Increased concessional and grant funding, blended finance, and increased funds for adaptation activities are clearly needed.

Figure 2.1 • **Breakdown of financing sources in South Africa, 2019–2021**



Source: De Aragão Fernandes et al. 2023.

Figure 2.2 • **Breakdown of the funding allocations by types of projects in South Africa, 2019–2021**



Source: De Aragão Fernandes et al. 2023

CHAPTER 3.

PUBLIC PERCEPTIONS AND ATTITUDES ABOUT CLIMATE CHANGE AND A JUST TRANSITION

In 2023, the PCC partnered with the HSRC to conduct the first nationally representative survey on the just transition. Although previous surveys on climate change had been done (e.g., Chapman et al. 2023; Poortinga et al. 2004), relatively little was known about public perceptions of the just transition in South Africa. This section presents previous research on public attitudes and opinions and makes comparisons with the recent PCC/HSRC survey on the just transition.

Previous research on attitudes and perceptions about climate change and the just transition in South Africa

The South African public ranks environmental problems and climate change very low on the list of priority issues facing the country (Ipsos 2022; Mpako and Govindasamy 2023). Surveys show that unemployment, cost of living/inflation, crime and corruption, and service delivery issues tend to be the highest-ranked concerns (Ipsos 2022; Mpako and Govindasamy 2023).[3] These issues, in turn, tend be given higher political priority as well. Although economics, safety, and service delivery concerns are undoubtedly of critical importance, climate change is likely to exacerbate many of these issues and other existing challenges in South Africa over the next two or three decades. The relatively low ranking of environmental issues, however, does not necessarily mean that South Africans are unconcerned about the impact that environmental shocks are having on society and their lives. In fact, direct survey questions on environmental and climate change concerns find that South Africans report considerable degrees of concern.

Recent research reveals concern about the impacts of the just transition in South Africa among those mostly likely to be directly impacted. In a recently published study, researchers assessed policy perceptions of 51 current and former coal miners and Eskom workers as well as community members in Mpumalanga using in-depth interviews (Mohlakoana et al. 2023). The results showed that most interviewees (72 percent) were aware of the possibility of mine closures and expressed concern (78 percent) that this would impact their jobs and ability to support their families. Despite the concerns about the transition, respondents overwhelmingly (94 percent) did not want their children to go into coal mining and recognised a link between coal, air pollution, and health issues (Mohlakoana et al. 2023). Interviewees did not trust the government to administer the just transition aid and would prefer aid be delivered by an independent body not affiliated with the government. Regarding reskilling, respondents perceived renewable energy as a nascent industry and did not want to receive training for a job that did not have opportunities readily available (Mohlakoana et al. 2023). Although this study is based on a small sample of respondents in coal-dependent communities and is not representative of the broader community in these localities, it does provide insight into perceptions of vulnerability and preferred social policy choices in the context of the just transition. As more research evidence becomes available on these dynamics, decision-makers will be able to determine whether this initial evidence is indicative of more general public sentiment.

However, a larger group of national stakeholders were more positive about the benefits the transition might bring. More than 750 stakeholders representing key social partner groups (government, business, labour, civil society) were consulted over 13 months in 2018–19 through workshops and meetings spanning all provinces to collect feedback to update the National Development Plan 2020 (Monteith 2019). During the engagements, stakeholders indicated that they viewed job creation through the renewable energy sector as a major opportunity of the transition (Monteith 2019). Other frequently cited opportunities associated with the just transition included using renewable energy to replace coal; increasing climate change awareness, education, and climate-sensitive behaviours; and

opportunities around small scale agriculture, climate-smart agriculture and improving water conservation, and strengthening food security.

Key challenges to achieving a just transition mentioned by stakeholders included a lack of government coordination and consultation and insufficient involvement of communities and ordinary people in decision-making (Monteith 2019). These challenges align with the governance issues facing climate change and just transition policy implementation as highlighted in Chapter 2.

In previous studies, stakeholders have been surveyed about what actions would help facilitate a just transition. The most-mentioned actions fell into four categories: the energy transition (renewable energy, decentralised energy, affordable energy, more competitive energy market); restoration of land (sustainable land use, densification of cities, land rehabilitation); safe water for all (land-water-energy nexus, fairness in water use, enforcing water laws); and green growth (reskilling of fossil fuel workers, green economy). These results, though not nationally representative, give important insight into the types of policies and actions stakeholders would support as part of climate action and the just transition.

PCC Survey purpose and approach

The PCC partnered with the HSRC to conduct the first nationally representative survey on the just transition. The survey included 21 questions to uncover the following:

- Awareness of and concern about climate change
- Personal experience with extreme weather events
- Perception of responsibility for addressing climate change
- Awareness of the general concept of the energy transition and the phrase *just transition* specifically
- Support for the transition away from coal toward renewable energy and perceived impacts of such a shift
- Support for various policy measures to mitigate against negative impacts of the transition
- Perceptions of who should be involved in and responsible for the transition

In this brief review, a few of the issues from the survey are highlighted. A comprehensive report with all results will be completed and released in late 2024. In undertaking the project, the HSRC suggested a conceptual model to guide the survey design and analysis (see Appendix B for more details on the conceptual model).

The survey was structured based on the HSRC's South African Social Attitudes Survey (SASAS), which has been administered nationally on an annual basis since 2003. Data was collected through face-to-face interviews and questionnaires, which were translated into all South African languages. The survey was undertaken between August and October 2023 and achieved a nationally representative sample of 3,103 respondents aged 16 years or older. The results were weighted to ensure the sample matched the demographics of the general population, using Statistics South Africa's latest available midyear population estimates for benchmarking purposes (i.e., the sample size and population is drawn and then weighted such that it is representative of all South African adults). The final weighted population therefore represented a little over 43 million respondents aged 16 years and older.

Survey results

Climate change perceptions

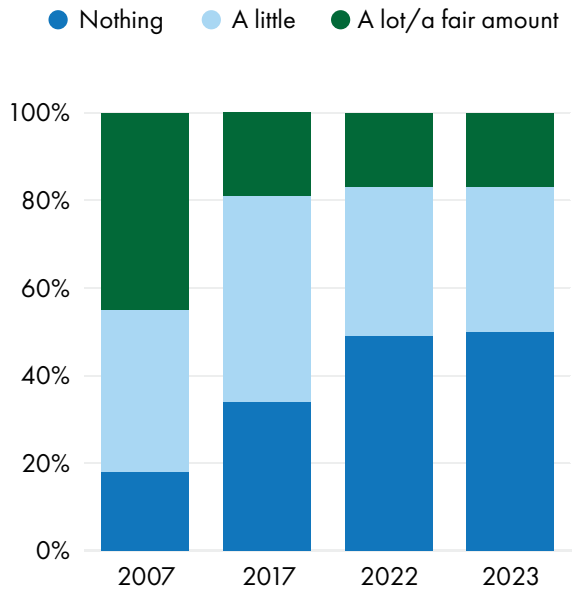
Half of South Africans (50 percent) reported that they know a lot or a fair amount about climate change, which shows a steady improvement in knowledge levels since this question was first fielded by the HSRC in 2007 (Figure 3.1). However, half of South Africans currently report knowing little to nothing of climate change, despite the increasing prominence of climate change coverage in the media during the aftermath of recent climate and weather disasters throughout the country.

One in 10 South Africans display scepticism regarding the existence of climate change in 2023. This figure is lower than what was recorded in 2020 (16 percent), but it remains higher than many countries across different world regions (Figure 3.2). More notably, scepticism regarding the cause of climate change remains persistently high among South Africans, with just 17 percent of the public in 2023 saying that the climate has been changing mostly due to human activity and 31 percent saying natural and human causes were equally the cause (the corresponding figures were 20 percent and 27 percent in 2020, respectively). Scepticism that climate change is caused predominantly by human activity is high in South Africa compared to other countries in the world, including other BRICS nations such as India, Russia, and China.

Attributing climate change to human activity in the South African context is not necessarily a precursor for being concerned about climate change. Approximately two-fifths (41 percent) of South Africans reported being very or extremely worried about climate change. Based on correlation analysis, the association between the cause of climate change and concern about climate change was significant but moderate in nature (Cramer's V = 0.306).[4] This concern level is a slight decrease from 2017 and 2020 (50 percent), although the proportion of respondents who are not at all or not very worried has remained mostly steady. At the same time, most South Africans (74 percent) reported that they or their families had been impacted by extreme weather events over the last 10 years to at least a minor extent, including 13 percent to a great extent. Experiences varied significantly based on provincial location (see Chapter 4), and such experiences have a significant effect on levels of concern about climate change.

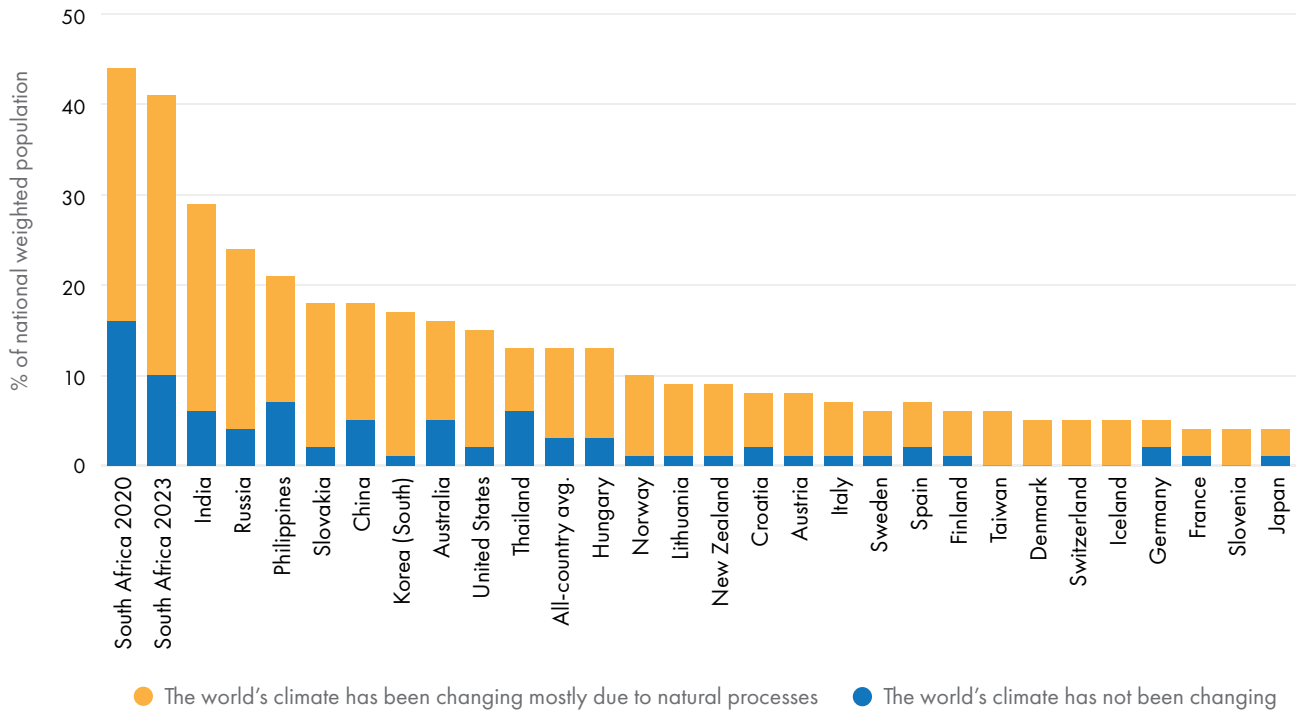
South Africans are increasingly likely to feel more personally responsible for protecting the environment. On a scale from 0 (not at all) to 10 (a great deal), the survey asked respondents to rate to what extent they feel a personal responsibility to protect the environment, and the mean value was 6.35. This is an increase over the average value of 5.50 from the 2017 survey. Breaking down the results by socioeconomic status reveals that

Figure 3.1 • **Climate change awareness, 2007–23: How much, if anything, would you say you know about climate change?**



Source: Based on the Human Sciences Research Council's South African Social Attitudes Survey for 2007, 2017, 2022, and 2023.

Figure 3.2 • **South African views on the cause of climate change in a comparative perspective**

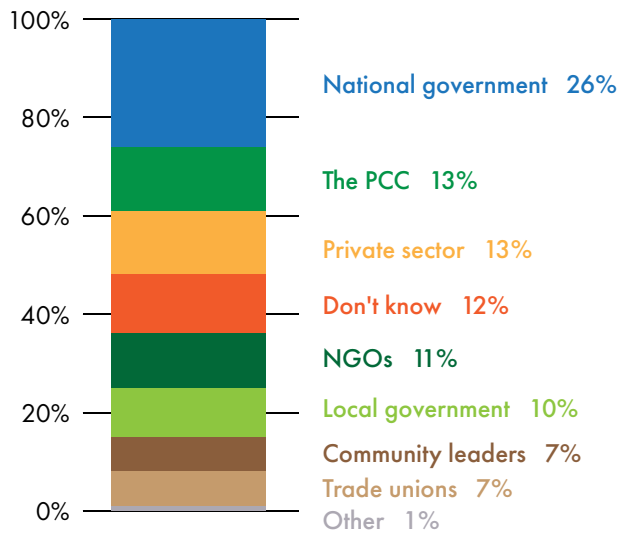


Source: ISSP 2020; HSRC SASAS 2023 PCC just transition module.

individuals in the wealthier households had a higher sense of personal responsibility than those in the poorer households. This difference could reflect the fact that environmental concerns tend to be displaced by economic concerns when basic needs are not being met and/or because consumption levels and carbon emissions are significantly higher for wealthier households, meaning that they do tend to more directly contribute to climate change (IEA 2022; Peisker 2023).

In terms of institutions that bear the most responsibility for preventing climate change from worsening, South Africans were most likely to select environmental groups (34 percent), large companies (32 percent), and the national government (29 percent). Respondents could select up to three options. These results may have less to do with who South Africans think is to blame for climate change and more to do with the expectations of institutions to act in the greater interests of society. The national government is the entity that is most trusted to manage the transition from coal to other forms of energy sources (Figure 3.3). More than a quarter (26 percent) mentioned they trusted the government, with a tenth mentioning a committee established by the President, such as the PCC, and a similar share mentioning local government. Just more than a tenth (13 percent) mentioned businesses or the private sector. This shows that trust is complex and multifaceted and that despite negativity, the national government is still the body expected to drive large national projects. The just transition thus affords an opportunity for the national government to garner support for the just transition and to build trust.

Figure 3.3 • **Whom do you MOST trust to manage the just transition?**



Note: NGO = nongovernmental organisation.
Source: HSRC SASAS 2023 PCC just transition module.

However, more people (13 percent) trusted the private sector or businesses than local government (10 percent). The relatively lower trust in local government could be related to the local governance challenges highlighted in Chapter 2.

Just transition perceptions

Less than one-third of South Africans report knowing a lot about the country moving away from coal to renewable energy. It was assumed that there would be low baseline awareness of the phrase *just transition*, therefore, respondents were introduced to the concept by stating the general idea that South Africa is moving away from coal as follows: "Most of South Africa's electricity currently comes from coal. There are now actions being taken to change from coal power to other sources of energy (like solar and wind)." Respondents were then asked whether they had heard or read about these efforts. The highest portion of respondents (41 percent) said they had read or heard a little about this, whereas 31 percent said they had heard or read quite a bit or a lot.

Very few South Africans are familiar with the term *just transition*. Only 9 percent reported having heard it and knowing what it means, and 78 percent said they had not heard it or did not know. This seems to indicate that there is more awareness of the general concept of the energy transition in South Africa but very little understanding of the specific term *just transition*. This finding seems to be echoed in research in other countries as well—in a survey of over 9,000 respondents across 10 European countries, two-thirds of respondents said they could explain the concept of the energy transition to someone, either precisely (19 percent) or vaguely (47 percent) (Chandeze et al. 2023). In comparison, a national survey on just transition perceptions in Japan from January 2022 found low awareness of the term *just transition*, with roughly 20 percent of the 6,000 respondents reporting that they were familiar with the concept (Chapman et al. 2023). These results may indicate that the concept of the energy transition is better understood than the just transition.

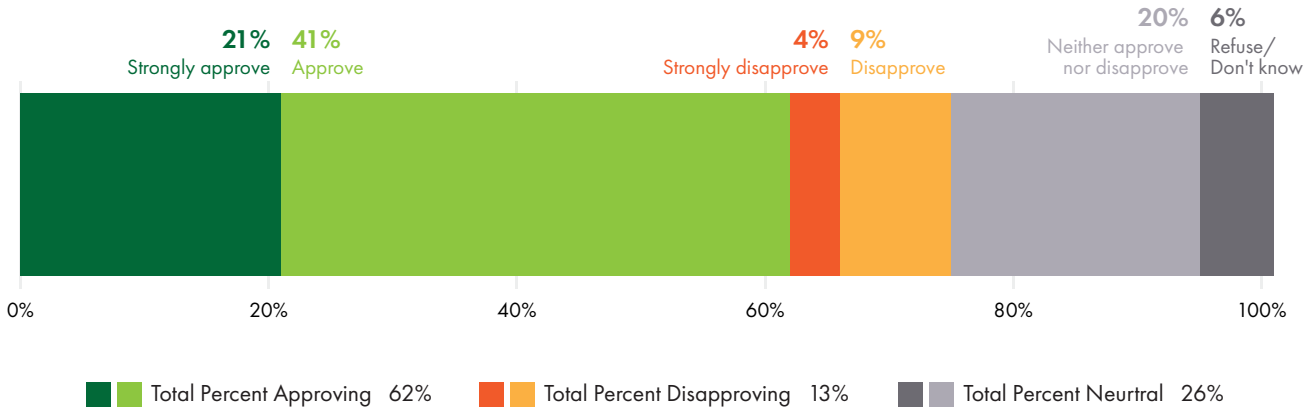
Awareness is an important precursor to behaviour change. The national survey on just transitions in Japan found a positive correlation between knowledge of the just transition and willingness to take action to foster the just transition through behaviours such as installing solar panels or switching to an electric vehicle (EV) (Chapman et al. 2023). And in Europe, where energy transition knowledge and climate change concern is quite high, over 90 percent of respondents reported that they had already changed their behaviour

in some way in response to climate change (Chandeze et al. 2023). In this survey, data on behaviour was not collected, but it was found that knowledge of climate change was significantly positively associated ($p < 0.000$) with concern about the environment, which, in turn, was significantly associated ($p < 0.000$) with a sense of personal responsibility to take action to protect the environment. This tends to be a precursor for behavioural change.

The majority of South Africans report that they approve of the idea of moving away from coal toward other sources of energy like wind and solar, with 62 percent approving or strongly approving and just 13 percent disapproving (Figure 3.4).

To better understand the perceived impacts of the transition, respondents were asked what positive impacts, if any, they believe will happen because of the shift from coal to other energy sources (Figure 3.5). The most frequently selected benefits had to do with energy—over half of South Africans believe the transition will reduce or end load shedding, and 41 percent believe it will lead to reduced energy prices. A further 41 percent believe the transition will help the economy grow, but there seems to be a weaker association with positive health and environmental impacts. Only 13 percent said that none of the potential positive impacts would occur.

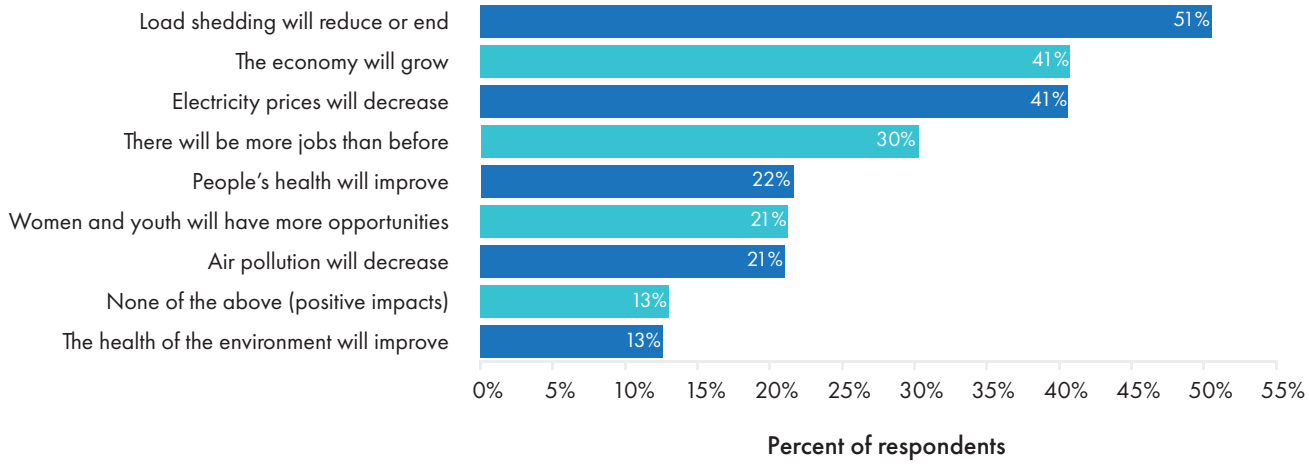
Figure 3.4 • **To what extent do you approve or disapprove of actions being taken to change from coal to other sources of energy (like solar and wind)?**



Note: The x-axis shows the percentage of respondents who selected each option. The six top bars break down all responses to the question, and the bottom two bars group together all respondents who approve (strongly approve plus approve) and disapprove (strongly disapprove plus disapprove).

Source: HSRC SASAS 2023 PCC just transition module.

Figure 3.5 • **Perceived positive impacts of energy transition**



Source: HSRC SASAS 2023 PCC just transition module.

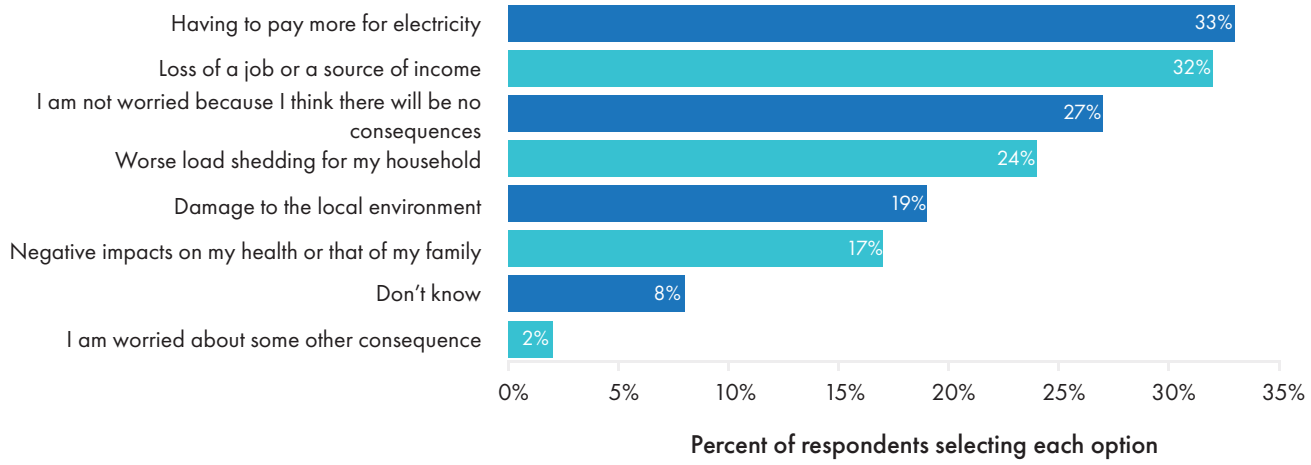
Outside of South Africa, the energy transition tends to be more associated with positive impacts on the environment and health than on the economy and energy prices. For example, over 60 percent of European respondents believed the transition would have net positive impacts on air quality and health, 63 percent of Americans believed it will improve local air and water quality, and 52 percent of Japanese respondents anticipated that it would contribute to a healthier environment (Chandeze et al. 2023; Chapman et al. 2023; Tyson et al. 2022). A slight majority (52 percent) of Europeans thought the impact on energy prices would be net negative, and Americans were more likely to say the impact on the pricing of energy goods would be negative (40 percent) than positive (29 percent) (Chandeze et al. 2023; Tyson et al. 2022). The socioeconomic context in South Africa compared to Europe, Japan, and the United States likely contributes to energy and economic benefits being more salient to South Africans. Unfortunately, the authors were not able to identify any surveys on perceptions toward the just transition or energy transition that had been conducted in middle- or low-income countries for a more direct comparison.

South Africans also are concerned about potential negative impacts of the transition. First, respondents were asked how worried they are that they or their family will be negatively impacted by the transition. Just over a quarter (27 percent) reported being very or extremely worried, 29 percent were somewhat worried, and 22 percent were not very or not at all worried. Another 15 percent said the transition will not impact them or their family. In terms of the specific negative impacts of concern (Figure 3.6), respondents were most worried about having to pay more for electricity (33 percent), followed by loss of job or income (32 percent). As with potential benefits, the energy and economic impacts seem to have the greatest salience to South Africans. A similar proportion of European respondents (33percent) reported concern that the energy transition would impact their job or the sector in which they work (Chandeze et al. 2023).

There is strong support for policies that could be enacted to help mitigate potential negative impacts from the transition (Table 3.1). The highest support was expressed for policies related to improved economic opportunity, including education, training and skills, and targeted employment opportunities for vulnerable groups. A slightly lower share of people was partial to short-term financial support for displaced workers and a basic income grant. Although these differences should not be overstated, it seems that first preference among the public would be for policies that would enhance employment-related opportunities.

South Africans think the country should accept financial assistance from wealthy countries to support the transition but are split on whether the government should manage the funds. Approximately two-thirds (64 percent) said that South Africa should accept such financial assistance, but only 34 percent thought the government should manage it. One-seventh (14 percent) said South Africa should not accept financial assistance, and the remaining respondents said they did not know or did not have an opinion.

Figure 3.6 • **Are you worried about any of the following happening to you or your family because of the change from coal power to other forms of energy (select all that apply)?**



Source: HSRC SASAS 2023 PCC just transition module.

Table 3.1 • **Support for just transition policy measures, ranked from highest to lowest support**

	POLICY SUPPORT					
	Improve education to help people find jobs in new sectors (%)	Help women, youth, and vulnerable groups find jobs (%)	Support local businesses and create job opportunities in affected areas (%)	Training and skills programmes for workers who lose jobs (%)	Short-term financial help to workers who lose jobs and can't find new ones right away (%)	Create a basic income grant that all South Africans would receive (%)
Agree	79	77	77	75	70	70
Neutral	13	15	14	18	19	16
Disagree	6	5	6	4	8	12
Don't know / refuse	2	3	3	3	3	2
Total	**100**	**100**	**100**	**100**	**100**	**100**

Source: HSRC SASAS 2023 PCC just transition module.

Recommendations and next steps

This survey represents a critical baseline on the state of knowledge about and perceptions toward the just transition in South Africa and shows how climate change opinions are evolving. As part of its ongoing monitoring and evaluation duties, the PCC aims to continue to partner with HSRC to administer this survey again in the future to track how both just transition and climate change knowledge and perceptions are changing over time. This will also enable the PCC to monitor the impact of its own work because building public awareness and consensus on the just transition and climate action is key to its mission as well as to the success of related policy.

These results will also feed into the PCC's communications strategy and annual work plans as more work is needed to socialise the concept of the just transition and correct misinformation about climate change among the public and stakeholders. The PCC will work to bolster public understanding and trust about the just transition and climate change and its potential impacts while addressing any misconceptions identified in the results and building upon points of consensus. The full survey results and detailed analysis will be made available in a separate report to be published on the PCC's website.

SECTION 2.

The race to build climate resilience

CHAPTER 4.

CLIMATE CHANGE IMPACTS AND ADAPTATION ACTION: THE RACE TO BUILD RESILIENCE

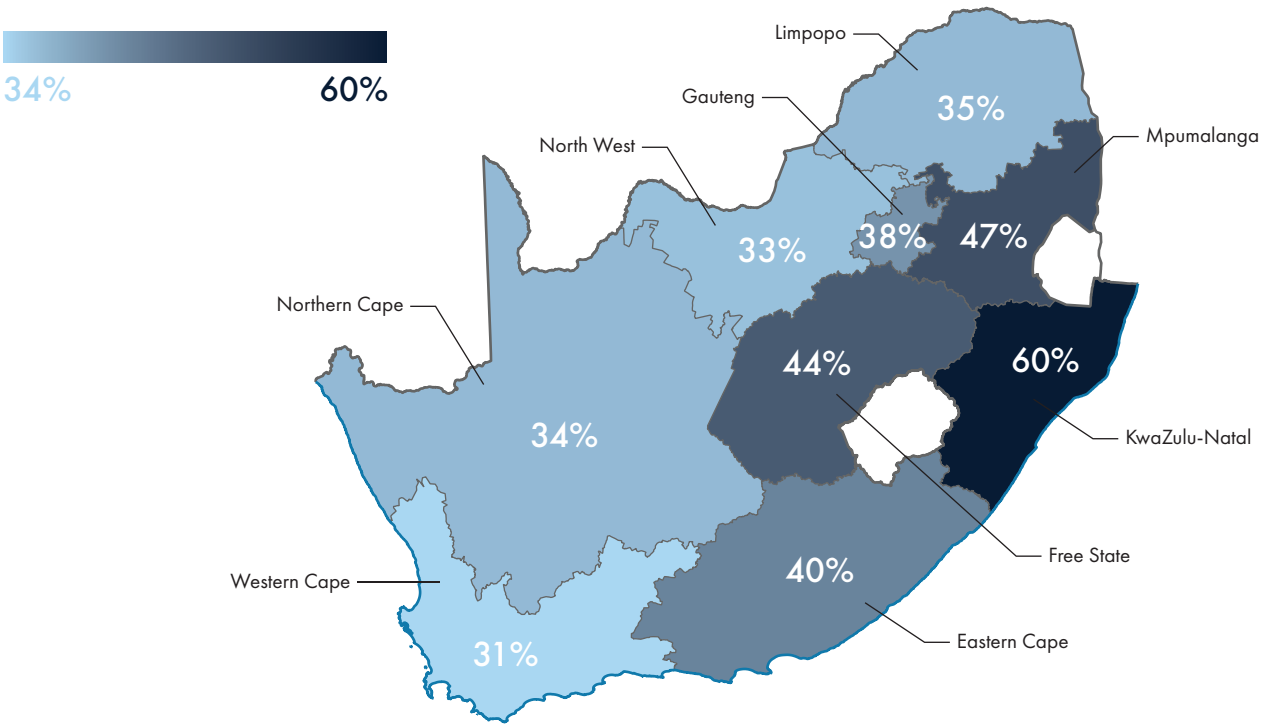
Observed and projected climate change impacts

South Africans are already experiencing widespread and, in some instances, devastating impacts of climate change. The country's annual temperature has increased twice as fast as the global average since 1990 (DEA 2013; Republic of South Africa 2021b), and the number of rainy days across the country has significantly decreased, with more intense rainfall events and dry periods (DEA 2013). These observed changes have led to numerous extreme climate-related events, including drought, floods, and extreme heat. Seventy-three percent of South African households have reported to have been affected to some degree by extreme weather events over the past decade. Figure 4.1 shows the differentiated experiences of these events across provinces.

These are some of the most dramatic climate-related events in recent years:

- **Nationwide heat wave (November–March 2023):** Most of South Africa faced heat wave conditions from late 2023 (SAWS 2023) through early 2024. The combination of climate change and the El Niño state—a natural phenomenon that brings warmer

Figure 4.1 • **Extent to which South African households in different provinces report being affected by extreme weather events (such as floods, big storms, droughts, heat waves) over the past 10 years**



Source: HSRC 2023.

and drier conditions to some parts of the world, including South Africa—contributed to abnormally high temperatures (Evans 2024). Large parts of the Northern Cape, North West, and Free State provinces, for example, all experienced extreme heat and maximum temperatures, which broke 63-year-old records in some areas (SAWS 2023). The high temperatures led to livestock losses and a decline in agricultural crop yields (Stats SA 2024a), and 6,000 wildfires—affecting an estimated 100,000 hectares—were reported between December 2023 and January 2024 in the Western Cape (Ngcuka 2024). Although the health impacts were not as well documented, extreme heat can exacerbate chronic medical conditions among vulnerable populations and cause dehydration, cramps, exhaustion, and strokes (Ngcuka 2024).

