12. Renewable energy and just energy transitions in South Africa

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Clean energy innovation is a highly contested policy area in South Africa, Africa's largest economy. Many livelihoods, industries and political ideologies continue to rely on fossil fuels and extractive industries as a critical driver of economic performance. The country has an unusually carbon- and energy-intensive economy compared to other countries in the region. South Africa faces intersecting challenges of poverty, inequality, unemployment, electricity supply and climate impacts, particularly in the form of fires, floods and droughts. As a result, clean energy transition policies and regulations in South Africa are closely interconnected with climate policy and sustainable development agendas.

This chapter analyses current clean energy innovation policy within the evolution of South Africa's national energy innovation system. We briefly review the status and evolution of the political economy of energy innovation policy and then analyse two case studies of recent energy innovation policy: the Renewable Energy Independent Power Projects Procurement Programme (REIPPPP) and the Just Energy Transition Programme (JET-P).

The REIPPPP case study can be seen as a cautionary tale of mixed success in diffusing renewable energy in a highly contentious political environment. Over the past 12 years, REIPPPP has explicitly sought to address social inequalities through special provisions in the procurement process. The JET-P is a more recent dynamic to support clean energy transitions through an innovative climate finance partnership with South Africa, first launched at COP26 in Glasgow in 2021.

Both case studies show the difficulties in using well-intended climate action to transform structural inequalities beyond market mechanisms. The South African experiences also demonstrate how rapidly decarbonisation can progress through private investment as well as the limitations to market mechanisms. Progressing “just energy transitions” requires a strong state for the provision of public goods, including the creation of social safety networks for labour in fossil fuel industries, and the development of skills, alternative industries and alternative ownership models for renewable energy to enable access to the benefits of technological change. Actively implementing South Africa’s many plans in a way that reduces inequality and deprivation among its people remains a constant challenge, undermined by the nagging resistance of corruption and powerful pro-fossil fuel lobbies.

Country context

South Africa is a nation of 62 million people, the sixth most populous country in Africa, with the largest GDP and the highest GDP per capita on the continent. Classified as an upper middle-income country, South Africa is the only African member of the G20 group of major economies. It is the most industrialised economy on the continent, concentrating income opportunities in its eight metropolitan municipalities. The country continues to urbanise, and it is projected that roughly three-quarters of its population will live in cities by 2035, up from 57% in 2000 and around 67% in 2020.

South Africa's current socio-economic structures continue to retain the legacies of resistance throughout centuries of colonial rule, extractive industrial development and the apartheid regime between 1948 and 1994. Mining continues to be a significant economic sector in South Africa, trading over 50 commodities.[1] The mining sector has shaped South Africa's society as well as its economy, with segregating hiring practices and low wages for local and immigrant miners from rural communities.[2] The displacement of male African workers from their communities continues to shape the social fabric of the present day. Half of South Africa's households counted as female-headed in the last census.[3]

These historical structures explain the results of Gini co-efficient measures that rank South Africa as the most unequal economy in the world. In 2021 the top 10% of earners received 65% of total income and controlled 86% of personal wealth. The benefits of economic growth and manufacturing have not been equally shared between ethnic groups and measures of inequality have not noticeably improved over the past 15 years. Progress on expanding access to healthcare, housing, electricity, piped water, sanitation and waste removal stagnated in the early 2000s and has even declined in some parts of the country in recent years. The global pandemic exacerbated existing vulnerabilities in 2020, during which the government enacted some of the world's strictest lockdowns. The economy shrank by 6% in 2020. Between 2016 and 2021 average annual GDP growth was 0.2%, compared with 2% between 2006 and 2016. In 2024 the economy is growing as a result of higher domestic demand.[4] The unemployment rate remains high, at 32% of the working population. Youth employment stands at 44%, resulting from a combination of the lack of opportunities in the labour market and weaknesses in the education system. Limited availability of apprenticeships and vocational courses, as well as difficulties in paying fees, resulted in a gross

[1] The main mining commodities are platinum, chromium, palladium, manganese, ferrochromium, zircon, vanadium, gold, diamonds, cobalt, nickel, coal and iron ore.
[2] Management positions were staffed predominantly by men of European descent.
[3] The authors acknowledge the controversies around household headship in South Africa and more generally, but have no space to debate the matter in detail. Further reading on the topic is available from Statistics South Africa .
[4] Water and electricity consumption are growing after the heavy rain in the winter storms and ease of loadshedding. Mining exports had carried the economy through the pandemic and its years of recovery.

enrolment rate in tertiary education of 27% of all youth, compared with an average of 10% in sub-Saharan Africa as a region. The prospects are challenging, given the state of basic education: 81% of ten-year-olds have reading difficulties and perform below international benchmarks, especially in rural areas.

The nation has faced several cycles of political instability since its first democratic election in 1994. The African National Congress could not win enough votes in the national election in 2024 to form a government alone. The seventh national assembly consists of a coalition in a so-called Government of National Unity (GNU) for the first time in the history of the young democracy.

