Mpumalanga

Renewable Energy and Electric Mobility Market Intelligence Opportunity Brief 2022

MPUMALANGA GREEN CLUSTER AGENCY

Mpumalanga Green Cluster Agency

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LIST OF ABBREVIATIONS AND ACRONYMS

Abbreviations & Acronyms	Meaning
APDP	Automotive Production and Development Programme
BAU	Business As Usual
BMS	Battery Management System
BRT	Bus Rapid Transport
BW	Bid window
CO_2e	Carbon dioxide equivalent
CSP	Concentrated solar power
DEA	Department of Environmental Affairs
DEFF	Department of Environment, Forestry and Fisheries
DMRE	Department of Mineral Resources and Energy
DPE	Department of Public Enterprises
DTIC	Department of Trade, Industry and Competition
DWA	Department of Water Affairs
EAF	Energy Availability Factor
EC	Eastern Cape
EIA	Environmental impact assessment
EA	Environmental authorisation

Abbreviations & Acronyms	Meaning
EPC	Engineering, procurement and construction
EPVA	Electric Powered Vehicles Africa
ERA	Electricity Regulation Act
EU	European Union
EV	Electric Vehicle
GDP	Gross Domestic Product
GCCA	Generation Connection Capacity Assessment
GHG	Greenhouse gas
GTS	Green Transport Strategy
GW	Gigawatt
I&F	Infrastructure and Facilities
ICE	Internal Combustion Engine
IEP	Integrated Energy Plan
IPP	Independent Power Producer
IPPO	Independent Power Producers Office
IRP	Integrated Resource Plan
kW	kilowatt

Abbreviations & Acronyms	Meaning
kWh	kilowatt hours
KZN	KwaZulu Natal
MW	Megawatt
MWh	Megawatt hours
MERRP	Mpumalanga Economic Reconstruction and Recovery Plan
NAAMSA	The National Association of Automobile Manufacturers
NDP	National Development Plan
NCCRP	The National Climate Change Response Policy
NERSA	National Energy Regulator of South Africa
NDC	Nationally Determined Contribution
NNR	National Nuclear Regulator
NT	National Treasury
O&M	Operation and maintenance
OEM	Original equipment manufacturer
OES	Original equipment supplier
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable energy
REDZs	Renewable Energy Development Zones

Abbreviations & Acronyms	Meaning
REIPPPP	Renewable Energy Independent Power Producers Procurement Programme
SAAM	South African Automotive Masterplan
SABIA	South African Biogas Industry Association
SAESA	South African Energy Storage Association
SALGA	South African Local Government Association
SANEDI	South African National Energy Development Institute
SAPVIA	South African Photovoltaic Industry Association
SAWEA	South African Wind Energy Association
SSEG	Small-scale embedded generation
TWh	TerraWatt hour
WWTW	Waste Water Treatment Works

Exchange rates used:
1 US Dollar = R16.49 (August 2022)

EXECUTIVE SUMMARY

This market opportunity brief is part of an annually updated series of reports that highlight investment opportunities in the green economy in Mpumalanga. It is written for investors who want to understand the opportunities for investment and job creation in green economy sectors in the province.

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The decarbonisation of the power sector presents investment opportunities if South Africa is to meet its increased NDC. Coal still dominates the South African energy mix, providing 81.4% of the total system load. Gradual efforts to be carbon neutral by 2050 have been aligned with the South Africa's National Development Plan (NDP) 2030, and earlier NDC targets through the adoption of the updated 2019 Integrated Resource Plan (IRP 2019). The share of renewable energy technologies (wind, solar PV and concentrated solar power (CSP)) continues to grow and by 2021 to a total of 5.7 GW installed capacity and 6.6% of the total energy mix.

Transportion also has major implications for sustainable development. Emissions from the transport sector in South Africa account for 10.8% of the country's total GHG emissions. In addition to these direct emissions arising from the combustion of fuels, there are indirect emissions from the production, refining and transportation of fuels.

The transition to zero-emission electric vehicles (EVs) in South Africa is of strategic national economic importance. The Department of Transport's Green Transport Strategy (GTS) aims to minimise the adverse impact of transport on the environment while addressing current and future transport demands. In the medium term, the electrification of the transport sector holds the strongest business case. However, this sector can expand to include alternative fuels such as hydrogen.

Mpumalanga province houses most coal power stations and coal mining activities in the country. The Mpumalanga provincial government has been proactive in exploring opportunities in the Green Economy for opportunity-led growth and transitioning the provincial economy to a labour-absorbing green-focused region.

The priority areas the government has listed include energy security and green economy, industrialisation through localisation and export promotion, agriculture and food security, rollout of infrastructure, employment stimulus, tourism, cultural and creative industries. The provincial government has a opportunity-focused approach that can smoothen this inevitable economic transition. Thus, there are a host of enabling factors that are going to be key to locating key renewable energy projects in the province, including:

- **Eskom transmission grid capacity:** Mpumalanga currently has 6 520MW of grid capacity to be connected to the grid on a first come, first served basis. This presents an exciting driver for large-scale renewable energy projects to locate in the province and take advantage of the existing transmission assets in the region.

- **Renewable Energy Development Zone (REDZ):** Emalahleni municipality, which is in Mpumalanga, is expected to benefit from the announcement that it has been allocated a REDZ as it plans to create other revenue streams than those that rely on coal mining and coal power generation activities. Renewable energy projects in this area will be able to get an environmental assessment completed in 147 days, compared to 300 days in other areas.

- **Solar irradiation:** Global horizontal irradiation in Mpumalanga ranges between a long-term average of 1752kWh/m2/year and 2044kWh/m2/year (only ~16% lower than the Northern Cape). This is because of the relatively long duration of sunshine in Mpumlanaga with approximately 2 576 hours of sunshine throughout the year.

- **Wind:** As technologies become more efficient, Mpumalanga's wind resources enable attractive investment opportunities. The wind speed in the province ranges between 4 ms-1 and 7 ms-1 at 100m above ground level. The cut-in speed is the minimum wind speed at which the wind turbine will generate usable power

The opportunities in this report are relevant for institutional investors, financiers, project developers, component manufacturers, and suppliers in the Mpumalanga region. The following emerging opportunities with a combined value of R96.73 billion have been identified through engagement with an array of green economy stakeholders:

Public offtake of renewable energy generation (R42 billion)

This is an immediate to medium term opportunity (0-8 years) with an estimated capacity of ~2.6GW under REIPPPP, through a tendering process by the government through DMRE and Eskom. A medium term opportunity is expected as municipalities exploring investment opportunities in solar PV for their office buildings and wastewater facilities. An estimated 341MW will be required for municipal buildings and waste water treatment works.

Private offtake of renewable energy generation (R24.3 billion)

Renewable energy for private offtakers has become attractive with South Africa's above-inflation electricity price rises; national energy insecurity; decreasing technology costs; supportive policies, regulations, and tariffs; and well-adapted finance options.

Increased uptake of rooftop solar PV presents an immediate and continuous opportunity. Recent power cuts and government interventions have increased uptake of ground mounted solar PV as an immediate to continuous opportunity and more industrial facilities are looking at cutting costs, reduce carbon intensity of their operations and shield themselves from rolling power cuts.

Biofuels are a medium to long term opportunity as the South African Cabinet approved the draft mandatory blending regulations in December 2019. Based on the total national fuel pool of over 23 billion litres per annum, at a penetration rate of 2% and 5% for petrol and diesel respectively through mandatory blending, this translated to a biofuels demand of at least 840 million litres per annum nationally.

Energy storage (R2 billion)

Commercial & Industrial (C&I) battery storage options are the latest trends that will influence the private sector market in the short to medium term. By 2030 the possible market demand for behind-the-meter could be ~336MWh. Similar to the renewable energy market growth, growth in this space is driven by rising electricity costs, increased financial returns from storage investments, and a growing need for energy security. there are a few technologies making inroads in the South African market in the backup power and energy security market, with the more tried and tested battery technologies like Lithium Ion (Li-ion) being the preferred technology in backup technologies.

Electric mobility (R28.43 billion)

Globally, the momentum for **electric mobility** has increased. This global shift has been primarily driven by national emission reduction commitments from the Paris Agreement on climate change, growing urban air pollution concerns, and continued crude oil price volatility.

It is expected that the South African market can follow a similar trajectory. However, the market currently remains small. Public transport electrification, EVs in eco tourism and EVs for underground mining have been identified as opportunities in this sector in Mpumalanga.

Table 1. Overview of the market opportunities, drivers, and barriers in the renewable energy and electric mobility markets in Mpumalanga

Opportunity		Term	Key drivers	Barriers
Public offtake of renewable energy	Utility scale renewable energy	Short to medium term (1 - 5 years)	• Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). • Upto 2.6GW expected to be allocated to Mpumalanga under REIPPPP by 2030. • 6.5GW available grid capacity in Mpumalanga. • The decreasing cost of large-scale renewable energy. • South Africa's climate change emission reduction targets. • Emalahleni REDZ.	• Delay in the process to obtain consent for above ground development on areas with mining rights, due to delays in the process of obtaining ministerial approval in line with section 53[1] of the Mineral and Petroleum Resources Development Act, 28 of 2002. • Perceived lower irradiation and wind resources than other provinces in the country.
	Municipal embedded generation	Medium term (5 years)	• The decreasing cost of large-scale renewable energy. • Rising electricity costs. • Localized power generation increases energy security. • Increased load shedding expected up until 2025.	Some municipalities may not be creditworthy, pose a risk of non-payment and nine(9) of the WWTWs are critical/non-compliant and require intervention.

[1] Section 53 relates to the consent that is needed for above ground development on areas with underground mining rights to install anything. This is needed for the project to be bankable. The Promotion of Access to Information Act PAIA application by <insert who has made this application> to get the names of the entities who hold the rights has been delayed to date.

Opportunity		Term	Key drivers	Barriers
Private offtake of renewable energy	Rooftop solar PV	Current	• Rising electricity costs. • Falling costs of renewable energy technologies. • Continued load shedding up to 2025. • Supportive energy policies and regulations by the local and national government.	• Only 6 out of 17 municipalities in Mpumalanga have defined SSEG procedures. • The municipal installation approval process takes at least four months. • Misalignment of local SSEG to national SSEG framework as some munics have different standards of approval.
	Ground mounted solar PV	Short to medium term (1 - 5 years)	• Rising electricity costs. • Falling costs of renewable energy technologies. • Continued load shedding up to 2025. • Mining companies commitment to Renewable energy in the Province. • Cap on license free generation for own use removed. • Available Eskom land and proximity to connection points at power stations.	• Backlog of 4 500 outstanding mining and prospecting licences at the DMRE poses a barriers as project developers are unable to deliver their projects in time. • Only Eskom and Mbombela Municipality have wheeling and energy trading regulations in the Province. • Municipalities framework currently regulates up to 1MW, and they have yet to update application procedures for plants larger than 1MW.
	Biofuel	Medium term (5 years)	• Localised liquid fuel generation increases energy security for South Africa. • South African Biofuels Regulatory Framework 2019. • South African Sugarcane Value Chain Master Plan to 2030. • Resource availability in Mpumalanga. • 30% higher yield per hectare in Mpumalanga sugar industry compared to KwaZulu Natal.	Lack of clear policy implementation and support from the national government on the implementation of the Biofuels Regulation.
Energy storage	Commercial & Industrial (C&I) battery storage	Current	• Technology cost per kWh has been dropping year on year. • Increased financial returns from storage investments. • Batteries provide energy security during load shedding. • The stacked benefit of time-of-use tariff management and demand charge reduction.	Upfront cost per kWh is still relatively higher than conventional sources of emergency power.

