

Status of **Embedded Generation** in South African Municipalities

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Abbreviations

AC	Alternating Current
BESF	Battery Energy Storage Code
CoC	Certificates of Compliance
DC	Direct Current
ECSA	Engineering Council of South Africa
EG	Embedded Generator
ERA	Electricity Regulation Act
IPP	Independent Power Producers
MFMA	Municipal Finance Management Act
NECOM	National Energy Crisis Committee
NERSA	National Energy Regulator of South Africa
PV	Photovoltaic
RPP	Renewable Power Plants Code
SAPVIA	South African Photovoltaic Industry Association
SSEG	Small-scale Embedded Generator



1. Introduction

South Africa's energy transition is well underway, with decentralised electricity generation becoming increasingly competitive. The country's regulatory framework has been amended to allow customers to more easily install behind-the-meter generation to offset their grid electricity needs. These Embedded Generators (EG) are connected to the customers wiring and are thus 'embedded' in, and synchronized with, the distribution network. Most EG is in the form of solar photovoltaics (PV); a low-carbon energy source, which supports South Africa's climate change mitigation and green economy policy objectives.

EG installations on South African distribution networks are accelerating (for both municipal distributors and Eskom distribution), driven by increasing electricity tariffs and system reliability concerns (load shedding), combined with steadily decreasing solar PV technology costs. Given the uptake of EG, this power source has been earmarked to play a pivotal role in alleviating the current energy crisis¹. An update to the Presidency's 2022 Energy Action Plan to end loadshedding and achieve energy security described five key interventions, two of which are directly related to EG²:

Intervention 2: Enable and accelerate private investment in generation capacity.

Intervention 4: Unleash businesses and households to invest in rooftop solar.

The Presidency's National Energy Crisis Committee (NECOM) has recognised the important role that municipal distributors will play in accelerating the connection of EG in distribution networks. NECOM has driven the development of a National Net Billing Framework which has subsequently been published by NERSA as draft Net Billing Rules³.

This report will provide an overview of the status of EG in South African municipal distribution networks and will include:

- An overview of key regulatory frameworks relevant to EG.
- A quantitative overview of EG uptake in South Africa.
- EG related challenges encountered in municipal distribution networks.
- A summary of assistance available to municipalities through the Municipal EG Support Programme.

¹ The draft 2023 IRP released by DMRE includes a large allocation of distributed (embedded) generation, indicating that it will be a significant contributor to the country's generation portfolio.

² Update on Energy Action Plan – January 2023: <https://www.thepresidency.gov.za/download/file/fid/2677>

³ Net Billing Framework: <https://www.nersa.org.za/wp-content/uploads/2023/04/Draft-net-billing-framework.pdf>

2. Key Regulatory Frameworks

This section provides a brief overview of the regulatory environment relevant to EG.

2.1. Electricity Regulation Act Schedule 2: Licensing Exemption and Registration

The **Electricity Regulation Act (ERA)** is a critical document in the regulation of the entire industry, including Embedded Generation. As reflected in the South African Grid Code, the **ERA** states that licensed Distributors have an obligation to allow access to generators wanting to connect to the network and may not refuse an EG facility connection, provided such access does not violate any technical and safety requirements as set out in the relevant Grid Codes, license conditions and tariff schedules. If the licensed Distributor is unable to provide access to the network at the point of connection applied for, it must provide reasons and advise the customer of alternative options available, which includes increasing the capacity of an existing connection or network strengthening.

The ERA's 2022 Schedule 2 amendments have been instrumental in enabling additional installed capacity – allowing larger system sizes to be installed more easily⁴. The amendments outline the specific conditions for registration and licensing with NERSA. According to the latest Schedule 2 the following registration and licensing exemptions exist for EG⁵:

- Exemption from NERSA **registration and licensing**:
 - o EG of any size which are primarily for self-consumption (not for wheeling/export)
 - o EG for wheeling/export up to 100kW
- Exemption from **licensing** but requiring NERSA registration:
 - o EG for wheeling/export over 100kW

The above guidelines apply whether the EG has storage or not.⁶

Although NERSA registration is a simpler and quicker process than NERSA licensing, there are still requirements to be complied with and the process can take several weeks or months.

2.2. Distribution Network Code

The Distribution Code sets out the basic rules for connecting to the Distribution system, ensuring that all users (including Embedded Generators) are treated in a non-discriminatory manner and that all technical requirements are specified to ensure the safety and reliability of the Distribution network.

According to paragraph 4(2) of the Distribution Code⁷, each distributor is required to make available to customers a '**Customer Connection Information Guide**' which shall cover as a minimum:

- The process to follow when applying for supply at the specific Distributor,
- Information requirements of the Distributor from the customer to enable an appropriate connection; and
- The process and related timeframes which follow the application.

Paragraph 4.4 of the Distribution Code states that the Generator/Customer must enter into a Connection Agreement with the licensed Distributor before any actual connection to the distribution system can take place. This will require that Generators/Customers comply with all municipal distributor requirements, including application and assessment processes. This also implies that, amongst other activities, appropriate grid studies may need to be done to ascertain whether Customers, including Generators, can be connected.

⁴ First released on 15 December 2022 with a re-release on 17 January 2023 with a minor correction. Available here: [Electricity Regulation Act: Amendment: Licensing Exemption and Registration Notice. Govt Gazette No 47877, 17 January 2023](#)

⁵ Note that the exemptions listed are based on meetings between SALGA and the Department of Minerals and Energy to clarify the interpretation of Schedule 2. The wording in Schedule 2 itself is not always clear, and other interpretations of the Schedule are possible. NERSA may issue clarifying statements.

⁶ Note: Although the regulations are not clear on licensing and registration of BESF, it is understood that stand-alone BESF should be treated as a generator and should comply with registration requirements based on their output in kW and self-consumption characteristics, as indicated above.

⁷ RSA Distribution Code: <https://www.nersa.org.za/wp-content/uploads/2021/08/RSA-Distribution-Network-Code-Ver-6.1.pdf>

2.3. Frameworks for EG Tariffs

While most EG systems are designed and built for self-consumption – to supply the electrical loads of the customer – there are times when excess energy is available. This excess energy represents an important opportunity to bring additional energy onto South Africa's constrained electricity grid. Municipalities should offer compensation for the exported energy in the form of an export tariff, sometimes also called net-billing.

Net Billing Rules

In April 2023, NERSA published draft Net Billing Guidelines for public comment.⁸ The objective of the guideline was to advise Distributors on how best to develop net-billing tariffs to compensate EG customers for feeding into the grid, and to set out the principles under which net billing tariffs could be developed. While the Net Billing Rules are yet to be finalized, most municipalities are implementing net billing in line with the draft guideline.

Removal of the net-consumer requirement

An important legal clarification has been made around the question of how much energy an EG customer is permitted to export. In the early years of municipal EG frameworks, municipalities required that EG customers remain 'net consumers' which meant they could only export as much energy (kWh) into the grid as they bought from the grid on a rolling 12-month period.

Recent legislative changes do not place an upper limit on the amount of energy an EG customer may export into the grid, and many municipalities have subsequently removed the net-consumer requirement. However, there remains an upper limit on EG exports which arises from the financial restrictions in the Municipal Finance Management Act (MFMA). EG customers may not export so much energy that the municipality 'owes' them money at the end of the financial year⁹. It should be noted that very few customers will find themselves exporting that volume of energy. EG export credits are typically around half the rate that customers pay for energy purchased from the municipality, so an EG customer would need to export at least double the amount of energy into the grid than what they purchase from the municipality for this situation to arise. Nonetheless, as a result of a special application it appears that the City of Cape Town recently obtained an exemption from National Treasury to pay customers cash for energy exported into the grid beyond the above MFMA limitations¹⁰.