Energy sector context

South Africa's energy sector continues to rely on its domestic coal resources, which provide over 70% of its primary energy. Oil and gas are imported predominantly from Nigeria, Saudi Arabia and Mozambique, respectively. In final energy terms, coal provides almost half of South Africa's demand, split roughly equally between coal-fired electricity and other uses, including conversion to liquid fuels. In 2022 the industrial and commercial sectors were responsible for 45% of total final energy demand (Figure 12.1). The transport sector was responsible for 27%, the residential sector for 13% and agricultural activities only 3%.[5]

The reliance on coal in the electricity sector has reduced significantly over the past two years, despite years of delays in implementing renewable energy policies in response to the shortages in electricity supply. The share of renewable energy in electricity generation almost doubled from 6.2 GW in 2023 to 12 GW in 2024 because more rooftop solar PV was added. The country currently has total installed capacity of 49 GW, of which 34.5 GW were available for consumption in 2024, almost 10 GW more than a year earlier at the height of the power supply crisis.[6]

South Africa's electricity governance has historically been centralised. Historically, Eskom has been a vertically integrated state-owned company, responsible for operating 15 coal-fired plants, Africa's only commercial nuclear power plant, and a few small hydroelectric and renewable energy plants. However, it is currently undergoing a process of "unbundling" to separate its transmission function as National Transmission Company South Africa, an independent entity. Eskom is a well-regarded employer in the Southern African Development Community region, providing 40 000 jobs in South Africa alone. Eskom's coal and large power plant focused business model struggles to keep pace with the changing costs of new

[5] Depending on the source, 4% to 9% of final energy demand is unspecified.
[6] These figures refer to maximum dispatchable capacity including imports and emergency generation resources and the available dispatchable generation, as well as renewable energy capacity and estimates of solar rooftop installations according to Eskom's weekly systems status report (in week 01/2023 and week 25/2024).

coal and nuclear power stations and the decline in renewable energy prices. The reasons for Eskom's debt crises are multifaceted, combining symptoms of a crisis in general governance, underinvestment and eroding infrastructure, market factors, human resources and institutional inertia to mention a few.

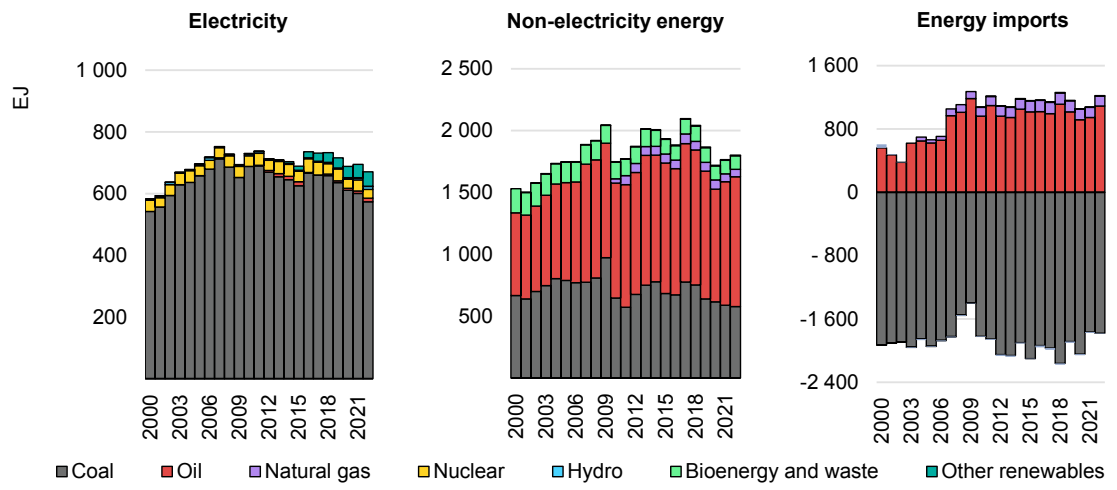
These factors also intersect with the municipal electricity industry, which distributes electricity to residential customers. In some cases, 75% of municipal revenues come from residential electricity sales, creating an incentive to use and sell more electricity rather than encourage energy efficiency or embedded generation. This model ran at a loss for Eskom from 2016, as some municipalities were unable to pay Eskom for the electricity they sold to their customers or to maintain the local infrastructure.

Despite public demand for increased generation capacity since electricity shortages began in 2007, the government's neglect of the urgency combined with the weakening governance at Eskom undermined its ability to efficiently allocate capital to new infrastructure and maintenance.[7] The electricity sector crisis had developed over a long time, as South Africa sold electricity at one of the lowest electricity tariffs worldwide, based on expectations of cheap and abundant coal. While the low price of electricity sustained the energy-intensive mining and mineral sectors, it has discouraged private investment in new generation capacity. In 2019 the Department of Public Enterprises declared Eskom to be technically insolvent unless it was supported via public bailouts. Rotational load shedding – a South African term for rolling power cuts to manage the gap between generation capacity and demand – became a common inconvenience of life in South Africa. Estimates of the costs to the economy range from South African rand (ZAR) 35 billion (USD 2.2 billion) to ZAR 58 million (USD 3.2 million) per day during the 12 years between 2007 and 2019. The lower of these estimates is approximately equivalent to South Africa's drop in GDP during the 2008 financial crisis.

The loadshedding crisis negatively impacted many livelihoods and caused frustration across the country. Political support for the ANC-led government declined significantly during the peak of the crisis in winter 2022. The government responded with an Energy Action Plan to End Loadshedding ahead of the national elections, which accelerated deployment of renewable electricity for residential and business use without the involvement of Eskom. The plan enabled an Energy Regulation Act, signed in 2024, that split Eskom's generation, distribution and transmission functions with the intention of addressing the municipal distribution conundrum and to enable more direct access for independent power producers.

[7] Over the past decade, a sequence of hearings and inquiries, including the Zondo Commission, have revealed details of corruption and state capture at Eskom. Mismanagement and misallocation of funds for maintenance worsened power plant efficiency and electricity supply shortages.

Figure 12.1 Energy sources for electricity and other uses, and level of imports, South Africa, 2000-2022



Notes: Electricity and non-electricity energy are shown on a final consumption basis. Imports are shown net of exports.
Source: IEA (2024), World Energy Balances.

These recent regulatory changes create uncertainty for the role of the targets expressed in the electricity sector plan. The participatory planning process for the Integrated Resource Plan (IRP) sets out a desired composition of power capacity up until 2030.[8] Beyond 2030, the 2019 IRP envisages the decommissioning of 24 GW of coal plants, which faces challenges due to the central role of coal in the South African economy. There is no equivalent of the IRP in non-electricity parts of the energy system. Plans for the oil and gas sectors are less formally co-ordinated and communicated in terms of the planning for major decisions, such as the closure of the oil refineries and development of national gas infrastructure.