- **The Nelson Mandela Bay water crisis (2015-23):** The Nelson Mandela Bay Metropolitan Municipality has only just recently emerged from a crippling eight-year drought that placed severe stress on its water system. When seasonal rains arrived late in 2022, poorly maintained water infrastructure and high water demand left the municipality's four dams operating at a combined 15 percent capacity (Majavu 2022). Residents were asked to reduce their daily water consumption to just 50 litres per day, and many households were left reliant on water tankers after going days without municipal water (Sizani and Mbovane 2023). Water supplies have since been replenished from rain, but water restrictions remain in place and the threat of water shortages continues as leakages in distribution systems lead to losses ranging between 30 percent and 40 percent (Pawson 2023).
- **The KZN floods (April–May 2022):** The KZN province was struck with record-breaking rain for four days in April 2022, with rainfall exceeding 200 millimetres (mm) in a 24-hour period (PCC 2023a; SAWS 2022). The subsequent overflow of 18 rivers caused floods and erosion that led to the loss of an estimated 443 lives and directly impacted 19,112 households by halting economic activity, damaging properties, limiting mobility, and disrupting essential services (PCC 2023a). Additional flooding in May exacerbated the destruction of critical infrastructure and caused fatalities across 8 of the province's 11 municipalities (PCC 2023a). The eThekwini Municipality alone suffered economic losses upwards of R540 million, and it is still struggling to get key public infrastructure fully functional, most notably wastewater treatment systems (PCC 2023a). Residents of KZN were significantly more likely to report being impacted by extreme weather events during the last 10 years than residents of other provinces (Figure 4.1).
- **Avoiding Day Zero in Cape Town (2015–18):** From 2015 to 2018, Cape Town was affected by a 1-in-400-year drought that brought the city's 4.6 million residents to the verge of running out of water—Day Zero (Hill-Lewis 2023). A protracted lack of rainfall and outdated water infrastructure left water supplies at minimum levels and led the city to restrict household water use to just 87 litres per person per day (Baker 2018). On a more macro level, the drought led to an estimated R15 billion in losses to the Western Cape province's economy, equivalent to 3.4 percent of its gross domestic product (GDP) (WBG 2022).

The frequency and intensity of such events are likely to increase due to the effects of a changing climate (IPCC 2022). Future projections indicate that the west and south of the country are likely to experience drier conditions, and wetter conditions are predicted for the east (DEA 2013). Mean monthly temperatures are consistently projected to rise by 2.0°C by the 2050s and 4.2°C by the 2090s under a high-emissions scenario (WBG 2021). Although the severity of climate impacts depends on global efforts to reduce GHG emissions, these changes are expected to result in more frequent droughts, floods, and heat waves (Johnston et al. 2024). Tropical cyclones might also become more intense due to projected climatic changes (Johnston et al. 2024).

The economic, environmental, and social damage of climate change, both observed and anticipated, threaten to undermine South Africa's achievement of its development goals and ability to overcome its intertwined challenges of poverty, inequality, and unemployment (PCC 2022b; Republic of South Africa 2021b). South Africa is vulnerable to climate change exacerbating existing water and food insecurity, but the country also faces risks related to health, human settlements, infrastructure, and critical ecosystem services (WBG 2021). Increasingly, severe droughts and floods have damaged public infrastructure, which has suffered from decades of mismanagement and underinvestment, and have complicated the provision of basic public services, to which many South Africans already lack access (Johnston et al. 2024). The tourism sector, which directly contributed 3.5 percent to South Africa's GDP and employed 4.7 percent of the workforce in 2022 (Stats SA 2024b), could also see a 4 percent decline in future visitors to national parks due to drought-related losses to biodiversity (Johnston et al. 2024). Importantly, the disproportionate impacts of climate

change on socially and economically vulnerable groups, including black and female South Africans, are likely to increase entrenched and already high inequality (Johnston et al. 2024) without addressing their unique vulnerabilities. Transformational change is therefore required to justly transition toward a climate-resilient society in a way that improves the lives and livelihoods of all South Africans.

The implementation gap for climate adaptation

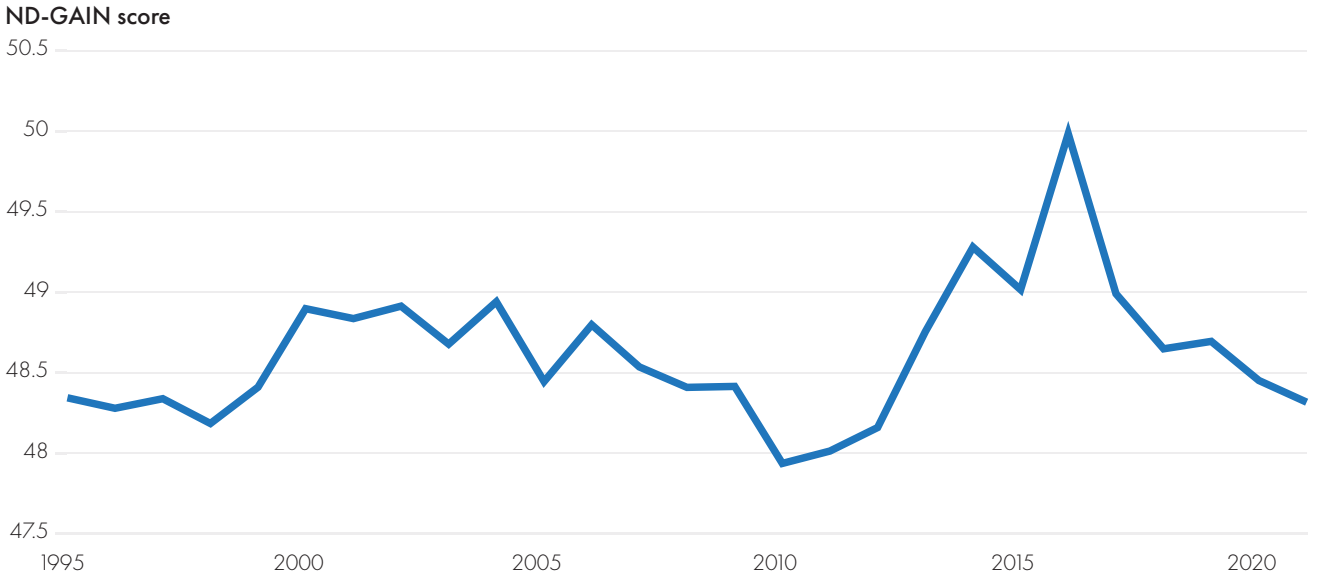
South Africa's updated NDC and its National Climate Change Adaptation Strategy (NCCAS) outline a comprehensive approach to address its climate vulnerabilities, with the latter serving as a national reference point for coordinated action across all sectors and administrative levels (DFFE 2019). The NCCAS's primary objectives are to

- build climate resilience and adaptive capacity to respond to climate change risk and vulnerability;
- promote the integration of climate change adaptation response into development objectives, policy, planning, and implementation;
- improve understanding of climate change impacts and capacity to respond to these impacts; and
- ensure resources and systems are in place to enable implementation of climate change responses (DFFE 2019).

In support of these objectives, adaptation priorities include increasing institutional capacity, governance, and legal frameworks; further developing the scientific basis for strengthening the national and provincial governments' readiness to respond; mobilising funding for adaptation; and implementing prioritised actions.

Since 2016, however, South Africa's vulnerability to climate change has steadily increased, and its readiness to leverage public and private investments for adaptation action has decreased. These two components—vulnerability and readiness—inform South Africa's Notre Dame Global Adaptation Initiative (ND-GAIN) Index[5] score, which has remained relatively the same overall despite ups and downs over the past three decades, as shown in Figure 4.2 (ND-GAIN 2021). The sharp decline in its ND-GAIN score since 2016 can partly be attributed to increasing climate vulnerability (ND-GAIN 2021). According to most recent data, the country's food and water sectors are the most vulnerable to climate change due to projected changes in its cereal yields, low capacity to acquire and deploy agriculture technology, and limited dam storage capacity per capita (ND-GAIN 2021). South Africa's readiness to translate investment into effective adaptation action to address these vulnerabilities has declined since 2016 due to high and persistent social inequality, as measured by the poorest quintile's share of national income, comparatively complex business environment, and declining governance (ND-GAIN 2021).

Figure 4.2 • **South Africa's ND-GAIN score**



Note: ND-GAIN = Notre Dame Global Adaptation Initiative.
Source: ND-GAIN 2021.

South Africa's increasing vulnerability to, and declining readiness for, climate change suggests that progress in adaptation planning has not translated into implementation of adaptation actions at the scale and pace required to keep up with intensifying climate change impacts. Although the DFFE is currently working to further refine the National Tracking and Evaluation System in coordination with subnational actors to better track and evaluate adaptation action (Pers. Comm. 2023a), only 28 of the 95 actions outlined by the NCCAS are listed as fully implemented or currently being implemented (DFFE 2019, 2021a). Most of these 28 actions aim to *enable* the planning, implementation, and monitoring and evaluation of adaptation action (DFFE 2019, 2021a) rather than actually *implementing* adaptation initiatives. Failure to address climate vulnerabilities could worsen South Africa's labour productivity, threaten biodiversity, and negatively affect human and livestock health (WBG 2022). As vulnerable groups are disproportionately impacted by climate change, high levels of poverty and inequality magnify the cost of inaction to improve South Africa's climate resilience (WBG 2022).

Bridging the implementation gap for climate adaptation

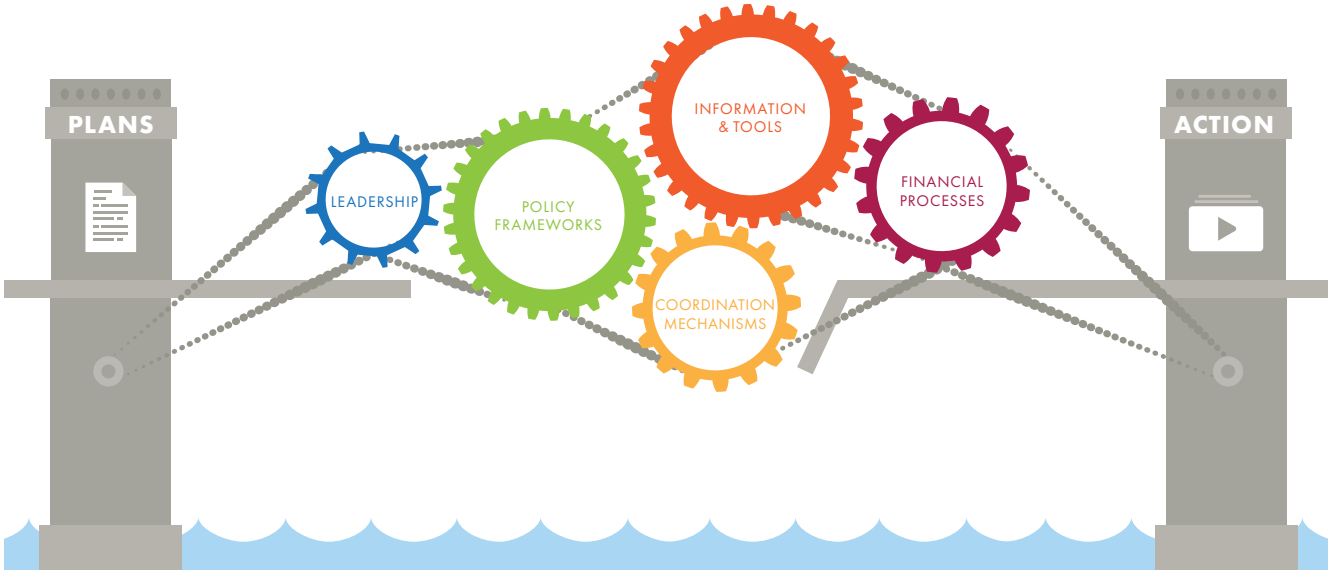
Literature has identified five complementary factors or gears that must be present—to differing degrees in different contexts—to close this implementation gap for adaptation (Mogelgaard et al. 2018). These five gears are policy frameworks, leadership, coordination mechanisms, information and tools, and supportive financial processes (Figure 4.3). The following sections evaluate achieved progress and challenges across each of these factors in South Africa, against the definitions established by Mogelgaard et al. (2018).

Policy frameworks

> *Mogelgaard et al. (2018) define adaptation* ***policy frameworks*** *as "including political commitments, mandates, and laws that support the integration of adaptation objectives into development planning and sectoral strategies," and they note that such frameworks are more likely to catalyse implementation when they include mechanisms for accountability or enforcement.*

South Africa has mainstreamed adaptation into its overall development and policy framework. Approved in 2011, the National Climate Change Response Policy's call for climate change action provided the basis

Figure 4.3 • **Gears to bridge the gap between adaptation planning and implementation**



Source: Mogelgaard et al. 2018.

for mainstreaming both mitigation and adaptation and led to a proliferation of adaptation policies, plans, and strategies across sectors and spheres of government (DFFE 2019). The National Development Plan 2030, established in 2013, identifies climate change as an external driver of change and emphasises enhancing the climate resilience of South Africa's people and economy, including by channelling public investment into research, new agricultural technologies, and the development of adaptation strategies and support services for smallholder farmers to protect rural livelihoods (NPC 2013). Submitted to the United Nations Framework Convention on Climate Change (UNFCCC) in 2021 and drawing from the NCCAS (DFFE 2019), its updated NDC included an adaptation component for the first time (Republic of South Africa 2021b), detailing planned adaptation actions across key sectors most likely to be impacted by climate change.

Guided by this national framework, efforts to mainstream climate adaptation across sectoral and subnational plans and policies are ongoing. With support from the DFFE and the South African Local Government Association (SALGA), through the Local Government Climate Change Support Programme, all provinces and district municipalities, as well as some local municipalities, have developed climate change response strategies based on climate risk and vulnerability assessments (DFFE 2019). Some provinces and municipalities have also begun to integrate their climate response strategies into their strategic plans, but full resourcing and implementation is yet to be realised, even in the most advanced municipalities (DFFE 2019). Almost all sectors that are considered highly vulnerable have also developed adaptation strategies based on their vulnerabilities, however, the quality and capacity to act on these strategies varies considerably and on average remains low (Pers. Comm. 2023a).

Multiple hurdles to implement plans and policies are, however, slowing down progress. With close to 300 municipalities across South Africa, it is difficult for the DFFE to provide continuous planning support, and high staff turnover necessitates having to repeatedly start over (Pers. Comm. 2023a). Without a common methodological framework to guide the mainstreaming process, the aggregation of response plans across sectors and government levels remains difficult (DFFE 2019). Within the existing policy framework, the scope of institutional responsibilities to address climate change are not always clear despite regular communications among at least some of the relevant government spheres and sectors (DFFE 2019). Numerous private coping and adaptation measures are being implemented autonomously by businesses and households in response to the impacts of extreme weather and climate events (Pers. Comm. 2024b). However, planning and regulation of private adaptation action is proving a challenge for many government entities (Pers. Comm. 2024b).

South Africa's Climate Change Bill may prove helpful in overcoming some of these challenges. The bill aims to enable a more coordinated achievement of a low-carbon, climate-resilient society by outlining the required contributions by and relationship between adminis-

trative and sectoral government entities (Republic of South Africa 2022). It requires, for example, that the objectives of a national adaptation strategy and plan (currently the NCCAS) be integrated into national planning policies and programmes (Republic of South Africa 2022). The bill also mandates designated departments to develop coherent sectoral plans, including for agriculture, the environment, health, and human settlements (Republic of South Africa 2022). Once approved, metropolitan or district municipalities would also be legally required to conduct a climate needs and response assessment to develop a climate change response implementation plan that is coherent with and supports provincial, metropolitan, or district municipal planning instruments, policies, and programmes (Republic of South Africa 2022).

Although the Climate Change Bill aims and is expected to help address the fragmentation of strategic and technical responsibilities within government, climate change is still viewed as a fringe issue by many ministries and has not yet been fully mainstreamed into key sectoral policies (WBG 2022). This fragmentation has also prevented the potential for economies of scale that could be achieved through joint training programmes for staff across relevant ministries (WBG 2022).

Leadership

> *As Mogelgaard et al. (2018) note, "Sustained, persistent leadership, from inside or outside government, including by political leaders, bureaucrats, and civil society organizations . . . can manifest itself by heads of state launching new strategies that encourage mainstreaming, ministries creating new institutions, or citizens championing innovating initiatives that accelerate implementation of mainstreaming commitments."*

Leadership from diverse actors, both public and private, across administrative levels has backed building climate resilience as a national priority. The achievement of a low-carbon, climate-resilient society is a central priority of the Ramaphosa administration, with the cabinet having recently approved a framework—developed by the PCC—to guide the just transition (Republic of South Africa 2023). As the designated custodian of environmental issues, the DFFE has supported sectoral departments and other government entities to understand and address climate-related risks by providing climate risk projections and recommending evidence-based adaptation strategies across key sectors through the long-term adaptation scenarios (Pers. Comm. 2023a). Universities have also demonstrated strong leadership as knowledge brokers by provid-

ing policymakers with evidence-based inputs into policies and strategies and translating research into actionable information (DFFE 2019; Pers. Comm. 2023b). Of 486 climate-related projects implemented from 2000 to 2020 that addressed adaptation, local governments or municipalities, especially metropolitan municipalities, were found to most frequently be the lead, implementing, or host agent, followed by local NGOs and universities or research institutions (Sibanda et al. 2023).

Nonetheless, stronger political will and capacity to address climate change risks are required to implement adaptation measures at the required scale and pace. The Climate Change Bill, for example, was introduced in February 2022 but was only approved by the National Assembly in October 2023 and the National Council of Provinces in April 2024. There is also an uneven distribution of adaptation projects across South Africa, with most of the adaptation projects evaluated by Sibanda et al. (2023) concentrated in the Western Cape and KZN provinces. A 2023 survey of South African government officials found that limited political will, gaps in human capacity, and the absence of a mandate at the local level are among encountered barriers to climate adaptation (Sibiya et al. 2023). Many municipal officials tend to still view building climate resilience as additional to, rather than a fundamental element of, their core responsibilities, which hinders the uptake of municipal climate change plans and strategies (Pers. Comm. 2023b). This has led to the integration of climate change into the standard curriculum for municipal politicians to improve their understanding and prioritisation of climate adaptation, without which little is achieved (Pers. Comm. 2023a). Municipal budget constraints are also a significant barrier to the implementation of local adaptation action (see Section 4.3.5).

Coordination mechanisms

> *The third factor included in Mogelgaard et al.'s 2018 evaluative framework is coordination mechanisms: "Coordination mechanisms across sectors and between government departments, such as inter-ministerial steering committees or task forces, that support shared mainstreaming goals . . . can cut across policy levels, encompass public and private institutions, and encourage ongoing public engagement."*

As the impacts of climate change transcend sectoral and administrative lines, diverse actors are responsible for and contribute to the coordination of adaptation action in South Africa. At the national level, the DFFE leads the coordination and implementation of the NCCAS (DFFE 2019). Line departments are responsible for the integration of climate change responses into their respective sectoral plans at both the national and provincial levels (DFFE 2019). In alignment with the NCCAS, provinces and municipalities should also develop and implement adaptation plans, with municipalities responsible for the provision of basic services, disaster risk management, and other important climate response actions (DFFE 2019). The private sector enhances public efforts by providing insights, experiences, and resources (DFFE 2019) as well as including climate risks in their corporate planning and implementing measures to protect their assets and operations. Civil society, labour groups, academia, and community leaders help to guide and support the implementation, monitoring, and evaluation of adaptation initiatives (DFFE 2019). Although coordination has improved over the last decade, fragmentation has not yet been overcome.

A range of coordination bodies and mechanisms have been established to enable these and other relevant actors to align actions while avoiding duplication and inefficiency in adaptation responses. These include the PCC, which President Ramaphosa established in 2020 as a multistakeholder entity to provide independent, transparent advice on South Africa's climate change response (PCC 2022b). The Inter-Ministerial Committee on Climate Change plays a key role in coordinating national adaptation action (Republic of South Africa 2021b). At the subnational level, seven of South Africa's nine provinces and all metro areas rely on coordinating forums for climate change (Pers. Comm. 2023a). These include the Nelson Mandela Bay Climate Resilience Forum, KZN Premier Climate Change Advisory Forum, and the Provincial Climate Change Coordinating Forum in the Mpumalanga province (Pers. Comm. 2024a). Additionally, the National Treasury and Banking Association of South Africa jointly coordinate initiatives through the Climate Risk Forum, which convenes regulatory agencies and industry associations and supervises the implementation of the technical paper, "Financing a Sustainable Economy" (Fallasch et al. 2023; National Treasury 2021b).

Yet despite the benefits that these mechanisms and others provide, improved implementation of adaptation plans and policies will require more frequent and coordinated communication between actors to fully overcome fragmented actions, avoid duplicative efforts, and improve investment efficiencies (DFFE 2019). South Africa's government remains fragmented (Pers. Comm. 2023b), with poor coordination across and between spheres constraining adaptation planning, implementation, and monitoring (Sibiya et al. 2023).

Many institutions are actively working to advance climate-related research, including the South African Weather Services, North-West University, the University of the Witwatersrand, the Council for Scientific and Industrial Research, the University of Cape Town, Stellenbosch University, and the South African National Biodiversity Institute. There is, however, limited inter-institutional coordination and no central database or platform to share data with one another (DFFE 2019). In addition to clarifying and harmonising institutional mandates for climate action, both in terms of adaptation and mitigation, the Climate Change Bill will help to reinforce the role of different coordination mechanisms, including Provincial and Municipal Forums on Climate Change (Republic of South Africa 2022).

Information and tools

> *Mogelgaard et al. (2018) note that "information and tools, including learning initiatives, training, or access to technical expertise that enables mainstreaming . . . [with] knowledge brokers . . . can facilitate information sharing across sectors and policy domain . . . bridging the implementation gap."*

Contributions from a rich ecosystem of stakeholders over the past two decades have contributed to an improved understanding of South Africa's climate vulnerabilities. For example, the University of Cape Town, among others, has long supported public and private decision-making by serving as knowledge brokers who translate research into actionable information for planning, provide evidence-based inputs for policymaking, and provide training for government institutions around climate adaptation (Pers. Comm. 2023b). However, as noted in the previous section, the university and wider academic community face a degree of fragmentation, much like the government (Pers. Comm. 2023b).

Climate services have been developed to provide decision-makers at different scales with the scientific data and information required to manage climate risks. These include the National Climate Change Information System, which offers a range of climate information and datasets to support decision-making (DFFE 2021). These datasets span different sectors and geographic areas, including an agrohydrological atlas, climate change projections, and a coastal risk atlas, among others (DFFE 2021). Another example is the Council for Scientific and Industrial Research's GreenBook. This online planning support tool provides local governments with scientific evidence around the expected impacts of climate change on South Africa's settlements to improve their integration of climate adaptation into local planning instruments and processes and enable more climate-resilient cities and towns (CSIR GreenBook 2023). The Let's Respond Toolkit also guides local governments and stakeholders with practical tools and technical information to use local planning processes to respond to climate change (Dazé 2017).

The uneven distribution of and fragmentation between climate service providers has, however, led to variances in the capacity of public institutions to manage climate risks. Efforts must also be made to improve the uptake of climate services by the most vulnerable populations. The expansion of early warning systems to under-served groups, locations, and sectors requires more funding. Marginalised communities should also be better integrated into campaigns to raise awareness of the actions they can take to prepare for and respond to weather alerts and community-based systems (PCC 2023a). Residents of the informal settlement Quarry Road, for example, were trained by researchers at the University of KwaZulu-Natal to develop hazard maps that identified areas prone to flooding and evacuation routes to improve their understanding of their risks, and municipal officials have communicated warnings via WhatsApp to make information more accessible in the face of limited climate literacy (Evans 2022a).

Supportive financial processes

> *Mogelgaard et al.'s (2018) fifth factor is supportive financial processes, which they say must "encourage decision-makers to consider climate risks as well as identify, track, and cover costs to adapt . . . including expenditure-tracking initiatives, budget-tagging efforts, and special funds governments establish to support mainstreaming."*

South Africa has taken action to foster financial processes that enable the proactive management of climate risks and tracking of adaptation efforts. In 2022, South Africa became the first and only African country to have developed a green finance taxonomy that provides a standardised framework to classify assets and projects that contribute to climate adaptation as well as mitigation (Fallasch et al. 2023; National Treasury 2022). With support from the World Bank, the National Treasury has also conducted 11 climate budget tagging pilots across government spheres and sectors to create and facilitate the uptake of a country-specific methodology for tracking adaptation and mitigation finance flows (National Treasury 2021a, 2022; OECD 2022). Both are examples of important steps toward

mainstreaming climate adaptation into annual planning and budget processes and an improved understanding of the volume and uses of adaptation finance, which are necessary to scale public adaptation investments in alignment with national development goals.

Despite positive developments, more work is needed. Public and private financial actors should continue coordinating, including through the Climate Risk Forum's Capacity Building Working Group to address knowledge gaps and improve uptake of climate risk management tools and guidance (Fallasch et al. 2023). Additionally, only a handful of companies have begun to disclose environmental, social, and governance data to the Task Force on Climate-related Financial Disclosures (Fallasch et al. 2023). Monitoring and evaluation of climate-related investments also needs to be improved (WBG 2022); and although 80 percent of private firms outside the financial sector are aware of climate risks, an estimated 60 percent have not yet developed plans for climate action (WBG 2022).

Adaptation finance must also increase in volume and flow more equitably to close the implementation gap without worsening South Africa's debt burden. The estimated cost of South Africa's adaptation response through 2030 ranges from R4.2 billion to R308 billion, depending on mitigation scenarios (DFFE 2019). Tracked adaptation finance flows in South Africa from 2019–21 increased by five percentage points from the 2017–18 period, but this amounted to just R16 billion or 12 percent of total tracked climate finance, which still heavily favours mitigation (de Aragão Fernandes et al. 2023). Grant financing and concessional debt—lending with interest below the market rate—decreased, and the average cost of borrowed capital ranged between 10 percent and 12 percent over the same period (de Aragão Fernandes et al. 2023). The volume of public and private finance, both domestic and international, supporting adaptation and activities with cobenefits must therefore continue to increase for South Africa to meet its adaptation needs. Adaptation finance must also be mobilised from diverse sources with instruments that do not further exacerbate South Africa's already high national debt, which currently accounts for 72.7 percent of its GDP (CEIC Data 2023). Without access to affordable capital to build climate resilience, South Africa is vulnerable to the climate debt trap. At the national level, the newly established Climate Change Response Fund aims to better coordinate the mobilisation of private and public finance for both adaptation and mitigation efforts (SA News 2024b).

Finally, constrained municipal budgets impede the implementation of adaptation and resilience-building initiatives at the local level. Beyond limited technical capacity and political will on the part of municipal officials to address physical climate risks (see Sections 4.3.1 and 4.3.2), municipalities, especially in rural areas (WBG 2022), lack the budget to support climate adaptation: 163 of South Africa's municipalities were in financial distress in 2021 (Mboweni 2021). Of these, 40 struggled to deliver basic services and 102 adopted budgets that exceeded their financial resources (Mboweni 2021). Local governments receive intergovernmental transfers, but channelling them through national and provincial governments erodes the total amount received (Keen et al. 2022). Kenya's County Climate Change Funds (Murphy and Orindi 2017) offer one potential model for municipalities to establish funds that mobilise and blend finance from international and domestic sources in alignment with national adaptation goals.

CHAPTER 5.

A MORE EQUAL, CLIMATE-RESILIENT AGRICULTURE SECTOR

Overview

South Africa's agriculture sector both contributes to climate change and is highly vulnerable to it. Small-scale farmers are particularly vulnerable because poverty and structural inequalities hinder their ability to adapt. Driving a well-planned shift toward more climate-resilient agriculture could simultaneously address both climate mitigation and adaptation goals while improving food and nutrition security and enhancing rural livelihoods—but only if significant inequalities are addressed.

Despite its limited contribution to South Africa's national economy, agriculture is the primary economic activity in rural areas. In comparison to other upper-middle-income countries, agriculture composes a relatively small component of South Africa's national economy (DALRRD 2020; ITA 2023; NPC 2013): just 2.83 percent of its GDP, when forestry and fishing are included (World Bank 2023c); and roughly 6 percent of employed South Africans (Stats SA 2023e). Agriculture remains the primary economic activity for rural South Africans, who account for 60 percent of those facing poverty despite representing only 30 percent of the population (DALRRD 2020), and it can play a significant role in promoting employment and rural development (Kapari et al. 2023; Sihlobo and Qobo 2021). There are an estimated 2 million small-scale farmers across South Africa (Mazenda and Masiya 2022), who are among the most vulnerable to climate change and have the least access to the resources needed to adapt and build resilience. Within the commercial agriculture industry, small-scale farms represent 18.5 percent of income and 26 percent of employment (Stats SA 2020).

Many South Africans rely on subsistence or small-scale agriculture to combat household food insecurity. Profits from South Africa's agricultural exports balance the cost of imported food (NPC 2013), making it food secure at the national level. However, one-fifth of South African households face food insecurity (Stats SA 2023a), meaning that their economic and physical accessibility of food remains unstable (USAID n.d.). Female-headed households—those for which women are the primary decision-makers or breadwinners—and those without an employed member are more likely to have inadequate or severely inadequate access to food (Stats SA 2023a). In the case of female-headed households, this is despite their tendency to engage in agricultural activities more than their male-headed counterparts (Stats SA 2023a).

In addition to contributing to rural livelihoods, agriculture can significantly contribute to household food security (Stats SA 2023a). The need to secure either a primary or secondary source of food motivates the vast majority (86 percent) of the roughly 16 percent of South African households that are involved in agricultural activities (Stats SA 2023c). Most households involved in agriculture activities produce fruit and vegetable crops, followed by grains and food crops, poultry, and livestock (Stats SA 2023b).

Climate change is magnifying the challenges faced by farmers, particularly those operating on a small scale. The impacts of climate change have caused overall agricultural productivity in South Africa to fluctuate over the past decade (PCC 2022b). A 2019 report by the South African Insurance Association showed that 42 percent of farmers had experienced losses due to drought, 29 percent because of storms, and 28 percent from floods (WBG 2022). In the future, the availability of water resources will largely determine the suitability of different regions to produce certain crops (PCC 2022b) due to a high reliance on rain-fed agriculture and limited availability of water resources for irrigation (WBG 2022). Small-scale farms are often in unfavourable locations, so their capacity for even subsistence production is low (Stats SA 2023a); thus, small-scale farmers are particularly vulnerable to climate impacts like rising temperatures, varied rainfall patterns and more frequent droughts, heat waves, floods, and outbreaks of pests and diseases (DALRRD 2020). Yet high rates of poverty often limit their access to adaptive measures like more resilient seeds, the ability to change planting times based on early warnings and weather alerts, small-scale irrigation, and improved cultivation techniques. Unless effective action is taken, small-scale

farmers will continue to bear the brunt of climate change impacts while having the fewest resources with which to manage the increasing risks they face.

The capacity of many of South Africa's small-scale farmers to mitigate and manage the impacts of climate change is constrained by entrenched spatial, gender, and racial inequality. The deregulation and liberalisation of South Africa's economy postindependence has enabled a highly concentrated, vertically integrated, and corporatised agriculture sector that is disproportionately influenced by a small number of large-scale agribusinesses (DALRRD 2020). Around 70 percent of all agricultural income, for example, is earned by less than 7 percent of farmers (PCC 2022b). Rural communities face limited participation and ownership throughout South Africa's agriculture value chain, including limited access to land (DALRRD 2020). Primary agriculture producers are also predominantly white (DALRRD 2020) and black South Africans are estimated to represent just a quarter of all formal farm owners (PCC 2022b). As a result, farming improvements are difficult for most South Africans engaged in agriculture (DALRRD 2020). Whereas commercial farmers have invested in drip irrigation, more resilient crop varieties, and other technologies to adapt to climate change, small-scale farmers largely require government support and financial incentives to do so (PCC 2022b).

Beyond the vulnerabilities faced by small-scale farmers, South Africa's agricultural sector as a whole is also vulnerable to climate change, and current production practices contribute to the challenge. The majority (68 percent) of agricultural emissions come from livestock, due primarily to enteric fermentation by nondairy cattle (DFFE 2024). Consecutive droughts have led to a decline in cattle populations and have resulted in lower related emissions since 2000 (DFFE 2024). This has contributed to a 9 percent decrease in GHG emissions from agriculture since 2000. However, agriculture still accounts for 11 percent of South Africa's total emissions (DFFE 2024). Improved livestock health, feed, manure, and breeding management could reduce related emissions (NBI 2021a). Poor soil management and biomass burning also contribute to agricultural emissions in South Africa (DFFE 2024) but could be reduced through improved practices.