Opportunity	Market segment	Sub-Opportunity	Term	Key drivers	Barriers
Electric mobiltity	Public transport	Electric buses Electric minibus taxis	Medium term (5 years)	• Rising fuel costs have increased operational expenditure for public transport operators, which has resulted in passenger fare increases. • Reduced operation and maintenance costs across bus/minibus fleets over internal combustion engine (ICE) technology. • Reduction in battery prices. • Defunding of liquid-based fuels as refineries are closing down. • Growth of the local manufacture of electric buses. • SA Green Transport Strategy. • Ability to charge using DC solar power that coincides with off-peak travel times.	• Limited electric vehicle finance. • Absence of supporting infrastructures like charging stations and maintenance stations. • High upfront investment costs of the technology.
	Mining	Electric underground mining vehicles	Medium to long term (5-10 years)	• Push for sustainable underground mining transportation with lower emissions, higher efficiency and lower heating. • High cost of underground mining ventilation. • The high price of underground mining heat regulation. • Health and safety concerns. • Increasing combustion fuel costs.	• High upfront investment costs of the technology. • Limited local technical support as the technology is still new in the country and province.
	Tourism	Manufacturing of electric game viewers & tourist shuttles Retrofitting of ICE game viewing vehicles & shuttles to electric	Short to medium term (1 - 5 years)	• Rising fuel costs. • Falling cost of electric alternatives. • Ecotourism campaigns. • Reduced environmental and noise pollution.	• High upfront costs. • Lack of financial incentives to purchase EVs.

1.

THE MPUMALANGA GREEN ECONOMY CLUSTER AGENCY

The Mpumalanga province of South Africa faces socio-economic and environmental challenges arising from its resource-intensive economic activities that contribute to climate change. Carbon intensive industries like mining, power generation and petro-chemicals are the core economic drivers in the Province. The region is also currently navigating high levels of unemployment, inequality and poverty, even as pressure mounts to transition away from its current coal-based economy.

Under the leadership of the Mpumalanga Department of Economic Development and Tourism work has begun to design a strategic intervention for the green economy in the province to attract investment and create jobs. This strategy identified the concept and theory of cluster development as an effective way to transition to an economy that has the ability to provide labour absorbing capacity through competitive green jobs.

Clusters can create the context to build trust between sector players, and work to unlock new mechanisms to enhance competitiveness and resilience. The Green Economy, in particular, lends itself to collaborative ecosystem building approaches. Set in this system of rapidly changing technology, and the economics surrounding that technology, are commitments to social inclusion, and greater equality.

The Mpumalanga Department of Economic Development and Tourism, working with GreenCape and with support from the international development finance community, has set up the Mpumalanga Green Cluster Agency. This cluster will focus on unlocking and unblocking economic opportunities in the green economy, with the aim of making a contribution to regional economic diversification and job creation efforts.

The Mpumalanga Green Cluster Agency is registered as a not-for-profit organisation in South Africa, with an appointed board of directors. The Cluster uses the triple helix cluster model with representation from government, industry and academia as part of its design set up. The Cluster hosted the Mpumalanga Energy Summit in 2022, where it was formally launched by the Mpumalanga Government MEC: Finance, Economic Development and Tourism.

The Cluster has made significant progress to date, in particular to systematically engage with businesses in the province to identify and highlight opportunities and barriers for green economy projects in Mpumalanga. The Cluster has had several hundred engagements with the private sector to understand barriers and opportunities and it has launch several capacity building programs and technical support interventions in Mpumalanga.

Some of these interventions has led to investment declarations and intent to develop ~ R60bn worth of projects, a primary impact goal for the Cluster. The Cluster has also been accepted to be the second African member of the International Cleantech Network, creating an international eco-system access point for green businesses in the Province for potential growth opportunities.

The Mpumalanga Green Cluster Agency's mission is to stimulate a vibrant green economy for communities in the Mpumalanga province, underpinned by a collaboration between government, business and academia. The vision is a vibrant, green and sustainable economy in the Mpumalanga province, that leverages the province's rich natural resources and heritage to create a legacy for South Africa low carbon economic growth. Collaboration through clustering on a local scale to build competitiveness on a global scale will support the growth of the green economy in Mpumalanga, and determine the green cluster in Mpumalanga's success.

To become a member of the Mpumalanga Green Cluster Agency, please sign up **here**.

Green Economy Market Opportunity Briefs

This market opportunity brief is part of an annually updated series of reports that highlight green economy investment opportunities in the green economy in Mpumalanga. It is written for investors who want to understand the opportunities for investment and job creation in green economy sectors the province.

Each brief provides an overview of the market within a sector, including key developments and achievements, the key players, legislation and regulation, market opportunities and challenges, and funding opportunities.

This brief focusses on the green economy investment opportunities in the renewable energy and sustainable mobility sectors.

To access the other sector briefs, please visit: **http://www.mpumalangagreencluster.co.za/**

2.

SECTOR OVERVIEW AND CONTEXT

2.1.

The decarbonisation of the power sector: Electricity landscape

South Africa's 2021 updated Nationally Determined Contribution (NDC) increased South Africa's climate ambition towards 2030, and improved market clarity. The country's efforts to limit climate change in a manner which "leaves no one behind"[2] presents green economy investment opportunities.

The decarbonisation of the power sector is one market that presents investment opportunities if South Africa is to meet its increased NDC. In addition, the decarbonisation of the power sector has been shown to have further-reaching impacts beyond the power sector alone. One of these, which has garnered increased interest, is switching from fossil fuel use in transport to renewable alternatives.

South Africa currently has 30 power stations with a wholesale/public nominal capacity of 57.3GW. The electricity generation fleet is presently dominated by coal-fired power generation stations, primarily owned and operated by Eskom, the national power utility. The current electricity demand in South Africa is met through Eskom generation, independent power producers (IPPs) and cross border suppliers. According to the CSIR's statistics of utility-scale power generation in South Africa in 2021, the total system demand increased by 6.5 terawatt hours (TWh), a 3% increase compared to the 2020 total system demand. The 2021 total system demand is, however, still lower by 5.3TWh, 2% decrease from the 2019 demand, pre-lockdown (Ferreira, 2022).

Coal still dominates the South African energy mix, providing 81.4% of the total system load. Renewable energy technologies (wind, solar PV and concentrated solar power (CSP)) increased in 2021 to a total of 5.7GW installed capacity and 6.6% of the total energy mix. This growing renewable energy contribution to the energy mix contributes to South Africa's ability to meet its commitments to limit greenhouse gas (GHG) emissions to 398-510 MtCO2e by 2025 and 350-420 $MtCO_2e$ by 2030, according to the latest NDC released in September 2021.

Aligned with the South Africa's National Development Plan (NDP) 2030, and earlier NDC targets, the country adopted the updated 2019 Integrated Resource Plan (IRP 2019). The IRP is an electricity infrastructure development plan based on the least-cost electricity supply and demand balance, considering a number of factors, including the security of supply and the environment. The promulgated IRP identified the preferred generation technology mix required to meet the expected electricity demand growth up to 2030. In addition, it incorporated government objectives such as affordable electricity, reduced GHG emissions, reduced water consumption, diversified electricity generation sources, localisation and regional development (DMRE, 2019). Figure 1 presents the IRP 2019 targets for installed generation capacity until 2030.

[2] 'leave no one behind" is a commitment to end extreme poverty in all its forms and to act explicitly to ensure that those who have been left behind can catch up to those who have experienced greater progress. (UNDP, 2018)

	Coal	Coal (Decom-missioning)	Nuclear	Hydro	Storage	PV	Wind	CSP	Gas/Diesel	Other (Distributed generation cogen, biomass, landfill)
Current	37 149	–	1 860	2 100	2 912	1 474	1 980	300	3 830	499
2019	2 155	-2 373	–	–	–	–	244	300	–	Allocation to the extent of the short term capcity and energy gap
2020	1 433	-557	–	–	–	114	300	–	–	
2021	1 433	-1 403	–	–	–	300	818	–	–	
2022	711	-844	–	–	513	400 1 000	1 600	–	–	
2023	750	-555	–	–	–	1 000	1 600	–	–	500
2024	–	–	1 860	–	–	–	1 600	–	1 000	500
2025	–	–	–	–	–	1 000	1 600	–	–	500
2026	–	- 1 219	–	–	–	–	1 600	–	–	500
2027	750	-847	–	–	–	–	1 600	–	2 000	500
2028	–	-475	–	–	–	1 000	1 600	–	–	500
2029	–	- 1 694	–	–	1 575	1 000	1 600	–	–	500
2030	–	-1 050	–	2 500		1 000	1 600	–	–	500
Total Installed Capacity by 2030 (MW)	33 364		1 860	4 600	5 000	8 288	17 742	600	6 380	–
% Total Installed Capacity (% of MW)	43		2.36	5.84	6.35	10.52	22.53	0.76	8.1	–
% Annual Energy Contribution (% of MWh)	58.8		4.5	8.3	1.2	6.3	17.8	0.6	1.3	–

- Committed/already contracted capacity
- Capacity decommissioned
- New additional capacity
- Includes distributed generation capacity for own use
- Extension of koeberg plant design life
- Installed capacity

Figure 1. IRP 2019 targets for installed generation capacity up to 2030 (Source: DMRE)

2.2.

The IRP 2019 marked a major shift in electricity policy, away from coal to renewables. The primary mechanism by which renewable energy has been brought onto the grid to date is through the government-led auction process, i.e. several bidding rounds to procure renewable energy under the Renewable Energy Independent Power Producer Procurement Programme (REIPPPP).

Through the competitive bidding process delivered through a series of bid windows (BW), the REIPPPP effectively leveraged rapid global technology developments and downward price trends to attract some of the lowest tariffs in the world.

To date, 6 322MW of electricity had been procured from 92 RE Independent Power Producers (IPPs) in REIPPPP. 5 661MW of electricity generation capacity from 85 IPP projects has been connected to the national grid (IPP, 2021). The estimated portfolio cost for all technologies under the REIPPPP has dropped consistently in every bid window to a combined average of R0.47/kWh in BW5 (2021/22).

The decarbonisation of the transport sector: Mobility landscape

Transport systems form the backbone of South Africa's socio-economic activities. A recent estimate by the South African Department of Transport indicates that the transport, storage, and communication sector contributes 9.3% to South Africa's GDP, while transport alone contributes about 6.5% (Teuterberg, 2021).

Beyond the contribution to the economy of local and cross-border transport systems, automotive manufacturing is the largest manufacturing sector in the country's economy. The South African automotive industry consists of a wide range of companies and organisations involved in the design, development, manufacturing, marketing, importation, exportation and selling of motor vehicles. It is one of the country's largest economic sectors by revenue as it contributes 4.3% to the country's GDP (2.4% manufacturing and 1.9% retail). The industry accounts for 17.3% of the country's manufacturing output.