2.4. Municipal Distributor Policies and By-Laws

Municipal Distributors have a duty to develop electricity services policies relating to the connection of generation to the distribution network, and to pass and implement by-laws with respect to their electricity distribution functions. The policy should highlight the municipality's requirements whilst the amended **Electricity By-Law** makes the policy enforceable¹¹.

Even if a given municipal Distributor does not have a policy document or by-law issued that governs the application process for EG, the Distributor does not have the right to simply refuse an application, but it should be dealt with in accordance with the Distribution Network Code, the Renewable Power Plants (RPP) Code, the Battery Energy Storage (BESF) Code and the ERA, as amended.

8 Proposed Net Billing Guideline: <https://www.nersa.org.za/wp-content/uploads/2023/04/Draft-net-billing-framework.pdf>

9 see <https://www.sseg.org.za/municipal-legal-framework-applicable-to-small-scale-embedded-generation/>

10 City of Cape Town media statement on the exemption: <https://www.capetown.gov.za/Media-and-news/Cash%20for%20power%20Cape%20Town%20gets%20Treasury%20exemption%20to%20pay%20businesses%20and%20residents%20directly>

11 see Municipal Legal Framework for Embedded Generation - <https://www.sseg.org.za/municipal-legal-framework-applicable-to-small-scale-embedded-generation/>

3. Municipal EG Progress

As electricity Distributors, municipalities have a critical role in enabling the connection of EG to distribution grids in a safe and legally sound manner. Municipalities have made steady progress towards becoming 'EG ready'. The key elements of a municipal EG process are detailed below, followed by a 2023 status update of municipal EG.

3.1. Elements of a Municipal EG Process

The key elements that a municipality needs to have in place to address EG can be divided into Institutional, Operational and Staffing categories, as outlined in Figure 1.



Figure 1: Elements required to address EG installations.

INSTITUTIONAL ELEMENTS

EG Policy: This specifies the distributor’s EG related requirements and the application process for connection.

EG By-Law: The municipal electricity by-law should be amended to make the EG policy legally enforceable.

It is important to have political buy-in. Since the above documents need to be brought before Council for approval, this provides the opportunity to motivate for ‘EG readiness’ and obtain the necessary political support.

OPERATIONAL ELEMENTS

EG Documentation: This includes the application form, technical requirements document, commissioning report, etc. These documents should be easily accessible to customers.

Metering and billing: To accept reverse feed, bi-directional meters should be installed by EG customers and the distributor's billing system should be updated to accommodate export energy.

EG Tariffs: Tariffs should compensate customers fairly for exporting to the grid while ensuring municipal fixed costs are covered.

STAFF ELEMENTS

Staff capacity: Central to EG progress is ensuring that staff are adequately capacitated to process EG applications. Inter-departmental buy-in is also required.

3.2. 2023 Municipal Progress

Municipalities have been making significant progress towards incorporating EG onto their networks. SALGA's 2023 survey monitored municipal readiness by assessing the number of municipalities that:

- Allow EG installations on their distribution networks (with or without a formal application process),
- Have established formal application processes for customers to get authorization to connect their systems to their distribution networks,
- Have approved EG tariffs, allowing them to credit customers for excess electricity exported onto their distribution networks.

The results of the survey showed that the number of municipal distributors allowing EG onto their networks has risen significantly from 10 in 2016 to 71 in 2023.

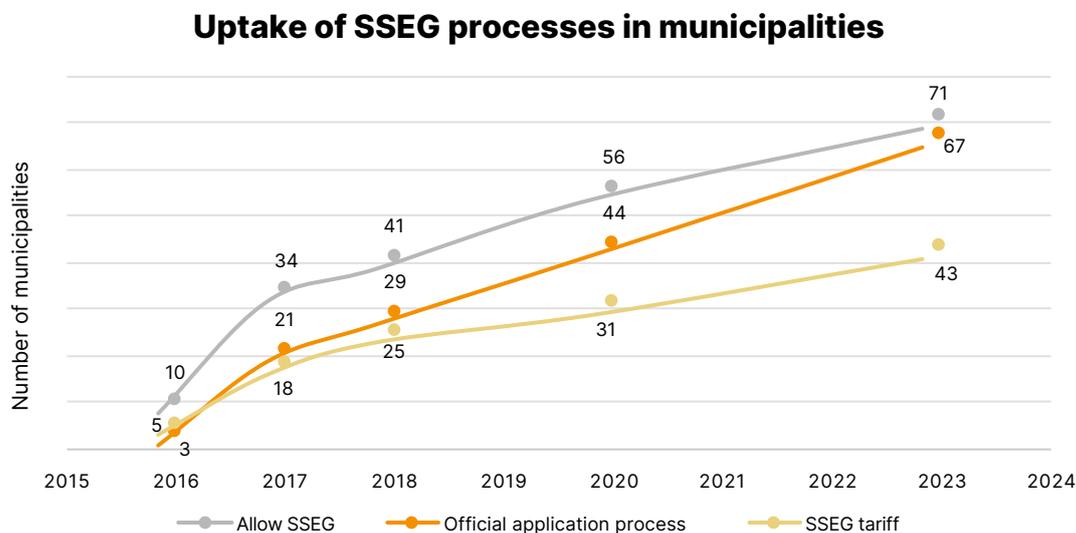


Figure 2: Overview of SSEG processes in Municipal Distributors

Of the 71 municipalities that allow EG connection, 67 municipalities have developed official application processes that allow customers to get authorisations for the installations. 43 municipalities had EG tariffs in their tariff books (formerly approved by NERSA and now only needing council approval). Numbers of municipalities with EG tariffs tend to lag those allowing EG, partly because of uncertainties regarding the NERSA application and approval processes, the unfamiliarity of asking councils to approve export tariffs, as well as internal municipal revenue concerns and billing system integration issues.

Despite this, many municipalities have developed generous export credits for EG customers, with tariffs ranging from 32c/kWh to 130c/kWh (Average of 86.9 c/kWh).