Energy policy in South Africa is closely intertwined with climate policy. The energy sector accounts for 78% of the country's emissions and puts the country well above the world average emissions intensity.[9] The government actively engages in international climate negotiations with a focus on the mitigation component in its climate policy. The delegation to the UN has consistently been well staffed by trained government officials and technical experts, a legacy of President Mandela's prioritisation of multilateralism. In 2011 South Africa hosted the annual UNFCCC Conference of the Parties, which drew an international spotlight to the country's emissions and climate action. The event created a window of opportunity

[8] 33 GW of coal (a net reduction due to decommissioning), 4.6 GW of hydropower, 17.7 GW of wind, 8.2 GW of solar PV, 6.3 GW of natural gas and diesel, 1.8 GW of nuclear (no change) and 0.6 GW of concentrating solar thermal.
[9] South Africa's per capita CO_2 emissions are 60& higher than the world average and 20% higher than those of the European Union. Per unit of GDP, South Africa's CO_2 emissions are three times the world average and 6.6 times the EU average.

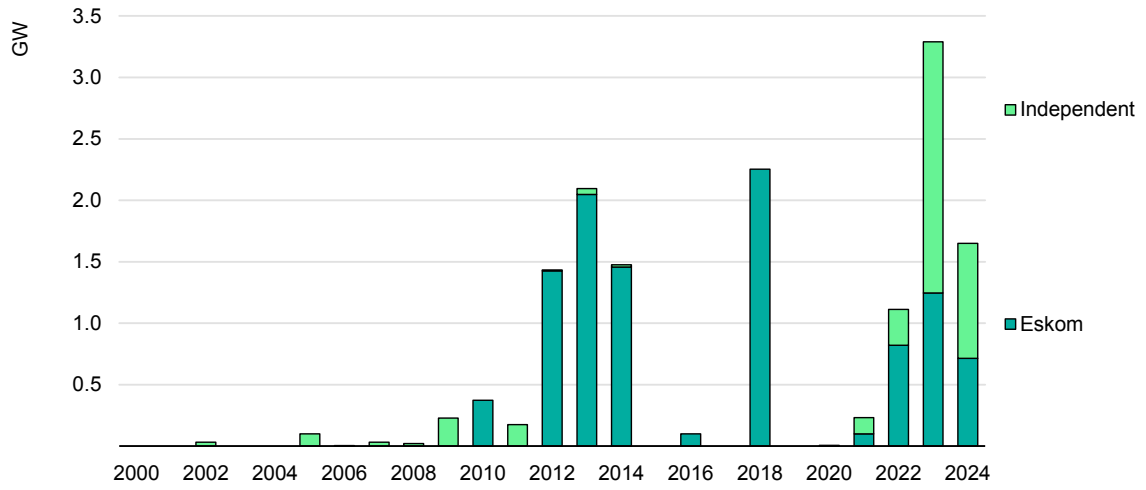
to approve three central climate policies, comprising the renewable energy programme for independent power producers (IPPs), a carbon tax and a National Climate Change Response White Paper.

As a signatory to the Paris Agreement, the South African government communicated in its NDC that it anticipates annual GHG emissions being in the range of 398-510 Mt CO_2-eq between 2021 and 2025. Between 2026 and 2030 South Africa's annual GHG emissions are anticipated to be in a range of 350-420 Mt CO_2-eq. The Greenhouse Gas Inventory reports emissions of 435 MtCO_2-eq for 2022, which implies that the NDC target ranges were already achieved in 2022.

The reductions result from a combination of factors, including the impact of the pandemic on the economy and its recovery period, stagnant electricity demand, reduced energy availability, loadshedding and limited additional renewable energy capacity. Progress in developing additional renewable energy capacity was delayed between 2016 and 2019 during the peak of state capture, which explains the gap in new IPP capacity between 2019 and 2022. It is essential to continue reforming the electricity sector as electricity consumption will eventually increase. Additional renewable energy capacity needs to be installed to meet the 2026-2030 emission reduction targets.

The regulatory changes in the electricity sector in response to the electricity supply crisis have encouraged the installation of large-scale renewable energy projects outside the renewable energy programme, with high uptake by industry. The uptake of private IPP projects shows that the market is responding to government policy (Figure 12.2). It also demonstrates that the additional climate finance generated in support of an equitable energy transition does not need to be used for further private sector incentives or to pay Eskom to close its coal-fired power stations. It needs to support training, skills development and innovation for new industries that create decent income opportunities and social protection in and beyond the energy sector.

Figure 12.2 Renewable electricity capacity additions, by power purchase agreement offtaker, 2000-2024



Note: By year of financial close.
Source: IPP database, Power Futures Lab, Graduate School of Business, University of Cape Town.

Innovation context

The South African government acknowledges the critical role of science, technology and innovation its White Paper on Science, Technology and Innovation (2019) and its Decadal Plan (2022-2032), which support achieving the overarching National Development Plan. A mix of science, technology and innovation policy aims to strengthen a national system of innovation across government departments and sectors to support equitable economic development. The Department of Science and Innovation and the Department of Trade, Industry and Competitiveness developed strategies for the localisation of support for job creation, industrial development and eco-innovation, including renewable energy innovation, with limited impact. Aspirations to create 400 000 new jobs by "greening" the economy are articulated in the White Paper for Science and Innovation, but require integrated approaches to economic development with the active implementation through the Department of Mineral Resources and Energy (DMRE), the Department of Public Enterprises and the Presidency.