A transformative shift toward a more resilient, low-carbon, equitable food system would need to reach beyond the farm gate. A sustainable food system is one that enables food security and nutrition in a profitable, socially beneficial, and environmentally friendly way (Nguyen 2018). In addition to farmers, many more people depend on and contribute to South Africa's food systems, which encompass a range of interlinked activities and actors involved in not only production but also processing, distribution, consumption, and disposal (Nguyen 2018). Although industrial agriculture plays an important role in South Africa's national food security, small-scale farming is enshrined in South Africa's climate and development policy framework as a key entry point for action that furthers climate resilience, rural development, and household food security. The next section therefore examines the major actions that the South African government has taken to address the climate challenge and reduce the risks to its agriculture sector, with a focus on how it is working to reduce the vulnerability of small-scale farmers.

Major policies

Agriculture and food security are central to South Africa's overall development and climate policy framework. The National Development Plan 2030 (NDP) enshrines agricultural development as an engine to achieve a more integrated and inclusive rural economy based on successful land reform, employment creation, and strong environmental safeguards (NPC 2013). Public investment in agricultural technologies; the development of resilient, environmentally sustainable strategies; and support services for small-scale and rural farmers are also included in the NDP as key to South Africa's transition to a sustainable, climate-resilient, and low-carbon economy (NPC 2013). The "National Climate Change Response White Paper" and NCCAS also both identify agriculture as a priority sector for adaptation, with the latter including gender-responsive support for vulnerable farmers to implement more efficient CSA practices (DFFE 2019).

Agriculture policies, however, are misaligned with climate adaptation policies and local institutional frameworks (SWITCH Africa Green 2020). Subsequently, limited coordination across agencies and spheres of government have hindered agricultural outcomes and improvements for small-scale farmers (WBG 2022). Additionally, related policies could better emphasise and integrate social and ecological justice to ensure that food is produced in a way that improves the resilience of food and ecological systems, strengthens adaptative capacities, reduces GHG emissions, enhances biodiversity, and contributes to landscape restoration.

Required shifts

The Department of Agriculture, Land Reform and Rural Development (DALRRD) is the designated custodian of related issues. Its Strategic Plan 2020–2025 identifies land reform, CSA, and water as directly influencing South Africa's realisation of sustainable agriculture and food security (DALRRD 2020). This section evaluates related efforts and the required shifts for success, leaving water to be discussed in its respective chapter of this report.

Accelerating land reform

In addition to redressing the historical dispossession of land from black South Africans, equitable land reform can also improve the productivity and climate resilience of small-scale agriculture. By mitigating the potential for expropriation and serving as a source of collateral (Murken and Gornott 2022), secure landownership can positively influence agricultural investments (Higgins et al. 2018) and subsequently agricultural productivity (Lawry et al. 2017; Mbudzya et al. 2022). Additionally, lack of tenure security affects the ability of an individual to make improvements to land that advance both climate adaptation and mitigation (IPCC 2019). Securing land tenure for small-scale and emerging farmers could therefore increase opportunities for their ownership of productive assets and incentivise their investment in infrastructure, sustainable land management, and climate-smart measures (WBG 2022).

The historical reliance of South Africa's land reform programme on both restitution and market-based redistribution has, however, not sufficiently changed landholding patterns (DALRRD 2020). Restitution efforts, for example, have largely prioritised urban cases rather than those regarding rural or agricultural land (DALRRD 2020). Financial support previously provided by the state to poor households through settlement/land acquisition grants did not match market prices and therefore largely failed to enable black farmers to purchase productive land (DALRRD 2020). As a result, white South Africans are estimated to still own around 72 percent of agricultural land (DALRRD 2020). Despite the constitution's promotion of equal land rights for women, most tribal authorities in rural South Africa still require women to acquire land through their husbands or male relatives (Masuku et al. 2023).

The effects of land reform on agricultural productivity in South Africa have also varied due to insufficient access to other productive inputs and technical support. Many beneficiaries of land reform, primarily from restitution, are not able to productively use the land they have received, due in part to a lack of infrastructure, inputs, and technical support (NPC 2013). Additionally, only a small number of black farmers who received land through reform have successfully commercialised (OECD 2021); black South Africans account for only an estimated 12.5 percent of commercial farmers (DALRRD 2020). In 2018, women owned just 20 percent of commercial farms in South Africa (Stats SA 2020). In many cases, farming enterprises operating on transferred landholdings go under, leaving large tracts unused and difficult to return to an economically productive state (Pers. Comm. 2023c).

Land reform will therefore only prove to be an effective lever to address climate, development, and agricultural challenges if more transparent, efficient, and equitable processes are adopted. For example, more must be done to improve land transfer mechanisms and land administration (WBG 2022). Likewise, land markets must be protected from opportunism, corruption, and speculation by strengthened monitoring institutions and practices (NPC 2013). In an effort to accelerate land reform efforts, President Ramaphosa's 2022 State of the Nation address prioritised the approval of the Expropriation Bill to create a clear legal framework, establish the Agriculture and Land Reform Development Agency to support emerging farmers, distribute input vouchers to 250 small-scale farmers, and transfer 14,000 hectares of public land to the Housing Development Agency (Republic of South Africa 2023). As of February 2023, however, none of these actions have yet been completed (Republic of South Africa 2023). The Expropriation Bill has, however, been approved by the National Assembly, and 140,000 small-scale farmers—7 percent of the roughly 2 million in South Africa (Mazenda and Masiya 2022)—have received production input vouchers (Republic of South Africa 2023). These are important advancements of land reform efforts in the face of rising input costs and wavering support by commercial farmers. Adequately addressing insecure land tenure, especially for black and female farmers, is necessary to enable investments in land and increase agricultural productivity (NPC 2013).

Enabling CSA

CSA practices enhance the long-term resilience, sustainability, and profitability of agriculture in the face of growing climate risks, rising input costs, and fluctuating productivity. Innovative agricultural technologies are increasingly required to minimise climate-related losses, increase productivity, conserve natural resources, and strengthen the adaptive capacity of farming communities (Myeni et al. 2023). Although not an all-encompassing solution, CSA is one of many effective approaches, such as agroecology, that meet these criteria while also decreasing GHG emissions (Myeni et al. 2023). Released in 2018 for public comment, the draft Climate Smart Agriculture Strategic Framework aims to enhance the resilience of people, food, and agricultural production systems; minimise GHG emissions from the agriculture sector; and safeguard food security (Myeni et al. 2023). (The draft framework has not yet been finalised and released publicly.)

However, the uptake of CSA practices by small-scale farmers has varied across the country (Nhamo et al. 2023; Pers. Comm. 2023c). There are numerous success stories of smallholder farmers across South Africa adopting CSA technologies to improve the sustainability and resilience of their farms. In the Mpumalanga province, for example, smallholder farmers use mixed cropping, rainwater harvesting, and crop rotation to adapt to climate risks (Magagula and Ndoro 2023). Yet uptake varies across the country and among different groups of farmers (UN South Africa 2022, 20). Whereas large-scale commercial farmers have access to high-quality advisory services, small-scale farmers rely heavily on extension officers for CSA information (Magagula and Ndoro 2023; Pers. Comm. 2023c). Many of these extension agents, however, are not sufficiently equipped with practical information to support small-scale farmers to address climate change—nor to navigate language, cultural, and regional differences—and few extension agents are women, who might be more effective at providing information tailored to female farmers (Pers. Comm. 2023c; Walker et al. 2023).

Uptake of CSA practices could be improved by strengthening the capacity and role of agricultural extension agents to provide small-scale farmers with more on-the-ground support to better understand and adapt to climate change (Pers. Comm. 2023c). This is especially true for new landowners who need to learn necessary skills to succeed (NPC 2013; WBG 2022). Agricultural extension agents can catalyse significant improvements by influencing innovation, technology, and decision-making processes at the farms they engage; but to do this, they need continuous training in the latest data on climate risks and effective adaptation measures suitable to smallholder farmers (Ncayiyana et al. 2023) as well as the resources required to do their jobs well (Nhamo et al. 2023). These resources can include practical examples of effective CSA technologies for adaptation and mitigation (Walker et al. 2023) as well as physical assets such as reliable vehicles and high-quality training materials. The agents' effectiveness also reflects their priority and funding by provincial agriculture departments (NPC 2013). Increased government investment in infrastructure and support services that target small-scale farmers is also needed to enhance agricultural development (NPC 2013). Improved infrastructure would also improve smallholder farmers' connectivity to wider markets for their products (DALRRD 2020), but is not currently equitable across all provinces (SWITCH Africa Green 2020).

Stronger partnerships between commercial and small-scale farmers and extension agents could also enhance knowledge transfers and improve smallholder agricultural productivity (Pers. Comm. 2023c). Commercial

farmers, agribusinesses, and organised agricultural industry bodies need to better engage with one another to reverse the declining productivity of South Africa's agriculture sector, promote food production, and raise rural income and employment (NPC 2013). Blended finance structures, as well as market linkages and farming training, have shown to be key components of successful partnerships aimed at driving inclusive transformation in the agriculture sector (Sihlobo and Qobo 2021) and could help incentivise such collaboration. South Africa's commercial farming sector offers many examples of major investments that have resulted in growth and job opportunities, including the expansion of the table grape industry along the Orange River and expanding the sugar industry into Mpumalanga (NPC 2013). Regions with untapped potential and underused land include the Eastern Cape, KZN, and Limpopo provinces (NPC 2013; Sihlobo and Qobo 2021).

Black smallholder and other emerging farmers also need improved access to the capital required to invest in CSA technology. For example, land is necessary collateral to access capital; but the continuing challenges with land reform may hinder small-scale farmers from making necessary investments in CSA and other approaches to adaptation (Pers. Comm. 2023c). Highly vulnerable farmers should also have improved access to inclusive insurance programmes to protect their assets when climate extremes such as droughts or floods lead to lost revenue. Such programmes could also serve as a proxy for collateral for farmers to access credit while protecting them against climate catastrophes. Making this shift would require improved data and statistical information to develop adequate insurance products that are priced accessibly, backed by enhanced ability to collect real-time data with automated weather stations and upgraded agricultural statistics portals (WBG 2022).

More collaborative research between government entities and extension agents, the private sector, and small-scale farmers could also help to improve the design and uptake of CSA technology. Growth in agricultural production in South Africa has historically been fuelled by technology and the returns on investment in agricultural research and development have been high (NPC 2013). Evidenced-based policies and interventions require more robust research into plausible climate and adaptation scenarios at different implementation scales to identify specific adaptation needs for different agricultural activities at the local level (DEA 2013). For example, investments in improved climate advisory services would make the latest climate science more accessible to government, agribusiness, extension services and farmers (DEA 2013). Efforts should focus strongly on the differentiated needs and experiences of people most vulnerable to climate change (Carter et al. 2021). CSA technologies, for example, should be designed and implemented with intentional consideration of gender and social inequalities to avoid their further entrenchment and enhance outcomes (Chakraborty et al. 2023). This requires that vulnerable groups have the opportunity to highlight what adaptation measures work best in their particular communities (Carter et al. 2021) and to share them with others in similar situations.

Other innovative approaches also have roles to play. For example, carbon credits may offer an innovative means of revenue generation to farmers. A system to maximise their potential benefits could be established that would require farmers to adopt green standards and guidelines and a credible monitoring, reporting, and verification mechanism. The government could collaborate with communities and academia to identify a set of CSA measures and practices and link them to carbon credits, which could then become a source of income for local rural communities through a transparent trading system (WBG 2022). In addition, the Conservation Agriculture Farmer Innovation Programme, which has been implemented across multiple provinces in South Africa over the past decade, is another instructive example. This programme succeeded in supporting commercial and smallholder farmers in climate-adaptive innovation and adoption of new techniques and technologies. This was accomplished through effective collaboration between farmers and researchers via participatory systems research approaches that recognised, rewarded, and utilised farmers as key innovators in building context-specific, climate-resilient farming systems (Smith 2023).

In addition to the approaches outlined above, concurrent transformative shifts are needed to ensure that farmers are prepared to withstand the more severe climate impacts that are projected over the coming decades. Anticipated changes in the availability of water resources will play a central role in determining what can be sustainably produced in different regions of the country. Farmers could be encouraged and supported to diversify away from water-intensive crop varieties to those that can better withstand hotter and drier conditions (Carter et al. 2021). This would help reduce the overall risk of water stress for farmers (WBG 2022). Importantly, this diversification should prioritise varieties that are naturally adapted, indigenous, and culturally appropriate.

CHAPTER 6.

SECURING WATER

As defined in the Just Transition Framework, equitable access to water and a healthy environment are essential components of the just transition. The water sector is not directly a large driver of South Africa's GHG emissions—wastewater treatment accounted for roughly 45 percent of the waste sector's emissions or less than 2 percent of total emissions in 2022. However, the sector is extremely sensitive to climate change and essential to climate action because it serves as a critical input to all economic sectors (DFFE 2024). This chapter presents an overview of the water sector, as it relates to climate action and the just transition, and the shifts that will be needed to ensure equitable access to adequate water and sanitation for all South Africans.

Overview

Impacts of climate change on South Africa's water sector

South Africa is already experiencing climate change impacts in its water sector, and these impacts are projected to grow. Evidence suggests that recent droughts and floods (see Chapter 2) could be attributed to climate change and that more events of this type can be expected in the future, with climate change contributing to changes in the frequency and intensity of these events (Douville et al. 2021; Pinto et al. 2022; Schiermeier 2018). In fact, the Sixth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC) found that climate change made the 2015–17 Cape Town drought three to six times more likely to occur. Recent analysis has shown climate change exacerbated the heavy rainfall that led to the 2022 KZN floods (Douville et al. 2021; Pinto et al. 2022). These events impact the quantity and quality of water that is available for human consumption and economic activities and can also damage water-related infrastructure.

Climate change–induced changes to rainfall and temperature patterns may increase water scarcity (Cullis and Phillips 2019; Petja 2022). The country is generally classified as being water scarce, with annual average precipitation roughly 52 percent of the global average. Varying regional climate conditions—rainfall ranges from 100 to 500 mm/year in different regions—and growing water demand contributes to the scarcity. Just 8 percent of South Africa's land accounts for 39 percent of its water flow, and water management is complicated by transboundary water considerations because 45 percent of South Africa's river flow is shared through international river basins with neighbouring countries (DWS 2023d; Le Maitre et al. 2018).

The country mainly relies on surface water, which is particularly vulnerable to climate change as temperature increases lead to higher rates of evapotranspiration. Many of the country's large dams are already fully allocated (or overallocated) to existing water users, and recent reports are showing a decrease in some dam yields (DWS 2018, 2022b). The Western Cape Water Supply System, one of the national integrated systems of large dams, is projected to face up to a 25 percent reduction in yield due to climate change (City of Cape Town 2020). At the country level, the National Water and Sanitation Master Plan projects water shortages of up to 30 percent by 2030 (DWS 2018). Increased temperatures and drought conditions also bring higher water demand, adding further stress to the water supply. Therefore, building water resilience in the face of anticipated declining water availability is critical.

Water and sanitation service provision

To achieve a just transition, all South Africans must have access to high-quality, reliable, and affordable water, sanitation, and hygiene. For water supply, this means having water that is healthy and safe to drink, in adequate quantities, easy to access, and resilient in the face of climate change.[6]

Nationally, access to piped water increased by 4.1 percent from 2002 to 2022, but progress was uneven and access declined in six provinces (Stats SA 2023c). Nearly 9 in 10 South African households (88.5 percent) have access to piped water—roughly 46 percent of households have piped water inside the house, another 30 percent rely on piped water on-site (e.g., in the yard), 2 percent use a neighbour's tap, and about 11 percent rely on a communal tap (Stats SA 2023c). Three percent of households get water from open surface water sources, which are generally not safe to drink (Stats SA 2023c). In terms of reliability, nearly 35 percent of households receiving water from municipal services (81 percent of all households) reported having disruptions in water supply service lasting more than two days at a time (Stats SA 2023c). Increased water

scarcity linked to climate change and demand could increase the frequency and duration of such disruptions if not properly managed.

The country's system of interconnected dams and bulk water supply infrastructure enable greater flexibility in the water system and increase adaptive capacity (Cullis and Phillips 2019). This integrated system allows for interbasin transfers of water to help proactively manage supply and demand, informed by complex water resource system models (Cullis and Phillips 2019). Having this system in place, including the professionals with experience managing water resources in the context of high temperature and rainfall variability, can help to manage some of the projected impacts of climate change on the sector and reduce the chances of water supply disruption (Cullis and Phillips 2019). However, smaller cities, towns, and rural areas that fall outside of bulk water distribution systems often rely on a single source of water, making them more vulnerable to climate change impacts without the ability to rely on interbasin transfers (Cullis and Phillips 2019). This will exacerbate existing inequities in access to sustainable water supply between urban and rural areas as well as in informal settlements.

National progress on increasing access to piped water obscures the challenges that remain in informal settlements and rural areas. A study of water access in informal settlements[7] spanning all provinces found that just 36 percent of surveyed households had access to piped water on their property, over 55 percent used a public tap (15 percent of which were far away), and 8 percent did not have access to any piped water (Oskam et al. 2021). Poorer households were more likely to be using untreated and/or distant water sources (Oskam et al. 2021). Furthermore, a survey of households in three rural communities in Limpopo found that 85 percent of respondents walk over four kilometres (km) to access drinking water, and the responsibility for fetching water disproportionately fell on women and children (Bazaanah and Mothapo 2023). These findings are consistent with other studies showing lower levels of water access in rural areas of South Africa (Bazaanah and Mothapo 2023). The persistent gaps in access to basic services and infrastructure in rural areas and informal settlements are rooted in South Africa's history of segregated service delivery under colonial rule and the apartheid system, which makes addressing this gap a matter of restorative justice (Abrams et al. 2021).

National access to improved sanitation has increased but lags water supply access. Over 83 percent of households have access to improved sanitation,[8] a 21.5 percent improvement from 2002. Nearly two-thirds of households have flush toilets connected to the public sewer system or a septic tank, and roughly 68 percent have access to handwashing facilities (Stats SA 2023c). Female-headed households, black Africans, and people living in traditional/rural areas and informal settlements are more likely to lack access to

basic sanitation (Bazaanah and Mothapo 2023; Pan et al. 2018). Climate change–induced increases in water scarcity may make it harder for households reliant on water sources outside the home to collect sufficient water for handwashing and hygiene purposes (DWS 2022b). Additionally, both wetter and drier conditions, which are expected to become more extreme as climate change advances, can impact sanitation; reduced water availability can impact the operation of waterborne sanitation systems, and flooding and extreme rain can cause overflows and damage infrastructure (DWS 2022b).

Although South Africa has made important progress across water, sanitation, and hygiene access over the past 20 years, there are still millions in the country whose basic needs are not being met. The most recent assessments of South Africa's water and sanitation (wastewater) service providers reveal a sector in crisis. DWS's 2023 assessment of water supply systems (WSSs)[9] found that less than 3 percent achieved the highest grade, and 29 percent were classified as being in a critical state (DWS 2023b). The assessment reported that "the most vulnerable and concerning area is the overall sub-standard quality of drinking water to the receiving population" (DWS 2023b, ix). More specifically, 71 percent of systems were not meeting standards for water quality compliance monitoring, and over 40 percent of systems were rated as having unacceptable microbiological water quality or chemical acute health compliance issues (DWS 2023b). Noncompliance, however, does not necessarily indicate that a system is providing unsafe water; many WSSs are not collecting and/or reporting sufficient data to confirm that they are providing safe water. The assessment of wastewater treatment works (WWTW) found that over two-thirds fall into the high- or critical-risk categories (DWS 2023c). The assessment grades for WSSs and WWTW have shown a downward trend over the last 10 years (DWS 2023b, 2023c). Climate change will make it even more challenging to improve overall service because larger amounts of already scarce funding will be needed to not only fix these existing issues but also make systems more resilient to climate change.

The National Water Security Framework for South Africa cites poor maintenance and lack of investment in water infrastructure as significant contributing factors to the sector's critical state (NPC 2020). The South African Institution of Civil Engineering (SAICE) publishes a report card for the country's infrastructure, with an overall grade as well as ones for several subsectors, ranging from A (world class) to E (unfit for purpose) (SAICE 2022). In the most recent report card, South Africa's water and sanitation infrastructure received higher marks for major urban areas, C+ and C- (satisfactory for now) for water supply and sanitation, respectively. Bulk water resources and water supply outside major urban areas both received a D- (at risk of failure), and sanitation infrastructure outside major urban areas received the lowest possible grade of E (SAICE 2022). Some of the cited factors for the low scores include insufficient data to assess safety, age of the infrastructure, significant need for improved maintenance and investment, and inability to properly treat water and wastewater (SAICE 2022). The DWS's most recent assessments of water and wastewater service providers validate SAICE's analysis (DWS 2023b, 2023c).

Climate change will exacerbate these existing infrastructure challenges. The 2022 KZN floods caused significant damage to water and sanitation infrastructure, which resulted in disruption to services and led to water rationing in some areas (PCC 2023a). Increased temperatures can also damage water and sanitation infrastructure through higher rates of corrosion (Petja 2022).

Water quality and environmental considerations

Many of South Africa's water bodies do not meet established standards for health and safety; poor water quality has environmental and economic effects, with implications for adaptive capacity and the just transition. The *National State of Water Report 2022* notes that there is severe microbial contamination in rivers and dams, with over half of the sites sampled representing a high health risk if used for recreation or to irrigate crops that are eaten raw (DWS 2022a). Climate change is likely to exacerbate water quality issues because higher evapotranspiration caused by warmer temperatures can increase pollutant concentrations and decrease oxygen levels in water (DWS 2022b). This, in turn, makes water more difficult and expensive to treat for both human consumption and economic uses. According to the DWS's latest annual report, the largest sources of water pollution in South Africa are "uncontrolled discharge of mine-affected water, dysfunctional wastewater treatment systems, runoff from agricultural lands, and runoff from settlements lacking sanitation or proper refuse management" (DWS 2023a, 8).

South Africa's water quality challenges may be exacerbated by climate change. For example, climate change–induced changes in rainfall and flooding could increase the risk of acid-mine drainage (AMD) due to increased runoff from mining sites. Coal and gold mines are the major sources of AMD in South Africa

and have been linked to surface and groundwater contamination (Baloyi et al. 2023). Eutrophication,[10] which is linked to agriculture pollution, can be worsened by warmer temperatures and more frequent droughts (DWS 2021). Furthermore, the risk of contaminated urban water runoff, especially from informal settlements without access to proper water and sanitation, increases with frequent and severe flood events. Informal settlements typically have inadequate water and sanitation infrastructure, if any. For example, an investigation of an informal settlement in Cape Town found that just 380 communal toilets were provided for 20,000 inhabitants (Totaro 2016). Without appropriate facilities, untreated excrement can easily end up in the water sources (Gqomfa et al. 2023).

Unsatisfactory performance of wastewater treatment plants continues to be a challenge in South Africa. Given that South Africa is a water-scare country, and is projected to become more so due to climate change, wastewater return flows to the environment compose a significant portion of the country's water budget (DWS 2021). In the latest Green Drop report, only 15 percent of WWTW were found to comply with microbial limits, and 10 percent with chemical compliance (DWS 2023c). Additionally, climate change–induced changes in rainfall and runoff can cause issues at water and wastewater management plants; smaller volumes of water can carry higher concentrations of pollution, which are harder to treat, and higher flows can overwhelm systems and result in the discharge of untreated water and wastewater (DWS 2022b; Petja 2022).

A just transition will require healthy water resources and ecosystems to meet environmental, human, and economic needs. Polluted water can cause both acute and chronic illness and threatens the health of water ecosystems, aquatic species, and those who depend on these for their lives and livelihoods (DWS 2023d). Water pollution can have significant economic impacts because it results in increased treatment costs for water boards, municipalities, and industry and can lead to reduced crop yields in agriculture (DWS 2023d).

Breakdown of water allocations between sectors and water use trends

Ninety-eight percent of South Africa's freshwater resources are allocated, which leaves little flexibility for accommodating growing demand across sectors (DWS 2022a). The agricultural sector is by far the largest user of water (61 percent for irrigation[11]), followed by the municipal sector (27 percent). The vision for a more just and resilient water sector should consider both equity and efficiency in how limited water resources are allocated.

Despite using the most water of any sector, agricultural users (particularly large-scale commercial farmers) also pay the lowest raw water tariffs (DWS 2018). These low tariffs provide little incentive to improve water use efficiency (DWS 2023d). Although there is a lack of comprehensive monitoring data for the sector, available data suggests that many operations lose nearly one-third of their water (DWS 2023d). Additionally, distribution of water within the sector and for other productive uses is highly unequal, with most water allocated to white users (Hydrosoft Institute 2021). Analysis supported by the Water Research Commission (WRC) on water allocated to individual users found that over 98 percent of recorded use went to white users (Hydrosoft Institute 2021). Race-disaggregated information is not available for businesses, but the WRC report states that these businesses "are predominantly white owned due to their racial historical origins" (Hydrosoft Institute 2021, 60). Additionally, agricultural water use is disproportionately allocated by gender, with women accounting for 10.5 percent of existing agricultural water use licences and nonwhite women just 4.5 percent of this (Tekwa and Adesina 2023).

The average per capita water consumption in South Africa was 218 litres per day in 2023 compared to a global average of 173 litres per day (DWS 2023d, 2023e). A significant amount of this is nonrevenue water (NRW), which is lost through leaks or theft and does not generate revenue. The DWS's 2023 No Drop report found that 47.4 percent of water provided by WSSs was considered NRW, which can be unfavourably compared to a global best practice value of 15 percent (DWS 2023e).

Industry, mining, and power generation use about 7 percent of South Africa's water resources. Although this is small compared to other uses, these sectors have an outsized impact on water quality.

Major policies

The national government of South Africa has, over the past 30 years, implemented key national water and environmental policies that drive and encourage climate action as well as aim to improve water access and quality. Cities have also been making strides toward developing and implementing climate-resilient strategies.

National policies

The National Water Act (NWA) of 1998 is the main statute governing the management of water resources in South Africa. The act is underpinned by three fundamental principles for managing water resources: equity, (environmental) sustainability, and efficiency (Republic of South Africa 1998). The NWA established the basic principles for water allocation in South Africa and called for the establishment of catchment management agencies (CMAs) to take over water management responsibilities in the country. Both the NWA and the National Water Policy are founded on the principles of integrated water resources management (IWRM), which "promotes the co-ordinated planning, development and management of water, land and related resources to maximise the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (DWA 2016, 68).

The first National Water Resource Strategy (NWRS) sets out the vision and strategic actions for effective water management to support equitable and sustainable water access and use for social and economic transformation and development (DWAF 2004). NWRS II builds on this vision and includes a chapter on managing water resources for climate change; it also operationalises the establishment of CMAs with a framework for water allocation and taxes.

NWRS III expands the climate change management focus to include both water and sanitation (DWS 2023d). The chapter on managing water and sanitation in a changing climate outlines six strategic objectives (DWS 2023d):

- Improve water management and sanitation for advanced adaptive capacity.
- Integrate climate change considerations in water and sanitation planning processes across time horizons.
- Develop adaptation measures to maximise water security and resource protection as climate conditions change.
- Improve internal capacity and provide resources to increase resilience to the impacts of climate change.
- Enhance awareness and capacity on issues related to climate change.
- Interlink climate and hydrological scenario projections and ensure they represent complex interrelated natural systems.

The DWS has identified several strategic actions under each objective to support achieving these goals. NWRS III also emphasises the importance of protecting strategic water source areas (SWSAs) and aquatic ecosystems and maintaining and restoring ecological infrastructure. These strategies are key to building climate resilience within the water sector as well as more broadly.

The 2017 *Water and Sanitation Sector Policy on Climate Change* report aims to provide a framework for implementing the Climate Change Response Strategy within the sector as well as to strengthen regulations that have implications for climate change (DWS 2017). It sets forth four policy positions. The first policy position is on adaptation and outlines strategic actions to build resilience and reduce vulnerability in the sector through water and sanitation governance, infrastructure development, and water and sanitation management. The second policy position focuses on the role of water and sanitation in mitigation, and the third concentrates on mainstreaming climate change into the sector through policy review, partnerships, and coordination. The fourth and final policy position focuses on costs and subsidies and states that climate change resilience must be factored into water pricing (DWS 2017). The DWS is in the process of updating the response strategy for the sector, and a draft of the updated strategy was released for stakeholder input in 2023 (SA News 2023).

The implementation of national policies has been complicated by a lack of institutional stability at the local level. The NWA called for the establishment of 19 CMAs, expecting these to be set up by the year 2000 (Munnik 2020). By 2012, only 2 had been

established and thus the planned CMAs were consolidated into nine areas (Munnik 2020). Then, in 2017, the Minister of Water and Sanitation announced plans for the creation of a single CMA, a decision that was then overturned in 2018 by the subsequent minister (Munnik 2020). As of 2023, there are still just 2 CMAs established, and the DWS has decided to further consolidate the catchment management areas from nine to six (DWS 2023d).

Subnational policies

South Africa is urbanising rapidly, and both people and economic activity are increasingly concentrated in the cities, which are also facing increasing water security risks (WBG 2022). Metropolitan cities account for approximately 57 percent of the country's gross value added and a similar proportion of jobs. Fortunately, some cities are leading the way when it comes to building urban water resilience. For example, Cape Town has developed and begun to implement several strategies to address its water risks, driven partly by the 2015–18 drought. The Cape Town Water Strategy guides implementation of actions for building climate resilience, including diversifying water sources; improving management of shared water sources with other water user groups; developing and introducing water reuse; improving management of ecosystems, particularly removal of alien invasive plants that reduce water runoff; and transitioning into a water-sensitive city (City of Cape Town 2020).

Johannesburg is also taking steps to mitigate the climate risks affecting its water supply. Johannesburg is one of the few major global cities that does not lie on a significant water source and relies heavily on a national integrated water supply. In 2021, the city developed its Climate Action Plan (CAP) which aligns with the Paris Agreement and the city's long-term strategy. Water is a key target area within the CAP, and it includes actions such as diversifying water sources, reducing water demand, and limiting physical water losses (City of Johannesburg 2021). The city's Water Resilience Action Plan (2022) identifies and develops short- to long-term water resilience actions. The plan was developed through an interactive process with city stakeholders where pathways for change were identified and corresponding priority actions set. Among the priority actions are nature-based solutions and green infrastructure,[12] diversification of water sources, knowledge exchange, and water-sensitive planning.

Required shifts

A just transition for the water sector will require building resilience to climate change, ensuring universal access to water and sanitation, and balancing water demand across users in an equitable manner. This section details the actions and investments necessary to achieve these shifts.

Fostering flexible planning and stable governance

One key shift will be the transition from conventional planning and engineering solutions to adaptive and flexible planning that emphasises cobenefits while providing institutional stability.

There is a growing concern that water institutions face challenges that limit their ability to provide adequate water and sanitation services in the face of current and anticipated climate changes. Building resilience to climate change is a priority not just for water and sanitation provision but also for the protection of infrastructure, livelihoods, and the economy. It will require holistic long-term planning, political will, and a greater level of coordination to enable the integration of climate adaptation into all types of planning and to integrate spare capacity to be better prepared for times of disruption. In South Africa, conventional engineering solutions, such a grey infrastructure, dominate in the water sector. This type of infrastructure, such as concrete dams or stormwater drainage, tends to be resource intensive to build, has a long lifespan, and can produce significant GHG emissions (Conservation International n.d.). There are elements of the traditional approach and infrastructure that will still be needed but could be strengthened by integrating climate resilience and adaptive management, for example, by integrating grey and green infrastructure. These types of strategies offer the potential for adaptation and mitigation cobenefits (Conservation International n.d.).

Municipalities, and national governments, tend to develop long-term water security strategies that limit flexibility and lag on implementation. Long-term plans quickly become outdated, and moving targets make it difficult to stick to plans. In the face of increasingly unpredictable climate and weather patterns, long-term plans that embrace climate resilience and utilise "no regrets" options, which yield benefits regardless of the future climate scenario, should be a priority. Examples of no regrets strategies include establishing mutual aid agreements with neighbouring communities to

provide services in times of disruption or hydrological modelling to project future water flows and plan accordingly (EPA 2013).