Municipal Export Credits 2022/23

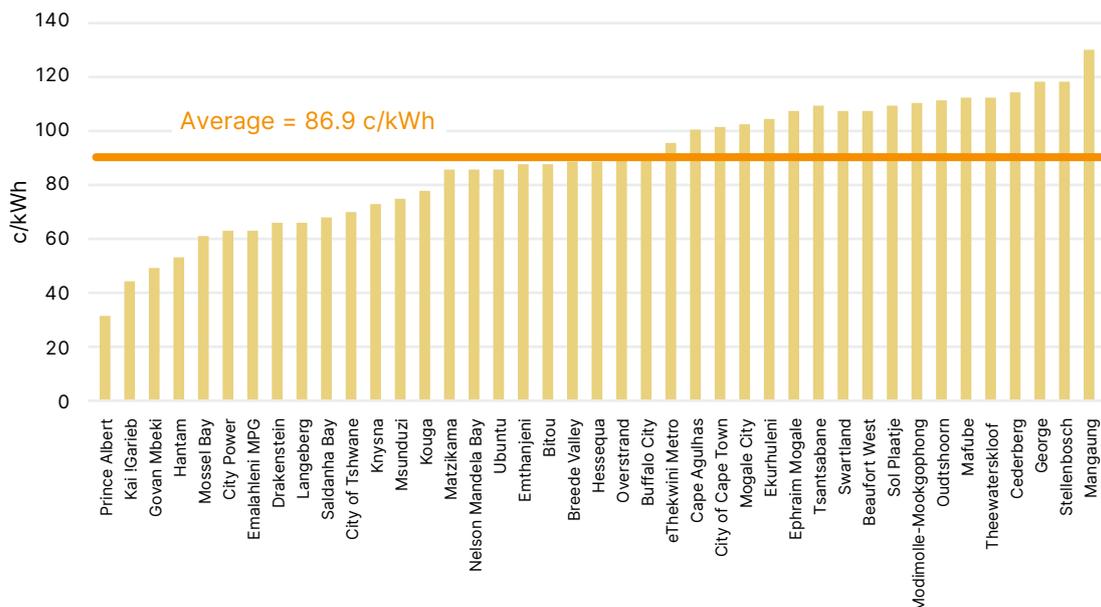


Figure 3: Municipal Export Credits for 2022/23¹²

Whilst significant progress has been made by many municipalities since 2020, concerted efforts are still needed to ensure that more municipal distributors are able to accommodate EG. According to the SALGA survey, only 43% of a total of 165 municipal distributors allow EG onto their network¹³, 41% have official application processes and 26% have approved EG tariffs.

Table 1: Municipal Distributors EG Process Status

	Municipalities allowing EG installations		Municipalities with official application processes		Municipalities with EG tariffs	
	2020	2023	2020	2023	2020	2023
Number of licensed municipal distributors	56	71	44	67	31	43
% of licensed municipal distributors	34%	43%*	27%	41%*	19%	26%

* - Although representing a low proportion of municipalities, they cover most of total municipal electricity demand and population.



¹² Export tariffs sourced from NERSA's 2022/23 Tariff Publication and Municipal Tariff books; Tsantsabane and Tshwane tariffs are from 2023/24
¹³ Although representing a low proportion of municipalities, these municipalities cover most of municipal electricity demand and population.

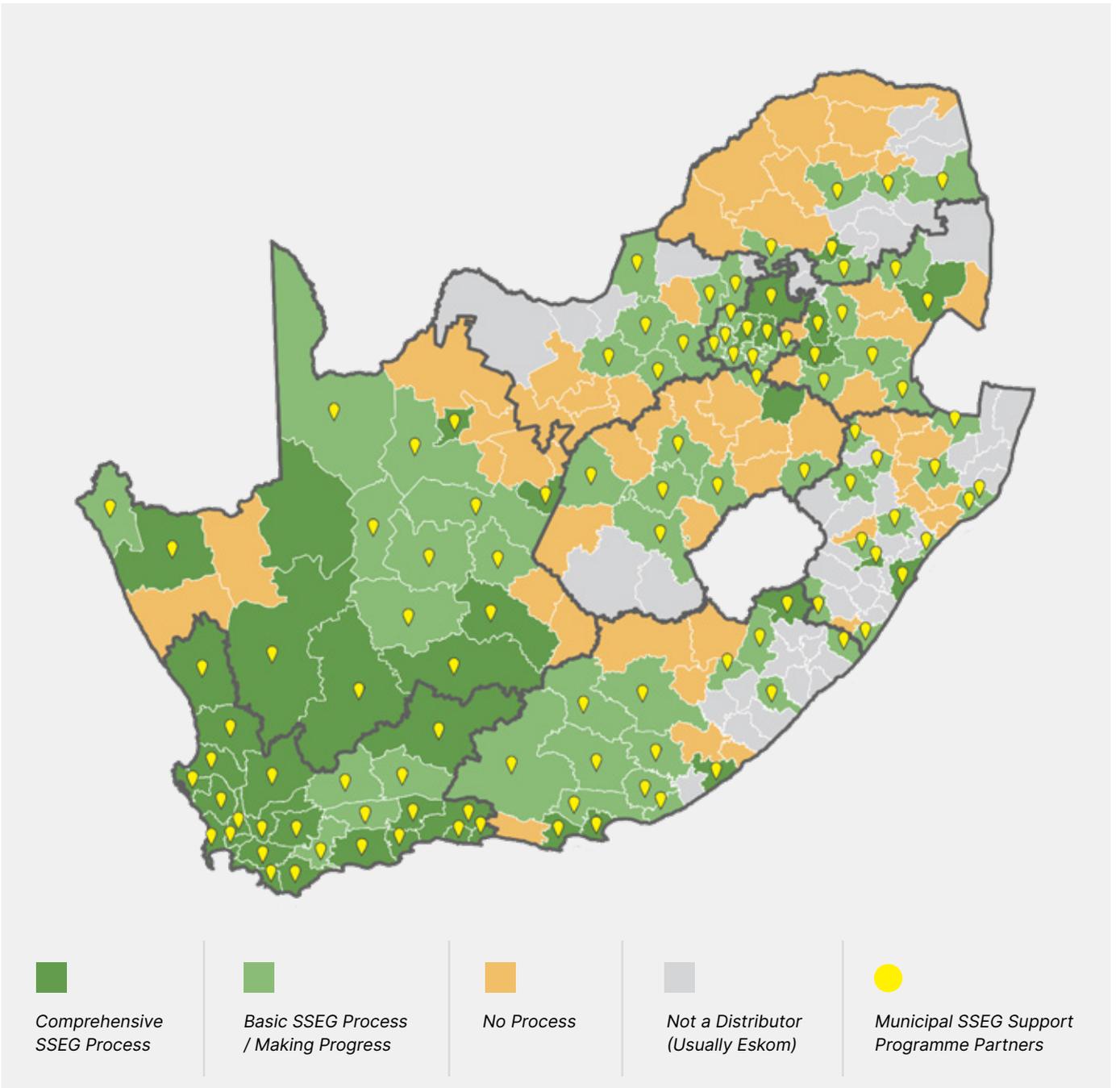


Figure 4: Status map of SSEG progress in Municipalities

4. Quantifying the Status of EG Roll-out

This section outlines the overall growth in South Africa’s EG sector, and more specifically the status of EG connected in municipal distribution networks.

4.1. National Overview

There has been a rapid uptake of EG installation in South Africa due to a number of factors, including avoiding loadshedding, electricity price increases, and steadily reducing solar PV prices. The graph of solar equipment import value reflects this exponential growth (Figure 5).