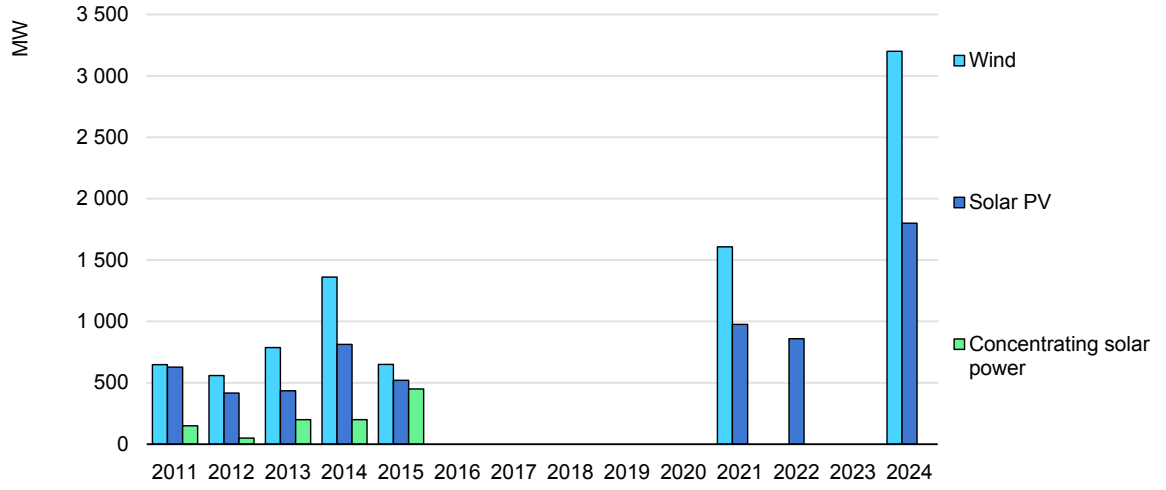
South Africa's economy has pockets of innovation excellence, but it lacks the capital, strategic policy support and scale to produce many transformative technologies or innovation-intensive, competitive exports. The country was ranked 61st in the world for innovation performance in 2022, the highest-ranking country in mainland Africa. The latest survey of innovation in South African firms, which covered 57 000 firms for the period 2019-2021, found that two-thirds of South African firms were engaged in innovation activities, with 83% of these using or offering a product or process innovation during the reporting period, mostly based on improvements or adaptations to sustain the firm's existing products. Among sectors, the information technology industry had the highest level of

innovation activity. Around 30% of the enterprises engaged in innovation activity were active in environmental technologies. However, less than a fifth of the companies surveyed carried out in-house R&D during the period, and most reported a decrease in their innovation efforts due to pandemic-related barriers to collaboration.

The case of the Renewable Energy Independent Power Producer Procurement Programme

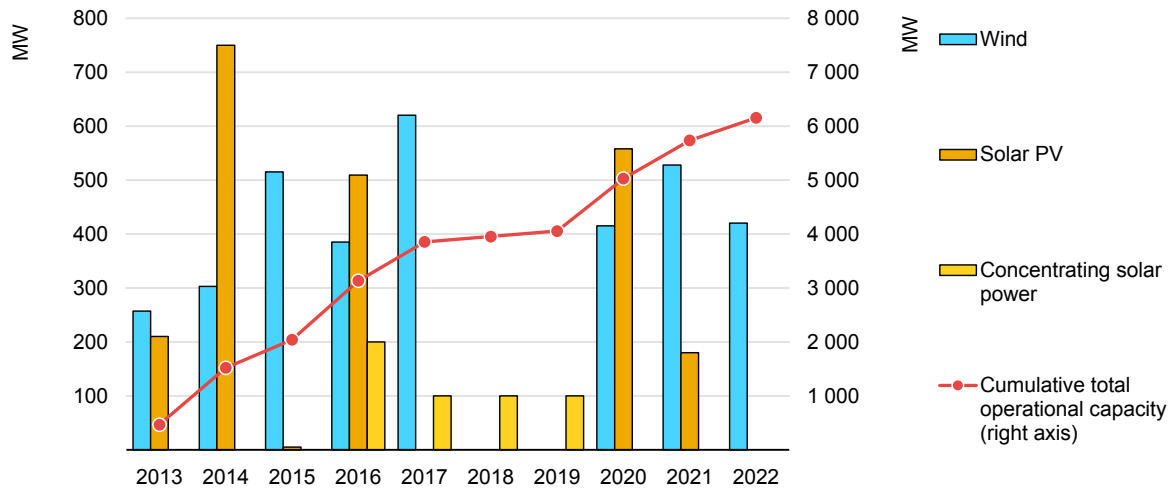
South Africa's Renewable Energy Independent Power Producer Procurement Programme (REIPPPP) is an innovative renewable energy policy in many ways. It was launched in 2011, spurred on by the political focus on climate change at the time of the country's hosting of the UNFCCC Conference of the Parties. The REIPPPP is an auction programme in which private bidders compete to win fixed-tariff offtake contracts for the construction of specified amounts of grid-connected renewable energy generation. Winning bidders receive guarantees that Eskom will transmit and distribute the privately generated electricity for 20 years. Since 2011, seven rounds of bidding have been held and contracts have been awarded for increasing amounts of renewable energy, mainly wind, solar PV and concentrating solar power (Figure 12.3). The total capacity available to be awarded for each technology is specified in advance, and included biomass energy and small hydro in the first windows, and battery storage in the most recent. The total installed capacity supported by REIPPPP has now exceeded 6 GW (Figure 12.4).

Figure 12.3 Capacity allocated per bidding window by technology, South Africa, 2011-2024



Note: Based on the year of the announced awardees of bidding windows 1 (2011), 2 (2012), 3 (2013), 3.5/4 (2014), Expedited (2015), 5 (2021), 6 (2022) and 7 (2024).
Source: IPP Projects (2024), IPP Office Reports, Quarterly Reports.