Flexible and adaptive management plans should be underpinned by stable institutions. The slow rollout of the CMAs as well as repeated changes to the institutional arrangements creates confusion and make it more challenging to tackle large-scale issues like climate change and water allocation reform in a holistic manner (Munnik 2020). Finalising the establishment of the currently planned six CMAs and ensuring they are properly resourced is essential. Other institutional arrangement matters that also need to be finalised include the creation of the National Water Resources Infrastructure Agency and the conversion of irrigation boards to water user associations (DWS 2023d).

Transforming management of water resources and infrastructure

Shifts are also required in the way water resources and infrastructure are managed; fostering an integrated management approach can improve resilience and ecosystem health.

South African water policy is underpinned by IWRM strategies, but the country has struggled to implement an integrated and holistic approach to water resources management on the ground (DWA 2016; Palmer and Munnik 2018). Adopting an integrated approach requires breaking down management silos and fostering coordination across levels of governance and different water users. Given the historical challenges in implementing IWRM, a study commissioned by the WRC recommends adopting an adaptive IWRM approach (Palmer and Munnik 2018). The study adopted the following definition of *adaptive IWRM*: "Using adaptive, systemic, processes and an understanding of complex social-ecological systems to coordinate conservation, manage and develop water, land, and related resources across sectors within a given river basin, in order to maximise the economic and social benefits derived from water resources in an equitable manner while preserving and, where necessary, restoring freshwater ecosystems" (Palmer and Munnik 2018, 1). This approach emphasises not only the complex interrelated nature of water ecosystems but also the importance of placing these within the context of social systems.

IWRM can support the restoration of ecological infrastructure and protection of SWSAs. *Ecological infrastructure* refers to the natural ecosystem (e.g., rivers, wetlands, etc.), which provides valuable services to humans, such as flood protection or water quality enhancement (DWS 2023d). SWSAs are part of the ecological infrastructure and are areas that contribute a disproportionately high amount to the country's water supply (DWS 2023d). Ecological infrastructure and SWSAs do not always fall neatly within the boundaries of one province or city and thus require a higher-level integrated approach to effectively manage, such as IWRM. Examples of strategies to restore ecological infrastructure and protect SWSAs include removing invasive alien species and replacing them with native vegetation to build a buffer around water ecosystems (DWS 2023d). Ecological infrastructure also supports climate resilience because healthy ecosystems are better able to adapt to and absorb shocks.

An integrated management approach can also help address the country's infrastructure challenges. South Africa's water and sanitation infrastructure is aging and in dire need of repairs and replacement; using an integrated management approach can enable the adoption of adaptation and resilience strategies and green infrastructure into existing and planned infrastructure. Repairs to fix leaks in water pipes will help reduce NRW loss and the potential for contamination and pollution while also building resilience to water scarcity. Prioritising the funding of routine maintenance of infrastructure will also help prevent further degradation, particularly in the face of climate change (DWS 2023b). Changes in the climate and water demand may result in having to treat different volumes of water and wastewater than systems were originally designed for; improvements in the monitoring of water quality and flows, along with predictive modelling, can be used to project future demand and ensure that infrastructure is designed with climate change in mind (DWS 2023c). Additionally, green infrastructure, such as green roofs or permeable sidewalks, can be used to capture water, which helps to reduce flood risks and store water for times of drought (Gulati 2020). Taking a holistic, integrated approach can help maximise the benefits of using green infrastructure alongside existing grey infrastructure.

Achieving universal access to water and sanitation

Achieving the goal of universal water and sanitation access will require building the human resource, financial, and technical capacity of service providers while also looking for innovative solutions for areas that are hard to reach with traditional, centralised water and sanitation. Reaching this goal will require both improving and maintaining existing services by addressing the challenges currently facing water and sanitation service

providers and extending service provision to places that currently lack adequate service, especially informal settlements and rural/traditional areas.

Human resource and financial gaps in the water sector must be addressed. The DWS's assessments show that there is a significant shortfall in staff at all levels within WSSs and WWTW (DWS 2023b, 2023c). As such, the water sector represents an important opportunity for job creation in the transition.

Water and sanitation providers also need greater financial sustainability to address their infrastructure and human resource challenges. The high levels of NRW loss mean a large portion of treated water is not paid for, and tariffs often do not reflect the true costs of service; the National Treasury is working with providers to revise this (DWS 2023b). Installing water meters at all points of water use can help providers collect greater revenues. However, tariff reform and more comprehensive tariff collection will likely not be sufficient to address the financial issues plaguing the water sector and municipalities more generally.[13] To help address some of these challenges, the DWS is partnering with the Development Bank of South Africa and SALGA to establish a Water Partnership Office, which will support municipalities in creating public-private partnerships (PPPs) to fund water projects (DWS 2023f).

Full implementation of existing regulations is essential. The DWS recommends strengthening the oversight role of water service authorities within municipalities and improving their own regulatory functions to ensure consistency in regulatory actions (DWS 2023b). There is also a proposal for a policy that would require municipalities to provide actual water consumption figures and proof that water loss is being properly managed before they can receive funding for new infrastructure projects (DWS 2023e).

Addressing disparities in water and sanitation service provision in rural areas and informal settlements will likely require additional and/or alternative shifts. For example, small-scale decentralised wastewater treatment systems might be more effective in these locations where connection to a larger sanitation grid is not feasible (Schaub-Jones 2022). In recent years, the South African government has tried to adopt the approach of upgrading informal settlements, where possible, as opposed to clearing them. The provision of basic water and sanitation services is fundamental to upgrading efforts.

Ensuring efficient and equitable water use

Shifts are needed to ensure that water is allocated in the most efficient and equitable manner while also building resilience to climate change. Water conservation and demand management (WC/WDM), water supply augmentation, and reallocation among users are tools that can be leveraged for this shift.

Shifting to technologies and behaviours that promote WC/WDM can support more efficient use of water across sectors. Repairing leaks and conducting routine maintenance, as mentioned above, can reduce NRW loss. Additionally, universal water metering and billing and/or licensing for all water users will help ensure that water and sanitation service providers have accurate usage data, which can be used to create WC/WDM plans and track water balances (DWS 2023d).

Different strategies that could be deployed to support WDM across sectors include more targeted water tariffs, targets and incentives for reducing water loss, water-efficient appliances and hardware, and water conservation campaigns to encourage behaviour change (DWS 2023d; Fourie et al. 2021; Ziervogel 2019). In the agriculture sector, more efficient irrigation techniques and technologies, improved soil management strategies, crop selection, and real-time monitoring of weather and water usage can also increase water use efficiency (Adebiyi Adetoro et al. 2020; DBSA et al. 2023; Mabhaudhi et al. 2019). For the industrial sector, water reuse has many potential applications, with several large businesses in South Africa already investing in water recovery and reuse (DWA and 2030 WRG n.d.).

Although WC/WDM has the potential to dramatically increase water availability across users, water supply augmentation strategies may still be needed. The degree to which these strategies will be needed will depend on climate impacts, population growth, and the success of WC/WDM. Some options for increasing South Africa's water supply include increased groundwater extraction, water recycling and reuse, desalination, and rainwater harvesting (DWS 2023d). There are significant trade-offs with many of these strategies and potential environmental implications. Desalination, for example, is expensive and energy intensive (Smit 2021). However, the National Water and Sanitation Master Plan notes that desalination and reuse of effluent are both becoming more effective as technologies improve (DWS 2018). Improved water monitoring can yield more accurate water balances, which municipalities and WSSs can use to determine the extent to which new water sources are needed. Economic and climate modelling can help determine which options are the most cost-effective and equitable in each situation.

Reallocation of water resources within and between sectors is the third category of policy options that can be leveraged to shift toward more equitable water access. Given the legacy of apartheid in both land and water allocations in South Africa, any shifts will have equity and political implications (Tekwa and Adesina 2023). Although the agriculture sector is the largest water user, any reallocation needs to consider potential impacts on food security and employment, particularly in rural areas (DBSA et al. 2023). Climate projections show that more water will be needed to achieve the same level of agricultural productivity in the future (DBSA et al. 2023). Therefore, maintaining current allocations would likely mean reduced yields in the absence of other mitigating strategies. In a study of water sector investments needed in South Africa through 2050, modelling revealed that reducing allocations to the agriculture sector would not yield significant cost savings—a 15 percent reduction would only reduce total investment needs by 0.9 percent (DBSA et al. 2023). Conversely, increasing allocations to agriculture did not significantly increase investment requirements. An increase of 6 percent—the amount estimated as necessary to maintain productivity under climate change—would increase total investment requirements by just 0.7 percent, and a 15 percent increase in allocations would result in 0.9 percent higher investment costs (DBSA et al. 2023). (See Chapter 5 for further discussion on supporting agricultural productivity in the context of climate change). Water could also be reallocated within sectors. For example, the reallocation of agricultural land and water to smallholder farmers and historically disadvantaged groups is a strategy that is already enshrined in South African policy but is not currently well implemented (Tekwa and Adesina 2023). Reform or implementation of related policies with a just transition lens can help support the more equitable distribution of water.

Required investments

Implementing these shifts to achieve a just transition in the water sector will require significant investment. However, these investments are likely to yield dividends in terms of resilience-building, equity, and economic development. Modelling looking at investments needed in the water sector through 2050 found that an average of R256 billion per year is needed between 2023 and 2050, or a total investment of R7.16 trillion (DBSA et al. 2023). The cost of this base case scenario would meet the Sustainable Development Goals without implementing any other major policy or operational interventions (DBSA et al. 2023). However, a wetter climate, aggressive WC/WDM, clearing of invasive alien plants, a successful energy transition, use of lower-cost technology options, and efficiency improvements would all decrease costs whereas the opposite (e.g., dry climate, no energy transition) would increase investment (DBSA et al. 2023).

Comparing the base scenario to current investments in the water sector, there is a shortfall of R91 billion per year (DBSA et al. 2023). The report makes recommendations for how to optimise available funding to reduce this gap, which, in total, could reduce investment requirements to R43 billion per year under the base case. However, new funding sources will still be needed, as well as cost reductions.

SECTION 3.

Mitigation: emissions, targets, and progress

CHAPTER 7.

EMISSIONS: TRENDS, DRIVERS, AND MEETING THE MITIGATION NDC

Emissions trends and drivers

South Africa's relatively high levels of historical GHG emissions have not translated directly into socioeconomic development, particularly when examined in the context of poverty, unemployment, and inequality. South Africa has comparable historical emissions (approximately 14,100 million tons of carbon dioxide equivalent [$MtCO_2e$] from 1990 through 2020) to more highly developed countries such as South Korea (about 15,000 $MtCO_2e$), Italy (13,800 $MtCO_2e$), and France (13,300 $MtCO_2e$) (Climate Watch 2022a). Although South Africa falls within the 20 top-emitting countries globally, both historically and annually, the country accounted for a little over 1 percent of total global emissions in 2020 (Climate Watch 2022b). Within Africa, it is the highest-emitting country (excluding land-use change and forestry[14]).

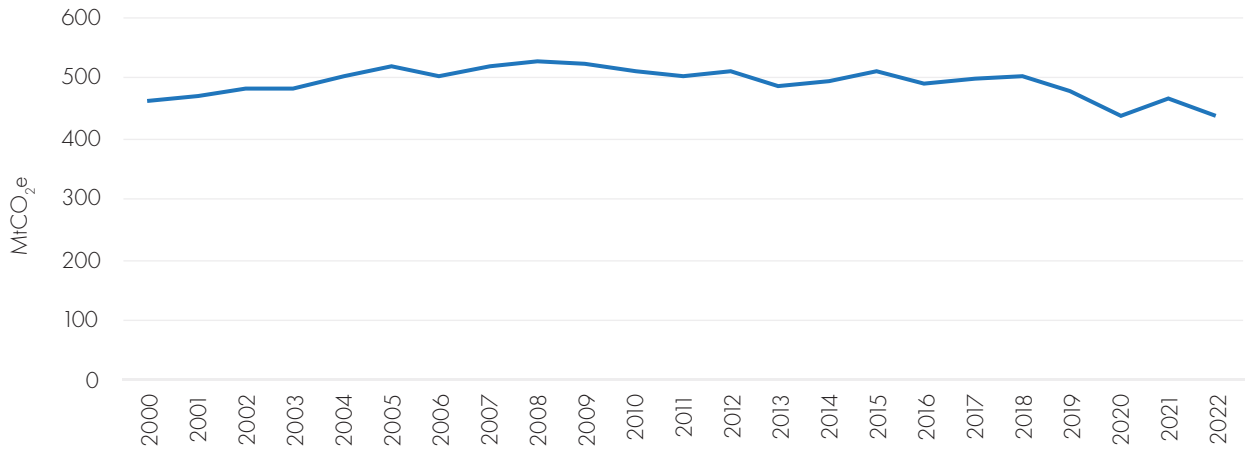
South Africa's emissions are driven largely by the energy sector, which accounted for approximately 78 percent of GHG emissions in 2022 (excluding forest and other land uses [FOLU]) (DFFE 2024). The contribution of the energy sector to South Africa's total emissions has remained relatively steady from 2000 to 2022, and overall energy sector emissions declined by 2.5 percent (DFFE 2024). Over half of the energy sector's emissions (roughly 53 percent in 2022) come from electricity production, the majority of which is produced by Eskom, the national electricity utility. After Eskom, Sasol (a large petrochemicals conglomerate) is the single-largest emitter of GHG emissions in South Africa, accounting for just under 13 percent[15] of the country's total emissions (excluding FOLU) in 2022 (DFFE 2024; Sasol 2023). The second-largest-emitting sector after energy is agriculture, which accounted for just under 12 percent of emissions (livestock emissions are the largest emissions source within the sector). The industrial process and product use (IPPU) category made nearly 6.5 percent of emissions (these are the nonenergy emissions from industrial processing plants, which include cement, glass, petrochemical, and metal production) (DFFE 2024). Over half of the IPPU emissions come from the metal industry, which produces iron, steel, ferroalloy, aluminium, lead, and zinc. Finally, the waste sector accounted for just over 4 percent of emissions, with solid waste disposal being the largest emissions source within the sector (DFFE 2024). The FOLU sector was a net carbon sink in 2022, absorbing rather than emitting GHG emissions, though this reverses from year to year (DFFE 2024). For example, between 2005 and 2010, FOLU was a net-emitting sector, largely due to forest fires.

South Africa's GHG emissions increased during the 2000s and decreased during the 2010s; in 2022, the country emitted an estimated 479 $MtCO_2e$ (excluding FOLU), slightly lower than the emissions levels of 2000 (DFFE 2024) (Figure 7.1). From 2000 to 2022, energy sector emissions decreased 2.5 percent in total over the entire period, but with years of sharp increase and decrease in between. The net decrease was largely driven by emissions declines in the residential sector, aviation, and petroleum refining (DFFE 2024). From 2000 to 2009, energy emissions grew steadily to reach their peak for the 20-year period in 2009. There was then a sharp decrease in 2010, associated with the global economic crisis. Energy sector emissions rebounded slightly from 2011 to 2013, then mostly decreased from 2014 to 2020, with a sharp decline in 2020 due to the COVID-19 pandemic (DFFE 2024). Energy sector emissions increased in 2021 and then declined again in 2022 (DFFE 2024). In instances where emissions have decreased, this seems to be largely driven by economic and climate factors (e.g., economic crisis, drought-induced livestock death, the pandemic) as well as load shedding, as opposed to mitigation efforts aimed at reducing emissions.

Mitigation commitments

South Africa is a Party to the Paris Agreement under the UNFCCC and thus ascribes to the global goal of limiting warming to well below 2°C, while making best efforts to meet 1.5°C. At the 28th Conference of the Parties (COP28) meeting in 2023, all Parties affirmed that limiting global warming to 1.5 °C with no or limited overshoot requires *deep*, *rapid*, and *sustained* reductions in global GHG emissions. Specifically, a reduction of 43 percent by 2030 and 60 percent by 2035, relative to the 2019 level, is needed to reach

Figure 7.1 • **South Africa's GHG emissions, 2000–2022**



Source: DFFE 2024.

net zero CO_2 emissions by 2050. The Parties also acknowledged that the decarbonisation pathways are subject to the capability, resourcing, and national circumstances of countries. The conclusions of recent IPCC reports continue to underscore that *significant* and *unprecedented* changes will be required across all sectors of the economy to meet these goals.

South Africa has set targets for reducing GHG emissions through 2030, in line with its development requirements. The country's revised NDC, which was submitted to the UNFCCC in 2021, sets a commitment for national GHG emissions to be in the range of 398–510 $MtCO_2e$ in 2025 and 350–420 $MtCO_2e$ in 2030. According to Climate Action Tracker, the lower end of the mitigation target in 2030 (i.e., 350 $MtCO_2e$) is almost aligned with a global trajectory of limiting warming to 1.5°C.[16] South Africa has also set an aspirational goal for reaching net zero CO_2 emissions by 2050, as articulated in its Low Emissions Development Strategy and the national Just Transition Framework. Figure 7.2 presents the gap that must be closed between current emissions trends and near-term and long-term climate targets.

By April 2025, South Africa, as a Party to the UNFCCC, will be required to submit an updated NDC that includes a new emissions reduction target for 2035. The sooner and more ambitious the emissions cuts occur in the near term, the easier it will be to reach the long-term aspirational goal of net zero CO_2 emissions by 2050. The PCC will be making recommendations to government on the updated NDC before the end of 2024, based on evidence and input from all stakeholder groups.

Meeting the mitigation commitments

The future of three major sectors will provide the greatest indication of whether South Africa will meet its mitigation commitments: electricity, industry (predominantly Sasol), and transport. Collectively, these sectors currently account for more than 80 percent of the country's GHG emissions. They typically have long-lived infrastructure (e.g., coal power plants, vehicle internal combustion engines), pointing to the need to establish effective policies and actions today to ensure a smooth and just transition toward reaching South Africa's net zero aspirations. These transitions are discussed in more detail in Chapters 8 and 9.

Recent international studies concur that South Africa is currently on track to meet the 2025 emissions reduction target but will likely fall short of reaching the 2030 target. The detailed methodologies for these projections are presented in the cited works below, broadly estimating South Africa's emissions trajectory by reviewing policies that have been implemented and comparing those to the country's emissions reduction goals:

- Nascimento et al. (2022) projects that, under current policies, South Africa's emissions will likely fall within its NDC range in 2025 but will miss 2030 targets.
- The Climate Pledge of the Planbureau voor de Leefomgeving (Netherlands Environmental Assessment Agency) also projects that South Africa will miss the 2030 targets based on a review of the implementation of current policies (PBL 2024).

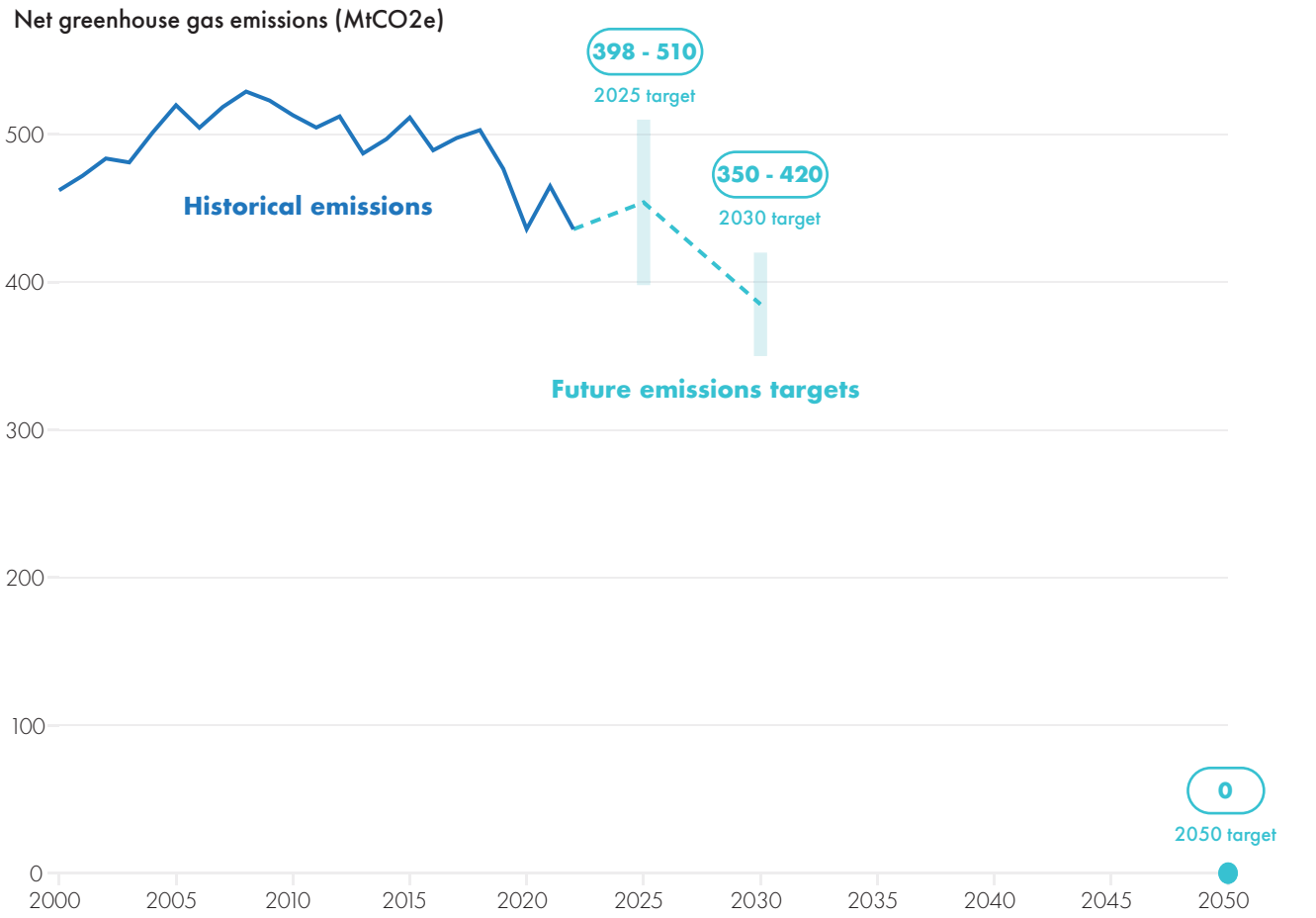
- The United Nations Environment Programme's *Emissions Gap Report 2023* projects an 11 percent gap[17] between South Africa's projected emissions under current policies and 2030 targets (UNEP 2023).

Recent domestic studies are more ambiguous about whether South Africa will meet the 2030 target:

- Modelling work undertaken by the University of Cape Town (Marquard et al. 2021) for the PCC and the DFFE, for example, shows that if the 2019 IRP and other existing policies were fully implemented as designed, then emissions in 2030 could be as low as 370 $MtCO_2e$; but this also depends on ambitious actions across other sectors. Although power accounts for the major share of emissions reductions to 2030, it is not the sole effort required.
- According to the government's draft 2024 *Sectoral Emissions Target (SET) Report*, the low target of the 2030 NDC (350 $MtCO_2e$) could be achieved with more ambitious actions in the electricity and transport sectors. The report cautions, however, that if key policies—such as the 2019 IRP with its prescribed electricity build and decommissioning plans—are not achieved, the 2030 target in the NDC may not be achieved. This is pertinent given Eskom's recent decision to further delay the decommissioning of three of its oldest coal-fired power plants (Camden, Grootvlei, and Hendrina).

These results indicate the need to strengthen the implementation of mitigation policies in the near term, particularly in the energy and transport sectors, as discussed in subsequent chapters.

Figure 7.2 • **South Africa's historical emissions and targets**



Note: Although South Africa's historical emissions and emissions targets for 2025 and 2030 are presented in units of million tons of carbon dioxide equivalent ($MtCO_2e$), and include emissions from non-CO_2 greenhouse gases, South Africa's 2050 net zero target is for net zero CO_2 emissions alone. Today, CO_2 emissions account for around 80 percent of South Africa's total annual CO_2e emissions (Climate Watch 2022a).

Sources: Historical data from Climate Watch (2022a); targets from Republic of South Africa (2021) and PCC (2022b).

CHAPTER 8.

DECARBONISING ENERGY SUPPLY

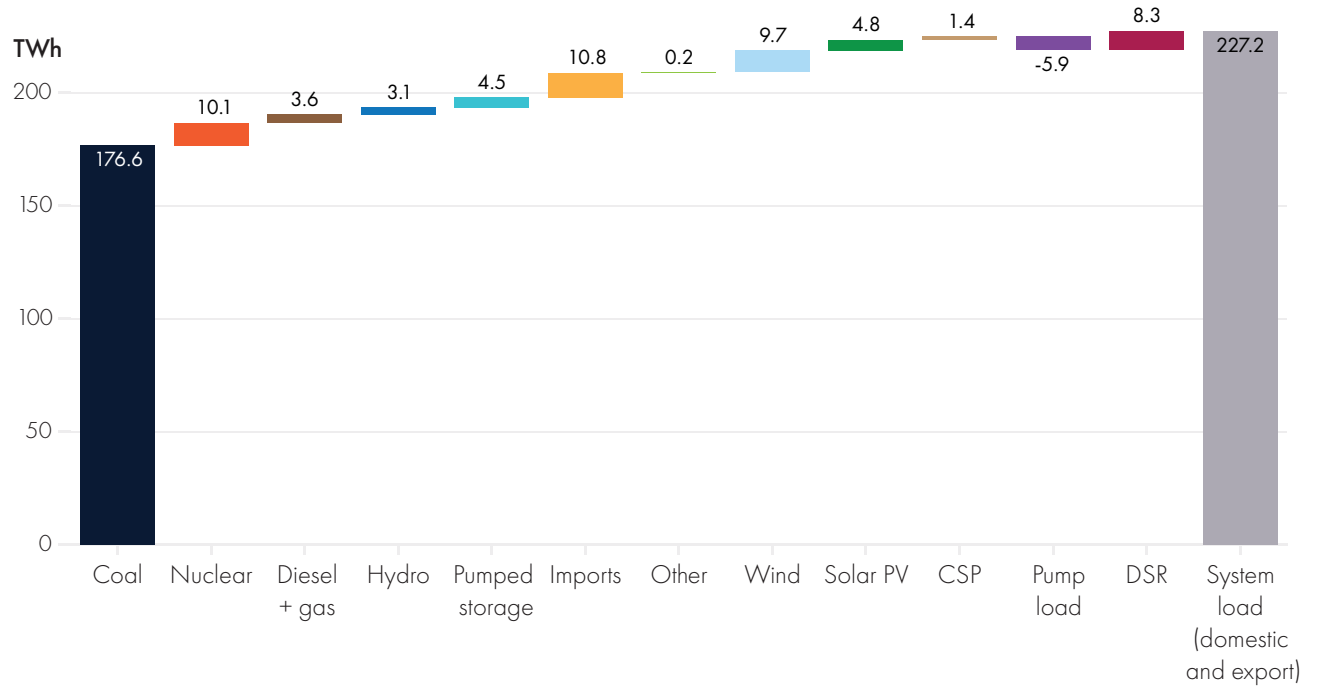
South Africa's energy supply system is the largest contributor to the country's GHG emissions; the country cannot achieve its climate commitments without decarbonising the sector. To meet the country's goal of reducing emissions to net zero CO_2 by 2050, significant and unprecedented changes will be required to transform the sector. This chapter examines South Africa's progress on some of these major transformations.

Overview

More than 40 percent of South Africa's GHG emissions are from the production of electricity (excluding coal mining). South Africa's electricity system is one of the most carbon intensive in the world, due to the predominance of coal in the electricity mix (coal contributed to a little under 80 percent of all electricity generated in 2022 (177 terawatt-hours) (Pierce and Le Roux 2023). The remaining electricity mix comprises renewable energy, nuclear energy, and diesel (Pierce and Le Roux 2023) (Figure 8.1).

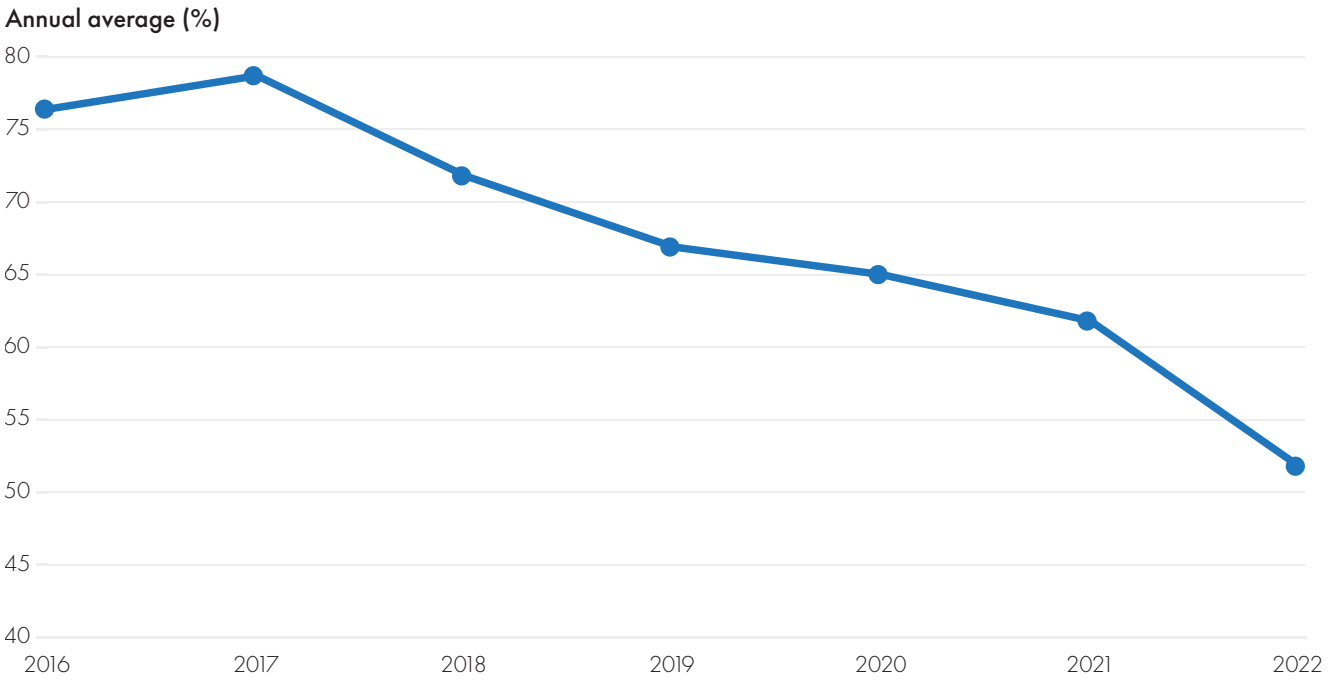
South Africa is facing severe electricity security challenges due to the decreasing energy availability factor (EAF)[18] of the coal fleet and increasing unplanned outages (Figure 8.2). The decreased EAF has led to a trend of declining electricity generation since 2010 (Figure 8.3). An independent assessment of Eskom's operational situation commissioned by the National Treasury found that Eskom's overly complex and bureaucratic governance structure is the root cause of the low EAF (VGBE 2023). With the coal fleet centrally managed, staff at the plant level are unable to implement operations and maintenance strategies in a timely manner, which has led to poor conditions at many plants (VGBE 2023). Complicated procurement processes and lack of internal capacity to address operations and maintenance challenges further exacerbate these issues (VGBE 2023). As a result of these operational challenges, as well as the general age of the coal fleet, load shedding has increased year on year since 2018, with large increases in 2022 and 2023; for example, load shedding in 2022 was four times more than in 2021 (Pierce and Le Roux 2023).