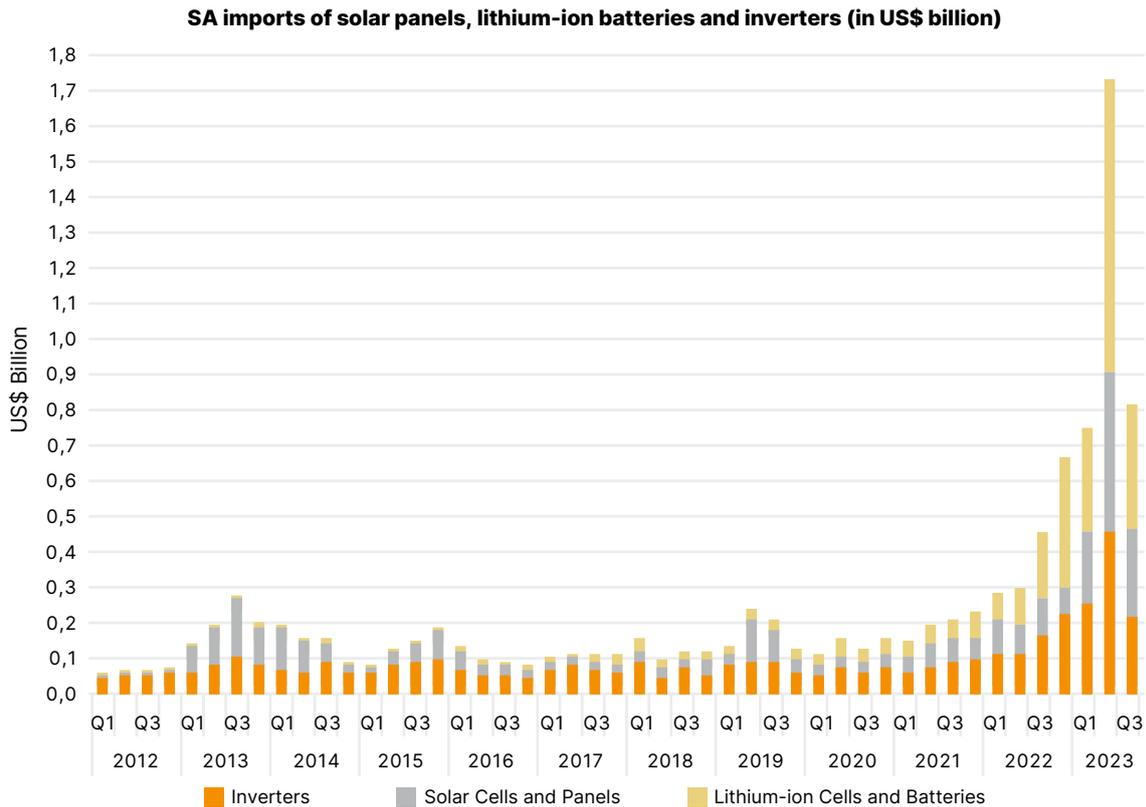


Figure 5: Solar PV equipment imports into South Africa¹⁴

SAPVIA solar PV data

According to the South African Photovoltaic Industry Association’s (SAPVIA) ‘Solar PV Installed Capacity Data Dashboard’, by the end of the first quarter of 2023 more than 5659 MW of solar PV was installed¹⁵.

Table 2: Installed Solar PV Capacity by Market Segment (SAPVIA data)

Market Segment	System Size	Total Capacity (MWp)
Residential	0 – 30 kWp	621
Commercial and Industrial	30kWp – 1 MWp	1248
Commercial and Industrial	1MWp – 50MWp	1926
Utility Scale	>50MWp	1865
Total		5659

14 https://www.linkedin.com/posts/gaylor-montmasson-clair-40188023_renewableenergy-solarpanels-lithiumionbatteries-activity-7133021718817685504-G2ut?utm_source=share&utm_medium=member_desktop

15 <https://sapvia.co.za/dataportal/dataportal-public>

The SAPVIA figures are based on aerial photography for the first quarter of 2023¹⁶. Deducting an amount of 2287MWp¹⁷ attributable to REIPPPP¹⁸ and other non-private IPPs, 3372MWp remains attributable to EG and private wheeling.

A more detailed breakdown of the SAPVIA data for the top Metros and Municipalities is in table 3.

Table 3: Solar PV MW by Municipal area for the top Metros and Municipalities by installed capacity (Q1 of 2023)*

Metro / Municipality	Residential (<30kW)	Commerce and Industry SSEG (30kW-1MW)	Commercial and Industrial Large Scale and Utility Scale (1MW – 50MW)	Total (MW)
City of Johannesburg	84.7	132.9	221.2	438.8
City of Tshwane	130.6	73.9	131.8	336.4
City of Cape Town	147.3	73.2	118.9	339.4
Ekurhuleni	45.8	58.3	95.3	199.5
eThekweni	17.2	25.3	42.6	85.1
Nelson Mandela Bay	11.3	3.5	3.9	18.7
Mangaung	13.4	13.3	38.3	65.0
Emfuleni	7.0	4.5	3.6	15.0
Govan Mbeki	9.6	2.0	10.0	21.6
Mogale City	6.6	4.7	9.7	21.0
Total	474	392	675	1541

* - Important notes:

- The data is per municipal area, not per distributor area (the two are often different) so cannot be directly compared with the Municipal Distributor Registered EG data provided in other sections of this report
- The data includes registered and unregistered EG
- The data includes off-grid systems, although they are expected to be a small component of totals

Data courtesy of SAPVIA and GeoTerra Image

Eskom solar PV data estimates

Similarly, a study conducted by Eskom which monitored the change in system demand due to solar radiation variations, estimated very similar figures for the first quarter of 2023, indicating that by March 2023, 3243 MWp of PV was installed, as shown in Table 2. By September 2023 this figure grew to 4883MWp¹⁹, increasing at an impressive rate of 273 MWp per month on average.

Table 4: Estimated PV EG in 2023 (EG and private wheeling)²⁰

Province:	EC	FS	GP	KZN	LP	MP	NC	NW	WC	Total
March (MWp)	163.2	160.5	917.5	417.5	189.8	317.9	117.5	669.3	289.7	3242.9
March (%)	5%	5%	28%	13%	6%	10%	4%	21%	9%	100%
September (MWp)	368.2	280.2	1207.8	810.9	413.3	476.6	129.5	669.3	527.4	4883.2
September (%)	8%	6%	25%	17%	8%	10%	3%	14%	11%	100%

According to this study, the majority of these systems are connected in Gauteng, Kwa-Zulu Natal and the North West Province.

¹⁶ Note that figures therefore include off-grid systems, although these numbers are expected to be of little significance in terms of installed capacity.

¹⁷ This figure is from an Eskom presentation on their estimation methodology and results (see later).

¹⁸ Renewable Energy Independent Power Producer Procurement Programme

¹⁹ This figure had risen to 5.2GW at the time of publication (end 2023).

²⁰ Eskom Study based on demand changes around the country as measured at key substations and linked to solar radiation levels, and compensating for REIPPP IPP PV plant.

The figure of 4883MWp has already excluded 2287MWp of solar IPPs, and thus reflects private solar for EG and wheeling. Eskom estimates that about 2.5GWp is private wheeling, leaving **approximately 2383MWp as PV EG²¹**. While some of this EG is located on Eskom's distribution network, a significant portion is also connected to municipal distribution grids. This split is not currently known.

Based on Eskom's estimates, the 2383MWp (as of Sept 2023) of solar PV EG represents 4% of the national total generation capacity of around 58GW. Rooftop PV is thus a significant contributor to national capacity. These systems connected to the distribution network, often unofficially, may pose challenges for network operators in future. Going forward it is important to consider how to minimise unofficial systems and maximise officially registered EG connections.

4.2. Municipal Overview

The 2023 Status of EG survey aimed to map out the progress that municipalities are making with EG. Responses to the survey were received from 48% of all municipal distributors (i.e. 79 out of 165), which included most of the large electricity distributors and most with EG processes. The survey results showed that collectively these municipalities had registered 657.9 MW, the majority of which were located in Gauteng, Western Cape and KwaZulu Natal.