It is the the country's 5th largest exporting sector out of 104 sectors and accounts for 18.1% of total exports (Naamsa, 2022). The government has capitalised on the wealth of experience brought about by the presence of major European, American and Japanese motor vehicle manufacturers based in South Africa. As a result, South Africa's attractiveness as an investment destination of choice, and production base for automotive products to be exported to global markets, has been well established.

Transport has major implications for sustainable development. Emissions from the transport sector in South Africa account for 10.8% of the country's total GHG emissions. In addition to these direct emissions arising from the combustion of fuels, there are indirect emissions from the production, refining and transportation of fuels.

Therefore, the transition to zero-emission electric vehicles (EVs) in South Africa is of strategic national economic importance. The Department of Transport's Green Transport Strategy (GTS) aims to minimise the adverse impact of transport on the environment while addressing current and future transport demands. The objectives of the GTS include:

- Enabling the transport sector to contribute its fair share to the national effort to combat climate change.
- Promoting behavioural changes towards sustainable mobility alternatives.
- Engaging the low carbon transition of the sector.
- Minimising the adverse effects of transport activities on the environment.
- Facilitating the sector's just transition to climate-resilient transport system and infrastructure.

In the medium term, the electrification of the transport sector holds the strongest business case. However, this sector can expand to include alternative fuels such as hydrogen.

EV car sales in South Africa have been steadily rising after a brief dip in 2020 due to the global Covid-19 pandemic. As shown in **Figure 2**, in 2021, 218 electric passenger vehicles were sold, including brands like BMW, Mini Cooper, Porsche, Jaguar and Audi (Montmasson-Clair, 2022). While still small, this trajectory of EV sales will continue to grow as more battery electric OEMs enter the South African market and prices continue to fall.

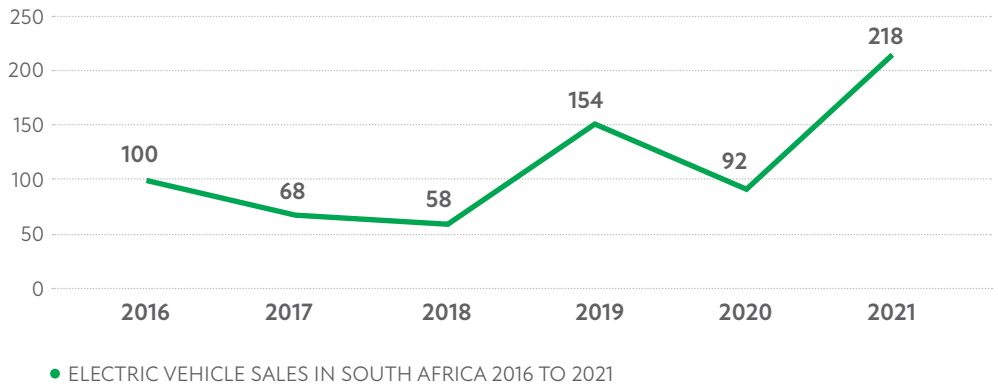

Figure 2. Electric vehicle sales in South Africa 2016 to 2021 (Source: TIPS policy brief, 3/2022)

The decarbonisation of the energy and transport sectors is building momentum in South Africa. This has created current investment opportunities in the renewable energy and sustainable mobility sectors. These opportunities are relevant for institutional investors, original equipment manufacturers (OEMs), equipment suppliers, project developers, and technical advisers.

2.3.

Governance, legislation and policies

The national government, provincial entities, municipalities and other relevant entities are actively working on their contributions to the shift to a low-carbon and climate resilient society in South Africa.

To this end, over the past two decades, South Africa has adjusted governance structures and adopted legislation and policies to guide the renewable energy and electric mobility sectors. These national and sectoral policies, plans and strategies are aimed at decarbonising the South African economy whilst meeting broad developmental objectives.

This section provides details of the institutions that guide the development of the renewable energy and sustainable mobility sectors and provide a high-level breakdown of the relevant legislation, regulations and policies for each sector.

2.3.1. Governance

National and local governments guide the development of the energy and mobility sectors in South Africa. This development is also aided by several industry associations.

In the renewable energy sector, the responsible national government department is the Department of Mineral Resources and Energy (DMRE). The mission of the DMRE is to regulate and transform the industry to provide secure, sustainable and affordable energy and promote and regulate minerals and mining.

The DMRE is supported in various roles by several government departments and institutions to guide the development of the renewable energy sector:

- **National Energy Regulator of South Africa (NERSA)** – NERSA issues licences for the operation of generation, distribution, and transmission infrastructure; regulates imports, exports, and trading of electricity; determines and approves electricity prices, tariffs, and the conditions under which electricity may be sold.
- **Local distribution utilities (i.e. municipalities)** – Local government plays an important role in the electricity industry in South Africa. Schedule 4B of the Constitution lists electricity and gas reticulation as a local government responsibility. In addition, section 153 of the Constitution places the responsibility on municipalities to ensure the provision of services like electricity.

- **Independent Power Producers Office (IPPO)** – The IPPO is a key procurement vehicle for delivering on the national renewable energy capacity-building objectives. It provides the following services: Procurement management services, professional advisory services and monitoring, evaluation and contract management services.

Various industry associations also support the development of the renewable energy industry in South Africa:

- **South African Photovoltaic Industry Association (SAPVIA)** is a not-for-profit organisation that represents the solar PV industry in South Africa. It aims to ensure that solar PV is the generation technology of choice in South Africa and Sub-Saharan Africa, supporting its socio-economic development targets.

- **South African Wind Energy Association (SAWEA)** is a not-for-profit, member-driven association that aims to enable a commercial wind power industry in South Africa.

- **South African Energy Storage Association (SAESA)** is an association that aims to represent, promote and aid the energy storage industry in its business development goals in South Africa and Africa.

- **Southern African Biogas Industry Association (SABIA)** is a registered non-profit organisation that represents and lobbies for the interests of the biogas industry in South Africa.

In the electric mobility sector, specifically electric vehicles, the responsible department is the Department of Transport (DoT). The DoT is responsible for the regulation and coordination of transportation in South Africa for all public transport, rail transportation, civil aviation, maritime transport and road transport

The DoT is supported in various roles by several government departments, entities and institutions to guide the development of the mobility sector. For example, the 12 public entities under the Ministry of Transport are the Airports Company South Africa (ACSA); The Passenger Rail Agency of South Africa (PRASA); The South African National Roads Agency (SANRAL); Ports Regulator of South Africa; Air Traffic and Navigation Services (ATNS); Cross-Border Road Transport Agency (CBRTA); Railway Safety Regulator; Road Accident Fund (RAF); Road Traffic Infringement Agency (RTIA); Road Traffic Management Corporation (RTMC); South African Civil Aviation Authority (SACAA) and South African Maritime Safety Authority(SAMSA).

Various industry associations support the development of the transport sector, including electric mobility:

- **The National Association of Automobile Manufacturers (NAAMSA)** is an association that represents the non-competitive interests of the motor vehicle manufacturing, importation and distribution industry in South Africa. All major multinational automotive companies and corporations are members.

- **The National Association of Automotive Component and Allied Manufacturers (NAACAM)** is recognised as the voice of the South African automotive component industry both domestically and internationally.

- **Electric Vehicle Industry Association (EVIA)** is a national platform comprised of government departments and agencies, electric vehicle OEMs, electricity infrastructure and suppliers, electric vehicle supply equipment (EVSE) suppliers and ICT / smart grid service providers as the users.

There are also various other relevant entities involved in the South African mobility sector, including the Road Freight Association, Private Public Transport Association (P.P.T.A.), The National Taxi Alliance (NTA), South African Petroleum Industry Association (SAPIA), South African Association of Ship Operators and Agents (SAASOA).

There are also various government departments and entities that provide aspects of governance to both the renewable energy and sustainable mobility sectors. These include:

- **Department of Public Enterprises (DPE)** – The Minister of Public Enterprises is the shareholder representative of the South African government and has oversight responsibility for State Owned Entities (i.e. Eskom and Transnet).

- **National Treasury (NT)** – Treasury manages national economic policy, prepares the South African government's annual budget and manages the government's finances.

- **Department of Forestry, Fisheries and the Environment (DFFE)** – Ensures adherence to environmental compliance and rights protection in preventing pollution, and ecological degradation, promoting conservation and securing ecologically sustainable development.

- **The Department of Trade, Industry and Competition (dtic)** – Ensures industrialisation through the REIPPPP's economic development component, especially local content and black economic empowerment and development of small businesses.

Another significant national level role player is with influence on the development of the renewable energy and sustainable mobility sectors and the development of Mpumalanga in particular is the Presidential Climate Commission (PCC). This is an independent, statutory, multi-stakeholder body established in 2020 to oversee and facilitate a just and equitable transition towards a low-emissions and climate-resilient economy. According to (PCC, 2022) it aims to:

- Create a social partnership around a Just Transition.
- Define a vision for a Just Transition, and means of achieving that vision, covering the necessary sectoral shifts, technological innovation, employment opportunities, and climate finance.
- Conduct independent analysis into climate change impacts on jobs, the economy, and policy.
- Monitor progress towards mitigation and adaptation goals, as well as the achievement of a just transition linked to broader development objectives.
- Engage with a wide range of stakeholders, including all spheres of government, business, labour, academia, communities, and civil society.

2.3.2. Legislation and regulations

Parliament, as the national legislature, has legislative authority in the national sphere of government. As a result, several relevant acts and regulations dictate the market opportunities in the energy and mobility sectors. The most relevant ones to this publication are detailed in Table 2.

Table 2. Relevant acts and regulations that inform the market opportunities in the energy and mobility sectors

Energy	**National Energy Regulator Act No. 40 of 2004** (NERA) establishes a single regulator to regulate the electricity, piped-gas and petroleum pipeline industries (NERSA) and to provide for matters connected in addition to that. **Electricity Regulation Act 4 of 2006** as amended by the Electricity Regulation Amendment Act 28 of 2007 (ERA) and expected to be amended again as per the February 2022 gazette by DMRE. These regulations guide issuing licences for generators and transmitters, wheelers, and electricity distributors. **National Energy Act 34 of 2008:** The National Energy Act was promulgated to ensure that diverse energy resources are available to the South African economy in sustainable quantities and at affordable prices to support economic growth and poverty alleviation.
Electric mobility	**The National Land Transport Act 5 of 2009** aims to further the transformation and restructuring of the national land transport system initiated by the National Land Transport Transition Act, 2000 (Act No. 22 of 2000); and to provide for matters connected in addition to that.
Combined	**The Carbon Tax Act, No 15 of 2019** was gazetted in May 2019 and came into effect on 01 June 2019. The impact of the carbon tax on the uptake of solar and other renewable forms of energy (which present a case for carbon offsetting by emissions generators) is still to be determined and will be monitored.

It is also important to note that local government does do not merely exercise powers delegated to it by the national or provincial government. Instead, local government / municipal councils are legislative assemblies that can pass local legislative acts. This is particularly relevant in the renewable energy sector, where local governments have set several pertinent by-laws over the past five years concerning renewable energy (e.g. regulations for small scale embedded generation, wheeling, procurement from Independent Power Producers etc.).