Figure 8.1 • **South Africa's electricity mix, 2022, by generation source**



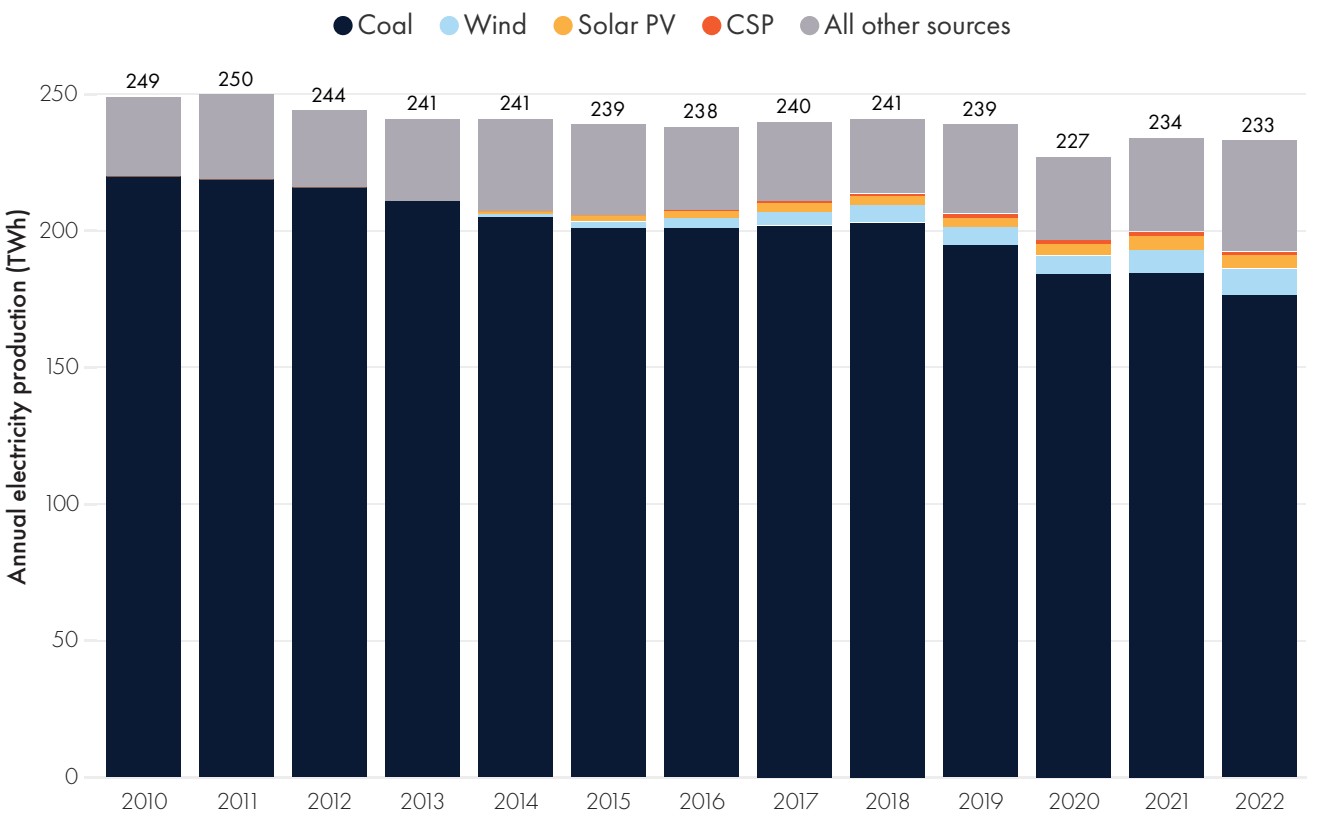
Notes: CSP = concentrated solar power; DSR = demand side response; PV = photovoltaic.
Source: Pierce and Le Roux 2023.

Figure 8.2 • **Declining EAF trends of Eskom fleet**



Note: EAF = energy availability factor.
Source: Pierce and Le Roux 2023.

Figure 8.3 • **Declining electricity generation in South Africa**



Notes: CSP = concentrated solar power; DSR = demand side response; PV = photovoltaic.
Source: Pierce and Le Roux 2023.

Load shedding has devastating impacts on South African people, businesses, and the economy. Analysis from Nova Economics[19] estimates that load shedding resulted in R43.5 billion in losses for the South African economy from 2007 to 2019, which is comparable to the impact that the 2008/9 financial crisis had on GDP growth (Walsh et al. 2023). The estimated impacts for 2020 through the first quarter of 2023 are significantly larger than the 2007–19 period, with roughly R224 billion in total losses (Walsh et al. 2023). These economic losses and other operational issues caused by load shedding—such as the inability for businesses to operate without electricity or the need to rely on expensive diesel as a backup source—impact productivity and employment.

The electricity system is facing one of the earliest disruptions in the transition to net zero CO_2 emissions by 2050. South Africa typically exports a quarter to a third of the coal it produces annually (Eskom 2021a; Minerals Council South Africa 2024). However, exports account for a higher portion of the value of total coal sales given the higher prices internationally compared to domestic sales; in 2022, exports accounted for 55 percent (R136 billion) of total coal sale value and 42 percent (R63 million) in 2021 (Minerals Council South Africa 2022, 2023). Although global coal demand rose in recent years because of conflicts, the expected longer-term trend is for demand to plateau and eventually decline, which means the sector will be impacted regardless of the pace of the transition domestically (PCC 2022b). These changes will have significant and far-reaching implications on the coal value chain and the people and communities that depend on it. These transitions clearly must be managed carefully, with an overriding centrality of justice. The risks and opportunities associated with transitioning the energy and coal value chains in South Africa have been covered extensively in literature,[20] but key takeaways from recent discussions are highlighted here.

The coal value chain encompasses between 150,000 and 200,000 jobs. Around 94,500 people were directly employed in coal mining in 2023, and roughly 43,000 employed between transport, power generation and petrochemical production, and local employment in the areas surrounding mines and power stations (Bhorat et al. 2023; Hermanus and Montmasson-Clair 2021; Makgetla 2021b; PCC 2023c; Minerals Council South Africa 2024; Patel et al. 2020). Analysis conducted for the Just Energy Transition Investment Plan (JET-IP) found that meeting the low end of the 2030 NDC would result in 4,500–7,500 new coal mining jobs not being created through 2030 and an additional 3,000–9,000 job losses between 2020 and 2030 due to reduced coal demand (Presidency of the Republic of South Africa 2022). Some of these losses can be at least partially mitigated through local employment diversification and investment in the renewable energy and other value chains (CSIR et al. 2021). However, the coal value chain is heavily concentrated in Mpumalanga—with 83 percent of operating coal mines in the country (Bhorat et al. 2023)—whereas new employment and economic opportunities may be less concentrated in the region. Indeed, the distributed nature of renewable power generation means that there are limited opportunities for centralisation other than in the upstream production elements of the renewable value chain.

Beyond creating employment opportunities for displaced workers, whether through job creation that aligns with transferrable skills or retraining programmes, another challenge during the energy transition is retaining job quality. Coal mining employment has offered formal benefits—such as unemployment insurance funds, pensions, collective bargaining rights, and leave opportunities—that are difficult to leave behind and, in many cases, have been seen as more favourable than the quality of other formal sector employment (Bhorat et al. 2023). Workers in disrupted industries thus stand to lose more than just income if there are minimal social protections in place amid the transition. The *Sector Jobs Resilience Plan: Coal Value Chain* (Patel et al. 2020) points to, for example, the need to assess the experience, age, and long-term career plans of workers likely to be affected by downsizing to inform labour market policies and economic diversification strategies.

The implications that emerge from the Komati Power Station closure reveal the conversations that need to take place prior to implementing actions toward developing clean energy. In October 2022, Eskom shut down the last unit of one of its oldest coal-fired power plants, the Komati Power Station. The PCC consulted with stakeholder groups following the Komati shutdown about the planned decommissioning and repurposing project. Consulted groups included representatives from civil society, community leaders and members, local business, organised labour, and local government. Although the full-time Eskom employees working at Komati have either been deployed to other Eskom sites or retained with the option of reskilling toward renewable technologies, many contract workers did not see any provisions from the Komati closure (PCC 2023b). In terms of the decommissioning process, workers and community members felt that they were only being consulted after the fact and emphasised a desire to have more involvement

in decision-making. They felt that there was a lack of transparency in the decommissioning process and that Eskom had an inadequate plan for retaining employees or creating new employment for those who lost jobs. The PCC recommended that in the future, impacted stakeholders be informed of a power plant closure years ahead of time to ensure the proper protections and alternative employment pathways are in place (Sguazzin 2023).

A just energy transition also requires access to clean, affordable, and reliable energy for all. South Africa has one of the highest electrification rates among countries in sub-Saharan Africa (World Bank 2023a). However, over 10 percent of households are not connected to the main electricity supply (Stats SA 2023c). Furthermore, household connection to the main electricity supply fails to capture the fact that many households with a connection are still energy poor. One study looking at both energy accessibility and affordability[21] as measures of energy poverty found that 27 percent of households are deprived of affordable energy and the same proportion do not use clean energy for space heating; one-fifth of households were energy poor as measured across accessibility and affordability dimensions (Ye and Koch 2023).

When households do not use electricity, either because they lack access to the grid or cannot afford to pay for electricity, they turn to alternative sources of energy that often come with safety risks. For example, use of candles or paraffin in informal settlements—where energy deprivation is concentrated—has been linked to deadly fires, burn injuries, and poisonings (Mohlakoana and Wolpe 2021; van Niekerk et al. 2022). Nearly a quarter of South African households do not use electricity as their main energy source for cooking (Stats SA 2023b). Use of alternative fuels (wood, charcoal, paraffin) in households is a major source of indoor air pollution throughout the country; a review of indoor air pollution studies in South Africa found a consistent link between use of nonelectric fuels and morbidity and mortality, particularly in children (Morakinyo and Mokgobu 2022).

Energy poverty also tends to disproportionately impact women and children. When a household relies on nonelectric fuels, it often falls to women and children to collect these fuels (Longe 2021). Time spent collecting fuel reduces time available to participate income-generating activities and can present health and safety risks because women and children may need to carry heavy loads of fuel (wood, charcoal) over long distances (Longe 2021; Mohlakoana and Wolpe 2021). Lack of electricity or adequate lighting at night can also increase the risk of gender-based violence (Mohlakoana and Wolpe 2021). As articulated in the Just Transition Framework, it is essential to consider the gender dimension in the transition (PCC 2022b).

A well-managed transition to a zero-carbon energy system has the potential to address energy equity issues while also improving public health. Air pollution from coal mining, transport, power generation, and industrial coal use has devastating health impacts for people living around these industrial activities (HEI 2022; Holland 2017). In particular, the people living in the airsheds of the 13 operational Eskom coal power stations—as well as the hundreds of coal mines and coal transport areas in Mpumalanga, Limpopo, and KZN—are continuously exposed to poor air quality with ongoing exceedances of health-based ambient air quality standards (Myllyvirta and Kelly 2023a). According to a recent report looking at the health impacts of Eskom's current planned retirement schedule and emission control retrofits, emissions from operational plants are projected to result in 79,500 air pollution–related deaths from 2025 until each plant's end of life (Myllyvirta and Kelly 2023b). Full compliance with minimum emissions standards could help avoid 2.300 deaths per year and save R42 billion annually from 2025 (Myllyvirta and Kelly 2023a, 2023b).

Decarbonising the electricity system will have significant positive health outcomes for millions of people living in affected airsheds. However, delaying the decommissioning of plants that are scheduled under the 2019 IRP to begin closing this decade, as Eskom has recently announced it will do, would have serious health and economic implications (Creamer 2024). Recent analysis shows that delaying the decommissioning of all coal plants such that they only start decommissioning in 2030, could result in an estimated 15,300 excess deaths and R345 billion (Myllyvirta and Kelly 2023a). Delays to closures this decade will likely have knock-on effects for the closure timelines during the 2030s and 2040s, which will, in turn, have impacts of air pollution–related deaths and costs (Myllyvirta and Kelly 2023a)

Major policies

Several government departments have a role in the governance of South Africa's electricity system, with related planning instruments and policies (adapted from PCC 2023d):

- The DMRE is responsible for energy-related policy and planning in South Africa, including electricity. It drafts and implements legislation and regulations governing the electricity sector, including the **Electricity Regulation Act (ERA)**. The DMRE is also responsible for the drafting and implementation of the **IRP** to guide electricity planning and procurement for the country. There are several other acts, regulations, policies, and plans owned by the DMRE governing the electricity and wider energy sector, however, the ERA, IRP, and **Gas Master Plan** (under development) are the most relevant for the electricity system. The last IRP was formally adopted in 2019 as the overriding plan to guide the future electricity mix. In early 2024, the cabinet approved the release of an updated IRP for public comment. The IRP is intended to be a "living plan" that is revised regularly, with an overarching goal to pursue a "diversified energy mix that reduces reliance on a single or a few primary energy sources." The PCC has provided comments on this draft plan, which are available on the PCC's website.
- Eskom is the state-owned, vertically integrated (generation, transmission, and some distribution) electricity utility. Eskom fits under the Department of Public Enterprises and has no mandate for energy policy and planning; however, as the largest electricity generator and system operator in the country, it holds the best information regarding the electricity system. Eskom is currently undergoing an unbundling process to separate into three independent units: transmission, distribution, and generation.
- The National Energy Regulator of South Africa (NERSA) is mandated to regulate electricity, piped gas, and petroleum pipeline industries in terms of various acts. This includes **licensing, permitting, registration,** and **pricing of electricity in the country**. NERSA is also required to concur with ministerial determinations for the procurement of new generation capacity by the state in line with the IRP.
- The Independent Power Producers Office (IPPO) was established to provide government with the support required to implement the Independent Power Producer Procurement Programme. Like the challenges faced by NERSA, the IPPO, as an implementer of policy and regulation, must contend with the restrictions of the law and rules as well as the need for a more dynamic, flexible response required to transition the electricity sector.
- Several other national government departments also have roles to play in the governance of electricity, through planning or authorisations (e.g., DFFE, Department of Trade, Industry and Competition [dtic]). There are also key platforms within the Presidency engaged in electricity-related policy and implementation initiatives (Operation Vulindlela, the National Energy Crisis Committee, the PCC, and the JET-IP Project Management Unit).

Required shifts

To realise South Africa's goal of achieving net zero CO_2 emissions by 2050, multiple key shifts across the electricity system will be required, some of which the IRP acknowledges and plans for, though policy disconnects persist (see Chapter 2). The needed shifts include building new electricity generation plants from variable renewable energy (i.e., wind and solar), increasing storage capacity, and accelerating the pace of fossil plant phasedown and closure. These transformations must be achieved in the context of the just transition, with simultaneous policy priorities to stabilise the grid; provide low-cost, reliable electricity to all; and ensure that workers and communities transitioning from the fossil fuel industry are supported and empowered.

Using methods outlined in Appendix B, this section examines progress across four key indicators that must transform to decarbonise the electricity system. The scale-up of renewable energy across South Africa is monitored by Power Indicator 1 (renewable energy

capacity), and Power Indicator 2 (battery storage scale-up) measures an enabling technology that will be required to facilitate the needed increase in renewables. Power Indicator 3 (coal power capacity) and Power Indicator 4 (natural gas consumption) track progress toward the phasedown[22] and phaseout of fossil power in South Africa. In future iterations of this report, the PCC will include additional indicators for transforming the energy sector that address the necessary justice imperatives, such as affordable, consistent electricity access for all; community involvement; and restorative, procedural, and distributive justice.

For each indicator that is assessed, we show the gap between historical data and future needed targets. The targets toward which progress is tracked for all indicators are derived from National Business Initiative (NBI) studies that model the shifts needed to achieve South Africa's net zero CO_2 target[23] (NBI 2022) but will be updated after the PCC develops its own sectoral benchmarks for assessing progress. We also note instances in which the indicators that are assessed are likely to follow a rapid, nonlinear growth trajectory sometimes known as an *S-curve*.

These indicators do not exhaustively measure all progress that will be required to transform the sector. Rather, each indicator assesses the gap between historical trends and the future targets that need to be achieved in a subset of areas with large mitigation potential in South Africa. An overview of how indicators and targets were selected for inclusion in this report is presented in Appendix B.

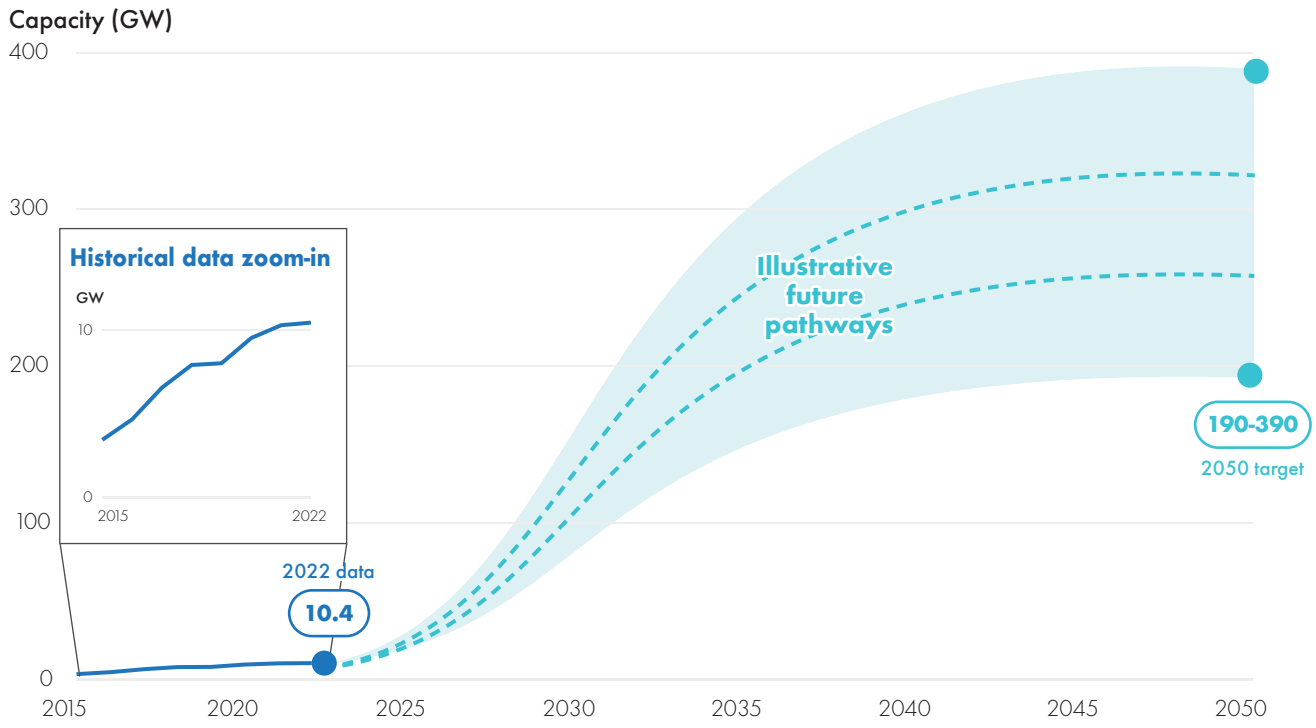
Power Indicator 1

RENEWABLE ENERGY CAPACITY

Target: Reach between 190 and 390 gigawatts (GW) of renewable energy capacity by 2050 (Figure 8.4), per the NBI (2022).

The build-out of renewable energy capacity in South Africa has risen over the last years, but a large gap persists between today's capacity and the capacity required to meet the country's long-term climate commitments (Figure 8.4). Renewable energy capacity reached 10.4 GW in 2022, growing from just 3.4 GW in 2015 (IRENA 2023a) by an average of about 1 GW per year. This growth over the last decade has primarily been driven by a more than quadrupling of solar capacity between 2015 and 2022 and a near tripling

Figure 8.4 • **Historical progress and future targets for renewable energy capacity**



Notes: Technology adoption typically follows a nonlinear, S-curve trajectory. Renewable energy is still in the emergence stage of an S-curve in South Africa but could accelerate with the right policy support. The illustrative S-curves shown here depict the type of S-curve pathways that the indicator would need to take to reach its targets. They are not forecasts for the future and are not the only possible pathways to reach the targets.

Sources: Historical data from IRENA (2023a); targets from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

in wind energy capacity from that same year (IRENA 2023a). However, much of the recent progress in building new renewable energy capacity has been in "behind the meter" household and corporate rooftop solar (i.e., individuals and companies procuring renewable energy technologies for their own use) (Eskom 2023b; Ferris 2023). This has the important implication that this growth in renewable energy takes place outside of the formal government-led just transition and may not lead to an equitable and wide sharing of benefits, as envisaged in the South African Renewable Energy Masterplan.

South Africa is falling behind on established targets for the electricity sector. Based on the latest capacity data provided by Eskom, the country is not meeting its targets for coal capacity phaseout or for building on-grid renewable energy capacity as measured against the targets set under the 2019 IRP (see Table 8.1). Eskom reported that it had approximately 44.6 GW of installed coal capacity and 39.1 GW of nominal (available) capacity in 2023, which is not on pace with the decommissioning proposed in the 2019 IRP (Eskom 2024). Renewable energy build is 5.2 GW behind schedule. Experts in the field have attributed the slow renewable energy build to delays in bidding windows under the Renewable Energy Independent Power Producers Programme, inconsistent political support, and limited grid access and capacity (Evans and Ngcuka 2023; Parker 2022).

NBI projections demonstrate that capacity will need to reach at least 190 GW by 2050 to decarbonise South Africa's power sector in line with its midcentury climate target and up to 390 GW by the same year to support anticipated demand for green hydrogen production (NBI 2022). Between now and 2050, this will require an average growth rate of between 6 and 14 GW[24] per year, as compared to the current growth rate of 1 GW per year. Thus, achieving this target range will require an enormous acceleration of new renewable capacity installation across the economy. To enable the rapid rollout of renewables that is required to achieve South Africa's climate targets while ensuring energy security, power grid infrastructure will also need to be equipped to meet rising supply.

Fortunately, a large body of literature has emerged in recent years demonstrating how certain technological innovations, including renewables like solar and wind power and storage technologies like batteries, have the potential to follow S-curve growth trajectories. This means they may grow much more rapidly than historically projected when nurtured by supportive enabling environments and infrastructure (see more in Box 2). Targeted policy interventions and financing that support rapid uptake of renewable power can enable such growth trajectories.

Table 8.1 • **Annual coal and renewable energy on-grid installation targets from 2019 IRP compared to actual achieved**

	COAL	COAL TO BE DECOMMISSIONED	PV	WIND	CSP	TOTAL PLANNED RE
Baseline installed capacity	**37,149**		**1,474**	**1,980**	**300**	**3,754**
2019	2,155	-2,373		244	300	4,298
2020	1,433	-557	114	300		4,712
2021	1,433	-1,403	300	818		5,830
2022	711	-844	1,400	1,600		8,830
2023	750	-555	1,000	1,600		11,430
Targeted total installed on-grid capacity by 2023 (MW)	37,899		4,288	6,542	600	11,430
Actual Installed on-grid capacity by 2023 (MW)	44,598[a]		2,287	3,443	500	6,230
Difference between planned and actual	6,699		-2,001	-3,099	-100	-5,200

Notes: a. Nominal capacity in 2023 was 39,099 MW. CSP = concentrated solar power; PV = photovoltaic; RE = renewable energy.
Sources: DMRE 2019; Eskom 2023b, 2024.

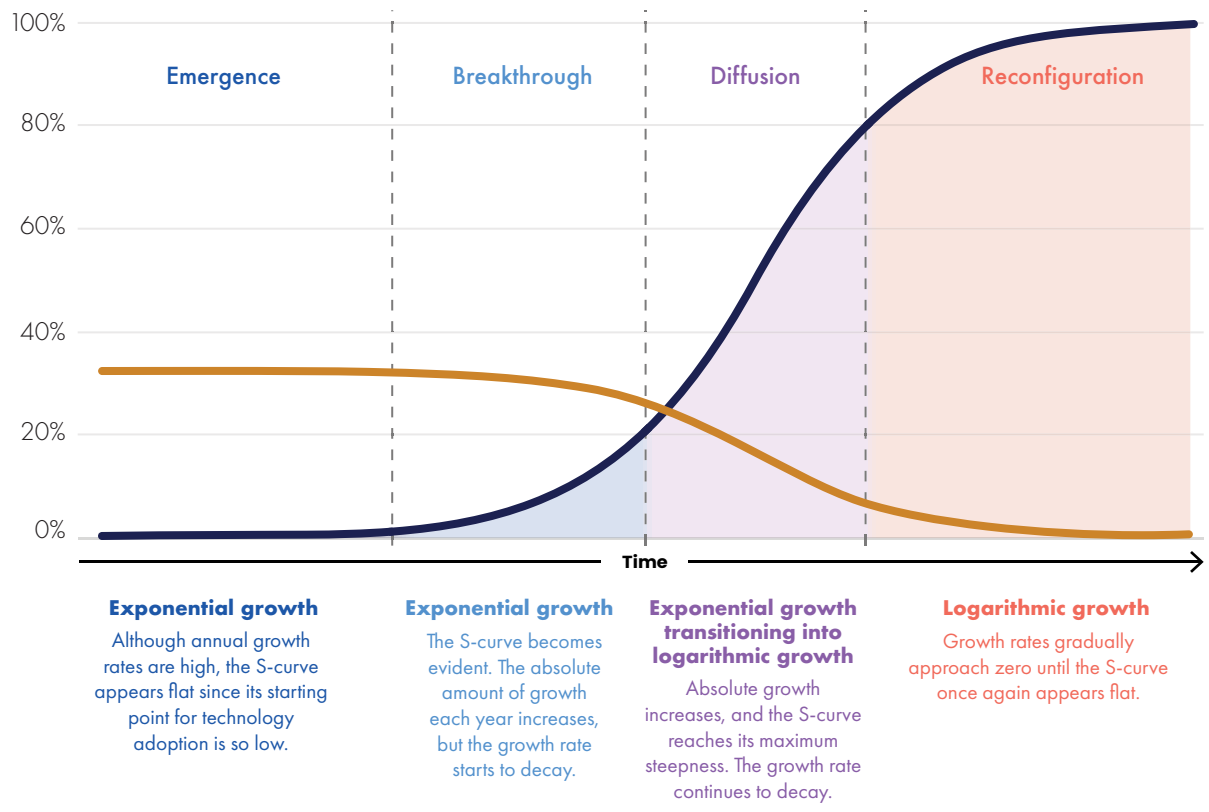
Box 2 • Potential for technologies to follow exponential growth trajectories

Historically, projections for future adoption of zero-carbon technologies such as wind, solar, and electric vehicles have been linear in nature, with modellers predicting a gradual increase over time. However, there is emerging evidence to suggest that these projections have actually underestimated the rates of uptake that have unfolded for many technologies.[a] For instance, the International Energy Agency has repeatedly needed to update its linear forecasts for solar growth because this market diffusion has accelerated more quickly than projected year after year. In one stark example, 2012 projections for the amount of solar capacity that would be installed across the world by 2030 were actually surpassed by 2018.[b]

An emerging body of literature points to the possibility that certain technologies are more likely to follow nonlinear growth trajectories, sometimes referred to as S-curves, wherein growth rates of a technology increases exponentially until saturating the market and then slowing back down toward zero.[c] The different stages of this S-curve trajectory are demonstrated in Figure B2-1, which show how a technology can move from early emergence to breakthrough within a market to large-scale diffusion and finally to eventual market saturation, or reconfiguration.[d] There is evidence that technology adoption follows this S-curve trajectory after crossing a particular tipping point, such as reaching price parity with an incumbent technology, after which demand skyrockets, prices continue to fall, and rapid and nonlinear growth takes off. Supportive policy and financing interventions such as green technology incentives, carbon pricing programmes, research and development investments, and more are often critical for unlocking this S-curve type of growth trajectory.

The shift away from coal power electricity to renewables, including as envisaged in the draft 2023 integrated resource plan (IRP), will create job fluctuations and could lead to a reduction in jobs if not properly managed. With appropriate planning and support, some of the job losses in the coal value chain can be offset by further development of the domestic renewable energy manufacturing industry. The South African Renewable Energy Masterplan (SAREM) outlines some of the potential benefits that can be realised by industrialising the renewable energy value chain, including targeted job creation in areas where former coal sector employees live.[e] As SAREM aligns with the IRP, any updates to the IRP that increase the renewable energy targets for 2030 or beyond would likely result in increases to the projected job and gross domestic product growth potential of the plan.

Figure B2-1 • **Illustration of an S-curve**



Source: Adapted from Boehm et al. 2023.

Box 2 • **Potential for technologies to follow exponential growth trajectories (cont.)**

Throughout the 20th century, and across many different geographies, we can observe how popular technologies, including the automobile, telephones, and the internet have followed this S-curve trajectory of growth.[f] We also see evidence that, in recent years, renewable technologies such as solar and electric vehicles have grown exponentially in leading countries with supportive enabling environments (e.g., policy regimes, prerequisite infrastructure).[g] Other zero-carbon technologies, including wind, green hydrogen, and alternative fuels for shipping and aviation, may soon follow suit.[h]

The implications of these trends for South Africa are significant: to nurture this type of exponential growth, it is paramount that government prioritise interventions that continue to bring costs down and improve each technology's enabling environment and supporting infrastructure. Exponential growth is not guaranteed, and the steepness of the S-curve depends on what the government does. But with the right support, the large gaps between levels of green technology uptake today and levels that are needed over the next decade(s) can shrink.

Sources: a. Jaeger et al. 2023; Lenton et al. 2023; b. Jaeger et al. 2023; c. Boehm et al. 2023; Jaeger et al. 2023; d. Boehm et al. 2023; Jaeger et al. 2023; e. DMRE et al. 2022; f. Systemiq 2023; g. Jaeger 2023a, 2023b; h. Boehm et al. 2023

Power Indicator 2

BATTERY STORAGE CAPACITY

Target: Scale up battery storage to reach about 70 GW of capacity by 2050 (Figure 8.5), per the NBI (2022).

Battery storage technologies that can store excess electricity generated by variable renewable energy sources like wind and solar and release it when needed to meet future demand will also need to be developed rapidly to enable South Africa's power sector decarbonisation.[25] Indeed, to achieve South Africa's net zero CO_2 target, estimates project that battery storage capacity will need to reach a total of around 70 GW of capacity by 2050 (NBI 2022). Despite this substantial need, South Africa's first battery plant facility began operations in December 2023, and it is providing around 60 megawatts (MW) (0.06 GW) of capacity to date (Eskom 2023a), with up to 360 MW (0.36 GW) planned over the next several years (Eskom n.d.).

Fortunately, these technologies may also follow S-curve growth trajectories when supported by government interventions and nurtured under the right conditions (see Box 2). To achieve the targets for battery storage capacity and support rapid uptake of variable renewables across South Africa, strategic policy and financing can be directed toward rapidly building up this burgeoning industry. Battery manufacturing is also one of the many ways that South Africa can build its green economic competitiveness and create new jobs in this labour-intensive industry.

Power Indicator 3

COAL POWER CAPACITY

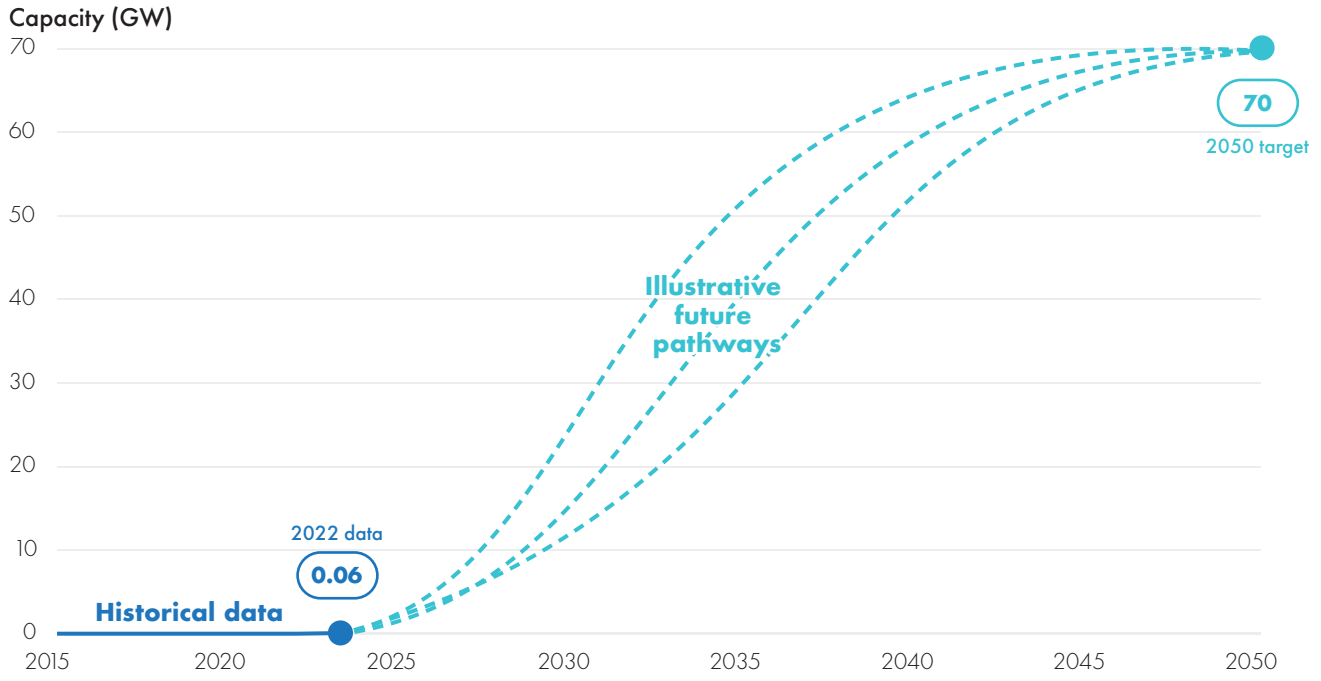
Target: Take 6 GW of coal offline by 2030 and retire the last coal power stations by 2042 (Figure 8.6), per the NBI (2022).