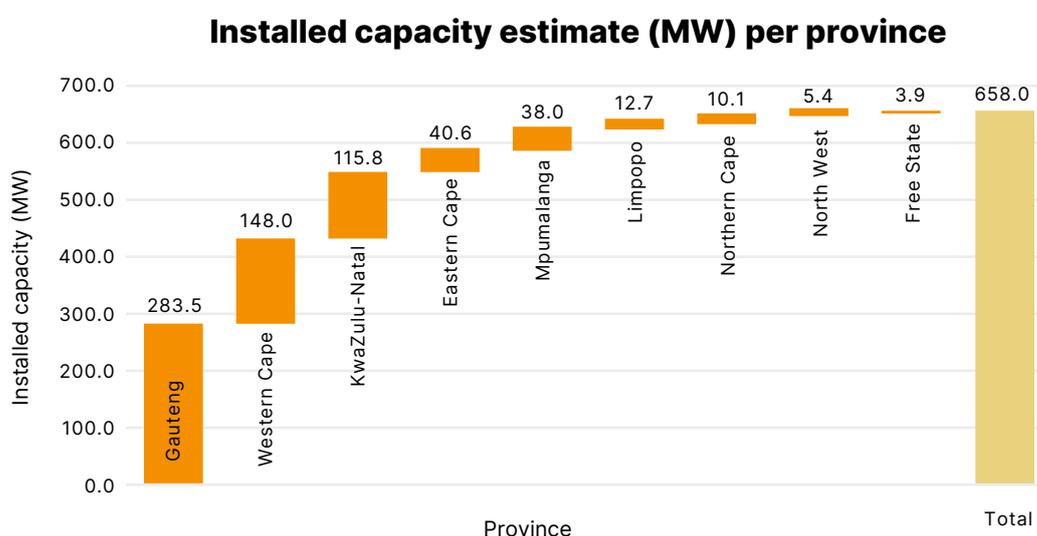


Figure 6: Estimated registered capacity of registered SSEG in each province (in municipality distribution networks)

Table 5 highlights the status of registered EG across all South African provinces as captured through SALGA's Status of EG Survey – the detailed municipal data can be found in the Appendices.

Table 5: Municipal EG Summary by Province

Province	Number of municipal distributors in the province	Number of municipalities allowing EG installations		Number of municipalities with official application processes		Number of municipalities with SSEG tariffs		Estimated capacity (MW) of registered EG systems	
		2020	2023	2020	2023	2020	2023	2020	2023
Eastern Cape	22	4	6	5	7	2	3	10.7	40.6
Free State	17	0	2	0	2	1	1	0.0	3.9

21 Figure estimated by Eskom staff.

Province	Number of municipal distributors in the province	Number of municipalities allowing EG installations		Number of municipalities with official application processes		Number of municipalities with SSEG tariffs		Estimated capacity (MW) of registered EG systems	
Gauteng	9	4	6	3	5	2	4	131.0	283.5
KwaZulu-Natal	25	3	7	2	7	1	2	35.5	115.8
Limpopo	16	5	5	5	5	1	2	3.7	12.7
Mpumalanga	14	5	5	4	4	3	3	17.0	38
Northern Cape	24	9	12	4	11	2	8	4.1	10.1
North-West	13	2	4	2	4	0	0	17.6	5.4
Western Cape	25	22	24	18	22	19	20	64.3	147.9
Total	165	54	71	43	67	31	43	283.8	657.9

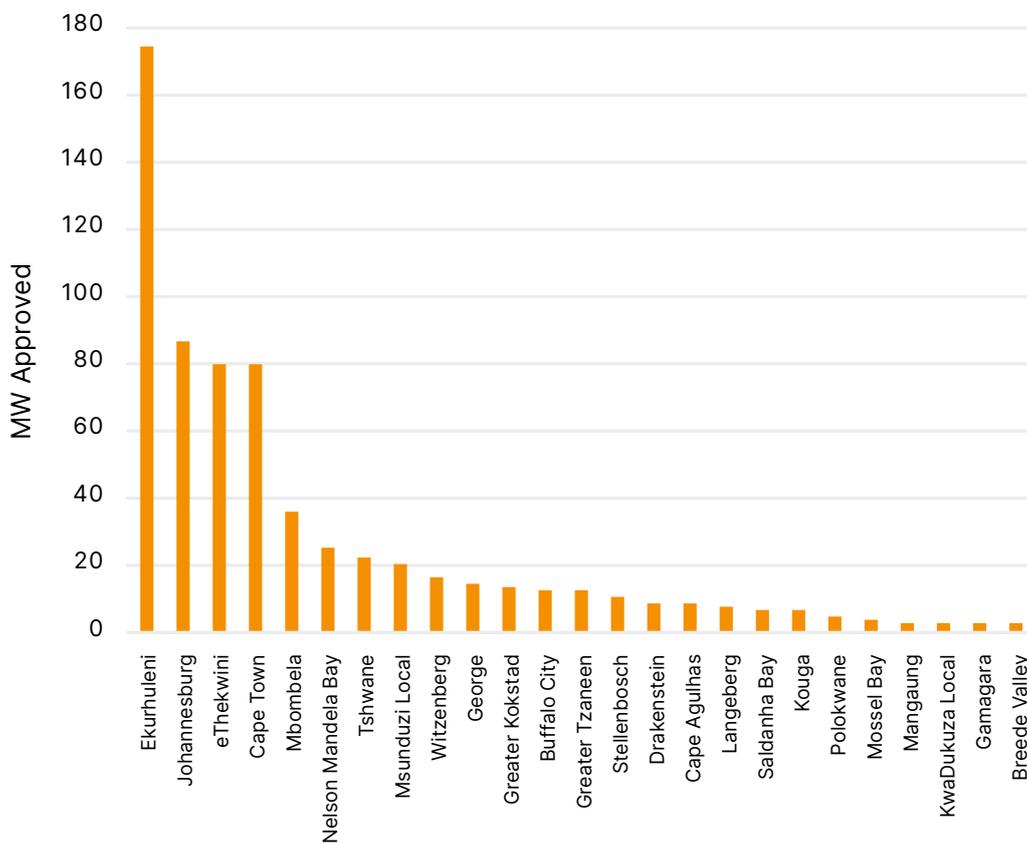


Figure 7: Municipal Distributors with >3MW of EG registered

The problem of unregistered EG systems and incomplete data

Most of the survey respondents indicated that their database of approved applications did not capture all the EG systems installed in their municipalities, as large numbers of systems remain unregistered. They noted that larger systems were more likely to register (partly because they are very visible and are cautious to comply with insurance requirements) while smaller, typically residential systems tend not to. Therefore a higher percentage of small systems tend to be illegal, while more large systems are compliant²².

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The expectation is that most MW are therefore registered, since the larger systems tend to be compliant. The data does not support this however, as unregistered MW is not far off registered MW (see later). Also, the situation varies significantly amongst municipalities, and the national picture regarding proportions registered vs unregistered remains unclear.

In Eskom distribution areas a similar issue with unregistered systems appears to exist, with **only 655 MW of EG being authorised by Eskom**²³. Combining both the SALGA municipal survey results and Eskom registered installation figures, the total still falls far short of the rooftop PV estimates recorded through the national Eskom estimates and national SAPVIA figures.