2.3.3. Policies, plans, strategies and white papers

Policies, plans, and strategies outline what a government department or relevant entity aim to achieve and the methods and principles it will use to achieve them. In addition, it states the goals or expected outcomes. A policy document is not a law, but it will often identify new laws needed to achieve its goals.

Several relevant policies, plans and strategies outline goals in the energy and mobility sectors and detail the methods and principles that will be used to achieve them. The most relevant ones to this publication are summarised in Table 3.

Table 3. Policies, plans, strategies and white papers that inform the market opportunities in the energy and electric mobility sectors

Energy	**White Paper on Energy Policy of 1998:** This paper identifies the need for energy demand-side management and promoting energy efficiency in South Africa. Appropriate and supportive energy policies are required to attain the energy efficiency and conservation targets embodied in the Integrated Resource Plan (IRP) framework. **The National Climate Change Response Policy (NCCRP) (2011)** is the key policy document guiding climate change response across all government departments. It recognises that response should be departmental, cost-effective, and integrated. **Integrated Energy Plan (IEP) 2016:** Outlines the general energy plan for the country up to 2050. The IEP looks into energy security, access to energy, reducing the cost of energy supply, energy efficiency, localisation and sustainability in all energy matters. **Integrated Resource Plan (IRP) 2019:** The IRP guides electricity provision in South Africa. Its custodian is the DMRE. The IRP, a living document that the DMRE is to update every two years, is developed in the context of the IEP. **Presidential Climate Commission:** One of the first tasks of the PCC was to develop a framework for a just transition. The just transition framework presents an opportunity to start dealing with practical issues relating to jobs, local economies, skills, social support, and governance.
Electric mobility	**Automotive Production and Development Programme (APDP) 2013-2020** – The APDP was implemented on 1 January 2013 and was in place until 2020, after which has been replaced with the South African Automotive Masterplan (SAAM) which applies from 2021 until 2035 **The South African Automotive Masterplan (SAAM) 2021 – 2035** guides policy on growing and supporting the domestic automotive industry from 2020 to 2035. **Green Transport Strategy (GTS) for South Africa 2018 – 2050** – To address the significant contribution of transport to national greenhouse gas (GHG) emissions, the Department of Transport (DoT) has developed a green transport strategy.

2.4.

Key players in the renewable energy and electric mobility sectors

Various players are active in shaping the South African renewable energy and electric mobility sectors. The sections below detail the key players or types of companies involved in the renewable energy and electric mobility sectors.

2.4.1. Renewable energy

Key players or types of companies involved in the renewable energy market are described in Table 4 below, indicating the project phase in which they are typically involved.

2.4.2. Electric mobility

Various key players are competing to shape the South African electric vehicle (EV) market. The exact dynamics of the industry are however still emerging. Notwithstanding, car manufacturers and charging infrastructure companies are the most active stakeholders in the market, with limited current activity from battery companies.

Figure 3 below provides a breakdown of key players and the industry value chain indicating the availability of the value chain element in South Africa.

Table 4. Typical company types involved at different stages of renewable energy projects.

IPP	Independent power producer or project developers. IPPs or project developers are responsible for project inception and development, land acquisition, sourcing finance, and bid submission. IPPs or project developers may sometimes be a project sponsor or may submit a bid with the backing of such an entity. In the small scale renewable energy market, this role is often played by an engineering, procurement and construction (EPC) company. **Project stages involved:** Project development, project construction, project operation and maintenance.
OEM	Original equipment manufacturer. Suppliers of key technology, e.g. the manufacturer of the selected turbine in a wind farm. This company will play a major role in determining the technology partners that will constitute a project, and may also play the role of O&M (see below). **Project stages involved:** Project construction, project operation and maintenance.
O&M	Operation and maintenance (O&M) company. It is usually the main equipment supplier or a technical entity well-versed in the specific technology. **Project stages involved:** Project construction, project operation and maintenance.
EPC	Engineering, procurement and construction. Typically, this player is responsible for managing the various sub-contracts in the construction phase of a project. It may also be involved in the design and development phase of the project. **Project stages involved:** Project development, construction and O&M.
Financiers	Due to significant market growth, numerous financial mechanisms to fund larger commercial and industrial solar PV installations and operations have emerged in recent years, including Power Purchase Agreements (PPAs), fixed roof rentals, lease or rental agreements, upfront capital investment, and bank financing options **Project stages involved:** Project development, funding, and O&M.

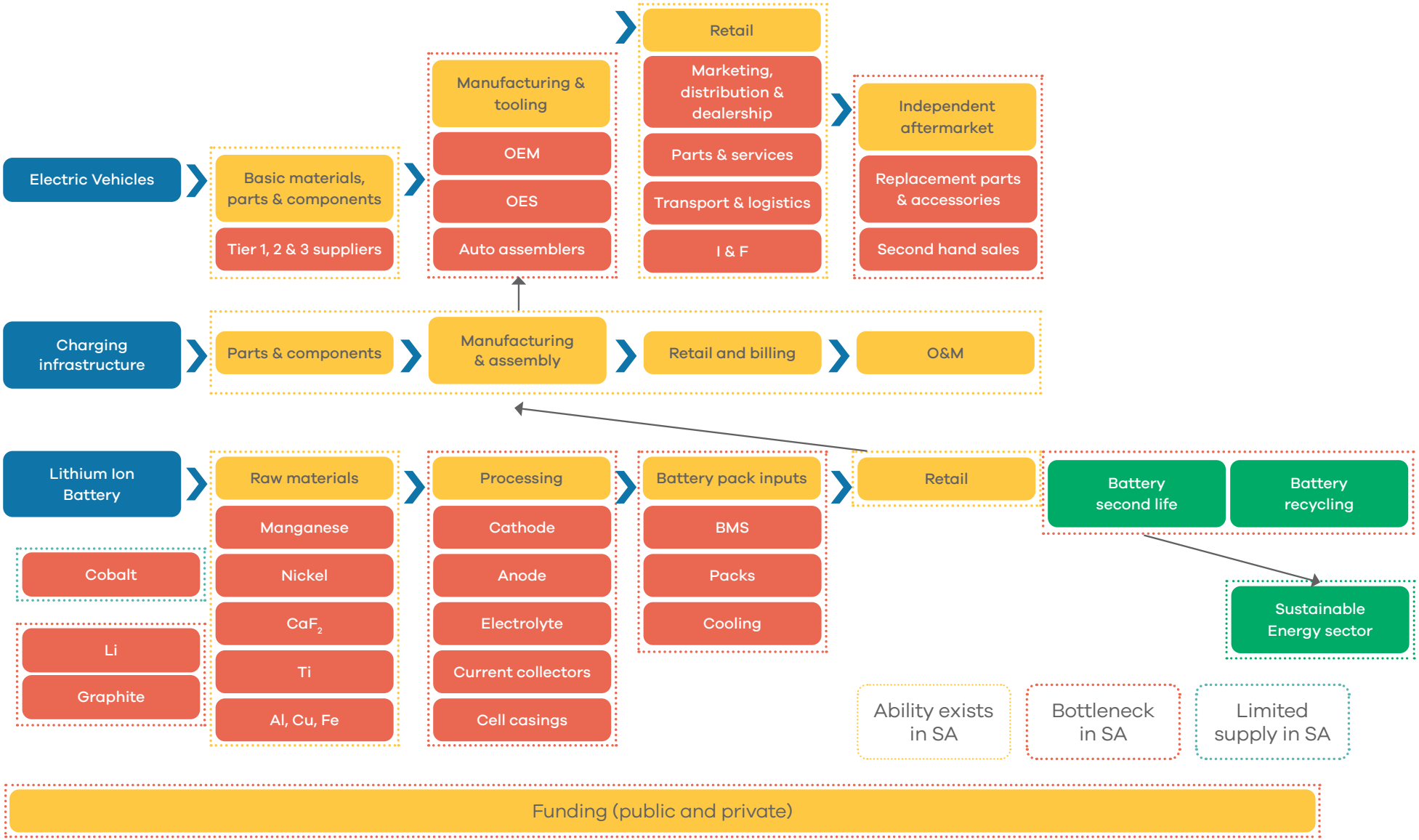

Figure 3 The South African electric mobility value chain and key players
(Source: GreenCape 2022)

2.5.

The Mpumalanga green economy potential

There are urgent imperatives for low carbon development globally and in South Africa. South Africa's commitment to a low carbon future is manifest in the National Development Plan, Nationally Determined Contribution and various policy and strategy documents. Moreover, as the country reduces its dependence on coal, specific regional economies will have marked impacts.

The Highveld region was identified as such a hotspot. The Mpumalanga province houses most coal power stations and coal mining activities in the country. The Mpumalanga provincial government has been proactive in exploring opportunities in the Green Economy for opportunity-led growth and transitioning the provincial economy to a labour-absorbing green-focused region.

The Mpumalanga Provincial Government is set to adopt the Mpumalanga Economic Reconstruction and Recovery Plan (MERRP) as of August 2022. MERRP's objective is to align the province with the National Development Plan (NDP) and prioritise strategic areas particularly specific to Mpumalanga.

The priority areas are expected to align with The South African Economy and the COVID-19 Crisis: Recovery and Renewal plan and these include:

- Energy security and green economy.
- Industrialisation through localisation and export promotion.
- Agriculture and food security.
- Rollout of infrastructure.
- Employment stimulus.
- Tourism, cultural and creative industries.

This opportunity focused approach can aid the inevitable economic transition. Thus, there are a host of potential investment opportunities; for example, the opportunities presented by re-purposing land on decommissioned mines and coal-fired stations to pivot to renewable energy production, utilising the existing transmission assets in the region.

2.5.1. Eskom transmission grid capacity

Eskom published its Generation Connection Capacity Assessment of the 2024 Transmission Network (GCCA – 2024) in March 2022. As depicted in the Figure 4, the GCCA-2024 shows the capacity following the construction of projects procured in the first five BWs of the REIPPPP. As a result, there is no additional capacity in the Northern Cape grid to evacuate power to the main load centres in Gauteng and elsewhere. And after BW6 (to be auctioned in 2022) and IPP projects being developed with direct agreements with large customers, there will soon be no transmission capacity left in other key resource areas.