In 2022, nominal coal capacity in South Africa was a little under 40 GW (Eskom 2015–22; NBI 2022). The overall percentage share of coal generation in South Africa's electricity mix, however, is dropping due to an aging coal fleet and reduced availability factors. For example, 2022 was the first year that coal generation dropped below 80 percent (Pierce and Le Roux 2023).

To remain consistent with achievement of South Africa's national climate goals, NBI projections demonstrate that at least 6 GW of coal power must be taken offline by 2030, and that all coal power stations must be retired by 2042, reversing today's trends of increasing capacity entirely (NBI 2022). To date, 72 percent of South Africa's coal capacity is already more than 30 years old (GEM 2024). The retention of coal in South Africa's electricity mix is under active debate, with the draft IRP (2023) proposing to delay shutting down coal-fired power plants to retain dispatchable capacity "where technically and commercially feasible." The PCC recommendations to government in 2023 stand in contrast with this, stating, "South Africa should adopt a least cost electricity pathway and seek opportunities to close coal faster, predicated on achieving energy security" (PCC 2023d).

The reduction in coal use for electricity generation will have significant implications on the workers in the coal value chain and the surrounding communities. From the 1980s to early 2000s, employment in the sector declined from its peak of roughly 130,000 jobs to its

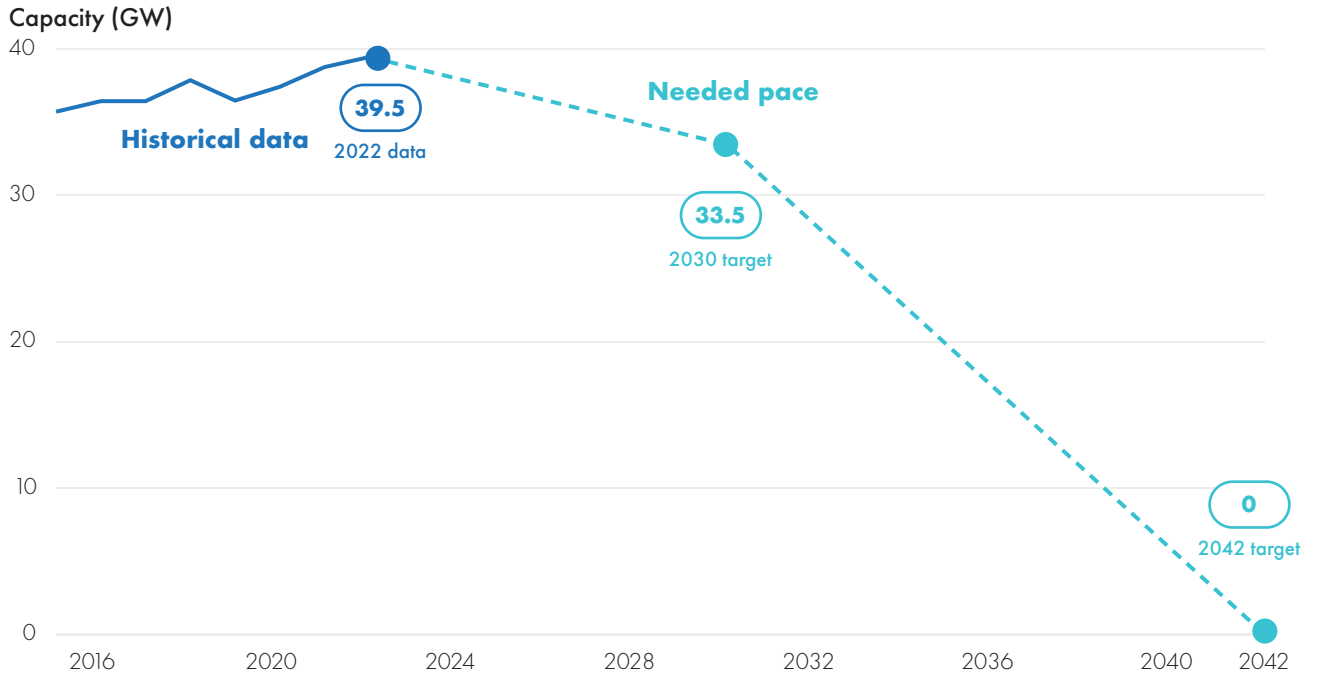
Figure 8.5 • **Historical progress and future targets for battery storage capacity**



Note: Technology adoption typically follows a nonlinear, S-curve trajectory. Battery storage capacity is still in the emergence stage of an S-curve in South Africa, but it could accelerate with the right policy support. The illustrative S-curves shown here depict the type of S-curve pathways that the indicator would need to take to reach its targets. They are not forecasts for the future and are not the only possible pathways to reach the targets.

Sources: Historical data from Eskom (2023a); target from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

Figure 8.6 • **Historical progress and future targets for nominal coal power capacity**



Note: Current rates of progress are headed in the wrong direction and require a U-turn to achieve the targets for 2030 and 2042. If rapid, nonlinear growth in renewable energy occurs, it may enable coal power to also decline in a nonlinear fashion.

Sources: Historical data from Eskom (2015–22); targets from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

lowest point of around 50,000 jobs before rising to 90,000 during the 2010s (Makgetla 2021b). Most miners have matric qualifications yet earn around 50 percent more than the median for the formal sector. This makes it harder to find equivalent livelihoods outside of mining (Makgetla 2021b).

Coal production is geographically concentrated, with 80 percent occurring in Mpumalanga and over 70 percent of South Africa's total value added from coal coming from just four towns: eMalahleni (Witbank), Steve Tshwete (Middelburg), Govan Mbeki, and Msukaligwa (Ermelo) (Makgetla 2021b; Patel et al. 2020). Around 1.1 million people live in these districts (Stats SA 2011). Besides the direct employment effects, the downsizing in coal will affect a range of businesses and informal sector work that support the mines' labour force. Moreover, the municipalities depend on Eskom and the mines to provide some infrastructure and services (Patel et al. 2020). This speaks to the just transition imperative—ensuring that workers and communities are supported and empowered to define new livelihoods and decent work in the context of transition.

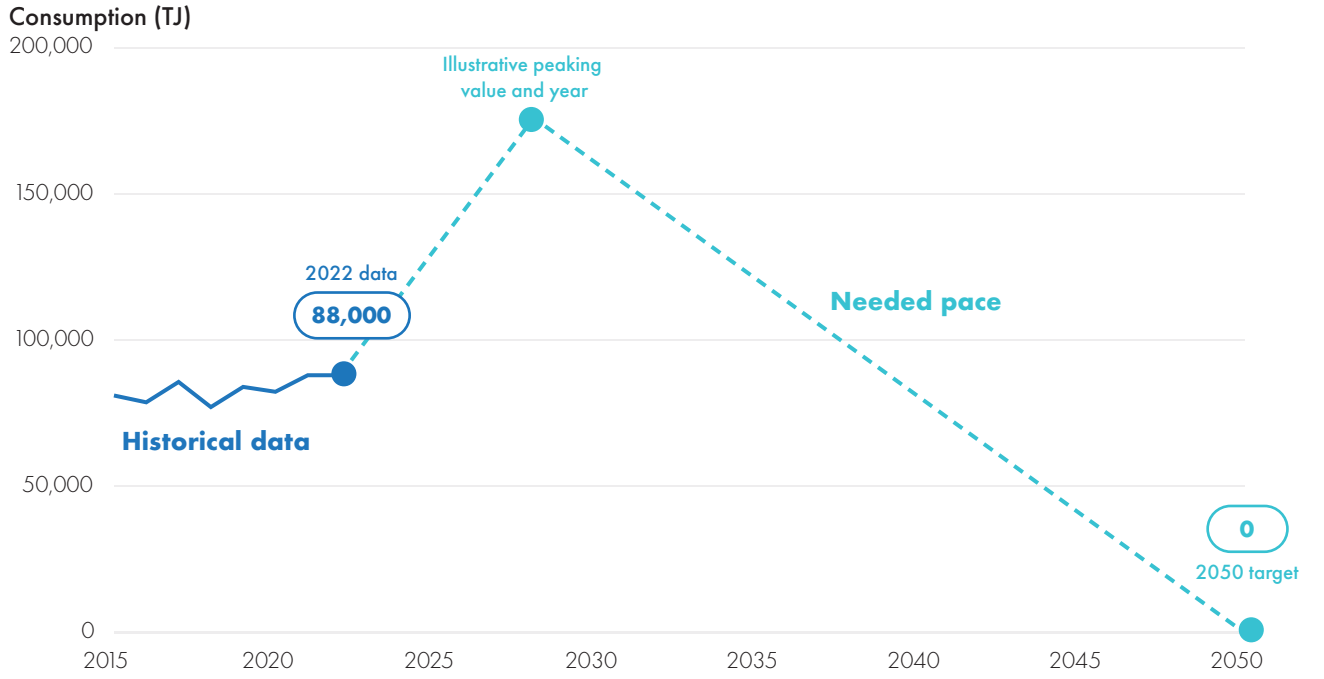
Power Indicator 4

NATURAL GAS CONSUMPTION FOR POWER

Target: Phase out natural gas by 2050 (Figure 8.7), per the NBI (2022).

Natural gas consumption in South Africa has fluctuated over the last decade, with consumption reaching about 88,000 terajoules in 2021 (IEA 2022).[26] But, according to the NBI, consumption of natural gas will need to be entirely phased out by 2050 as renewables grow to replace it (NBI 2022).[27] It is important to note here that any gas turbines that continue to remain operational during this peaking and declining period should be "green hydrogen ready," such that these turbines can be quickly switched over to green hydrogen once this critical technology becomes market ready at scale (see Box 3 for more information about green hydrogen needs in South Africa).

Figure 8.7 • **Historical progress and future targets for natural gas consumption for power**



Sources: Historical data from IEA (2022); targets from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

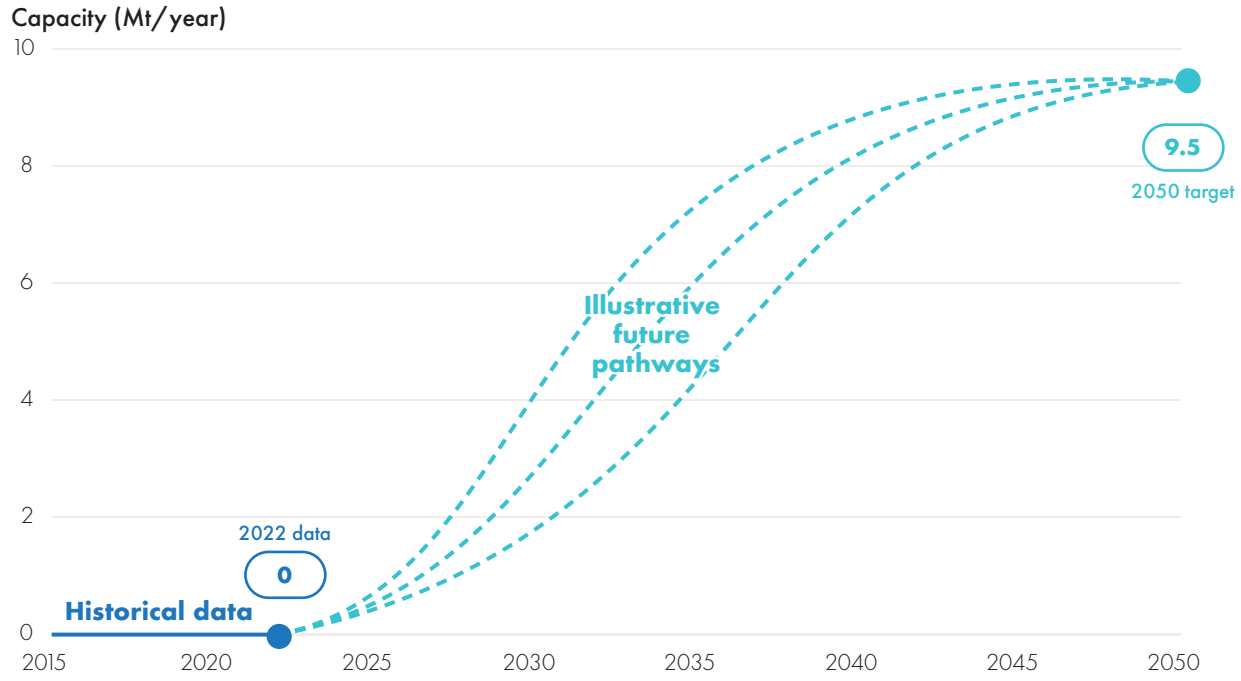
Box 3 • Scaling up green hydrogen capacity in South Africa

Scaling up green hydrogen, or hydrogen that is produced using zero-carbon electricity that splits water into hydrogen and oxygen with an electrolyser, will be critical for enabling South Africa's transition to net zero.[a] Within the power sector, green hydrogen has a role to play in providing seasonal balancing of variable renewables and replacing natural gas in gas-peaking plants.[b] Additionally, green hydrogen will also be needed to support decarbonisation of South Africa's industry and transport sectors, where it can be used as a net zero energy carrier in high-heat industrial processes such as steel, cement, glass, and chemical production, deployed as an alternative transport fuel for heavy-duty fuel cell electric vehicles, and utilised as a feedstock for synthetic fuel production such as for sustainable aviation fuel.[c]

GREEN HYDROGEN INDICATOR • Green hydrogen capacity

Target: Increase green hydrogen capacity to 9.5 million tons (Mt) by 2050 (Figure B3-1), per the National Business Initiative (NBI) (2022).

Figure B3-1 • **Historical progress and future targets for green hydrogen capacity**



Note: Technology adoption typically follows a nonlinear, S-curve trajectory. Green hydrogen capacity is still in the emergence stage of an S-curve in South Africa but could accelerate with the right policy support. The illustrative S-curves shown here depict the type of S-curve pathways that the indicator would need to take to reach its targets. They are not forecasts for the future and are not the only possible pathways to reach the targets.
Sources: Targets from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

Although the country is not currently producing any green hydrogen at commercial scale, the NBI estimates that by 2050 South Africa will be able to deliver 9.5 Mt of green hydrogen per year to achieve these multiple decarbonisation opportunities.[d] Supportive policy can put green hydrogen on a path toward exponential growth.

Sources: a–d. NBI 2022.

CHAPTER 9.

IMPROVING PUBLIC TRANSPORT AND SHIFTING TO NEW ENERGY VEHICLES

The transport sector accounts for approximately 11 percent of South Africa's total GHG emissions and 14 percent of energy sector emissions (DFFE 2024).[28] Most of these emissions (97 percent) come from road transportation. Transport demand is projected to grow significantly in the coming years, potentially doubling by 2050 (NBI 2023). Sectoral emissions will, in turn, also grow unless the sector can be decarbonised through electrification, shifts to public transport, and other greener transport modes.

Overview

The transport sector, and its workers, are particularly exposed to climate and extreme weather events (ITF 2022). As frontline workers, those in the transport sector are relied upon to continue moving people and goods even in the face of extreme heat, storms, and so on. Interviews of transport workers in Johannesburg revealed that heavy rains and storms have caused damage to rail tracks and vehicles and left both workers and users stranded (C40 and ITF 2021). In addition to the significant risk posed by extreme weather events, longer-term climate impacts can also threaten the sector. For instance, sea level rise can damage or make port infrastructure inaccessible, and increased temperatures and drought can cause deformation of rail tracks and roadways (Greenham et al. 2022).

A just transition to a low-carbon transport and automotive sector must address the current challenges facing the sector as well as the climate and transition-related risks. Current notable challenges include poor public transportation and road infrastructure; a public transportation system plagued by accessibility, reliability, safety, and affordability concerns; and the legacy of apartheid, in which spatial planning was used to implement and enforce racial segregation, thereby creating an inefficient and inequitable transport system (Ahjum et al. 2020; NBI 2023). Additionally, the automotive industry faces significant transition risks given its reliance on exports of internal combustion engines (ICEs) to markets that are set to ban the sale of ICEs in the 2030s (dtic 2023).

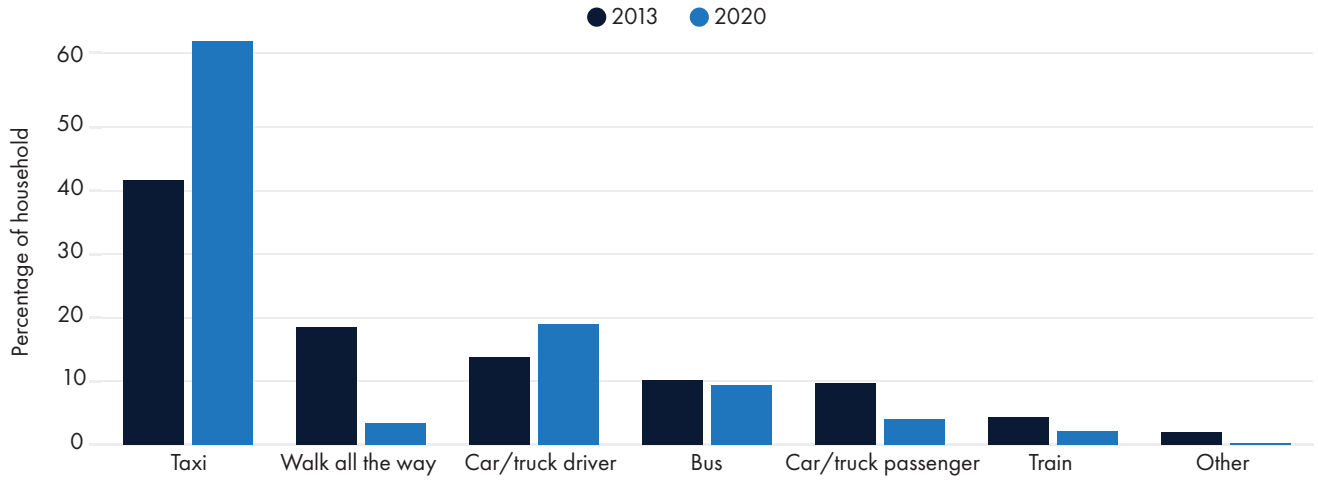
Public transportation

Less than one-third (31 percent) of South African households own a working vehicle (Stats SA 2023b). Accordingly, most South Africans rely on walking, public transit, or taxis to reach their destinations (Stats SA 2022a) (Figure 9.1).[29] At the household level, transport is dominated by taxi use, particularly minibus taxis (MBTs) (Stats SA 2022a). Less than 10 percent of households reported using the bus as the main travel mode, and just over 2 percent reported using the train (Stats SA 2022a).

MBTs offer the benefit of greater flexibility in terms of routes and schedules; however, they are more costly than public transit (NBI 2023). The MBT industry evolved in response to apartheid transportation policies that made it difficult for black South Africans to access formal public transportation (Walters and Pisa 2023). MBTs are responsible for 15 million commuter journeys daily, and the industry generates over R40 billion in revenue annually (DoT 2023). Although the industry fills a critical gap in the sector and is economically important, it is not well regulated, which has resulted in poorly maintained and unsafe vehicles in operation, reports of reckless driving, and conflict and violence within the industry due to intense competition (Walters and Pisa 2023).

Public buses are the most utilised form of formal public transportation. Bus fares are subsidised by the government, but they are nevertheless struggling to compete with MBTs (Walters and Pisa 2023). South Africans cited lack of availability and other service-related issues as the primary reasons for not using buses (Stats SA 2022a). Insufficient funding, policy uncertainty, and noncompetitive procurements for short-term contracts have made it difficult to invest in improvements that could increase ridership (Walters and Pisa 2023). Furthermore, the commuter bus industry has been unable to effectively adapt to changing passenger demand since the introduction of the Public Transport Operations Grant came into effect in 2009, which changed the subsidy system from a passenger-based to

Figure 9.1 • **Main travel method used by households in 2013 and 2020**



Source: Stats SA 2022a.

a kilometre-based system (Walters and Pisa 2023). This change meant that increased ridership does not result in increased subsidies to fund new routes or frequencies (Walters and Pisa 2023).

To help increase transportation access in metropolitan areas and formalise the MBT industry, a bus rapid transit (BRT) system was proposed by the Department of Transportation (DoT) in 2007 (Walters and Pisa 2023). With respect to the MBT industry, the idea was to incorporate existing taxis and bus operators into new vehicle operating companies established to manage the BRTs (Walters and Pisa 2023). Despite these efforts, a significant portion (30 percent) of MBTs continue to operate without a licence (Walters and Pisa 2023). The initial BRT rollout in Johannesburg and Cape Town was promising, thanks in part to the need to rapidly roll out transit for the 2010 World Cup (Hook and Weinstock 2021). However, progress since then has been slow, with just 88 km built throughout the country, limited success in integrating MBTs into the system, and decreasing political support for funding and expansion (Hook and Weinstock 2021; Walters and Pisa 2023).

The railway system is currently the least utilised form of public transit in South Africa. The public rail system (which does not include the Gautrain system) is managed by the Passenger Rail Agency of South Africa (PRASA) and includes 585 stations covering 2,280 km concentrated in main metropolitan areas (Walters and Pisa 2023). Currently, about 60 percent of the rail system is electric, and the rest runs on diesel (NBI 2023). The rail system faces issues related to safety, reliability, frequency, corruption, and crime, which has led to massive and continual decline in ridership over the last several decades (Walters and Pisa 2023). For example, in 2023 the highest month for metrorail travel was August, with 3.9 million journeys; in comparison, August 2013 saw 50.1 million journeys (Stats SA 2013, 2023d). In the 2020 National Household Travel Survey, the most popular response to "reasons for not having used trains" across every province was that trains were simply not available (Stats SA 2022a).

The transport sector is a large employment and economic contributor for South Africa. The most recent labour force statistics show 966,000 people are currently employed in the sector, accounting for just under 6 percent of total jobs (Stats SA 2023f). Nearly half of these jobs are from MBTs, followed by the freight sector (handling and road transport) as the next largest contributor. Women make up a small share of sectoral employment, accounting for just 3 percent of taxi drivers and 14 percent of other transport workers (Maseko et al. 2020).

The just transition should consider strategies to increase women's participation in the sector and to determine what protections workers will need from both transition and climate risks. The International Transport Workers' Federation has made recommendations for how to ensure a just transition for urban transport, though they are relevant for the broader sector (ITF 2022). Some of the recommendations include worker-led formalisation, hazard pay during extreme weather events, pension support for retiring workers, and democratic control of transport (IFT 2022).

The automotive industry

The automotive industry is another important component of the transport sector. It encompasses automotive manufacturing as well as related support services such as forecourt attendants, auto mechanics, and car salespersons. South Africa has the largest automotive manufacturing sector on the continent and accounts for over half of all vehicles produced in Africa (dtic 2023; Lamprecht 2023b). It is the only manufacturing industry outside of mining with products ranking in the top five exports for the country, and it contributed 4.9 percent to GDP in 2022 (Maseko et al. 2020; Lamprecht 2023b).

The automotive manufacturing industry is particularly exposed to transition risks. There were nearly 556,000 vehicles produced in the country last year, and over 60 percent of those were exported (Lamprecht 2023b). The United Kingdom and European Union serve as the largest export markets, and both have commitments to ban the sale of ICEs by 2035 (Presidency of the Republic of South Africa 2022). This represents a significant transition risk because South Africa currently does not have a new energy vehicle (NEV)[30] value chain or manufacturing capabilities (dtic 2023). Although demand for NEVs has grown exponentially in some countries, it remains extremely small in South Africa. In 2022, just 502 battery-powered EVs were sold in the entire country, representing less than one-tenth of 1 percent of total sales (Lamprecht 2023a). This is important because the sector relies on domestic demand as well as exports. Key barriers preventing the growth of the domestic market include cost, lack of public charging infrastructure, and load shedding (dtic 2023; NBI 2023).

The industry accounts for over 497,000 formal jobs (about 23 percent in manufacturing and the rest in sales, repairs, and maintenance), or just under 3 percent of total employment (Lamprecht 2023b). Manufacturing is geographically concentrated in Nelson Mandela Bay, eThekwini, Gauteng, and Buffalo City (Maseko et al. 2020). Workers along the automotive value chain face significant transition risks because manufacturing and maintenance of NEVs require a new skill set, as does maintenance of charging infrastructure. Additionally, manufacturing NEVs is less labour intensive than ICEs and the vehicles require less maintenance, so fewer workers may be needed (Maseko et al. 2020). Compared to formal employees in other sectors, auto mechanics were less likely to have a retirement fund, which may indicate that workers in the industry have less adaptive capacity (Maseko et al. 2020). Furthermore, both the automotive and wider transport sector include many small businesses and relatively large informal employment outside of vehicle manufacturing (Maseko et al. 2020). As with the public transport sector, the automotive industry is male dominated; just 8 percent of mechanics and between 22 percent and 33 percent of transport equipment manufacturing and petrol retail workers are women (Maseko et al. 2020).

Major policies

Since the establishment of South African democracy in 1994, the country has developed numerous policies and frameworks to guide the country toward more reliable, energy-efficient, sustainable, and accessible transportation. Prior to 1994, public transport services, specifically segregated commuter bus services, were used to further enable the apartheid system by dividing communities and maintaining physical separation between residencies and places of work (DoT 2024). The apartheid government heavily subsidised the commuter industry to enable this inefficient system (DoT 2024). This is just one example of apartheid-era policy in transport and spatial planning that continues to have negative impacts today. Policies put in place after 1994 have sought to address these historical inequities, and the country is making strong progress to design more equitable transport policies.

The Green Transport Strategy (GTS) is a 2018–50 road map outlining policy and general recommendations to cultivate a transformative shift in South Africa's transport system to reduce GHG emissions and negative environmental and human health impacts. The GTS sets a target to reduce emissions by 5 percent below business-as-usual projected emissions for the transportation sector by 2050. It is organised across five central implementation themes: green transport technologies, climate change response norms and standards, green rails, green fuel economy standards, and green roads. Although the GTS reviews all transport modes across South Africa, it particularly focuses on critical shifts from road transport and freight to rail and from private vehicle use to public transportation (buses and rail), and it promotes cleaner vehicle technologies (DoT 2018). The GTS proposes the following initiatives to support these shifts: integrated transport planning, taxation schemes, cleaner alternative fuels research, sustainable urban planning, conversion of public and national fleets to cleaner fuels or efficient technology vehicles, energy storage research, bus transit system expansion, smart tags, operation system

reviews, and more (DoT 2018). The strategy demonstrates South Africa's vision for a more efficient and sustainable, integrated transport system.

The transport sector requires a more comprehensive policy implementation system, particularly a stronger monitoring and evaluation system with identified responsible parties to better coordinate and track progress. The GTS, the 2021 revised "White Paper on National Transport Policy" (DoT 2022b), and the South African Automotive Industry Master Plan 2035 all highlight the need for development of agreed-upon key performance indicators for monitoring and enabling stronger cross-entity coordinated transport systems. Other strategies for improving transport policy implementation could include more cohesive timelines, the introduction of transport authorities at the metropolitan level, integrated ticketing systems, and more (Walters and Pisa 2023). Ultimately, stronger implementation systems can serve as a tool to attract investments for more sustainable and equitable transport from the private sector, multilateral development banks, and other international financing mechanisms to fund the just transition. The DoT's Revised Strategic Plan (2020–25) is one of the few documents that provides a detailed approach with clear outcomes, outcome indicators, baselines, and five-year targets across its priority focus areas (DoT 2021).

Although transport policies mention the importance and potential roles the private sector can play, PPPs remain minimal. Overall, the approach to regulation, management, and funding of public transport systems continues to be segmented across departments and different spheres of government; this creates uncoordinated responses to issues that fail South Africa's policy goals of developing an integrated public transit system (Walters and Pisa 2023). This lack of centralised decision-making and coordination makes it difficult to attract and implement transport-related PPPs, a low-cost and effective method of bridging public budget deficits on transport infrastructure with private capital (PCC 2023b; Sebitlo et al. 2022). Other studies have found the lack of proliferation of transport PPP projects in South Africa, especially as compared to its BRICS counterparts, is due to a lack of political commitment, cooperative decision-making, public official capacity, long-term financing instruments, and more (Sebitlo et al. 2022). Ultimately, there is a clear need to strengthen PPP frameworks to streamline existing and enable new transport-focused PPPs. The South African government recognises this need and is in the process of finalising amendments to existing PPP legislation that promise to address gaps and shortcomings of current PPP frameworks (National Treasury 2024).

The decline of the formal public transport sector is largely attributed to government policy and implementation failures that lead to underfunding, corruption, poor security management, limited operational oversight, inefficient management, inconsistent contract timelines and award systems, and myriad other problems (Walters and Pisa 2023). The DoT recognised the shortcomings of current passenger and freight rail and in 2022 published a new "White Paper on National Rail Policy," building on a 2017 draft white paper outlining a multidecade vision to revitalise rail networks to "play a meaningful role as a backbone of a seamlessly integrated transport value chain." The paper highlights the DoT's intent to develop a private sector participation framework for the rail industry as well as develop a devolution strategy with the integrated urban development framework to assign commuter rail function to municipal governments when appropriate (DoT 2022a, 9). To date, there has been some revised rail policy implementation success; as of early 2024, PRASA has brought 31 of 40 passenger rail lines back into partial operation, and ridership is increasing; however, passenger rail still has a long way to go to return to former peak-use levels (SA News 2024a).

There have been some initial efforts to formalise the MBT industry through the National Land Transport Act 5 of 2009 and, more recently, the National Land Transport Strategic Framework 2023–2028. The latter aims to integrate MBTs into the national public transport suite of offerings, proposing formal bus operations to replace informal MBT operations (DoT 2023). Due to the aforementioned funding, monitoring, implementation, and evaluation gaps, it is difficult to sufficiently or accurately analyse the impact of current policies or determine what reforms are needed to improve ridership and other aspects of the public transportation sector. Ultimately, revitalising public transport services to increase accessibility, reliability, and affordability—especially for passenger rail—while also formalising the MBT industry will be important steps in achieving a just transition for all in the transport sector.

Recent policies are promoting NEV production to reduce domestic transport emissions, retain jobs, support black South African businesses, and boost competitiveness in domestic and global auto markets. Since 2018, South Africa has produced several policy directives targeting NEV production as a priority, including the South African Automotive Master Plan (dtic 2018), the Just Energy Transition Investment Plan (Presidency of the Republic of South Africa 2022), the dtic's green paper on NEVs (dtic 2021), and the dtic's white paper on EVs (dtic 2023). This latest EV white paper summarises the industrialisation opportunity for South Africa to work nationally and with regional partners to develop critical minerals for the batteries value chain, bolstering Africa's ability to move beyond serving as only a source for critical minerals by also becoming an industrial producer of batteries and other automotive components. The paper describes 16 unique policy actions for EVs between 2023 and 2035 to increase manufacturing capacity as well as expand market development, including, but not limited to, reducing import duties for domestically produced and sold batteries, commercialising green hydrogen production, developing an electric battery regional value chain, refurbishing critical rail lines, creating an EV certification programme for skills development, establishing energy reforms, and more (dtic 2023). Directly related to the just transition, several transport-related policies explicitly mention the upskilling of black South Africans and empowerment of black-owned dealerships, repair facilities, and manufacturers as an opportunity within NEV production (DoT 2021; dtic 2018). Ultimately, it is the view of the South African government that increasing production capabilities of NEVs in-country can generate sector stability as well as new economic and jobs growth, ensuring the automotive industry is not left behind in the global transition away from ICE vehicles (Presidency of the Republic of South Africa 2022).

Required shifts

Decarbonising South Africa's transport sector will require a combination of key shifts that together result in reduced emissions, increased mobility access across the country, and improvements in public health. Broadly, the needed shifts can be categorised into those that increase collective and shared transit modes, such as public transportation, walking, and cycling, and shifts that enable decarbonisation of carbon-intensive modes of transport through electrification or switching to zero-emissions fuels (Boehm et al. 2023). Planning efforts that bring jobs, services, and goods closer to where South Africans live may also help to decrease the need for some motorised travel altogether.