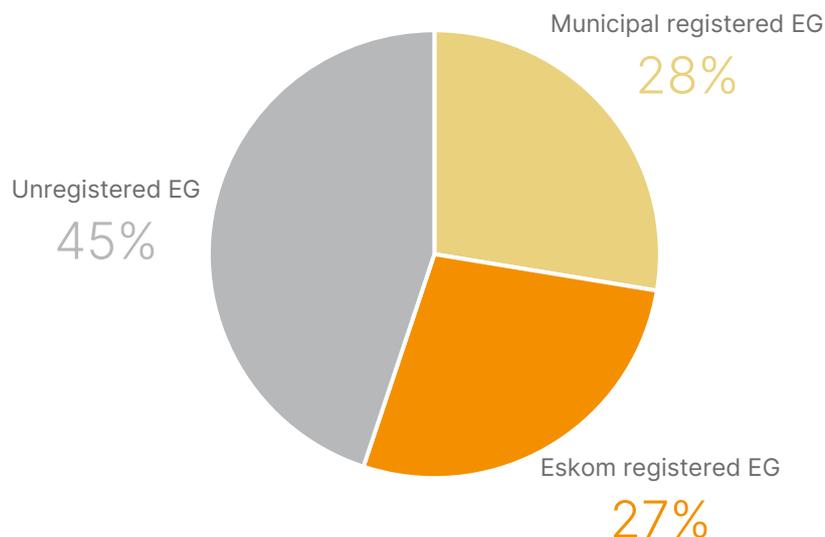


Figure 8: % of EG MW registered with Municipal Distributors and Eskom vs Unregistered systems

Table 6: Breakdown of total private solar PV installed

	MWp	% of total	% of EG only	Data source
TOTAL private solar PV	4883	100%	n/a	Eskom study (Sept 2023)
Wheeling PV (private)	2500	51%	n/a	Eskom estimate (end 2023)
Municipal registered EG	658	13%	28%	SALGA survey (May-Nov 2023)
Eskom registered EG	655	13%	27%	Eskom data (Sept-Oct 2023)
Unregistered EG	1070	22%	45%	Calculated from above

While there remain uncertainties in the data, the estimated volume of unregistered MW (45% of all EG, or 22% of the total private PV capacity) is a concern²⁴.

Although addressing the issue of unregistered systems will require a broad strategy, **encouraging official EG customer registrations** through the following actions should be amongst the priorities:

- 1) Raise awareness and improve communication with customers around the benefits of registering systems (including insurance compliance, export credits) and the challenges associated with non-registration.
- 2) Implementing user-friendly processes in municipalities and NERSA that allow for efficient registration.
- 3) Reducing the costs incurred by customers to have compliant systems (e.g. expensive signoff and meters).
- 4) Supporting municipal capacity to process applications swiftly (e.g. through use of the online application portal)
- 5) Incentivising registration by providing reasonable export credits.

Addressing registration bottlenecks and improving process efficiency is discussed in the next section.

²³ Pers Comm Silesh Mansingh of Eskom, November 2023.

²⁴

5.Key Trends and Issues

5.1. Bottlenecks in EG approval processes

Processing EG applications is a relatively new field of work for distribution utilities. Because there are potentially significant technical and financial implications for increasing numbers of EG on their networks, municipalities may introduce conservative requirements in their permitting processes which can frustrate their customers. These requirements can increase the cost of EG systems and delay their approval. Examples of requirements which the EG industry and customers have raised for review include:

- **Requirements for sign-off by Engineering Council of South Africa (ECSA) registered persons:** Registered electricians are authorised to provide Certificates of Compliance (CoC) for normal AC wiring, but since South Africa does not yet have a national standard for the direct-current (DC) wiring of an EG system, many municipalities require professional engineers or other ECSA registered persons to sign off such systems. This can be expensive, and the industry has called for properly trained and certified installers to also be given the authority to sign off on the commissioning of systems up to a certain size. While opinions vary as to the best way forward for different size systems, the cost of ECSA registered person sign-off is undoubtedly a barrier to residential customers coming forward to register their EG systems. Fortunately, this ECSA-person-signoff requirement will largely fall away upon the publishing of the long awaited SANS10142-1-2 standard which covers DC wiring and other aspects of PV installations.
- **Expensive bi-directional smart meters:** To allow EG systems to feed into the grid and compensate customers accordingly, most municipalities require the installation of bi-directional meters at the customer's cost. While this is a necessary requirement to measure energy exports, customers have complained that several municipalities are requiring overly expensive meters when cheaper meters can do the same job. These additional costs often contribute to customers not wanting to register their EG systems.
- **Tariffs that include a high fixed charge:** When customers install EG and reduce their purchases of energy from the grid, municipalities can lose revenue if their tariffs are not properly structured. To ensure that municipalities recover the fixed costs of maintaining the grid, many municipalities have introduced higher fixed charges for customers with EG. While such a move to cost-reflectivity is sound practice and is to be encouraged, it needs to be noted that customers have not responded well to the resulting negative impact on the EG payback period. **Ideally all tariffs should include a fixed component – not just EG tariffs** – firstly because such tariffs are more cost-reflective for all customers, and secondly because it avoids perceptions of discrimination against EG customers. The practice of having fixed charges for EG customers but not for non-EG customers is a deterrent for customers to register their systems.
- **Bureaucratic delays to achieve approval:** Many municipalities have now put in place an application procedure to enable approval of EG connection. However, staff capacity to process applications efficiently is often a challenge, potentially leading to delays for the EG developer - who has a clear commercial interest to generate power as soon as possible. These delays are a common frustration, often leading developers to connect generators to the network prior to receiving approval from the municipal distributor.

5.2. Improving customer-centricity

Bi-directional power flow with EG customers feeding into the grid is an inevitable component of our future energy system, and a partnership approach toward EG customers is therefore becoming increasingly important. A few ways that municipalities can improve their customer-centricity in relation to EG are noted below.

Fast-tracking applications using the Online Application Platform

Municipalities should look to fast track the approval times for standard applications. One recommended way to do this is to participate in the SALGA-endorsed **Online SSEG Application Portal** launched in early 2023 specifically for this purpose. It allows easy submission of applications, does away with all the paperwork associated with the existing EG application processes, reduces errors in applications, undertakes standard checks and calculations quickly and easily, and flags out-of-bounds criteria in applications. The Online SSEG Application Portal - <https://apply.sseg.org.za> - already has 20 municipalities using it, with over 700 systems and 26MW worth of capacity registered thereon. Experience to date shows that it can expedite the application approval process significantly, and features such as error checking and automated progress tracking facilitate the processes for both municipalities and customers.