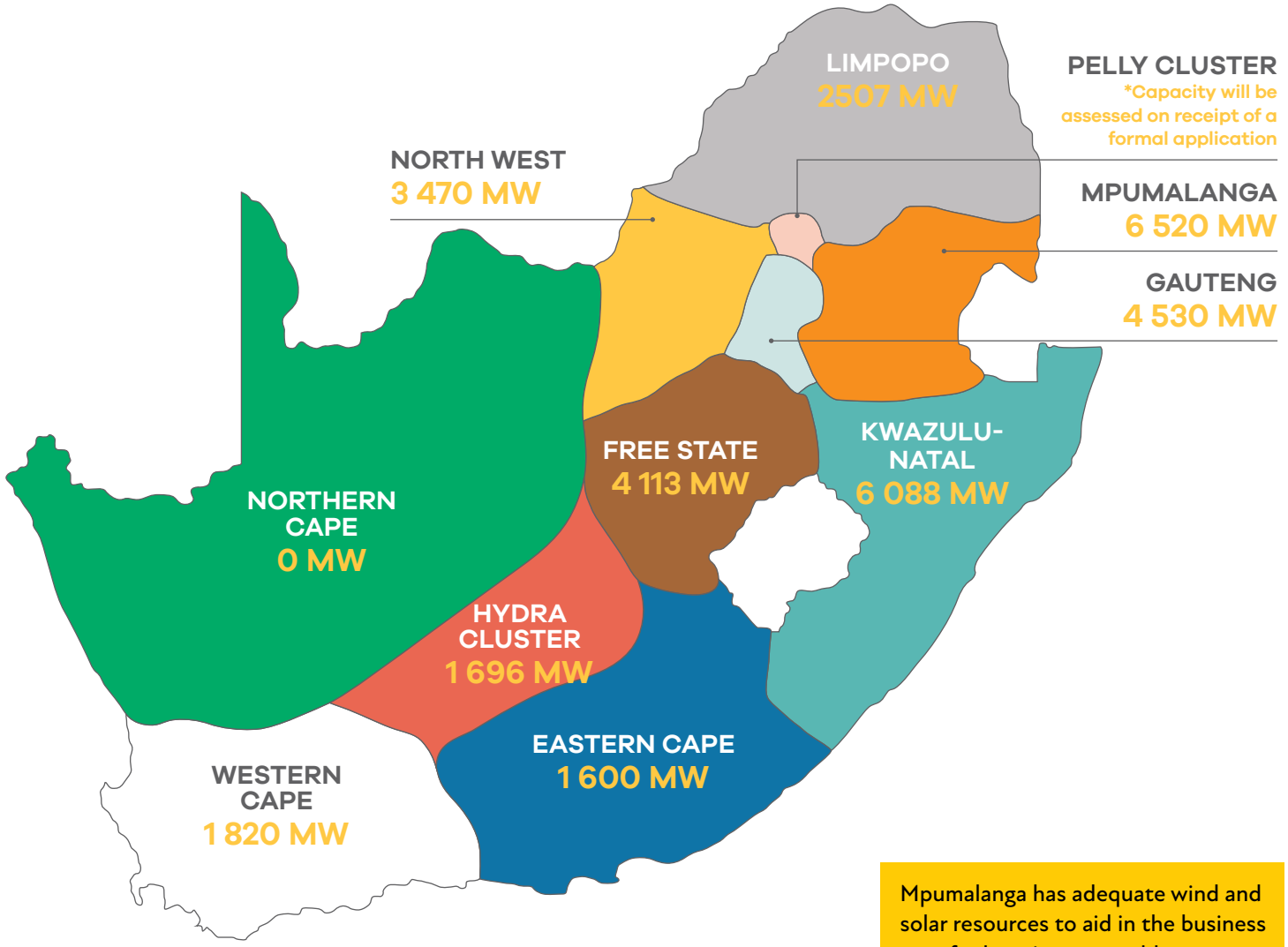

Figure 4. Generation connection capacity in the country supply areas (Source: Eskom)

Mpumalanga has adequate wind and solar resources to aid in the business case for locating renewable energy projects in the province.

Mpumalanga currently has 6 520MW of grid capacity to be connected to the grid on a first come, first served basis. This presents an exciting driver for large-scale renewable energy projects to locate in the province and take advantage of the existing transmission assets in the region.

While the country's coastal, desert or hilly regions are typically more attractive for the installation of wind turbines or solar power, a wide geographical spread of renewable energy facilities would enable supply to be maintained, particularly if weather conditions are unfavourable for wind or solar in another area.

2.5.2. Wind resources

As technologies become more efficient, Mpumalanga's wind resources enable attractive investment opportunities. As shown in Figure 5, the wind resource in the province means wind speed ranges between 4ms-1 and 7ms-1 at 100m above ground level. The cut-in speed is the minimum wind speed at which the wind turbine will generate usable power. This wind speed is typically between 10km/h and 15km/hr (~3m/s and 4m/s). Despite Mpumalanga not being known for high levels of wind, this challenge could be overcome with increased turbine hub height. Figure 5 is a map of wind speeds across South Africa.

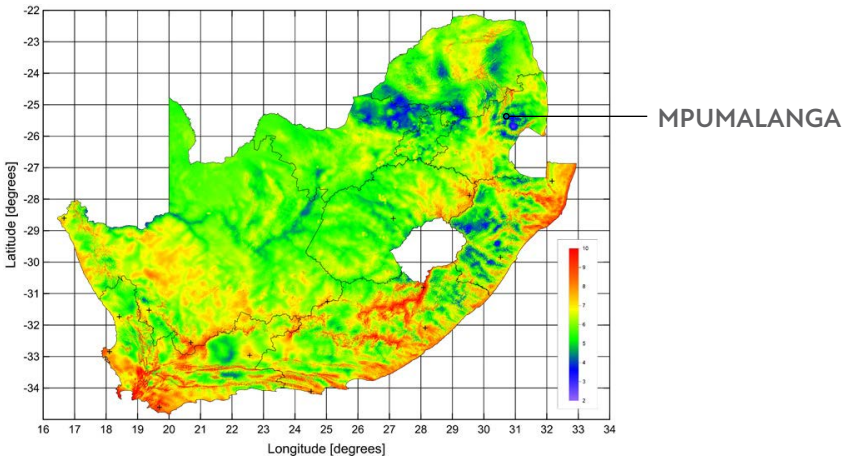

Figure 5. Wind resources map for South Africa highlighting Mpumalanga (Source: CSIR)

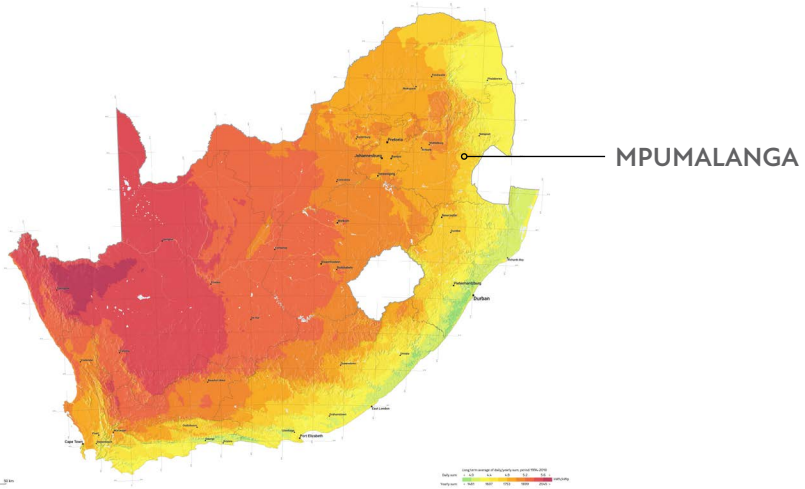

Figure 6. Solar irradiation map for South Africa highlighting Mpumalanga (Source: SOLARGIS)

2.5.3. Solar irradiation

According to the DMRE website, most areas in South Africa average more than 2 500 hours of sunshine per year[3], and average solar radiation levels range between 4.5 and 6.5kWh/m^2 in one day.

The Northern Cape has been dubbed South Africa's "green hub" because of its numerous solar installations, including CSP and solar PV plants. As a result, the Northern Cape has some of the world's highest global horizontal irradiation levels.

The global horizontal irradiation in the Northern Cape ranges between a long-term average of 2 190kWh/m^2/year and 2 336kWh/m^2/year.

As shown in Figure 6, the global horizontal irradiation in Mpumalanga ranges between a long-term average of 1752kWh/m^2/year and 2044kWh/m^2/year (only ~16% lower than the Northern Cape). This is because of the relatively long duration of sunshine in Mpumlanaga with approximately 2 576 hours of sunshine throughout the year.

It is important to note that along with these natural wind and solar resources comes significant fauna and flora biodiversity in Mpumalanga. This means that the environmental impact assessment (EIAs) requirements may be more stringent than in other areas.

Power corridors and Renewable Energy Development Zones (REDZ) have been established as a strategic guide to project and grid infrastructure development. They should provide benefits in expediting EIAs and land acquisition in these zones.

[3] Sunshine hours is a climatological indicator, measuring duration of sunshine in given period (usually, a day or a year) for a given location on Earth, typically expressed as an averaged value over several years.

2.5.4. Renewable Energy Development Zones (REDZs)

On 16 February 2018, Minister Edna Molewa published Government Notice No. 114 in Government Gazette No. 41445, which initially identified eight renewable energy development zones important for developing large-scale wind and solar photovoltaic facilities. The new zones increased to 11 following the three additional geographic areas – Emalahleni, Klerksdorp and Beaufort West – officially declared as REDZs on 6 February 2021 by Minister Barbara Creecy (Government Notice No. 142, 144 and 145 in Government Gazette No. 44191).

Emalahleni municipality in Mpumalanga is expected to benefit from this announcement as it plans to create other revenue streams than those that rely on coal mining and coal power generation activities.

Renewable energy projects will require environmental authorisation (EA) under the National Environmental Management Act (NEMA), but the Department of Forestry, Fisheries and the Environment (DFFE) has indicated that the EA process has been "shortened to allow for a smoother implementation of alternative energy growth in South Africa". This geographical zone has made it possible to complete an EA in 147 days, compared to 300 days previously. The shortening of the period was enabled as a result of proactive site sensitivity work, conducted as part of Strategic Environmental Assessment (SEA) processes for the zones, as well as on the sensitivity of transmission and gas-pipeline corridors, undertaken over a two-and-a-half-year period from 2016 to 2019 (Creamer, 2021).

Figure 7 is a map of all the REDZs in South Africa for Phase 1 and 2.

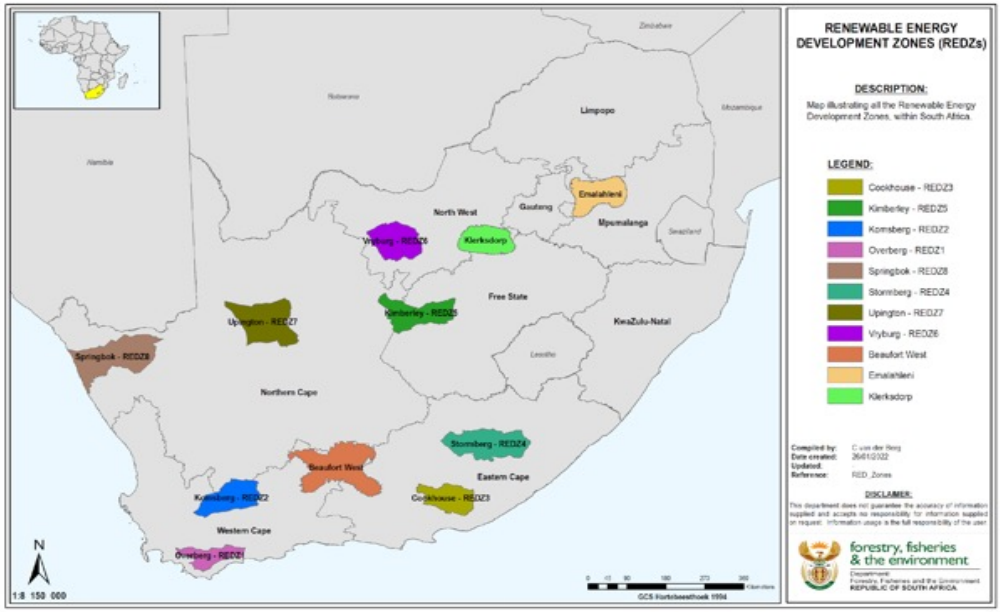

Figure 7. REDZs map for Phase 1 and 2 (Source: DFFE)


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3.