These shifts must also take into consideration what is needed to build climate resilience in the sector. This will require a mix of hard (infrastructure) and soft (operational/logistical) adaptations as well as nature-based solutions (Greenham et al. 2022). Examples include elevating infrastructure to limit exposure to flooding or sea level rise, adjusting maintenance schedules, and enhancing soil stability to reduce road maintenance needs and improve road safety. Although there are no resilience-specific indicators captured in this section, many of the shifts needed to decarbonise the sector will yield mitigation and adaption cobenefits.

Using methods outlined in Appendix B, this section examines historical trends as compared to future targets for five indicators of progress across the shifts that are needed to decarbonise the sector.

Transport Indicator 1 (number of public road transport vehicles) and Transport Indicator 2 (private ownership of vehicles) monitor progress toward improved public transport outcomes across the country. Although public transit modes are improved, decarbonisation of emissions-intensive vehicles must also be prioritised. As road transport composes the bulk of South Africa's transport sector emissions, Transport Indicator 3 (share of NEVs in light-duty vehicle sales), Transport Indicator 4 (share of NEVs in the light-duty vehicle fleet), and Transport Indicator 5 (number of public charging stations) hone in on the needed scaleup of NEVs on roads, in particular.

For each indicator that is assessed, we show the gap between historical data and future needed targets. The targets toward which progress is tracked for all indicators are derived from NBI studies, which are aligned

with achieving South Africa's net zero CO_2 target but will be updated after the PCC develops its own sectoral benchmarks for assessing progress (NBI 2022). We also note whether the indicators that are assessed are likely to follow a linear growth trajectory or a rapid, nonlinear growth trajectory sometimes known as an S-curve (see Box 2 for more details).

As in Chapter 8, these indicators do not exhaustively measure all progress that will be required to transform South Africa's transport sector. For instance, the country must also work to deploy solutions that improve rail services and decarbonise heavy freight, shipping, and aviation. Appendix B provides more information about how indicators and targets were selected for inclusion in this report.

Transport Indicator 1

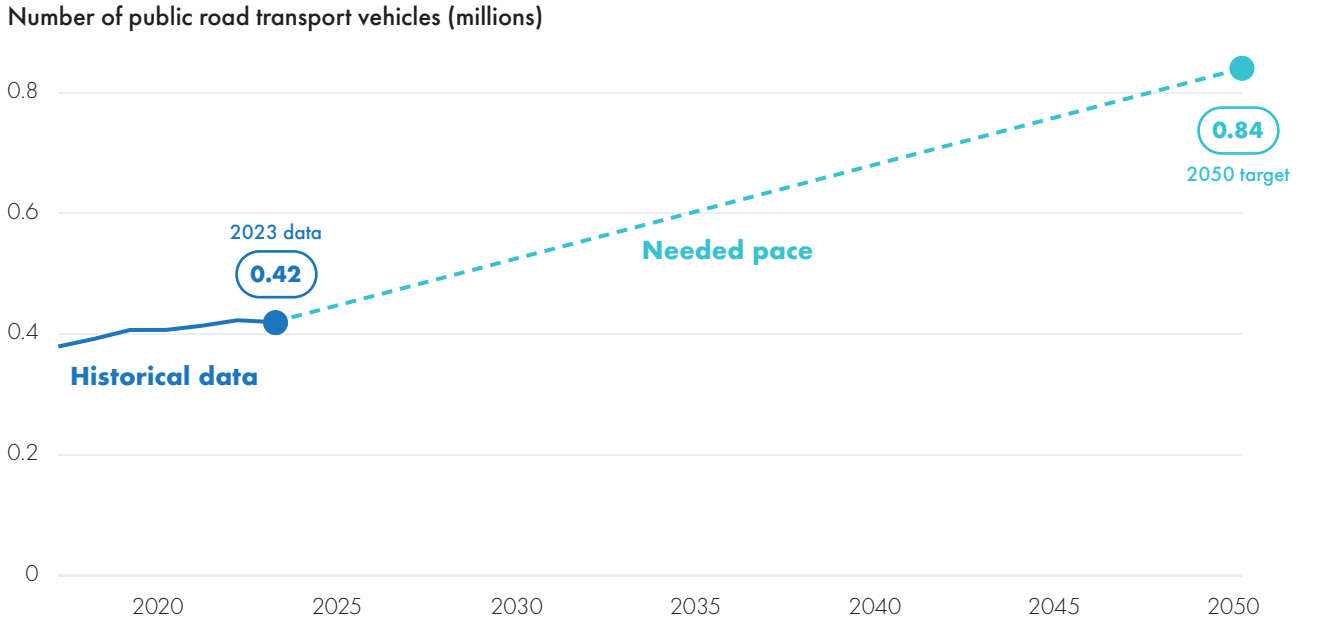
NUMBER OF PUBLIC ROAD TRANSPORT VEHICLES

Target: Double the number of public road transport vehicles by 2050 (Figure 9.2), per the NBI (2022).

To transition to a net zero transportation sector that serves all South Africans, a much-improved public transit system will be required. Indeed, estimates show that public road transport vehicles such as buses release fewer emissions per passenger-kilometre as compared to private vehicles (Systems Change Lab 2023). Simultaneously, improved public transit leads to fewer traffic fatalities, less urban congestion, better air quality, and more active lifestyles, all critical for improved public health and development outcomes (Welle et al. 2022). Research has also shown that investments in public transit can yield significant jobs benefits. One study found that ensuring South Africa's public transit system is aligned with the Paris Agreement would create an additional 127,100 public transit jobs (C40 and ITF 2021).

Estimates project that to achieve South Africa's climate targets while unlocking these cobenefits, the number of public road transport vehicles in operation today—some 420,000 vehicles—will need to double by 2050 (NaTIS 2017–23; NBI 2022). To achieve this target and get on track for 2050, rates of change over the last five years will need to accelerate by 1.9 times. Simultaneously, although not measured by this indicator, commercial rail needs to increase from 20 percent to 40 percent of commercial demand and passenger rail from 5 percent to 20 percent of passenger demand by 2050 to keep climate and mobility goals in reach (NBI 2022).[31] As this critical shift from private vehicle use to public transit scaleup takes place, it is paramount that policy and financing measures are in place to allow for increased uptake of zero-carbon public transit vehicles such that the emissions reductions achieved by this shift are expanded even further.

Figure 9.2 • **Historical progress and future targets for number of public road transport vehicles**



Note: Compared to the linear trend from the past five years, the rates of progress would need to accelerate by 1.9 times to achieve the above target for 2050, meaning that the indicator is heading in the right direction, but is off track to achieve its target.

Sources: Historical data from NaTIS (2017–23); targets from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

In addition to scaling up the number of public transit vehicles, just transition policies must also enable the efficient operation and management of the system while considering the affordability, accessibility, and equity of public transportation. Poor households in South Africa often spend significant portions of their income on transportation (NBI 2023). Roughly half of all households spend R500 monthly on transportation, which is one-third of the upper-bound poverty line (R1,558 in May 2023 prices) and half of the lower bound (R1,058) (DoT 2023; Stats SA 2023e). According to the DoT (2023), low mobility exacerbates poverty, whereby "unaffordable public transport would restrict entire households from economic opportunities."

As it stands, rail and bus transit are highly subsidised, but the MBT industry receives little direct government funding, despite its status as South Africa's most utilised form of transit (DoT 2024). Rail is the least utilised form of public transit, but two-thirds of public expenditure on urban transit goes to the PRASA (NPC 2022). Providing additional subsidies for MBT transit while much-needed improvements are made to the rail system could help improve affordability in the near term before transport demand is shifted from road to rail in the longer term. The draft Public Transport Subsidy Policy proposes evaluating additional capital subsidies for MBTs through the Taxi Recapitalisation Programme and other interventions to improve the efficiency and effectiveness of transport subsidies more broadly (DoT 2024). Simultaneously, continued policy incentives to ensure that bus travel is accessible and affordable to commuters will be critical.

Accessibility of transport is another critical factor to consider in creating a just, low-carbon transportation system. As noted earlier, the legacy of apartheid-era spatial planning has resulted in poor access to public transportation in rural areas and highly segregated access in urban areas. The time required to walk to public transit is a central measure of accessibility. In 2020, roughly 52 percent of South Africans lived within a 5-minute walk of public transport, a 4 percent decline from the rate in 2003 (DoT 2023). The number of people living more than a 15-minute walk away from public transit increased between 2003 and 2011 (DoT 2023). These statistics point to a decline in transit accessibility over time. Fortunately, rural households experienced an improvement in accessibility from 2013 to 2020, with access times reducing. However, travel in rural areas is still more time consuming than in urban areas (DoT 2023). Improved spatial planning and expansion of transit routes and infrastructure to situate housing closer to transit could help improve these trends. Increased funding and policy support to expand commuter bus services is also essential,

and greater private sector involvement could also help in closing urban-rural transportation access gaps (Pettersson 2019).

It is also important to consider characteristics that impact the accessibility and safety of public transit for different groups, such as women and persons with disabilities. Research has shown that women use public transit differently from men and often have more complex travel patterns due to the domestic and work tasks they handle (ADB 2013). Furthermore, South African women are more likely than men to rely on public transit to get to work (Stats SA 2021). Despite women's reliance on public transit, recent research has shown that South Africa's public transportation system largely does not meet the safety and accessibility needs of women (Moghayedi et al. 2023). A large survey of female transit (train, bus, and minibus) users in Gauteng conducted in October 2021 found that the majority experience some form of gender-based violence (verbal or physical assault, stalking, mugging, and/or pickpocketing) when using public transit and often experience it repeatedly (Moghayedi et al. 2023). Alarmingly, very few women reported never experiencing any form of violence on public transit. A just transition for the transport sector must address these issues and consider how to make transit safe and accessible for all users.

Transport Indicator 2

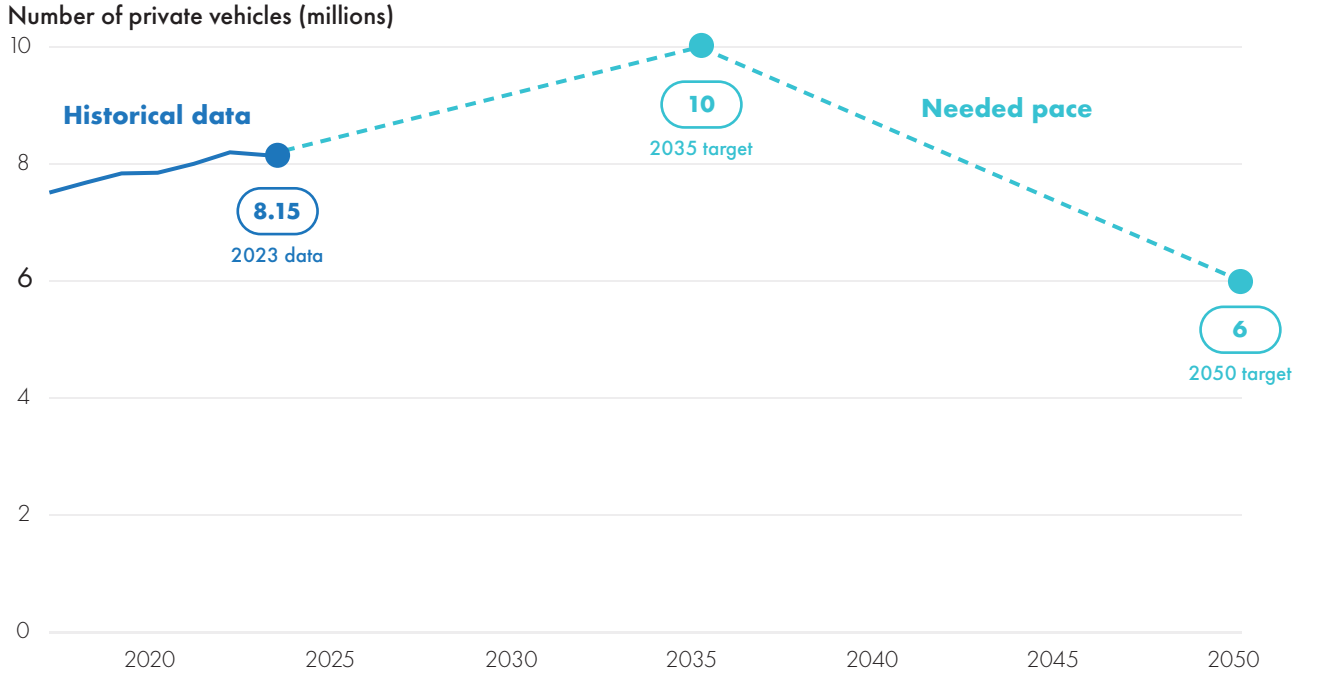
PRIVATE OWNERSHIP OF VEHICLES

Target: Peak private ownership of vehicles at 10 million in 2035 and decrease to 6 million by 2050 (Figure 9.3), per the NBI (2022).

Across the world, cars emit more CO_2 per passenger-kilometre travelled than all other urban land transport modes (Boehm et al. 2023; Cazzola and Crist 2020). Accordingly, as public transit options that are clean, affordable, reliable, safe, and accessible to all are scaled, private ownership of vehicles will need to peak and eventually decline to keep South Africa's climate targets in reach. Critically, this transition from private to public transport hinges on substantially greater funds being made available to support bus and rail services as well as migration of a significant portion of MBTs to bus travel, which emit less per passenger-kilometre. There is also a need to better plan, coordinate, and implement integrated transport plans across the country.

Today, there are around 8.2 million private vehicles on the road across the country (NaTIS 2017–23). Estimates aligned with achieving South Africa's near- and long-term emissions targets project that private vehicle ownership should peak at no more than 10 million private vehicles by 2035 and decline to no more than 6 million by 2050 (NBI 2022).

Figure 9.3 • **Historical progress and future targets for private ownership of vehicles**



Sources: Historical data from NaTIS (2017–23); targets from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

Transport Indicator 3

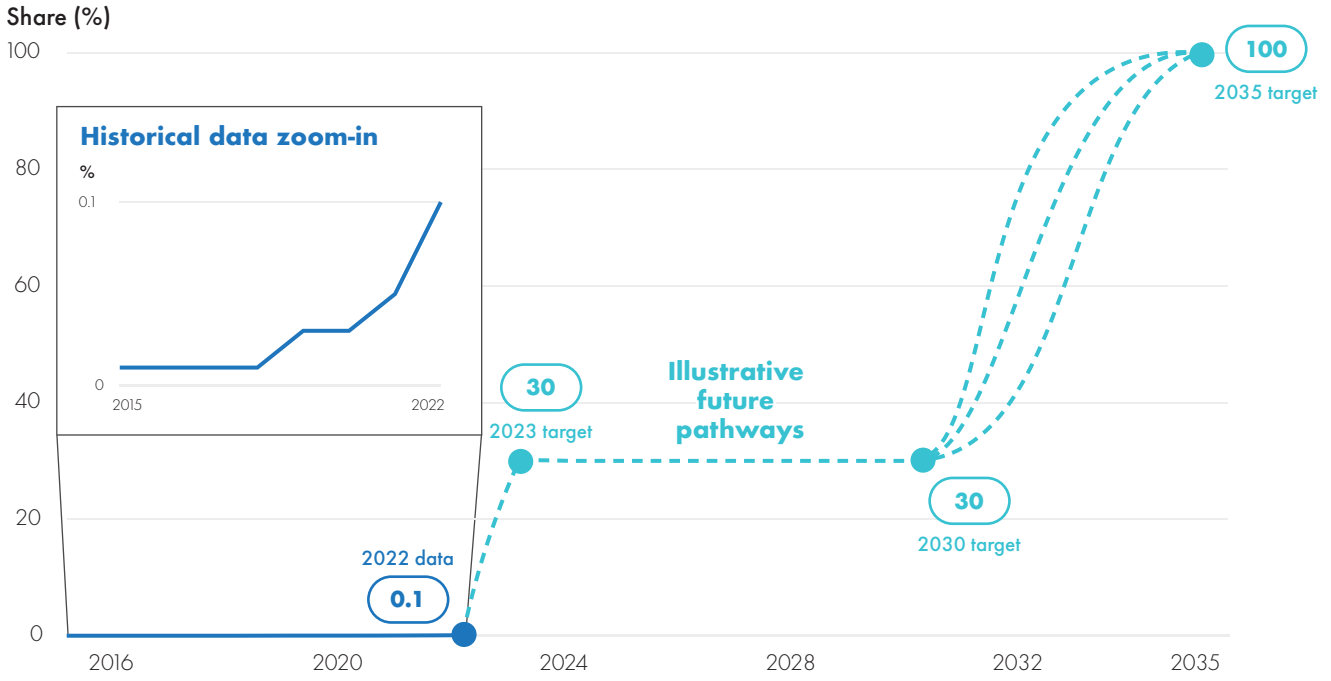
SHARE OF NEVS IN LIGHT-DUTY VEHICLE SALES

Target: Ensure 30 percent of all new light-duty vehicle sales are for NEVs between today and 2030 and that 100 percent of all new light-duty vehicles sales are for NEVs by 2035 (Figure 9.4), per the NBI (2022).

Although public transit infrastructure across South Africa is improved, this decade also needs to see a massive scaleup of the share of NEVs in light-duty vehicle sales. Although increasing attention to compact urban design, buildup of rail, and other investments in nonmotorised mobility will eliminate the need for some road vehicle travel in South Africa, many South Africans will continue to depend on road transport via private passenger vehicles to meet at least some of their transport needs. In 2022, this share hit just over 0.15 percent of sales, but projections in line with achieving South Africa's climate targets show that it must reach 30 percent by 2030 (IEA 2023; NBI 2022). This share should then ramp up during the 2030s to reach 100 percent by 2035 (NBI 2022). This indicator measures private passenger vehicles, including cars and sport utility vehicles only.

Although a large gap persists between today's sales and the sales required to achieve a 100 percent share, evidence supports the strong potential for S-curve growth of new energy passenger vehicles (see Box 2). This indicates the potential for rapid closure of this gap with the appropriate resources devoted to scaleup. Closing this gap will require targeted policies to ensure that NEVs are more affordable than ICE vehicles for South African households. As it stands, less than one-third of South African households currently own a working vehicle, and car ownership is concentrated in wealthier households; over 75 percent of households in the highest income quantile own a vehicle, whereas only 6 percent of households in the lowest quintile do (Stats SA 2022b). Although the longer-term trend should move toward reduced private vehicle ownership, it is important to consider how to ensure that everyone has access to the right type of transportation to meet their needs.

Figure 9.4 • **Historical progress and future targets for share of NEVs in light-duty vehicle sales**



Note: Technology adoption typically follows a nonlinear, S-curve trajectory. New energy vehicle sales are still in the emergence stage of an S-curve in South Africa, but they could accelerate with the right policy support. The illustrative S-curves shown here depict the type of S-curve pathways that the indicator would need to take to reach its targets. They are not forecasts for the future and are not the only possible pathways to reach the targets.

Sources: Historical data from Lamprecht (2020, 2023a); targets from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

Transport Indicator 4

SHARE OF NEVS IN THE LIGHT-DUTY VEHICLE FLEET

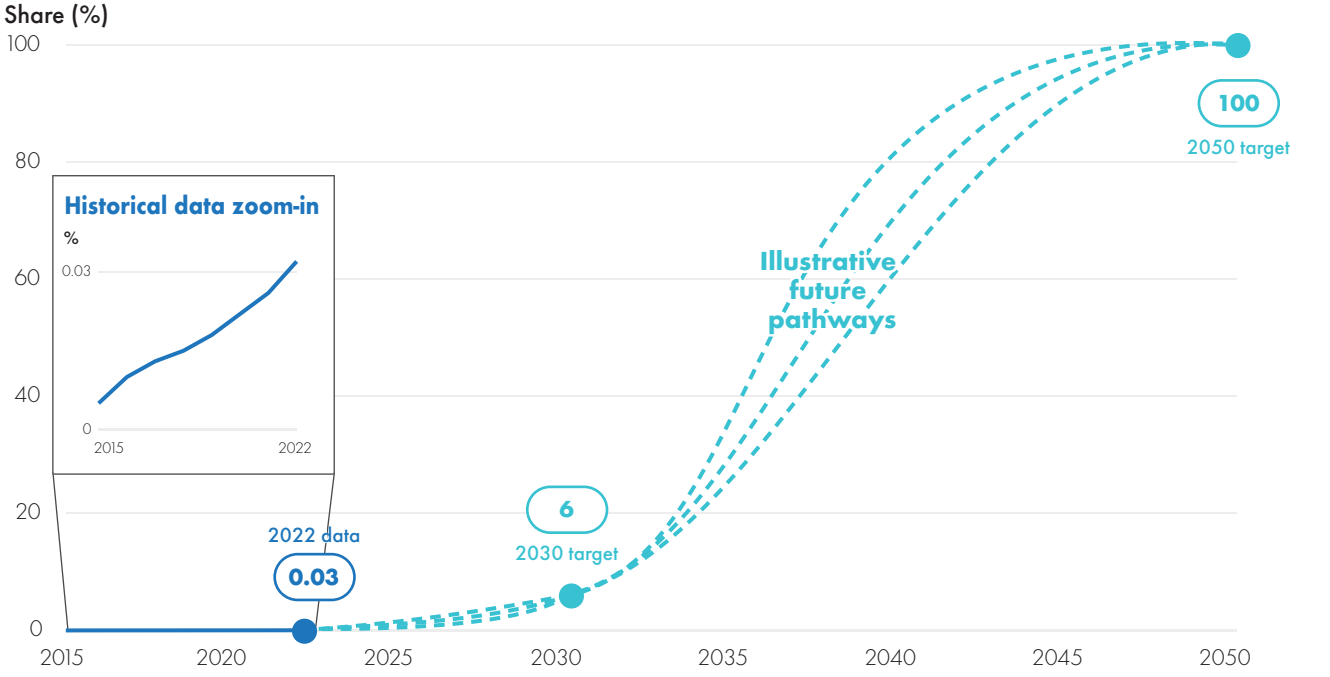
Target: Ensure NEVs reach 100 percent adoption in the light-duty vehicle fleet by 2050 (Figure 9.5), per the NBI (2022).

The share of NEVs in the light-duty vehicle fleet will grow as NEVs replace older ICE vehicles. Although this share sat at just 0.032 percent of all light-duty vehicles in 2022, estimates project that it will need to reach 6 percent by 2030 and 100 percent by 2050 to keep South Africa's climate targets in reach (IEA 2023; NBI 2022). If South Africa implements the right policies to promote exponential growth in NEV sales, exponential growth is likely to occur in the NEV fleet, albeit on a delayed timescale given the amount of time it takes for the fleet to turn over.

This indicator does not measure progress toward decarbonisation of public transport road vehicles, although new energy MBTs and buses should both reach 100 percent share of the total fleet by 2050 (NBI 2022). Given that such a large share of transportation demand is currently met by MBTs, ensuring the transition to NEVs in the industry will be critical to decarbonisation. Targeted subsidies, tax incentives, and reduced import tariffs can help increase the affordability of imported EVs while domestic capacity is built to manufacture more affordable EVs locally. Government efforts to formalise and regulate the MBT sector can help facilitate the distribution of subsidies and other resources that will be needed to help transition the industry. However, more passenger demand will still need to shift toward higher-density public transport (bus, rail) in the longer term to enable decarbonisation. As with other industries facing transition risks, workers in the MBT industry will require support—such as reskilling or early retirement assistance—as demand shifts.

Simultaneously, policy support, funding, and other interventions will be needed to decarbonise the bus industry. According to the NBI, one of the top priorities should be investing in a green BRT system for major cities, which could be initiated through pilot programmes deploying NEV buses in Cape Town, Durban, and/or Johannesburg (NBI 2023). A recapitalisation programme for the bus fleet can help support the financing of NEVs, and government procurement targets can be leveraged to stimulate initial demand

Figure 9.5 • **Historical progress and future targets for share of NEVs in the light-duty vehicle fleet**



Note: Technology adoption typically follows a nonlinear, S-curve trajectory. The new energy vehicle fleet is still in the emergence stage of an S-curve in South Africa, but it could accelerate with the right policy support. The illustrative S-curves shown here depict the type of S-curve pathways that the indicator would need to take to reach its targets. They are not forecasts for the future and are not the only possible pathways to reach the targets.

Sources: Historical data from IEA (2023); targets from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

(NBI 2023). Additionally, reforming public transport funding and subsidies to better align with consumer demand and prioritise cost recovery can help increase available funding for NEVs and related support infrastructure. These interventions could all fall under a comprehensive strategy for the introduction of NEVs in the public transport industry, which the government currently lacks.

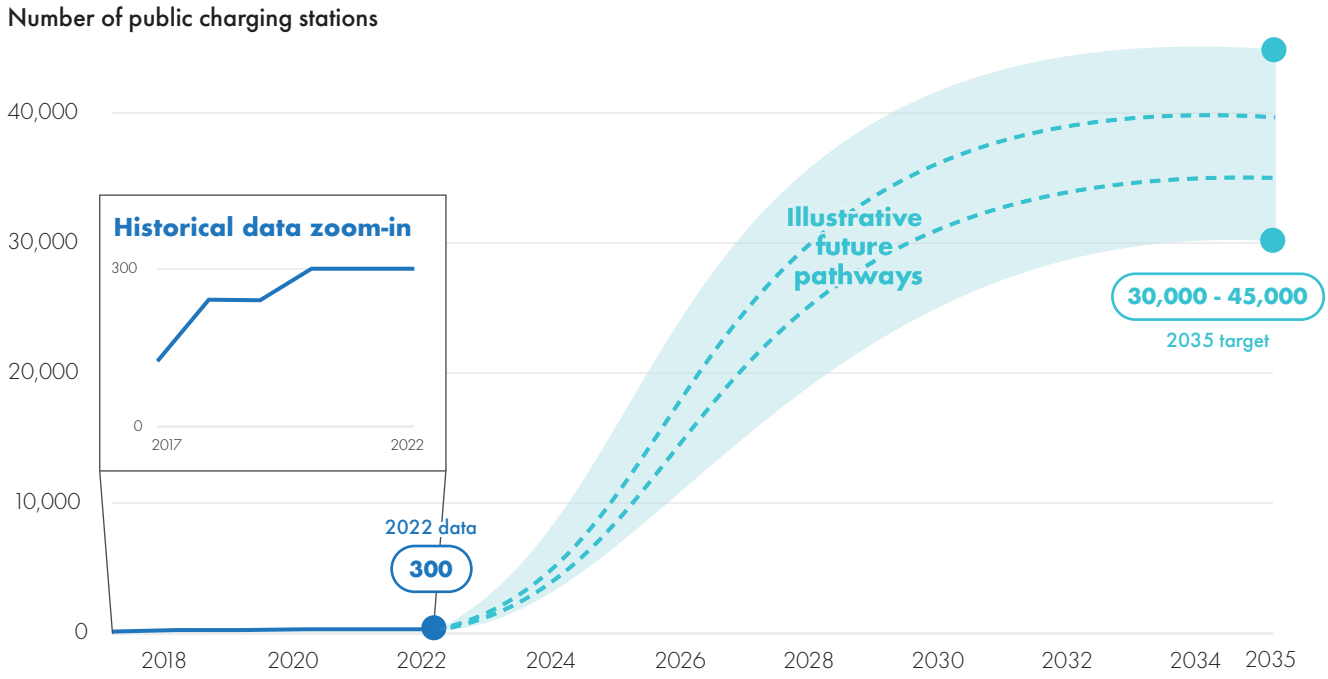
Transport Indicator 5

NUMBER OF NEW PUBLIC CHARGING STATIONS

Target: Install 30,000–45,000 public charging stations by 2035 (Figure 9.6), per the NBI (2022).

The massive scaleup of NEVs in South Africa that must take place over the next years and decades will only be achieved if accompanied by a simultaneous scaleup of key enabling infrastructure. Chief among these critical enablers are public charging stations that will be able to deliver reliable, clean, and fast power for both long- and short-range NEV trips (NBI 2023). In 2022, approximately 300 public charging stations were installed across the country (IEA 2023). However, estimates aligned with achieving South Africa's climate targets indicate that the country will require the installation of between 30,000–45,000 public charging stations by 2035 to support the growing NEV economy (NBI 2022). It is important to note here that although there exists significant potential for off-grid charging stations with captive renewable energy along national routes, the majority will need to be powered by a reliable—and decarbonised—electricity supply that hinges on the power sector transformation outlined in Power Indicators 1–4.

Figure 9.6 • **Historical progress and future targets for number of public charging stations**



Note: Technology adoption typically follows a nonlinear, S-curve trajectory. The number of public charging stations is still in the emergence stage of an S-curve in South Africa, but it could accelerate with the right policy support. The illustrative S-curves shown here depict the type of S-curve pathways that the indicator would need to take to reach its target range. They are not forecasts for the future and are not the only possible pathways to reach the targets.

Sources: Historical data from IEA (2023); targets from NBI (2022). Data visualisation adapted from Boehm et al. (2023), following methods from Jaeger et al. (2023).

CONCLUSION

This report has presented the PCC's first independent and evidence-based assessment of climate action in South Africa.

The key message from the report is that South Africa has strong commitments toward tackling climate change and facilitating a just transition, but incoherent policies, weak governance structures, and mixed actions by social partners are hindering progress at the pace and scale required. From these analyses, we are beginning to identify the immediate actions that must be affected to realise South Africa's vision for the just transition.

Our learning from this exercise shows that we must measure what is important, not just what is easy to measure. And we must consider how external changes affect progress across all stakeholder groups, such as global trade, energy security, and increases in the cost of living. Further, as this report illustrates, we must collect a range of information and data, both qualitative and quantitative. Indeed, people's perception on "how goes the battle on climate change and the just transition?" could be arguably seen as just as important as the data that can be measured.

Looking ahead, the PCC will continue to scrutinise and monitor implementation progress in detail—focusing on what is working, what is not, for whom, and why. The intention is to produce a biennial State of Climate Action in South Africa report so that all social partners—government, business, civil society, and labour, among others—have the most comprehensive, accurate, and up-to-date information to enable change.

The PCC is currently developing a monitoring, evaluation, and learning framework to track early indicators of progress on the just transition for publication in late 2024. Accordingly, our next reports aim to include the PCC's own benchmarks for assessing progress toward key sectoral and regional transitions as well as a deeper examination of the progress on key facets of the just transition: progress on economic diversification, industrial development, innovation, education and skilling, and social support mechanisms.