Figure 12.4 REIPPPP annual capacity additions by technology and total operational capacity, 2013-2022

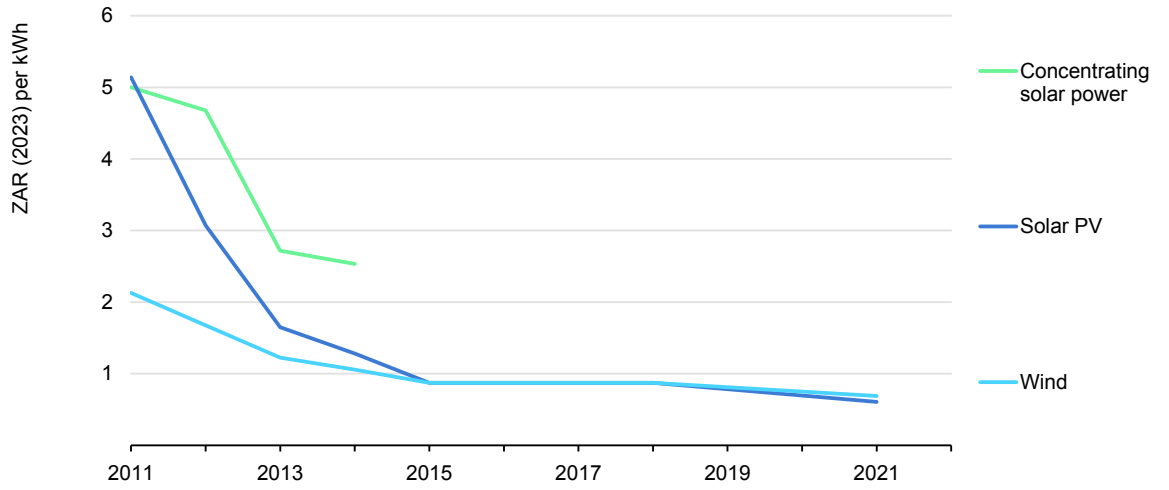


Source: IPP Projects (2024), IPP Office Reports, Quarterly Reports.

The competitive nature of the auctions, which attracted over 300 submissions to the first four bidding windows, led to rapid declines in contracted prices (Figure 12.5). These dropped below Eskom's average cost of supply. This development, as well as the REIPPPP's facilitation of the first IPPs in the South African power market, created competition for Eskom, who was building two new coal-fired plants at the time.[10] Eskom had a preference for a feed-in-tariff, which the National Energy Regulator (NERSA) had been developing before the REIPPPP superseded it, and also campaigned for renewables to be matched by an equal amount of fossil fuel-fired capacity. Between 2015 and 2018 Eskom continued to refuse to sign the offtake agreements and found allies in the government of the day. This opposition led to a three-year gap between bidding windows, which resumed under President Ramaphosa's administration in 2018.

[10] While coal-based technology has long been the core of Eskom's expertise, these two new plants suffered from delays due to technical and design faults, strikes and sabotage that reflected poorly on the company and its century-old monopoly on power generation and distribution.

Figure 12.5 Resulting tariffs from REIPPPP bidding rounds



Notes: Based on the year of the announced awardees of bidding windows 1 (2011), 2 (2012), 3 (2013), 3.5/4 (2014), Expedited (2015), 5 (2021). Bidding windows 6 and 7 not included. Other sources show slight differences with respect to concentrating solar power prices.

Source: IPP Projects (2024), IPP Office Reports, Quarterly Reports.

The REIPPPP had close alignment with the national vision for socio-economic development

The REIPPPP was well aligned with the national vision for energy supply articulated in the 2003 Energy White Paper and Renewable Energy White Paper, which contained both renewable energy and innovation objectives. The White Paper advocated "promoting the development and implementation of appropriate standards and guidelines and codes of practice for the appropriate use of renewable energy technologies [and] appropriate research and development and local manufacturing to strengthen renewable energy technology and optimise its implementation". However, the innovation objectives were not significantly pursued between 2002 and the Integrated Resource Plan of 2011, which established the renewable energy targets for which the REIPPPP was designed as the implementation instrument. Also in 2011 the National Climate Change Response White Paper introduced the concept of a "just transition" to create a new vision against which policy choices would be made. In this white paper, just transitions for South Africa have a clear innovation component (Box 12.1).

Box 12.1 Innovation-related elements in the South African concept of a just transition in its National Climate Change Response White Paper (2011)

South Africa's first formal climate policy, the National Climate Change Response White Paper, referenced clean energy innovation as an emerging idea of a just transition in 2011.

Relevant excerpts include:

"South Africa can become a significant global player in the green economy. More specifically, South Africa should aim to be a leading supplier of climate change knowledge, technologies and services."

"The decision at a national level to adopt innovations depends on the benefits users expect from the innovations as well as on the expected costs to research and master them. In addition, a country needs the technological capability to imitate, adapt and absorb foreign technologies into local productive activities. This capability influences the relative costs and benefits of adopting new technologies."

"For South Africa to enhance its international competitiveness in climate change response science and technology, it needs sound science, a robust technology base and sound human capital in this arena."

"Technology transfer continues to be very prominent in the multilateral environmental agreements in general, and in climate change-related agreements in particular. A national capacity to optimally engage climate change-related technology for South Africa, both as a recipient as well as donor to other developing countries, will be developed."

The Renewable Energy Flagship Programme "will be informed by enhanced domestic manufacturing potential and the implementation of energy efficiency and renewable energy plans by local government. Furthermore, the Department of Energy's solar water heating programme will be expanded through, amongst others, the promotion of the domestic supply of products for solar heating with support from the [Department of Trade and Industry] to build local manufacturing capacity."