EMERGING OPPORTUNITIES, DRIVERS AND BARRIERS

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The evolving South African renewable energy and electric mobility sectors, combined with the green economy potential and Just Transition focus in Mpumalanga, creates unique opportunities. The opportunities in this section are relevant for institutional investors, financiers, project developers, component manufacturers, and suppliers in the Mpumalanga region.

The following emerging opportunities have been identified through engagement with an array of green economy stakeholders in the province:

- Public offtake of renewable energy generation
- Private offtake of renewable energy generation
- Energy storage
- Electric mobility

Each opportunity, and the relevant sub-opportunities, are outlined in detail below, with market size, term, trends and barriers provided for each. The combined value of these opportunities is R96.73 billion. Table 5 summarises the estimated market size for Mpumalanga's combined renewable energy and electric mobility sectors.

Table 5. Emerging opportunities market size estimates

Emerging opportunity	Sub-opportunities	Estimated market value
Public offtake of renewable energy generation	• Renewable Energy Independent Power Producer Procurement Programme. • Municipal power procurement.	R42 billion
Private offtake of renewable energy generation	• Increased uptake of rooftop solar PV. • Increased uptake of ground mounted solar PV. • Biofuels.	R24.3 billion
Energy storage	Commercial & Industrial (C&I) battery storage.	R2 billion
Electric mobility	• Public transport electrification. • Electric vehicles in mining. • Electric safari game viewer vehicles.	R28.43 billion
Total estimated market size for the renewable energy and electric mobility sectors in Mpumalanga		**R96.73 billion**

3.1.

Public offtake of renewable energy generation

This opportunity falls under the public procurement process by the state and local municipalities. South Africa's above-inflation electricity price rises; national energy insecurity; decreasing technology costs; supportive policies, regulations, and tariffs; and well-adapted finance options have all played an important role in driving the growth of the renewable energy market. As a result, several opportunities have been identified as outlined below

3.1.1. Renewable Energy Independent Power Producer Procurement Programme

Under the IRP 2019, approximately 26GW of renewable energy will be procured by 2030, of which almost 6.3GW has already been procured between BW1 to BW4 and 5.6GW already operational.

Mpumalanga currently has one project procured through REIPPPP, a 25MW biomass energy plant at Ngodwana Mill awarded in BW4. According to the latest IPPO report released in December 2021, the REIPPPP has resulted in R1.8 billion investment, R233 million in socio-economic developments[4] and 2 709 job years in Mpumalanga.

On 28 October 2021, 25 preferred bidders for BW5 were announced. The total capacity from these projects is 2 583MW, and the total project cost is projected at R50.1 billion. In addition, BW6 was launched and the deadline for submission of responses to the RFP was extended to 22 September 2022. This procurement round is expected to procure 5 200 MW (3 200MW from wind and 2 000 MW from solar PV), as the Presidency announced on 25 July 2022 in an official address.

BW4 and BW5 saw an increased interest in Mpumalanga as a location for bioenergy projects. Given the strong Just Transition focus in South African policy, the Eskom repowering and re-purposing plans, the declaration of Emalahleni as a REDZ, the viable wind and solar resources and the available grid capacity, it can be assumed that Mpumalanga will receive additional bids in future rounds of the REIPPPP.

Assuming that 10%-15% of the remaining IRP wind and solar allocation (2025 – 2030) is located in Mpumalanga, there is a potential of ~2GW of public market for REIPPPP projects in Mpumalanga by 2030. This equates to an estimated market size of ~R38 billion[5], assuming all 2GW is solar and prices remain constant.

Table 6 below outlines the drivers and barriers to this opportunity.

[4] SED is used to ensure that the build programme secures sustainable value for the country and enables local communities to benefit directly from the investments attracted into the area.

[5] Price from the most recent bid window of South Africa's REIPPPP puts the capital costs used for wind and solar PV at R18 847/kW and R16 555/kW respectively for large-scale and R12 000/kW for small scale.

Table 6. Key drivers and barriers for utility-scale renewable energy under the REIPPPP

Key drivers	Barriers
• Renewable Energy Independent Power Producer Procurement Programme (REIPPPP). • Upto 2.6GW expected to be allocated to Mpumalanga under REIPPPP by 2030. • 6.5GW available grid capacity in Mpumalanga. • The decreasing cost of large-scale renewable energy. • South Africa's climate change emission reduction targets. • Emalahleni REDZ.	• Delay in the process to obtain consent for above ground development on areas with mining rights due to delays in the process of obtaining Ministerial approval in line with section 53[6] of the Mineral and Petroleum Resources Development Act, 28 of 2002. • Perceived lower irradiation and wind resources than other provinces in the country.

3.1.2. Municipal power procurement (embedded generation)

Municipalities are exploring investment opportunities in solar PV for their office buildings and wastewater facilities. Mobilisation of the private sector through the District Development Model across the three district municipalities in Mpumalanga to support local municipalities in addressing infrastructure challenges is a top priority.

Municipal building stock can account for as much as 10% – 15% of electricity consumed in municipal operations and projects, hence an intervention that impacts buildings' energy consumption would have a noticeable effect on total electricity consumption.

Across the 17 local municipalities, with an estimated building stock of ~2 500 municipal-owned buildings and facilities and an average installation size of 100kWp, a market of up to 250MWp or ~R3 billion is possible in the province.

The treatment of wastewater is an energy-intensive process. Wastewater treatment and pumping is usually the largest single consumer of (electrical) energy for a municipality, ranging from 30% – 60% of total consumption[7], depending on the size of the municipality and the complexity of the infrastructure in the urban area. Therefore, optimising energy use in wastewater treatment works (WWTWs) is important to reduce municipal energy consumption and costs.

Rising electricity costs and the need to use resources prudently have compelled municipalities to review their electricity usage. Hence, the optimisation of water and energy use at WWTWs could play an important role in municipalities' financial and environmental sustainability.

The Mpumalanga Province has a total of 91 WWT plants (not all are operational) (CoGTA, 2022):

- Gert Sibande District has 29.
- Nkangala District has 24.
- Ehlanzeni district has 24.
- 14 WWTWs are owned by the National Department of Public Works and Infrastructure.

Mpumalanga mainly has small and medium size plants (small size plants 0.5-2Ml/day and medium size plants 2-10Ml/day). In wastewater treatment plants with a flow rate below 20Ml/day, a 500kWp – 1MWp solar PV (with storage) can be the only source of renewable energy, producing up to 100% of the energy demand of these plants. Solar PV can be installed in hybrid configurations with anaerobic digestion in larger plants.

By installing an average of 1MW per WWTWs across the 17 municipalities in Mpumalanga, the market size is estimated to be ~91MW and worth ~R1 billion in the medium to long term.

[6] Section 53 relates to the consent that is needed for above ground development on areas with underground mining rights to install anything. This is needed for the project to be bankable.

[7] Based on figures derived from the Western Cape Energy Consumption and CO2 Emissions Database Report

In both cases, installing solar PV systems can result in a positive return on investment. There are a number of funding opportunities that municipalities can apply for funding to install these solar systems on buildings or WWTW. Table 7 below outlines the drivers and barriers to this opportunity.

Table 7. Key drivers and barriers to embedded generation in municipalities

Key drivers	Barriers
• The decreasing cost of large-scale renewable energy. • Rising electricity costs. • Localized power generation increases energy security. • Increased load shedding expected up until 2025.	Some municipalities may not be creditworthy, pose a risk of non-payment and nine of the WWTWs are critical/non-compliant and require intervention.

Re-purposing and re-powering of Eskom coal-fired power plants and mines

Eskom is set to decommission up to 11GW of coal fired generation by 2030. The extent of the planned decommissioning will provide space for an entirely different energy mix, focusing on incremental capacity addition (modular) and flexible technology to complement the existing installed large scale base load capacity.

There are plans to re-purpose and re-power coal power plants. About 80% of the total production of coal in South Africa is undertaken in Mpumalanga. Consequently, most of Eskom's coal-fired plants are also located in the province. This decommissioning process presents an opportunity for re-purposing and re-powering of coal-fired power plants and the adjacent land. This will drive the uptake of renewable energy projects in the province.

In April 2022, Eskom issued out tenders for leasing some of its land that will be used to develop renewable energy projects. Eskom was targeting between 1 000 – 5 000MW of renewable energy capacity from the country's coal belt, where coal-fired power stations will eventually be retired. In June 2022 Eskom announced that it had selected 18 companies to lease land to develop renewable energy projects amounting to 1 800MW of additional capacity. The projects are capped at 100MW, which means they will not require a licence as provided for in the amendments to the Electricity Regulation Act, gazetted last year (albeit that this cap was lifted by the President in July 2022). These bids will cover 4 000ha of land, out of a total 36 000ha available. The regulations allow for wheeling charges to apply for the feeding of power on the grid for sale to a third party.

The re-purposing and re-powering of coal-fired power plants is a medium to longer term opportunity based on the scheduled decommissioning plans which are not yet concluded, albeit that plans are well advanced for two/three of the plants (Komati, Hendrina, and Grootvlei) that are due to come offline this year according the IRP 2019.

3.2.

Private offtake of renewable energy generation

The key drivers for renewable energy cited earlier, namely South Africa's above-inflation electricity price rises; national energy insecurity; decreasing technology costs; supportive policies, regulations, and tariffs; and well-adapted finance options have all played an important role in driving the private renewable energy market growth in particular.

The offtake of renewable energy generation by the private sector is dominated by solar PV. This is due to the competitive price, technical maturity, and ease of implementation of this technology.

The markets are mainly the farming, mining, heavy industry, and tourism sectors. Additional market services like smart metering, innovation engineering, design and project services are expected to grow as this market opportunity expands.

3.2.1. Increased uptake of rooftop solar PV

The private sector demand for renewable energy is largely driven by price and supply security. Currently, this market is dominated by rooftop solar PV

The national embedded generation market for installations, operation and maintenance of rooftop solar PV has been identified as an important part of the country's immediate efforts toward energy security.

In November 2020 Mpumalanga had registered ~25 – 30MW[8] of rooftop solar PV projects, according to a South African Local Government Association (SALGA) report in 2020 (SALGA, 2020). This figure only covers registered solar systems in 6 municipalities with SSEG registration procedures. More solar systems are being installed in other municipalities and by Eskom clients that are not yet accounted for. The current installed capacity in the province as of 2022 is estimated to be 80MW (~R960 million). A breakdown by market segment is provided in Figure 8.