APPENDICES

Appendix A: List of stakeholders relevant to climate action and the transition

Table A-1 • **List of relevant (but nonexhaustive) stakeholders for South Africa's climate and just transition development**

STAKEHOLDER GROUP	SUBCATEGORY	ORGANISATION/INSTITUTION
Government	National	Cooperative Governance and Traditional Affairs (CoGTA)
		Department of Agriculture, Land Reform and Rural Development (DALRRD)
		Department of Employment and Labour
		Department of Forestry, Fisheries and the Environment (DFFE)
		Department of Health
		Department of Higher Education and Training
		Department of Human Settlements (DHS)
		Department of Mineral Resources and Energy (DMRE)
		Department of Planning, Monitoring and Evaluation (DPME)
		Department of Public Enterprises (DPE)
		Department of Science and Innovation (DSI)
		Department of Trade, Industry and Competition (dtic)
		Department of Transportation
		Department of Water and Sanitation (DWS)
		Department of Women, Youth and Persons with Disabilities
		JET-IP Project Management Unit (PMU), the Presidency
		Ministry of Electricity
		National Economic Development and Labour Council (NEDLAC)
		National Empowerment Fund (NEF)
		National Energy Crisis Committee (NECOM)

Table A-1 • **List of relevant (but nonexhaustive) stakeholders for South Africa's climate and just transition development (cont.)**

STAKEHOLDER GROUP	SUBCATEGORY	ORGANISATION/INSTITUTION
Government (cont.)	National (cont.)	National Energy Regulator of South Africa (NERSA)
		National Planning Commission
		National Treasury (NT)
		The Presidency
		Presidential Climate Commission (PCC)
		Sector Education and Training Authorities (SETAs)
		South African National Energy Development Institute (SANEDI)
	Provincial	Eastern Cape
		Mpumalanga
		Northern Cape
		Western Cape
	Local/municipal	City of Cape Town
		City of Johannesburg
		eThekwini Metropolitan Municipality
		South African Local Government Association (SALGA)
	Intergovernmental	African Union
		United Nations Industrial Development Organization (UNIDO)
Research	University/academia	Cape Peninsula University of Technology (CPUT)
		Mpumulanga University
		Nelson Mandela University (NMU)
		North-West University
		Rhodes University
		Stellenbosch University
		University of Cape Town (UCT)
		University of Pretoria
		University of Western Cape
		University of the Witwatersrand (Wits)
	Research institutes/ think tanks	Academy of Science South Africa (AASAf)
		Agora Energiewende
		Council for Scientific and Industrial Research (CSIR)
		Gauteng City Region Observatory
		Human Sciences Research Council (HSRC)
		Labour Research Service (LRS)
		Mapungubwe Institute for Strategic Reflection (MISTRA)
		Meridian Economics

Table A-1 • **List of relevant (but nonexhaustive) stakeholders for South Africa's climate and just transition development (cont.)**

STAKEHOLDER GROUP	SUBCATEGORY	ORGANISATION/INSTITUTION
Research (cont.)	Research institutes/ think tanks (cont.)	National Cleaner Production Centre (NCPC)
		Sam Tabani Research Institute (SATRI)
		South African Institute of Electrical Engineers (SAEIE)
		South African National Energy Development Institute (SANEDI)
		Southern Centre for Inequality Studies
		Stockholm Environmental Institute
		Trade & Industrial Policy Strategies (TIPS)
		Water Research Commission
Nongovernment organisations	Environmental	350 Africa
		Alternative Information & Development Centre (AIDC)
		Earthlife Africa Johannesburg
		Federation of Sustainable Environment (FSE)
		Fossil Free South Africa
		GreenCape
		Green Connection
		GreenPeace
		groundWork
		Highveld Environmental Justice Network (HEJN)
		Institute for Economic Justice (IEJ)
		Just Share
		Just Urban Transitions
		Khuthala Environmental Care Group / Khuthala Women's Movement
		Life After Coal Campaign
		MANSA Advisory with Adapt
		OneWorld
		Project 90 by 2030
		SA Faith Communities Environment Initiative (SAFCEI)
		SouthSouthNorth (SSN)
		Sustainable Energy Africa (SEA)
		Vaal Environmental Justice Alliance (VEJA)
		Vukani Environmental Movement (VEM)
		WWF SA
	Transparency/ democracy	amaBhungane Centre for Investigative Journalism
		Defend our Democracy
		Just Share

Table A-1 • **List of relevant (but nonexhaustive) stakeholders for South Africa's climate and just transition development (cont.)**

STAKEHOLDER GROUP	SUBCATEGORY	ORGANISATION/INSTITUTION
Nongovernment organisations (cont.)	Transparency/ democracy (cont.)	My Vote Counts (MVC)
		Open Secrets
		Oxpeckers Investigative Environmental Journalism
	Legal services/ advocacy	All Rise Attorneys
		Natural Justice, Biodiversity Law Centre
		Lawyers for Human Rights
	Legal services/ advocacy (cont.)	Centre for Applied Legal Studies
		Centre for Environmental Rights (CER)
		Cullinan & Associates
		Legal Resources Centre (LRC)
		Webber Wentzel
Advocacy coalitions and networks	Coalition	Adaptation Network
		African Climate Alliance (ACA)
	Network	African Women in Energy and Power (AWiEP)
		African Women's Development and Communication Network (FEMNET)
		C40 Cities South Africa
		Climate Justice Coalition
		Energy Governance SA
		Fair Finance Coalition of Southern Africa (FFCSA)
		Fossil Fuel Foundation
		International Council for Local Environmental Initiatives (ICLEI) Africa
		Mining Affected Communities United in Action (MACUA)
		Muslim Judicial Council of South Africa
		South Africa Climate Action Network (SACAN)
		South African Cities Network (SACN)
		South African Council of Churches (SACC)
		South African Institute of International Affairs (SAIIA)
		South African Youth Climate Action Plan (SAYCAP)
		South African Youth Economic Council (SAYEC)
		Women for Climate Justice Southern Africa
		Women in Energy and Climate Change Forum (WECCF)
		Women in Extractive Mining South Africa
Private sector	Organised business	AgriSA
		Banking Association South Africa (BASA)
		Black Energy Professionals Association (BEPA)

Table A-1 • **List of relevant (but nonexhaustive) stakeholders for South Africa's climate and just transition development (cont.)**

STAKEHOLDER GROUP	SUBCATEGORY	ORGANISATION/INSTITUTION
Private sector (cont.)	Organised business (cont.)	Business Unity South Africa (BUSA)
		Ducat Energy Trading
		Impact Catalyst
		Liquified Petroleum Gas South Africa (LPGSA)
		Minerals Council
		National Business Initiative (NBI)
		South African National Taxi Council (SANTACO)
	Industry association	African Association of Automotive Manufacturers (AAAM)
		National Association of Automobile Manufacturers of South Africa (NAAMSA)
		National Association of Automotive Component and Allied Manufacturers (NAACAM)
		National Automobile Dealers' Association (NADA)
		South African Petroleum Industry Association (SAPIA)
		South African Photovoltaic Industry Association (SAPVIA)
		South African Power Producers Association (SAIPPA)
		South African Wind Energy Association (SAWEA)
		Southern African Gas Association (SAGA)
	Business-led coalition	Eastern Cape Automotive Industry Forum (ECSIF)
		South African Energy Forum (SAEF)
		South African Energy Storage Association (SAESA)
		South African National Energy Association (SANEA)
	Private business	Anglo American
		Automotive Industrial Development Corporation (AIDC)
		EBOR Automotive Systems
		Electric Mission (E-Mission)
		Exxaro
		Sasol
		Seriti
		Retail Motor Industry (RMI)
		VM Automotive State of the Art
	State-owned enterprises	Eskom
		Transnet
Development financial institutions (DFIs), banks, and funds	DFIs	African Development Bank (AfDB)
		China Development Bank (CDB)
		Development Bank of Southern Africa (DBSA)

Table A-1 • **List of relevant (but nonexhaustive) stakeholders for South Africa's climate and just transition development (cont.)**

STAKEHOLDER GROUP	SUBCATEGORY	ORGANISATION/INSTITUTION
Development financial institutions (DFIs), banks, and funds (cont.)	DFIs (cont.)	European Investment Bank (EIB)
		Industrial Development Corporation of South Africa (IDC)
		International Finance Corporation (IFC)
		World Bank Group
	Banks	ABSA Corporate Investment Banking
		FNB
Development financial institutions (DFIs), banks, and funds (cont.)	Banks (cont.)	Nedbank Capital Corporate and Investment Banking
		Standard Bank
		Rand Merchant Bank (RMB)
	Funds	Adaptation Fund
		Automotive Industry Transformation Fund (AITF)
		Climate Fund Managers: SA-H2 Fund
		Climate Investment Funds (CIF)
		Green Climate Fund
	International development aid	France: Agence Française de Développement (AfD)
		Germany: Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ)
		Germany: Friedrich-Ebert-Stiftung (FES) Germany: International Climate Initiative (IKI)
		Germany: International Climate Initiative (IKI)
		Germany: Kreditanstalt für Wiederaufbau (KfW)
		United Kingdom: Foreign, Commonwealth and Development Office (FCDO)
		United States: United States Agency for International Development (USAID; with Power Africa)
Organised labour	n/a	Chemical, Energy, Paper, Printing, Wood and Allied Workers' Union (CEEPPWAWU)
		Congress of South African Trade Unions (COSATU)
		Democratised Transport Logistics and Allied Workers' Union (Detawu)
		Federation of Unions of South Africa (FEDUSA)
		Fuel Retailers Association (FRA)
		International Labour Organization (ILO)
		Metal and Engineering Industries Bargaining Council (MEIBC)
		Motor Industry Bargaining Council (MIBCO)
		Motor Industry Combined Workers' Union (MICWU)
		National Automobile and Allied Workers' Union (NAAWU)
		National Labour and Economic Development Institute (NALEDI)
		National Union of Metal Workers of South Africa (NUMSA)
		National Union of Mineworkers (NUM)

Table A-1 • **List of relevant (but nonexhaustive) stakeholders for South Africa's climate and just transition development (cont.)**

STAKEHOLDER GROUP	SUBCATEGORY	ORGANISATION/INSTITUTION
Organised labour (cont.)	n/a	National Union of Public Service and Allied Workers (NUPSAW)
		South African Federation of Trade Unions (SAFTU)
		Tirisano Transport and Services Workers Union (TASWU)
		Transport, Retail & General Workers Union (THORN)
		United National Transport Union (UNTU)
Private donors and agencies	n/a	African Climate Foundation (ACF)
		Children's Investment Fund Foundation (CIFF)
		ClimateWorks
		European Climate Foundation (ECF)
		Ford Foundation (United States)
		Frederich-Ebert-Stufting (FES)
		Global Energy Alliance for People & Planet (GEAPP)
		Heinrich Bohl Foundation (HBF)
		Konrad-Adenauer-Stufting (KAS)
		Open Society Foundation for South Africa (OSF-SA)
Other	n/a	Congress of Traditional Leaders of South Africa (Contralesa)
		Disabled People in South Africa
		Global Strategic Communications Council (GSCC)
		LGBT+ Forum
		OUT LGBT Well-being

Source: Authors, based on Climate Investment Funds and Presidential Climate Commission consultations.

Appendix B: Methodological approach

Conceptual model for the 2023 nationally representative survey on climate change and the just transition

Chapter 5 presents the results from the PCC/HSRC nationally representative survey on climate change and the just transition. The conceptual model for the national survey has been tested and proven through previous research. The HSRC has been working with the European Social Survey (ESS) on issues related to climate change since 2016. The ESS is a cross-national European Research Infrastructure Consortium consisting of 18 European members and has undertaken extensive survey work on climate change and energy transition, with the last one fielded in the ESS 2016 round.[32] The ESS undertook a systematic and detailed comparison of public attitudes to climate change, energy security, and energy preferences and addressed critical components of the social transformation to a low-carbon Europe (Poortinga et al. 2004).

These surveys and questionnaire modules conform to a high standard of rigour and contain questions that are the best effective, direct measures of the topics and concepts being examined. As such, some of the questions designed for this project replicated some of the items from the ESS Round 8. In addition, the conceptual framework used by the ESS also formed the foundation of this study. In line with the conceptual framework used by the ESS, the current survey used the value-belief-norm (VBN) model by Stern (2000) as a general framework, covering the four broad areas of beliefs about

climate change and the energy transition; concerns about climate change and the energy transition; personal norms, efficacy and trust; and policy preferences (Figure B-1). The VBN theory of environmentalism suggests that pro-environmental personal norms are influenced by the belief that environmental conditions pose a threat to the things that an individual values, and that an individual could reduce the threat. These personal norms influence an individual's behaviour. Behaviour-specific personal norms and other social-psychological factors, such as the perceived personal costs and benefits of an individual's action and beliefs about the efficacy of actions, may affect pro-environmental behaviours (Stern 2000). According to the VBN model, "pro-environmental personal (moral) norms are at the core of linking climate change concerns to energy preferences" (ESS 2016).

This current survey explored individual awareness of climate change and exposure to climatic shocks, and it examined how these shape beliefs focusing on the reality of climate change and perceived causes. It then examined the degree to which these beliefs, in turn, shaped concern about climate change. This study also assessed whether these constructs influenced how South Africans feel about personal responsibility to take action to address climate change. The VBN model considers these factors to be important for understanding climate change and just transition perceptions, and they are seen as key variables that may subsequently motivate personal climate action in practice.

Methodology for tracking mitigation progress

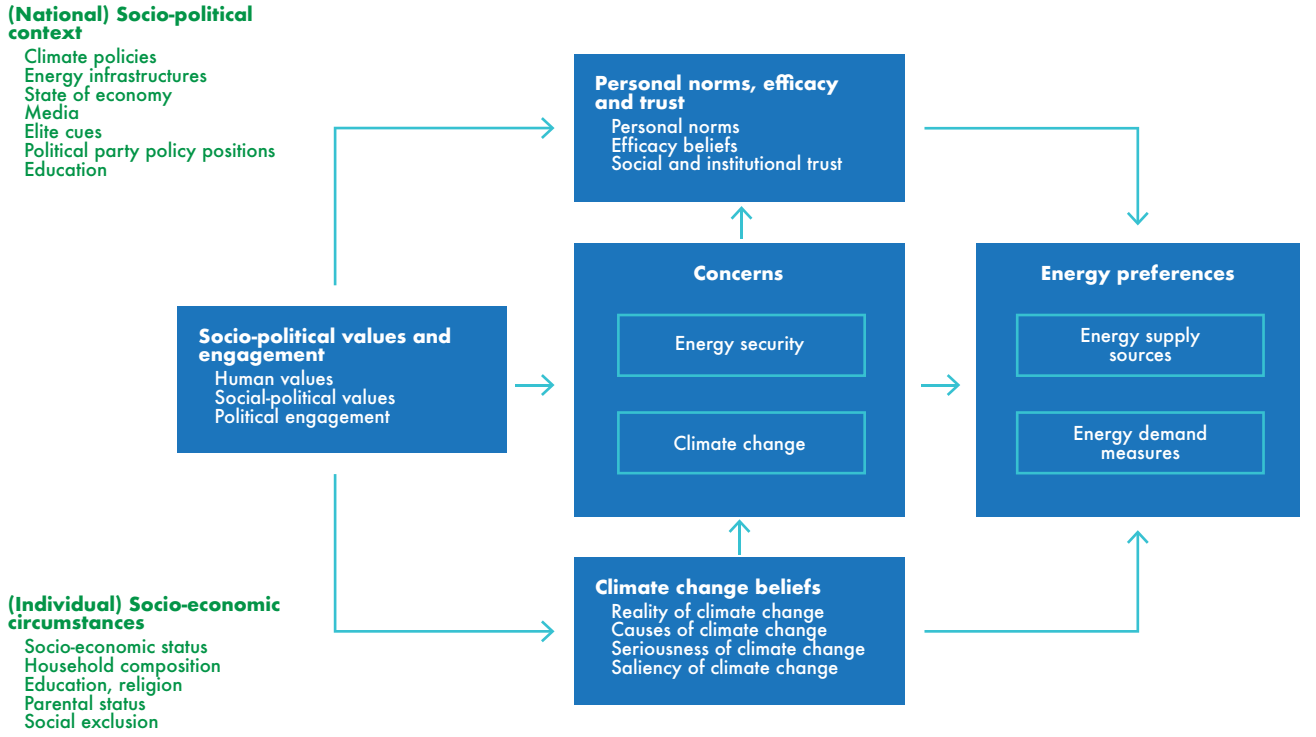
Chapters 8 and 9 of this report track historical progress toward achieving future targets aligned with the shifts needed to realise South Africa's 2050 net zero CO_2 target across the country's power and transport sectors. Tracking mitigation progress for these two sectors is prioritised in this report due to their role as the largest contributors to South Africa's annual economy-wide emissions. Future work, however, is merited in tracking mitigation progress across other emissions-generating sectors, including, but not limited to, buildings, industry, forests and land, and food and agriculture.

This section describes the methodology used to track mitigation progress in the power and transport sectors. The approach is adapted from the *State of Climate Action 2023* report (Boehm et al. 2023) and its accompanying methodological document, "Methodology Underpinning the State of Climate Action Series" (Jaeger et al. 2023). Although these reports track mitigation progress toward 1.5°C-aligned targets for a variety of global indicators, this report tracks mitigation progress at the national level in South Africa alone.

SELECTION OF INDICATORS AND TARGETS

Throughout this report, indicators and targets for tracking mitigation progress were derived from the NBI's Climate Pathways and a Just Transition for South Africa project,

Figure B-1 • **Conceptual framework for measuring public attitudes to climate change, energy security, and energy preferences**



Sources: ESS 2016; Roberts et al. 2023.

produced in partnership with Business Unity South Africa and Boston Consulting Group (NBI n.d.). With a goal to "collectively develop a view of what the decarbonisation pathways could look like for the South African economy together with the South African private sector and other relevant stakeholders from government, labour and civil society," this project produced decarbonisation pathways for multiple emissions-intensive sectors across the economy, which are described across a set of 11 reports (NBI n.d.). The targets derived from this particular decarbonisation pathway modelling exercise were selected for inclusion in this report because of the multistakeholder and domestically led nature of the Climate Pathways and a Just Transition for South Africa project and because it is the only complete domestically led model describing the sectoral shifts required to meet South Africa's net zero goal.

After mapping all targets for the years between 2030 and 2050 presented in the project's summary report, *South Africa's Net-Zero Transition* (NBI 2022), we selected all targets in the power and transport sectors for which robust historical datasets that met several criteria, described below, were available. We then assigned corresponding indicators to each target. For instance, the modelling study includes targets to take 6 GW of coal offline by 2030 and to retire the last coal power stations in South Africa by 2042. In this report, we group these targets under a corresponding indicator that tracks "coal power capacity." This approach of assigning indicators to derived targets matches the approach used in the global State of Climate Action report series (Boehm et al. 2023; Jaeger 2023b; Jaeger et al. 2023).

Critically, the mitigation indicators derived from the NBI project that are tracked in this report do not exhaustively measure all shifts that will be required to decarbonise South Africa's power and transport sectors. Rather, each indicator assesses the gap between historical trends and the future targets that need to be achieved in a subset of areas with large mitigation potential in South Africa.

It is also important to note here that the targets for each indicator tracked in this report represent just one set of illustrative benchmarks that, if achieved, align with South Africa's goal to reach net zero CO_2 by 2050. However, different modelling assumptions yield different potential futures and trajectories, and targets for the indicators measured in this report vary across other modelling studies (e.g., Climate Analytics 2022). As such, the targets that are presented for each indicator in this report illustrate the direction and scale of the change that is required, but they do not exclusively portray the only future pathway that will enable achievement of South Africa's climate targets.

SELECTION OF HISTORICAL DATASETS

Upon establishing indicators and targets to track future objectives for South Africa's power and transport sectors, we collected historical data for each indicator to portray past and current trends. Drawing on the global State of Climate Action series (Boehm et al. 2023; Jaeger et al. 2023), we selected datasets that met the following criteria, as originally defined in Jaeger et al. (2023):

- **Relevance:** Datasets are directly relevant to each indicator and were created following a methodology that allows them to measure progress toward their respective targets.
- **Accessibility:** Datasets prioritised for inclusion are readily accessible to the public. They are not hidden behind paywalls.
- **Accuracy:** Datasets are from reputable, trustworthy sources, with well-documented, openly accessible, and peer-reviewed methodologies that clearly note limitations. They are taken from data providers, including both authors of articles and organisations hosting datasets, that are well recognised as either core data providers or known experts in their fields as suggested by authors and reviewers.
- **Completeness:** Datasets have sufficient temporal and spatial coverage, and each report notes where the best available data are not globally available or not published annually.
- **Timeliness:** Datasets selected represent the most up-to-date data available to reflect recent developments, and there is evidence that data have been and will be updated regularly.
- **Ease of collection:** Datasets prioritised for each indicator are relatively easy to collect (e.g., those that require minimal processing or that are directly downloadable).

ASSESSING PROGRESS TOWARD FUTURE TARGETS

After determining both future targets and historical trends for selected indicators across South Africa's power and transport sectors, we adapt methods from the global State of Climate Action series (Boehm et al. 2023; Jaeger 2023b; Jaeger et al. 2023) to design indicator figures that portray the gap between historical trajectory and future need. These figures exemplify the scale of the existent gap and are intended to galvanise action by illustrating the work that lies ahead.

As noted in Box 2 (Chapter 8), future growth of clean technologies may not follow linear trajectories, marked by constant rates of annual growth. Rather, technological adoption is more likely to follow rapid, nonlinear growth in the shape of an S-curve trajectory. To account for the likelihood of such growth, we categorise indicators that track technology adoption in the power and transport chapters as "S-curve likely." This categorisation is noted in the figure notes for each relevant indicator. The list of "S-curve likely" indicators that are tracked in this report includes the following:

- Renewable energy capacity
- Battery storage capacity
- Green hydrogen capacity
- Share of NEVs in light-duty vehicle sales
- Share of NEVs in the light-duty vehicle fleet
- Number of public charging stations

For each "S-curve likely" indicator, we sketch several illustrative S-curves that demonstrate potential growth trajectories between the current historical data point and the future targets toward which we are tracking progress. We show multiple potential S-curve trajectories to emphasise that we are neither predicting the exact future pathway that the indicator will follow nor prescribing exactly what that pathway should be. Rather, the purpose of these illustrative S-curves is to demonstrate the likelihood that the technology adoption that is being measured by the "S-curve likely" indicator follows a rapid, nonlinear trajectory of growth.

To track needed progress between the most recent historical data point and future targets for indicators not categorised as "S-curve likely," we use the most recent five years of data to construct a linear trend line and then extend this trend line from the most recent historical data point to the target. This trajectory is positive sloping if the most recent historical data point must increase to achieve future targets (e.g., for total power grid capacity), and it is negative sloping if the most recent historical data point must decrease to achieve future targets (e.g., for coal power capacity).

Following methods outlined in the global State of Climate Action series (Boehm et al. 2023; Jaeger et al. 2023), we also assign "acceleration factors" for indicators that are classified as "S-curve unlikely" that measure the amount by which historical rates of change over the last five years of data would need to increase to achieve the indicator's targets. To calculate these acceleration factors, we divide the average annual rate of change needed to achieve the indicator's future target(s) by the average annual rate of change that occurred over the most recent five years of historical data obtained in the step above.

If the acceleration factor is between 0 and 1, the historical rate of change is equal to or above the rate of change needed to achieve the future target(s), and we categorise the indicator's progress as "on track" accordingly. If the acceleration factor is between 1 and 2, the historical rate of change is heading in the right direction at a promising yet insufficient pace, and we categorise the indicator's progress as "right direction, off track." If the acceleration factor is greater than or equal to 2, the historical rate of change is heading in the right direction but well below the pace required to achieve the future target(s), and we categorise the indicator as "right direction, well off track." Finally, if the acceleration factor that is calculated is negative, the historical rate of change is heading in the wrong direction entirely, and we categorise the indicator as "wrong direction, U-turn needed." For indicators falling into this last category, we do not present the negative acceleration factor because a reversal of the current trend is needed rather than an acceleration.

The results of this analysis are presented with the corresponding indicators in the report body and are summarised in Table B-1.

In future iterations of this report, there may be scope to extend this analysis to cover further indicators in the power and transport sectors as well as indicators across other sectors that must also decarbonise to achieve South Africa's long-term climate goals.

Table B-1 • **Summary of acceleration factors and categories of progress for indicators that are not "S-curve likely"**

INDICATOR	ACCELERATION FACTOR	CATEGORY OF PROGRESS
Coal power capacity	N/A	Wrong direction, U-turn needed
Natural gas consumption	N/A	Targets have been set to allow for continuation of historical trends in the wrong direction until a peaking date is reached and a reversal of trends into the right direction begins
Number of public road transport vehicles	1.9	Right direction, off track
Private ownership of vehicles	N/A	Targets have been set to allow for continuation of historical trends in the wrong direction until a peaking date is reached and a reversal of trends into the right direction begins

Note: N/A = not applicable.

Abbreviations

AMD	acid-mine drainage
BAU	business as usual
BRT	bus rapid transit
BUSA	Business Unity South Africa
CAP	Climate Action Plan
CIF	Climate Investment Funds
CMA	catchment management agency
CSA	climate-smart agriculture
CSO	civil society organisation
CSP	concentrated solar power
DFFE	Department of Forestry, Fisheries and the Environment
DFI	development financial institution
DMRE	Department of Mineral Resources and Energy
DoT	Department of Transportation
DRC	Democratic Republic of the Congo
DSR	demand side response
dtic	Department of Trade, Industry and Competition
DWS	Department of Water and Sanitation
EAF	energy availability factor
ERA	Electricity Regulation Act
ESS	European Social Survey
EV	electric vehicle
FOLU	forest and other land uses
GDP	gross domestic product
GHG	greenhouse gas
GTS	Green Transport Strategy
HSRC	Human Sciences Research Council
ICE	internal combustion engine
IPCC	Intergovernmental Panel on Climate Change
IPPO	Independent Power Producers Office
IPPU	industrial process and product use
IRP	integrated resource plan
IWRM	of integrated water resources management
JET-IP	Just Energy Transition Investment Plan
JETP	Just Energy Transition Partnership
KZN	KwaZulu-Natal
MBT	minibus taxi
MEC	minerals-energy complex
NBI	National Business Initiative
NCCAS	National Climate Change Adaptation Strategy
NDC	nationally determined contribution
ND-GAIN	Notre Dame Global Adaptation Initiative
NDP	National Development Plan 2030
NERSA	National Energy Regulator of South Africa
NEV	new energy vehicle
NGO	nongovernmental organisation
NRW	nonrevenue water
NWA	National Water Act
NWRS	National Water Resource Strategy
RE	renewable energy
PCC	Presidential Climate Commission
PPP	public-private partnership
PRASA	Passenger Rail Agency of South Africa
PV	photovoltaic
SAICE	South African Institution of Civil Engineering
SALGA	South African Local Government Association
SASAS	South African Social Attitudes Survey
SAREM	South African Renewable Energy Masterplan
SWSA	strategic water source area
UNFCCC	United Nations Framework Convention on Climate Change
VBN	value-belief-norm
WC/WDM	water conservation and demand management
WRC	Water Research Commission
WSS	water supply system
WWTW	wastewater treatment works

Endnotes

1. The South African Judicial Commission of Inquiry into State Capture defines *state capture* as "a network of relationships, both inside and outside government, whose objective is to ensure the exercise of undue influence over decision-making in government and organs of the state, for private and unlawful gain" (Zondo 2022).
2. Cadre deployment is the appointment of individuals by a government's governing party that are loyal to that party, for various reasons, including ensuring buy-in by individuals or institutions to the mandate of that party.
3. Based on the HSRC's South African Social Attitudes Survey for 2003–23.
4. The Cramer's V coefficient ranges from 0 to 1, where 0 means no association between the variables being tested and 1 signifies perfect association. As a rule of thumb, values of less than 0.2 represent a weak association, values of between 0.2 and 0.6 a moderate association, and greater than 0.6 a strong association.
5. The ND-GAIN Index measures a country's vulnerability to and readiness for climate change. The first component, *vulnerability*, is defined as the predisposition of human societies to be impacted negatively by climate hazards and is evaluated across six key sectors: food, water, health, ecosystem services, human habitat, and infrastructure (Chen et al. 2023). The vulnerability of each sector is scored based on its exposure, sensitivity, and adaptive capacity (Chen et al. 2023). The second component of the index, *readiness*, refers a country's ability to effectively use investments for adaptation action and is evaluated using economic, governance, and social indicators (Chen et al. 2023). See ND-GAIN (2021) for more detailed information about South Africa's scores across vulnerability and readiness subindicators.
6. A basic water supply facility, as defined by the *Strategic Framework for Water Services*, should be within 200 metres of the household and provide at least 25 litres of potable water per person daily with minimal interruptions (DWAF 2003).
7. According to the latest census, 8.1 percent of South African households are characterised as informal dwellings (Stats SA 2023b). In urban areas, nearly a quarter of the population was living in an informal settlement in 2020 (UN-HABITAT 2020).
8. Defined as "flush toilets connected to a public sewerage system or a septic tank, or a pit toilet with a ventilation pipe" (Stats SA 2023c, 39).
9. The Blue Drop reports cover water supply providers, and assessments are based on a range of criteria looking at capacity, financial and technical management, and drinking water quality risk management and compliance. The Green Drop Reports cover wastewater service providers, and criteria look at design and operational capacity, effluent quality compliance (e.g., whether wastewater is being treated to regulatory standards), and technical skills.
10. Eutrophication occurs when excess nutrients in water (e.g., from fertiliser runoff) cause excessive plant growth, eventually leading to depleted oxygen levels in the water, which can kill animals (NOAA n.d.; Van Der Laan and Franke 2019).
11. Although high, this is below the global average; roughly 70 percent of freshwater worldwide is used for agriculture (FAO 2020).
12. The DWS defines *green infrastructure* as "any infrastructure that is good for the environment and promotes sustainable development" (DWS 2023d, 102).
13. For more information on the latter, see Bureau for Economic Research (2021).
14. South Africa is the second-highest-emitting country after the Democratic Republic of the Congo (DRC) when land-use change and forestry are included due to deforestation-related emissions in the DRC.
15. This includes Sasol's scope 1 (direct) and 2 (indirect from use of energy in operations) emissions from its Secunda and Sasolburg plants, Natref refinery, and its mining activities (Sasol 2023).
16. It is important to note that, according to Climate Action Tracker, South Africa's updated 2030 NDC target is "almost sufficient" when compared to modelled domestic pathways (the "almost sufficient" rating indicates that a country's climate policies and commitments are not yet consistent with the Paris Agreement's 1.5°C temperature limit but could be with moderate improvements), and "insufficient" when compared with its fair share contribution to climate action (the "insufficient" rating indicates that a country's climate policies and commitments need substantial improvements to be consistent with the Paris Agreement's 1.5°C temperature limit) (Climate Action Tracker 2024). Per this analysis, South Africa's targets and policies are not stringent enough to limit warming to 1.5°C. If fully implemented, current policies would result in emissions reductions only in line with holding global warming at—but not well below—2°C. The Climate Equity Reference Project finds that the entire NDC range for 2030 does not satisfy the fair share target range for the 1.5°C pathway and that most of the NDC range for 2030 fails to satisfy the fair share target range for the 2.0°C pathway (CERP 2021).
17. Plus a range of uncertainty that reflects model variations as well as interpretation of policies and targets.
18. *EAF* refers to the percentage of maximum energy generation over time that a plant is capable of supplying to the electrical grid.
19. Nova Economics was commissioned by Eskom in 2020 to quantify the economic impacts of load shedding. It subsequently updated its analysis in 2023.
20. For more detailed discussions on this topic, see CSIR et al. (2021); Hallowes and Munnik (2022); IRENA (2023b); Nel, Marais, and Mqotyana (2023); Patel et al. (2020); and PCC (2022c).
21. Energy was deemed unaffordable if it accounted for more than 10 percent of total household expenditure (Ye and Koch 2023).
22. A temporary increase in gas is expected to be required in the near term as a constant supply of power to balance out variable renewables on the grid (NBI 2022).

23. Throughout this report, indicators and targets for tracking mitigation progress were derived from the NBI's Climate Pathways and a Just Transition for South Africa project, produced in partnership with Business Unity South Africa and Boston Consulting Group (NBI n.d.). With a goal to "collectively develop a view of what the decarbonisation pathways could look like for the South African economy together with the South African private sector and other relevant stakeholders from government, labour and civil society," this project produced decarbonisation pathways for multiple emissions-intensive sectors across the economy, which are described across a set of 11 reports (NBI n.d.). The targets derived from this particular decarbonisation pathway modelling exercise were selected for inclusion in this report because of the multistakeholder and domestically led nature of the Climate Pathways and a Just Transition for South Africa project, and because it is the only complete domestically led model describing the sectoral shifts required to meet South Africa's net zero goal.

24. Separate PCC analysis has found that, to limit warming to 1.5°C and align with the low end of the 2030 NDC target, South Africa would need to have between 50 and 60 GW of renewable energy capacity installed by 2030 (PCC 2023d).

25. In addition to battery storage, storage solutions that can economically store energy for longer periods of time, such as pumped hydro storage, flow batteries, thermal storage, hydrogen fuel cells, and mechanical storage, will be critical. Although many of these technologies have not yet reached market diffusion, future iterations of this work will endeavour to track their progress.

26. Although data from 2021 are the most recently available consumption figures, the gas supply market in South Africa tends to exhibit stability and relative flatness. Consumption in the years since 2021 is therefore likely to have remained stable.

27. During South Africa's trajectory to achieving net zero CO_2 emissions, gas is expected to play a role as a transition fuel to balance and enable the scale-up of renewables at the required pace, which vary during each day and across seasons (NBI 2021b, 2022). Indeed, these power stations can meet peaking capacity needs to ensure energy security while battery capacity is scaled up to provide short-term power balancing (see Power Indicator 3) and green hydrogen capacity is scaled up to provide seasonal balancing (see Box 2).

28. Only domestic transport emissions are included, though international transport GHG emissions would not be a significant additional amount.

29. According to the most recent National Household Transportation Survey from 2020, more South Africans walked all the way to their destination than any other mode of transport. However, at the household level, taxis were reported to be the most frequently used mode of transport.

30. Also referred to as *zero-emissions vehicles*, for this report, NEVs include battery-powered EVs and fuel cell EVs.

31. A formal indicator measuring public rail use is not included in this report due to lack of data availability. Future iterations of this report will endeavour to include this information.

32. For more information about the ESS 2016 round, see the ESS Data Portal: https://ess.sikt.no/en/study/f8e11f55-0c14-4ab3-abde-96d3f14d3c76.

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