"Reporting on climate responsibilities and adaptation measures will consequently be integrated into the Programme of Action and the Ministerial delivery agreements, as well as the quarterly reporting requirements of government at all levels. Key outcomes include… Decent employment through inclusive growth… A skilled and capable workforce to support an inclusive growth path… Vibrant, fair and sustainable rural communities and food security for all… Sustainable human settlements and an improved quality of household life… Responsive, accountable, effective and efficient local government system… Environmental assets and natural resources that are well protected and continually enhanced… Creating a Better South Africa and Contributing to a Better (and Safer) Africa and a better World"

The REIPPPP included incentives for local production and employment, but no provisions for R&D. The so-called socio-economic development criteria were implemented at the same time as the Preferential Procurement Policy Framework Act came into force, which required any public tender to use non-price elements for at least 10% of the decision criteria. To be consistent and credible in this dual context, socio-economic development (SED) criteria were introduced for the REIPPPP. SED accounted for 30% of the total project selection criteria (the rest being based on price) and initially consisted of the following components:[11]

- Rules for preferential procurement from black and female-owned local businesses.
- Local content requirements for a share of jobs to be staffed by South African nationals, rising from 12% to 20% over time.
- Requirements for transfer of 1-1.5% of the project value to the local communities in the proximity of 50 km of any renewable energy plant, a practice adopted from South Africa's mining policies.

The REIPPPP therefore goes beyond the basic requirements for non-price components and emphasised socio-economic development more strongly than other public tenders had before, especially broad-based black economic empowerment, which remains a key component of the REIPPPP. In addition, REIPPPP uses economic development criteria thresholds to determine whether bidders can pass on to subsequent rounds of evaluation. For bidding windows five and six, this required exceptional permission from the National Treasury to use such a measure. This, and the use of SED, show how South Africa was moving towards the concept of "just energy transitions" before the term had been widely promoted. The use of auctions and socio-economic selection criteria also made South Africa a frontrunner in policy design when many other countries were using fixed feed-in tariff approaches to support renewables deployment.

Choosing the REIPPPP approach precipitated several complementary policy choices

While the REIPPPP has been the dominant instrument to create a market for renewable energy technologies in South Africa, its effectiveness has required further market pull measures, including legislative reforms. These additional measures show how the decision to reward private investment in renewable energy, while minimising the cost to the government of the offtake contracts, led to a broader set of reforms that encouraged competition and innovation.

[11] As the evaluation criteria were adjusted for each bidding window, the weight of SED changed over time and was just 10% in bidding window seven.

Sections 12B and 12U of the Income Tax Act were amended to support investment in renewable energy, including:

- Accelerated depreciation for all wind energy and biomass projects, plus solar PV and concentrating solar power projects above 1 MW and hydropower projects up to 50 MW.
- One-year 100% depreciation for solar PV projects below 1 MW, instead of three-year accelerated depreciation.
- Accelerated depreciation for other infrastructure expenditure linked to the construction and generation of renewable power plants.

In addition, the CO_2 emissions avoided by renewable energy projects were made eligible under the carbon offset programme, which allows taxpayers to use offsets to reduce their carbon tax liability. This incentive was very successful in attracting interest and rapidly exhausted the availability of all credits in the South African carbon market.

The drop in the costs of renewable energy that were revealed by the bidding windows created a strong argument in favour of allowing municipalities to procure their own distributed electricity and reduce their incentive to demand more power from the grid. In 2020 DMRE amended the Electricity Regulation Act of 2006 to enable municipalities to procure electricity directly from IPPs. So far, only a few municipalities – including the City of Cape Town and Stellenbosch – have been in a financial position to take advantage of this provision.[12]

The IRP did not originally foresee power generation projects below 100 MW, except for small projects below 1 MW that were exempt from generation licences. All IPP projects above 1 MW were required to obtain a generation licence from NERSA and permission from DMRE. This administrative process was cumbersome and prevented renewable power projects from helping to alleviate Eskom's supply constraints. In 2021 the President increased the licensing threshold to 100 MW and amended the Electricity Regulation Act so that renewable electricity projects below this threshold need only register with NERSA. As small and medium-sized enterprises had found it difficult to compete with larger bidders due to the costly paperwork involved, a small project auction was launched in 2013 to accommodate these smaller companies and it has attracted 20 renewable energy projects between 1 MW and 5 MW. In 2022, when international energy prices rose steeply, the government lifted the licensing threshold altogether.

[12] The recent changes under the Electricity Regulation Act in 2024 enable future municipal procurement through a new National Transmission Company South Africa, which climate finance could easily support.

Implementation and evaluation of the REIPPPP

The performance of the REIPPPP has not yet been formally evaluated against its objectives of socio-economic development, job creation and enterprise development. However, there is evidence of how difficult it is to create new competitive businesses from scratch using only market pull policy measures without enabling pre-conditions to support local content and community preference rules. One design feature of the programme that possibly limited the "just transition" elements of the REIPPPP was the imposition of penalties for late implementation of projects, which firms had to trade off against penalties for non-compliance with local content requirements, which tended to make projects slower to arrange. Despite the government's concerns about ratepayer funds subsidising foreign technology suppliers, the REIPPPP did not include provisions to assist project developers with local content compliance. There was no support for vocational training and technical skills development to empower local workers to secure jobs in the new activities or help attract foreign investment. The REIPPPP catered for local project developers in collaboration with mature, international original equipment manufacturers that could demonstrate experience and absorb the substantial bidding costs. It is estimated that the costs of developing each project proposal for the first few bidding windows was almost USD 2 million, an issue that recent rounds have attempted to address, for example by streamlining applications from compliant developers from previous rounds.

Eventually, the local content requirements created manufacturing jobs in two wind turbine tower production factories and several assembly plants for solar PV panels.[13] These requirements stimulated the development of scientific, engineering and technical skills in the South African wind energy industry, despite conflicting policy barriers constraining their growth.