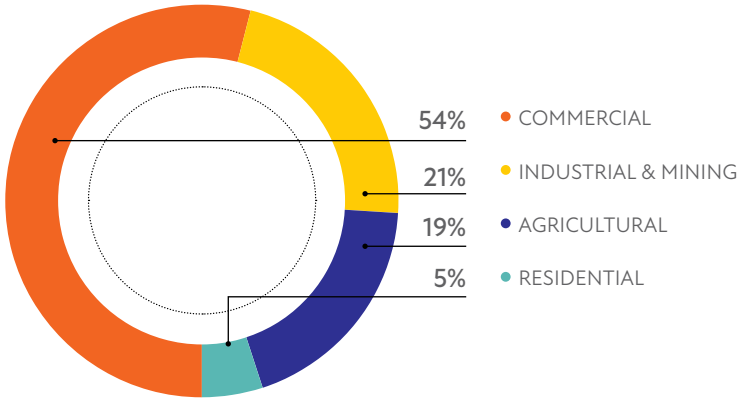

Figure 8. Sector breakdown – Rooftop solar PV in Mpumalanga (Source: GreenCape analysis)

This market is expected to grow by ~40MW/year of rooftop PV projects (mostly between 500kWp – 1MWp) in the agriculture, commercial, industrial and mining sectors up to 2030. This presents a possible market size of R3.2 billion by 2030.

The industrial and commercial sector is expected to be a leading contributor to growth in this segment as corporates engage in long-term decarbonisation pathways to "green" existing industries with on-site generation as a key part of the early journey. Table 8 below outlines the drivers and barriers to this opportunity.

[8] Municipalities in Gauteng have an estimated 129MW and Western Cape has 64.3MW of SSEG systems.

Table 8. Key drivers and barriers to rooftop solar PV

Key drivers	Barriers
• Rising electricity costs. • Falling costs of renewable energy technologies. • Continued load shedding up to 2025. • Supportive energy policies and regulations by the local and national government.	• Only 6 out of 17 municipalities have defined SSEG procedures in Mpumalanga. • The municipal installation approval process takes at least four months. • Misalignment of local SSEG to national SSEG framework as some municipalities have different standards of approval.

To date, few market players have been developing solar PV projects in Mpumalanga. Market growth potential is linked to the ability of local municipalities to allow grid access and pay a basic feed-in tariff or allow wheeling. Mpumalanga municipalities capable of driving and leading the solar PV market are Mbombela, Msukaligwa, Emalahleni, Steve Tshwete, Thaba Chewu and Govan Mbeki, as they have some form of SSEG procedures in place. See Table 9 for more detail.

Table 9. List of municipalities in Mpumalanga allowing SSEG to connect to the grid

Municipality	Allow SSEG onto the network	Have an official SSEG application process?	Have a NERSA-approved SSEG tariff?
Emalahleni	Yes	Yes	Yes
Govan Mbeki	Yes	Yes	Yes
Mbombela	Yes	Yes	Yes
Msukaligwa	Yes	Yes	No
Steve Tshwete	Yes	Yes	No
Thaba Chewu	Yes	Yes	No

3.2.2. Increased uptake of ground mounted solar PV

The DMRE has gazetted the amendment to Schedule 2 of the Electricity Regulation Act, enabling private entities to generate up to 100MW of "distributed" or self-generated electricity without a licence[9]. Albeit that this cap was lifted by the President in July 2022 and the country awaits the DMRE to update the Electricity Regulation Act. This is a welcome development for large power users in the province, including industrial and mining companies who now have the opportunity to generate electricity or purchase electricity from IPPs on a larger scale.

The 2021 amendment included the following breakdown:

- Systems of up to 100kW – No registration with The National Energy Regulator of South Africa (NERSA) needed, no generation licence needed, approval required from the distribution utility (either Eskom or a municipality).
- Systems from 101kW to 100MW – must be registered with NERSA; no generation licence needed, approval required from the distribution utility (either Eskom or a municipality).
- Systems greater than 100MW – must be registered with NERSA; no generation licence needed approval required from the distribution utility (either Eskom or a municipality), at the time of writing.

The new provisions aim to unlock significant investment in new generation capacity in the short to medium term and help the country reduce the impact of load shedding. In addition, this move aims to help the private sector build large-scale wind and solar plants outside the REIPPPP.

This regulation change has removed barriers facing independent power producers in getting project approvals and accessing additional offtake opportunities (through, for example, electricity wheeling and trading). Energy intensive users, including mines in Mpumalanga, can now generate power without a licence behind the meter and access or sell electricity through wheeling via the Eskom grid or where wheeling mechanisms are established on the Mbombela municipal grid.

This market is expected to grow by ~250MW/year in Mpumalanga in the short to medium term to ~2GW (2030), representing a possible market size of R21.1 billion. However, this could grow more rapidly with mining companies committed to building 4GW of renewable energy nationally to support The Just Energy Transition valued at R65 billion (Government, 2022).

So far this year, the National Energy Regulator of South Africa (Nersa) has registered 295 MW of 73 projects for mining companies applied for (Weekly, 2022) albeit that not all of this will infrastructure will be in Mpumalanga. **Table 10** below outlines the drivers and barriers to this opportunity.

[9] Noted that the revised Schedule 2 has no implications for how distribution utilities process grid-connected applications (e.g. the NRS097-2-3 is still used as normal, and grid studies are still required for SSEG over 350kVA)

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Table 10. Drivers and barriers of ground mounted solar PV

Key drivers	Barriers
• Rising electricity costs. • Falling costs of renewable energy technologies. • Continued load shedding up to 2025. • Mining companies commitment to renewable energy in the province. • Cap on license free generation for own use removed. • Available Eskom land and proximity to connection points at power stations.	• Backlog of 4 500 outstanding mining and prospecting licences at the department of mineral resources & energy poses a barriers as project developers are unable to deliver their projects in time. • Only Eskom and Mbombela Municipality have wheeling and energy trading regulations in the province. • Municipalities framework currently regulates up to 1MW, and they have yet to update application procedures for plants larger than 1MW.

3.2.3. Biofuels

Like other developing countries, South Africa recognises that first-generation (crop-based) biofuels particularly sugar, can reinvigorate the declining agricultural sector. The biofuels industry could play a critical role in South Africa's transport sector as it reduces the country's dependence on imported oil. This move improves South Africa's national energy security, reduces the trade deficit and gives the government more ability to curb fuel price increases.

At the same time, biofuel production boosts the SA's economy by creating jobs, generating tax revenue and increasing the nation's GDP.

On 13 December 2019 Cabinet approved the draft mandatory blending regulations. These regulations require licensed manufacturers and wholesalers of petroleum products to buy and blend locally produced bioethanol and biodiesel at a minimum of 2% of their petrol and 5% of their diesel.

This can create some certainty for the demand for biofuels in South Africa. Based on the total national fuel pool of over 23 billion litres per annum, at a penetration rate of 2% and 5% for petrol and diesel respectively through mandatory blending, this translated to a biofuels demand of at least 840 million litres per annum nationally. Mpumalanga has a 30% market share of sugar production and can potentially supply 252 million litres per annum valued at an estimated R2.77 billion assuming an average price of R11/litre. This is a medium to long term opportunity.

Mpumalanga and Kwa-Zulu Natal (KZN) are expected to receive their share of this opportunity to produce biofuel due to substantial amounts of sugar cane, sweet sorghum cultivation, corn and oil-bearing crops such as groundnuts and sunflower being grown in these provinces. Table 11 provides a breakdown of the drivers and barriers for this opportunity

Table 11. Key drivers and barriers for biofuels

Key drivers	Barriers
• Localised liquid fuel generation increases energy security for South Africa. • South African Biofuels Regulatory Framework 2019. • South African Sugarcane Value Chain Master Plan to 2030. • Resource availability in Mpumalanga. • 30% higher yield per hectare in Mpumalanga Sugar Industry compared to KwaZulu Natal.	Lack of clear policy implementation and support from the national government on the implementation of the Biofuels Regulation.

Mpumalanga Bio-Energy Cluster is an initiative of the Mpumalanga Department of Economic Development and Tourism and was established in 2012. The Cluster's objectives are:

- To create a common vision amongst the cluster members regarding the implementation of bio-energy in Mpumalanga Province,
- To provide guidance, play an advisory role & provide leadership in driving the sector in the Province (through its Cluster Committee)
- Share expertise and knowledge that will assist in the implementing of this sector

Mpumalanga Bio-Energy resources are dominated by biomass, municipality solid waste (MSW), bioethanol and biodiesel and the Cluster is there to ensure the potential market is converted into a reality.

3.3.

Energy storage

The continued growth in the renewable energy market combined with more than 10 years of load shedding has led households, businesses and farmers to explore alternative means of energy security and resilience. According to the CSIR'ssStatistics of utility-scale power generation in South Africa, 2021 overtook 2020 as the most intensive load shedding year yet, based on the upper limit of power lost, with 2 521GWh. This is a 40% increase compared to the upper limit last in 2020 (1 798GWh).

The number of hours spent loadshedding has also seen an increase, jumping to 1 169 hours in 2021 compared to 859 in 2020.

Eskom continues to report a declining Energy Availability Factor (EAF). This is the percentage of maximum energy generation that the utility is capable of supplying to the electrical grid. The data points to a declining trend in 2021 to an average EAF of 61.8%. This downward trend, combined with unexpected outages, is making 2022 look like its going to be the worst year for load shedding in South Africa. According to the CSIR, Eskom had cut 2 276GWh of electricity in the first six months of 2022. That was more than 90% of the 2 521GWh it shed for the entire 2021.

On the back of this, continued loadshedding behind-the-meter battery storage has been identified as an opportunity in Mpumalanga.

3.3.1. Commercial & Industrial (C&I) battery storage

Developments such as battery storage options are the latest trends that will influence the private sector market in the short to medium term. Similar to the renewable energy market growth, growth in this space is driven by rising electricity costs, increased financial returns from storage investments, and a growing need for energy security.

As seen in Table 12, there are a few technologies making inroads in the South African market in the backup power and energy security market, with the more tried and tested battery technologies like Lithium Ion (Li-ion) being the preferred technology in backup technologies. Other storage technologies are available, but they do not have existing demonstration projects in South Africa compared to their direct competitors. The most promising short-duration application (<4hrs) is Li-ion batteries in the agricultural and industrial sectors

Table 12. Energy storage technologies in the South African market

Technology	Use case	Key benefits	Current barriers	Cost ranges R/kWh
Lithium-ion (Li-ion)	UPS, backup power, utility-scale storage.	Low maintenance, high energy density, has a very prominent presence in the market, constantly evolving and improving.	Transport limitations, ever-evolving chemical combinations and improvements, high cost.	R4 000 – R10 000
Vanadium redox flow battery	Backup power, utility-scale storage.	A very high depth of discharge has an almost unlimited storage potential (the size of the electrolyte tanks can be increased).	Market entry.	Ranges omitted due to limited market penetration.
Super capacitors	UPS, backup power.	100% depth of discharge, unlimited charge and discharge, robust for travel. 45-year life expectancy.	10-year warranty on electronics. High self-discharge.	R10 000 – R15 000

Beyond a handful of private customers that have invested in battery technology to ensure energy security for their operations, the price is not yet right for behind-the-meter (BTM) applications. However, energy storage is expected to become the keystone of the future small-scale embedded generation (SSEG) market.