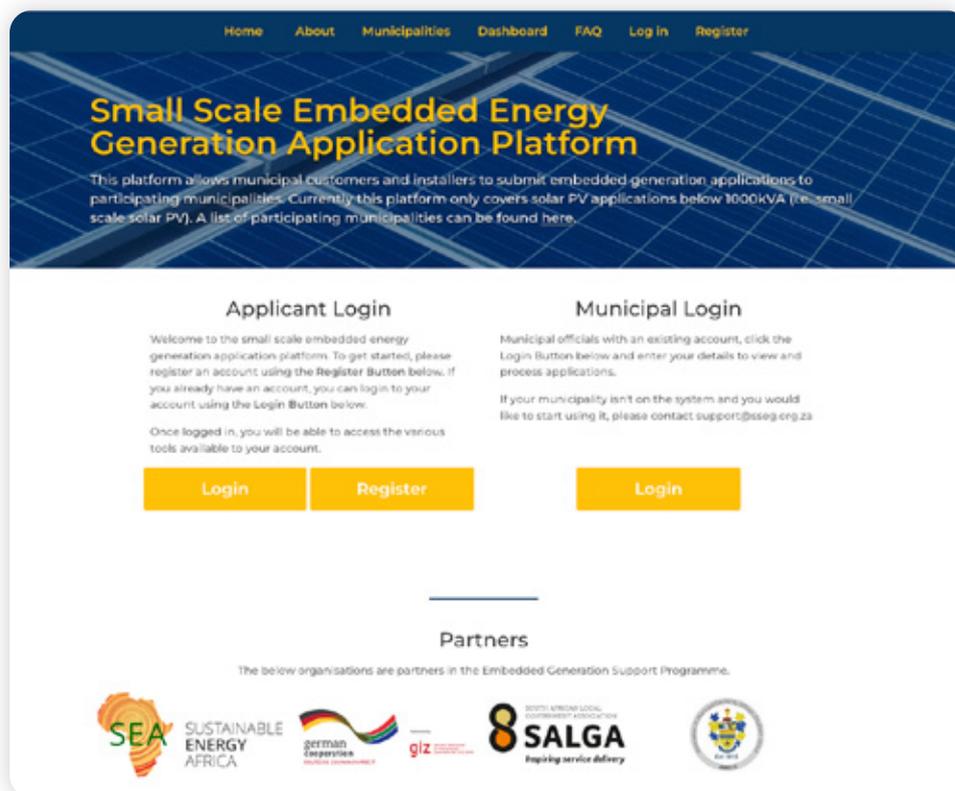


Figure 9: A screengrab of the Online Application Portal²⁵

Export tariffs to incentivise customers to feed into the grid

Most EG systems are designed to maximise self-consumption and minimise export into the grid. However, when EG systems export into the grid, they offer considerable value to the local distributor. This value arises primarily from the distributor's reduction in purchases of wholesale energy from Eskom. To encourage local energy production, some municipalities are actively seeking ways to incentivise their customers to feed into the grid. This is encouraging, as a favourable tariff regime with sufficient export compensation means that customers are more likely to comply with distributor requirements to be eligible for the export compensation. An important principle when determining an export compensation scheme is to consider the value of the avoided costs to the distributor, sometimes also called the 'value of solar'. The distributor should compensate EG customers related to the value of what they would have paid for that energy at that location and time had they purchased it from the wholesale market.

²⁵ <https://apply.sseg.org.za/login>. To arrange onboarding and training for your municipality contact support@sseg.org.za (note that applicants can register themselves, but Municipalities need to be onboarded by the EG Support Program team to login and begin accepting applications on the platform)

Standardised EG system design

A further way to streamline the process for both customers and distributors that could be explored is to publish a **standardised EG system design** eligible for fast tracking. This would reflect permissible criteria in terms of EG system capacity, inverter types, export limits and customer voltage level, amongst others. A similar approach has been followed in India where these systems are fast tracked for approval, from initial review to interconnection agreement within 20 days (NexantECA, 2017). Although the practicalities of such an approach in South Africa are yet to be assessed, pioneering municipal distributors could consider exploring this further.

5.3. Increase in Large EG System (> 1MW) applications

While many municipal distributors have been focusing on establishing processes for EG under 1MW - which covers most applications - applications over 1MW have increased significantly over the past few years, and municipalities are capacitating themselves to be able to accommodate such systems.

These larger generators connected to distribution networks require a significantly different assessment process to 'small scale' systems. They are subject to different

- regulatory environments
- technical standards, and
- implementation steps

For example, most of the important technical checks for small scale EG are handled by the NRS097-2-1 and NRS097-2-3 specifications which make assessment relatively straightforward. However, systems over 1MW require a more complex Grid Code compliance process and additional attention to network impact and power quality, amongst several other steps and checks.

The Municipal EG Support Programme has developed a guide²⁶ to assist municipal distributors with the assessment of these larger systems. It also serves as a resource for customers or developers wishing to install such generators.



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Figure 10: Steps in assessing EG larger than 1MW²⁷

5.4. Impact of Battery Storage

EG installations with battery storage have accelerated rapidly over the last 5 years, driven primarily by loadshedding. Most residential EG systems installed today include battery storage. To illustrate, of the 700 systems registered on the Online SSEG Application Portal, 86% included storage (totalling 32MWh for an installed PV capacity of 26MW - i.e. more than 1 kWh of storage per kWp of PV). Other sources estimate that national installed capacity of storage in early 2023 may have been around 500MWh but growing fast²⁸.

²⁷ Details of each step are outline in the guide mentioned earlier.

²⁸ 2023 Energy Services Market Intelligence Report (GreenCape 2023) – based on the assumption that 5% of the then 2.3GW of rooftop solar PV had 4 hours of backup storage installed. Given the recent growth rate of PV MW installed this figure is now likely much higher, possibly double or more.

While the motivation for installing battery storage is usually to reduce the impact of loadshedding, once batteries are installed, households typically cycle the batteries daily while keeping a minimum state of charge in the case of a power outage. As such, the presence of battery storage is significantly changing the overall load profile on municipal networks. Figure 10 shows a typical production and consumption profile of a residential household with solar and storage.

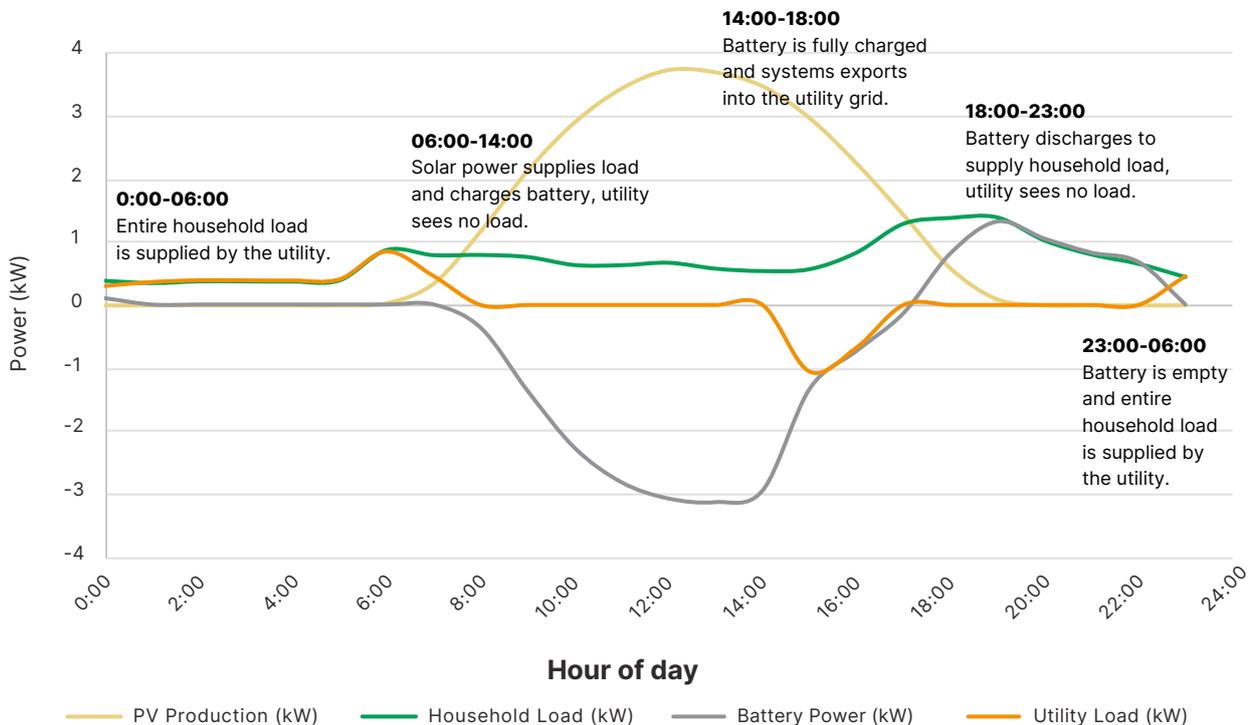


Figure 11: Typical production and consumption profile of a household with solar and storage

One of the implications of fast-growing storage capacity on the distribution network is increased **cold-load pickup**. After a loadshedding period ends, all the storage in the area starts to charge, leading to a peak that can easily exceed the network design parameters which are based on a certain amount of diversity in the load. Although several municipalities are already experiencing this as a problem, the extent of the issue is still being assessed, as are solutions which can be easily implemented by municipal Distributors.