The wind tower manufacturing factories closed when the REIPPPP experienced delays between bidding windows. Some companies found creative workarounds, such as building wind turbine towers in situ at remote installation sites rather than using a local factory. The solar PV plants involved only low-tech assembly of imported components. These imports were cheaper and readily available due to global overcapacity and integrated production in China and elsewhere. South African production, by contrast was a new economic activity for which there was a shortage of trained personnel. The selection criteria in the REIPPP did not support innovation in South African manufacturing by companies with limited prior experience. To some extent, South Africa experienced disadvantages from trying

[13] Fyvie, Richard (2017), Local Content Requirements in the South African Wind Industry, University of Cape Town: Doctoral Thesis.

to attract international clean energy technology investment at the same time as Brazil's policy push in the same arena, but on a larger scale.

The structure of the community development criteria was an innovation itself, unique to the South African renewable energy programme and new to all actors involved. The first 64 projects generated approximately USD 600 million available to local communities for the duration of the power purchase agreement of 20 years. Local communities, businesses and government officials were equally unfamiliar and needed to work out how to set up the new SED system. Hence, the funds were only available after the installation of the plant and could not be used upfront in support of the project's installation. Most of the funds have been used to form community trusts and benefit projects that the communities can determine themselves.

The case of South Africa's Just Energy Transition Partnership

The JET-P is an innovative form of finance for equitable and climate-resilient development and emissions reduction.[14] The South African government developed the idea to attract climate finance in a collaborative effort with an international group of governments and funding agencies from Denmark, the European Union, France, Germany, the Netherlands, the United Kingdom and the United States.

The partners agreed on a five-year investment plan (JET-IP) was agreed in 2022. The Cabinet of South Africa – the executive branch of the government's most senior body – approved a JET Implementation Plan a year later. The partnership outlines actions for several highly emitting sectors, including the accelerated decommissioning of a 56-year-old coal-fired coal plant and repurposing the site to supply renewable electricity coupled with battery storage and employing the current workers. Two ambitious technology-specific elements of the investment plant are those for electric vehicles and hydrogen.

Alignment with the national vision and international diplomacy

The narrative of the JET-P caters for both national interests and international agendas. The government adopted a Just Transition Framework as a basis to align the country's development and climate change objectives, including achieving net zero emission by 2050.

[14] Since the announcement of South Africa's JET-P in 2021, Indonesia has launched a similar process and ten more are said to be under discussion in other countries.

The JET-P was originally presented to the Presidential Climate Commission as a programme to relieve Eskom's debt. The national interest in reforming Eskom and its financial sustainability stood at its core. The continuous downgrading of its credit ratings also impacted on the investment climate in the wider economy. Eskom had established its own Just Energy Transition Unit at the time to move this process forward internally. The plan attracted critique within and outside the government when it was presented by Eskom's former CEO André de Ruyter to the national planning commission ahead of COP26 in Glasgow.

The focus on Eskom expanded over the course of the negotiations between the South African government, its advisory group and the group of international partners to include the hydrogen and transport sectors, aligning with national programmes to develop these industries.

The South African government pronounced its ambition to support the development and expansion of local EV manufacturing capacity in its recent White Paper on EVs. The strategy aligns with the provisions in the JET-IP to incentivise investment in domestic industries for the manufacture of vehicles, charging components and infrastructure.

Alignment with international commitments

The Paris Declaration on Aid Effectiveness has had the aim of institutionalising the co-ordination of funding efforts between the industrialised countries since 2005. The principles of the Paris Declaration (ownership, alignment, harmonisation, results and mutual accountability) are reflected in the governance of the JET-P and its JET Implementation Plan in different ways. Ownership could be witnessed in the initial motivation to decarbonise Eskom's electricity supply infrastructure when the proposal was first put together in the context of the updating South Africa's NDC. The South African Climate Advisory Council, known as the Presidential Climate Commission, co-ordinated the processes and manoeuvred the NDC towards a more ambitious emissions reduction target, despite contention between political actors. The partnership is recent and was formed during preparation for COP26 in Glasgow in 2021.

The JET-P's results in terms of physical technological change remain to be seen. In terms of institutional innovation, however, the partnership has increased the alignment between climate finance and development efforts, focused around mutually agreed areas of socio-technical change. A detailed implementation and investment plan under the JET-P has an important function in the absence of an implementation plan for the NDC and can help to benchmark the progress in investment towards technological change that underpins the decarbonisation process in energy, fuel production and transport. The JET-P exemplifies the important role of cross-governmental co-ordination in directing incentives to

private investment. Critiques express concerns about the inclusiveness of the most vulnerable members of society in the benefits of the JET-P, as well as the risk of corruption in the public sector.

Clean energy innovation in hydrogen and EVs in the JET-P

Hydrogen is a second priority sector for the JET-IP, after electricity. The production of hydrogen in South Africa currently accounts for around 2% of the world's total and is an emissions problem. Current hydrogen production is linked to South Africa's chemical sector, which is one of the largest among EMDEs and largely dependent on coal as a raw material and energy source. SASOL, a private chemical company that was previously state owned, is the largest single company in this sector and one of the country's largest emitters of CO_2. It is a global leader in the development of technology to convert coal to liquid fuels and chemicals, a technology that was originally selected and licensed by the apartheid government in 1955 in pursuit of energy independence based on the country's extensive coal reservices. Since then, SASOL has improved the core technology, which requires the production of hydrogen as an intermediate step, and has executed projects to make other types of synthetic fuels (including from bioenergy), hydrogen from electrolysed water and hydrogen fuel cells.