The potential market will depend on the growth of the solar PV market. The market size is expected to be up to 48MWh (R288 million) per year assuming an average of R6 000/kWh installed price in commercial applications. This estimate assumes that 30% of all rooftop solar PV (40MW) will have at least 4 hour storage. By 2030 the possible market demand for behind-the-meter could be ~336MWh (R2 billion). Table 13 provides a breakdown of the key drivers and barriers to this opportunity.

Table 13. Key drivers and barriers to commercial and industrial (C&I) battery storage

Key drivers	Barriers
• Technology cost per kWh has been dropping year on year. • Increased financial returns from storage investments. • Batteries provide energy security during load shedding. • The stacked benefit of time-of-use tariff management and demand charge reduction.	• Upfront cost per kWh is still relatively higher than conventional sources of emergency power.

Green Hydrogen

The green hydrogen market presents a possible green economy investment opportunity over the next 10 – 15 years. There is a developing consensus from COP26 and the oil and gas industry that green hydrogen will play a pivotal role in the Just Energy Transition. The current levelised delivered cost for green hydrogen is ~$8/kg which is roughly equivalent to an oil price of $900/bbl, the most viable options with good business cases include the following applications:

- Ammonia for fertilizer
- Hydrogenation
- Hydrocracking
- Desulphurisation

Hydrogen as a fuel source is a developing market with some applications being ready for market in the immediate term as listed above. There is a long term opportunity in Mpumalanga with a market size potential that is yet to be determined so it has not been included as an opportunity as yet.

3.4.

Electric mobility

The momentum for electric mobility has increased globally. This global shift has been primarily driven by national emission reduction commitments from the Paris Agreement on climate change, growing urban air pollution concerns, and continued crude oil price volatility.

It is expected that the South African market can follow a similar trajectory. However, the market currently remains small. Public transport electrification, EVs in eco tourism and EVs for underground mining have been identified as opportunities in this sector in Mpumalanga.

3.4.1. Public transport electrification

According to the National Household Travel Survey (NHTS) conducted in 2020 in South Africa, buses (2.1 million households) and minibus taxis (11.4 million households) represent the most dominant forms of public transport. These two sectors also represent the best business case for public transport electrification.

3.4.1.1. Buses

The public bus industry presents the best business case for electrification in South Africa. Mpumalanga has the second highest number of buses in South Africa, after Gauteng (eNATIS, 2022). Bus companies in Mpumalanga are expected to be looking at replacing a portion of their estimated 8 287 diesel-powered buses with electric buses in stages in the medium term. The bus companies replace 10% of their fleet every year, and there is an opportunity to procure electric buses to replace the internal combustion engine (ICE) buses.

This presents an initial annual market of up to 800 buses annually. This presents a potential market of ~R24 billion to replace 2 400 buses by the end of 2030 if bus companies order an average of 400 electric buses from 2025, assuming a cost of ~R10m for an electric bus (Nunno, 2018).

3.4.1.2. Minibus taxis

Electric Powered Vehicles Africa (EPVA) converted an ICE minibus taxi[10] to electric for a private game reserve in Mpumalanga. The driving factor for this market shift was to shield the game reserve from rising fuel costs by converting the vehicle to electric and charging the vehicle with sustainable energy. According to eNatis, there are approximately 26 599 registered minibus taxis in Mpumalanga, representing the potential market size for electric minibus taxi conversions. Assuming a 5% – 10% penetration rate, this means the market size is between 1 300 – 2 700 minibus taxis in the medium to long term. Assuming a cost of R1.5m for an electric minibus (15 seaters) represents a possible market size of R3 billion if 2 000 taxis are electric by 2030. Table 14 provides a breakdown of the drivers and barriers to this opportunity.

[10] The standard Toyota Hiace Ses'fikile model which is the most common ICE minibus taxi model that is used for informal public transport in Mpumalanga.

Table 14. Key drivers and barriers to public transport electrification

Key drivers	Barriers
• Rising fuel costs have increased operational expenditure for public transport operators, which has resulted in passenger fare increases, resulting in the need for cost savings initiatives. • Reduced operation and maintenance costs across bus/minibus fleets over internal combustion engine (ICE) technology. • Reduction in lithium battery prices. • Defunding of liquid-based fuels as refineries are closing down. • Growth of the local manufacture of electric buses. • SA Green Transport Strategy. • Ability to charge using DC solar power that coincides with off-peak travel times when the buses are idle.	• Limited electric vehicle finance. • Absence of supporting infrastructures like charging stations and maintenance stations. • High upfront investment costs of the technology.

3.4.2. Electric vehicles in mining

Mpumalanga accounts for 83% of South Africa's coal production. Current major mining projects in Mpumalanga include 68 coal, 19 industrial, 14 platinum group metals, 13 gold, 5 nickel, 3 ironore and 1 chrome.

There is a long-term opportunity for battery-powered EVs and machinery in underground and opencast mining in Mpumalanga. The 122 heavy mining operations in Mpumalanga and a potential 610 ICE vehicles and machinery could be replaced with EVs. At a 30% replacement rate/market penetration, the EV market opportunity is an estimated ~R1.23 billion in the medium to long term at an average of $400 000/EV truck.

The billion rand market opportunity in underground mining is driven by the high costs of ventilation for clean air underground and temperature regulation. These costs are closely linked to using ICE vehicles and machinery. Compared to ICE applications, electric mining equipment/vehicles produce no fine particular matter (PM2.5) from diesel and other tailpipe emissions, necessitating less ventilation, lower costs, and safeguarding the health of miners. Additionally, EV mining equipment produces less heat because of the higher efficiency of converting mechanical energy from electricity than from diesel. Table 15 provides a breakdown of the key drivers and barriers to this opportunity.

In May 2022, Anglo American unveiled a 2MW hydrogen battery hybrid truck designed to operate in everyday mining conditions with each of the trucks having a capacity to carry up to 315 tons of ore each.

Anglo American plans to replace the company's 40 diesel-powered fleet with green hydrogen systems, reducing emissions and ensuring that eight of the company's mines in Limpopo and Mpumalanga reach carbon neutrality by 2030.

Solar power will be utilised by a hydrogen electrolyser to provide hydrogen fuel.

Table 15. Key drivers and barriers to EVs in underground mining

Key drivers	Barriers
• Push for sustainable underground mining transportation with lower emissions, higher efficiency and lower heating. • High cost of underground mining ventilation. • The high price of underground mining heat regulation. • Health and safety concerns. • Increasing combustion fuel costs.	• High upfront investment costs of the technology. • Limited local technical support as the technology is still new in the country and province.

President Ramaphosa is pictured at the unveiling of the hydrogen powered mining truck by Anglo American. Jairus Mmutle, GCIS

3.4.3. Electric safari game viewer vehicles

Mpumalanga is a tourism hub for South Africa. In addition, Mpumalanga has seen a growth in recent years of the electric safari game viewing vehicles. This is driven by the need to reduce the cost of fuel consumption, but also to reduce noise pollution. This, combined with the growing demand from eco-tourism and pressure to decarbonise the tourism sector, has created a unique local opportunity.

The manufacturing or retrofitting of electric safari game viewer vehicles is an investment opportunity in Mpumalanga. There are two suppliers in the country servicing the Mpumalanga market. These are EPVA, which has retrofitted 12 units so far and Thula Solutions, which has an estimated 180 units in the country, mainly in the Mpumalanga and Limpopo regions.

This represents a growing market for electric vehicle conversions in Mpumalanga due to the proximity to private game reserves and other tourist safari attractions such as the Kruger National Park. There are an estimated 50 safari and game viewing facilities in Mpumalanga, and an estimated 100 – 200 vehicles will be required in the short to long term. Assuming a unit cost of ~R2 million per vehicle, this represents a potential market of R200 million. Table 16 provides a breakdown of the drivers and barriers to this opportunity.

Table 16. Key drivers and barriers to electric safari game viewer vehicles

Key drivers	Barriers
• Rising fuel costs. • Falling cost of alternatives. • Ecotourism campaigns. • Reduced environmental and noise pollution.	• Lack of financial incentives to purchase EVs. • High upfront costs.

Retrofitted electric safari vehicle built and maintained by Electric Power Vehicle Africa in Mbombela. Source: EPVA

4.

FUNDING AND INCENTIVES


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South Africa ranks as one of the top 15 nations in the world in terms of driving the green growth agenda (ahead of Australia, Singapore, and Finland). This drive is on the back of a range of funding solutions and tax incentives available to green technology manufacturers and service companies, as well as those who use or procure such goods and services.

The South African Climate Finance Landscape looks at detailed project-level data, understanding in detail the source, disbursement, instrument and use. The insights can support public and private role-players with information to shape sectoral strategies and selected policies and improve coherence and coordination between public and private level spending in the sectors. The South African Climate Finance Landscape has tracked R62.2 billion in annual climate finance invested in SA. Find out more **here**.

General database web page
The GreenCape Finance Desk hosts a web page with a number of Green Finance resources that cover funding and incentives available to companies operating in the green economy.
A few of the available database are highlighted below.

The Green Finance Desk (GFD) primarily acts as a facilitator in the financing of green projects and green business. The GFD works across all sector desks at GreenCape. For more support please contact jack@greencape.co.za

Green Finance Database

GreenCape maintains a database of funding sources and incentives that may be relevant to green economy investors. The database contains information on more than 150 funding opportunities, including an overview of the opportunity and relevant contact details and links. It is ideal for any entity seeking a broad range of funding solutions and financial incentives, with South African institutions being the main source of opportunities. The database is available to view and download online[11].

Government funding and incentives database

An updated document focused on South African government funding and incentives is available to view and download online[12]. These incentives cover local manufacturing, critical infrastructure grants, small enterprise development and a diverse set of sector specific incentives (i.e. Aquaculture Development and Enhancement Programme).

Finfind database

Finfind[13] is an innovative online finance solution that brings together SMME finance providers and finance seekers. With a focus on finance readiness, Finfind has more than 200 lenders and over 350 loan products available to SMEs. The database is ideal for South African SMMEs who are seeking funding and/or business advisory services, and those who want to improve their understanding of finance.

AlliedCrowds database

AlliedCrowds[14] is the first complete aggregator and directory of alternative finance providers in the developing world.

Sign-up is free and allows users to access a global database where one can filter for sector (including greentech, agriculture and social impact), type of capital (equity, lending, grant), and type of funding (crowdfunding, angel investing, venture capital, impact investing). In addition:

- Themed databases around the Sustainable Development Goals (SDGs) and the World Green Economy Organisation (WGEO) are available.
- Reports, including a number specifically about African funding sources, can also be downloaded for free.
- Businesses / organisations can also contact Allied Crowds to create a customised funding database. This resource is ideal for any entity seeking a broad range of financial solutions on a global scale.

[11] https://www.green-cape.co.za/content/focusarea/green-finance-databases
[12] https://www.greencape.co.za/assets/Uploads/Government-Funding-and-Incentive-Booklet.pdf
[13] https://www.finfindeasy.co.za/
[14] https://alliedcrowds.com/

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5.

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