JET-P's funding of 11 hydrogen production projects, including the production of ammonia from hydrogen as a means of exporting it in a more convenient form, aligned South Africa's technical expertise and the policy interests of its funders in 2022. Particularly, the German government has a strong interest in diversifying its dependence on fossil fuels and energy security independently from Russian gas. There is a strong historical foundation in research collaboration in synthetic fuels between German and South African research organisations and universities, including hydrogen fuel cells, hydrogen-based cooking fuel and aviation fuels. In 2021 a feasibility study identified three potential hubs and nine potential pilot projects for hydrogen production from renewable electricity, for applications ranging from mining trucks, freight trains and heavy-duty trucks, to data centre backup power. SASOL has also launched a feasibility study into a large facility for making hydrogen from a dedicated new renewable power plant and converting it to ammonia for export markets, which are considered the only realistic markets that could cover the costs of hydrogen production by this method in the near term. Trade-offs between revenue from exports for the private sector need to be carefully weighed against the benefit of renewable energy for electricity use and security of supply for wider societal benefit in line with just transition objectives.

EV manufacturing is the third priority sector articulated in the investment plan, also with an export dimension. A total of USD 6 billion is earmarked to support industrial development and innovation. The choice of EVs reflects existing

capabilities: nine international car manufacturers already produce vehicles in South Africa, of which around 60% are exported.[15] Existing supply chain infrastructure could support a transition towards EVs from internal combustion engines. There are other favourable economic factors, including high import taxes on cars that make imported EVs very expensive, high gasoline prices that could make sales of domestic EVs attractive in South Africa, and good solar resources that could be paired with manufacturing to give South African EVs very low life cycle emissions intensities. However, previous attempts in this area have encountered challenges. In the early 2000s the Department of Science and Technology used its Innovation Fund to invest USD 5 million in equity in a private company to produce a new South African car designed by Jaguar. Insufficient private investment made the business unviable and only a small of fleet of four "Joule" cars was built between 2008 and 2012.

Implementation of innovation priorities in the JET-P

The JET-P has raised expectations in South Africa for the development of new energy industries and international expectations for how multilateral co-operation can support emissions reductions and economic growth in EMDEs. Since 2021 international funding pledges for the JET-P increased from ZAR 170 billion to ZAR 240 billion and the inclusion of the New Development Bank of Brazil, Russia, India, China and South Africa (BRICS), located in China, is an encouraging sign of collaboration at a time of heightened geopolitical tensions. However, in terms of the design of the JET-P funding, the reliance on debt and guarantees rather than grants has been criticised in South Africa for its potential costs to the domestic economy in the longer term. Nonetheless, in terms of innovation, by selecting priorities that build on existing strengths in chemicals and automotive manufacturing, it attempts to address the country's concerns about the future of local jobs in fossil fuel-related sectors during a transition to clean energy.

As of mid-2024, it is too early to judge the overall contribution of the JET-P to technological innovation and just transitions in South Africa. Despite being a pioneer in its engagement with this model of financing, the institutional co-ordination between multiple countries and their development banks takes time. At the same time, a large number of projects have already been committed relatively quickly. The mixed pace of progress and ways of distribution of funds in implementing the plan are sources of concern among the South African public and funders, and for the model more generally.[16] One emerging issue to be navigated is the tension between the closure of coal plants, which is scheduled as part of the

[15] International carmakers in South Africa include Mercedes, BMW, Toyota, Ford, Mahindra, Nissan and Isuzu. South Africa has a competitive, low-cost workforce and is a strategic entry point to the African market, as well as a good location for imports of parts and vehicle exports to all other continents.

[16] Critics of the JET-P have expressed concerns about the rapid pace of the allocation of the grant funds, counterbalanced by the slow progress in phasing out coal.

JET-P, and the construction of renewable energy infrastructure to power clean energy technology and fuel production for export. The lack of improvement in the outlook for the availability of electricity and social security for local communities has begun to create political tensions about who will benefit from the JET-P.

Findings

The analysis of clean energy innovation policy reveals mixed success in advancing 'just energy transitions' in South Africa. The public policy processes to develop clean energy in South Africa reflect the slow progress of the country's energy transition, caused by the ongoing struggle between coal and renewables in the energy sector.

The narrative of a just transition to a sustainable and universally accessible energy future aligns with the country's policies over the past decades as well as its ambition as a global citizen to achieve the Sustainable Development Goals. These aspirations continue to be undermined by historical institutions designed to protect the fossil fuel industry, hidden incentives for fossil fuels and strong political interests.

The role of technology development in a just transition was articulated in the National Development Plan, the REIPPPP and National Climate Change Response White Paper, and this guiding vision has since supported the inclusion of local content and technology objectives in the REIPPPP and JET-P. These two initiatives are both innovative approaches to policy and funding challenges in an emerging economy. South Africa's experience is therefore highly valuable for learning about the viability of linking energy transitions with local community prosperity in this way.

The responses to the electricity supply crisis have fast-tracked regulation that had been resisted for decades, including the unbundling process of Eskom, lifting the limits for private sector involvement and closing the gap in overdue new capacity installation. The global economics of the cost of new energy installations did not support the preference for installing new coal and new nuclear, which the lobbyists from both industries negotiated into the electricity plans. The temporary spike in the uptake of renewable energy through private installation at household, business and utility-scale levels requires continuity to achieve the much-needed security of supply so that the ageing coal fleet can retire smoothly.

The electricity crisis has caused frustration and loss of quality of life for many South Africans, with the result that political support for the governing ANC party has declined. The responses to the crisis triggered action and reform, but there is

a risk of slipping back into reactive rather than proactive management of energy transitions once the inconvenience of loadshedding has been resolved for parts of the population.

Overall, the country has made progress in the deployment of renewable energy technologies, but the innovation components of the REIPPPP were superseded with the opening of the market. The rapid installation of renewable energy through imports from China and other parts of the world has helped to resolve the load-shedding crisis, but possibly at the expense of developing local industries and much-needed manufacturing jobs. The window of opportunity for supporting domestic innovation in renewable energy technology as set out at the outset of the REIPPP is closing.

The more difficult parts of closing coal mines and power plants, and building and financing new transmission infrastructure, are already being contested and resisted – the harder parts of providing public goods beyond the market in the just energy transition have yet to be resolved and will require continued commitment to “justice” in the transition.