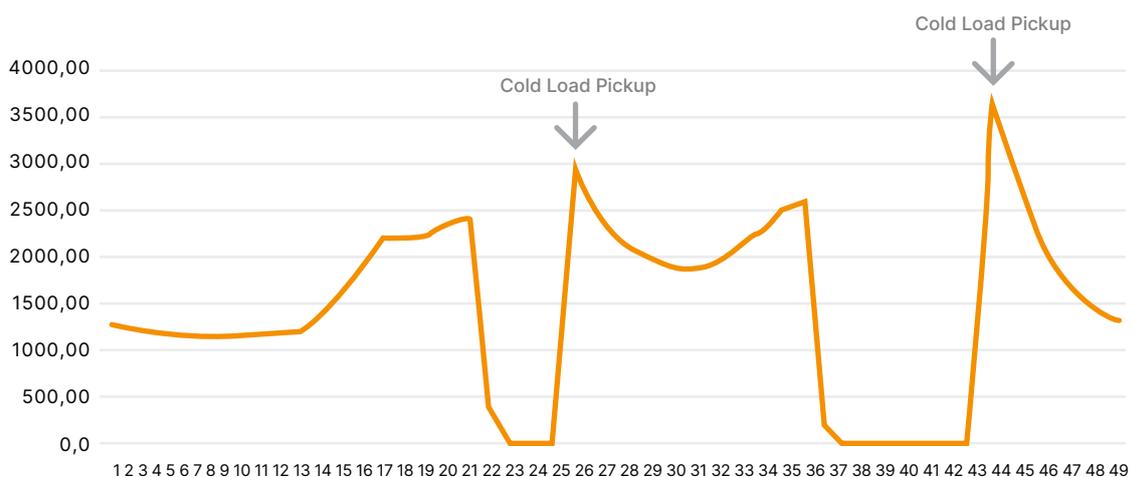


Figure 12: Load profile from an Eastern Cape municipality showing cold load pickup spikes after loadshedding

In the longer-term, the presence of significant quantities of storage on networks presents opportunities for peak shaving and general load profile optimisation, and once loadshedding tails off incentivising customers to use their storage in a way that benefits the grid will become an important area of focus.

6. Overview of Municipal EG Support Programme

The Municipal Embedded Generation Support Programme (www.sseg.org.za) is a multistakeholder support programme offering ongoing technical assistance to safely integrate EG into municipal distribution networks. Since the programme's inception in 2017, over 100 municipalities have participated in a range of training sessions and support activities. The programme is led by SALGA, funded by GIZ²⁹ and implemented by Sustainable Energy Africa NPC in partnership with the Solar Training Centre. Its objective is to capacitate municipalities to allow EG onto their networks in a technically sound and safe manner, and to support EG tariff setting to protect both the interests of the municipality and EG investors. The programme provides training for municipal distributors, as well as a comprehensive set of documentation which can be used in municipal EG processes. There are currently 106 municipal partners in the programme. Municipalities interested in joining the programme should email support@sseg.org.za for more information.

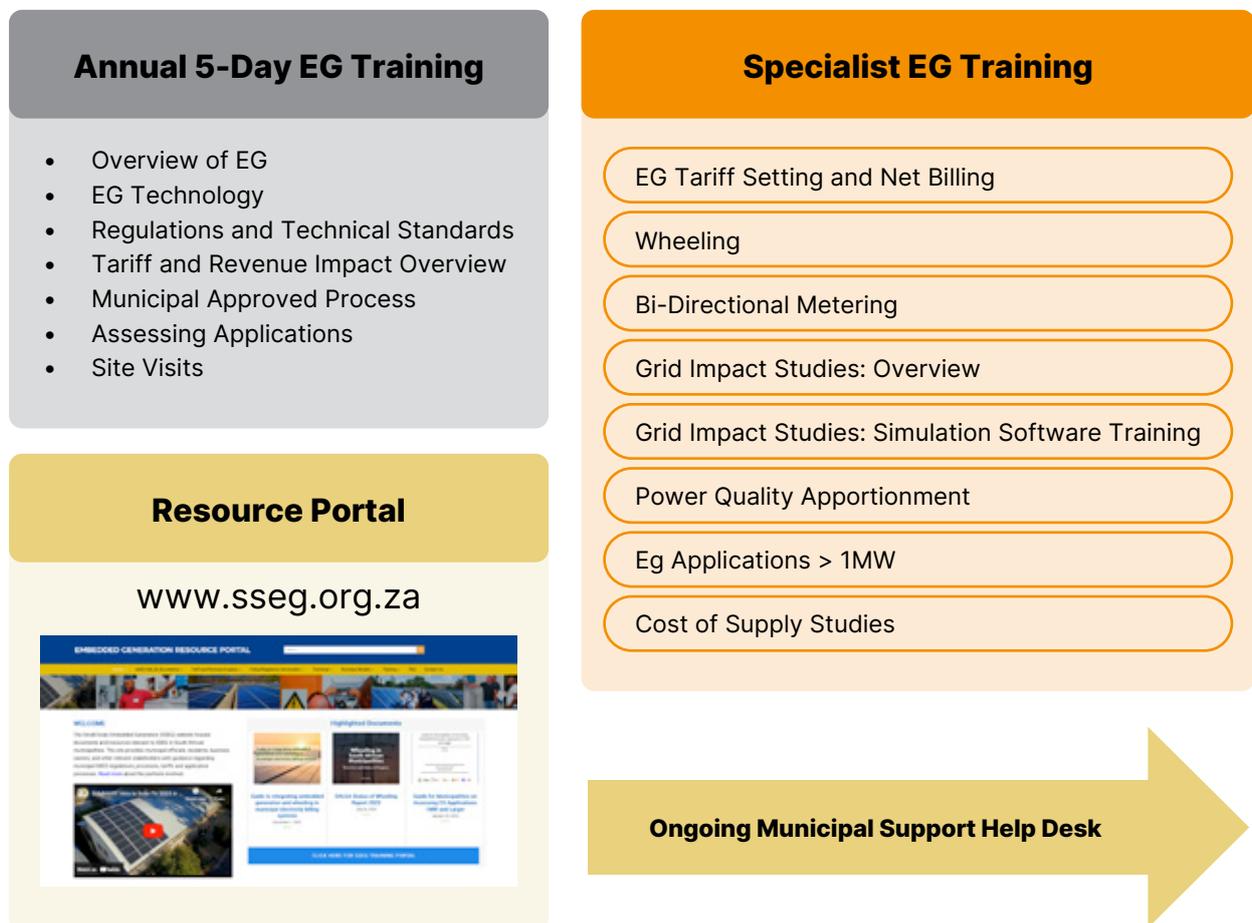


Figure 13: Components of the Municipal Embedded Generation Support Programme

²⁹ German Federal Ministry for Economic Cooperation and Development (BMZ) executed by the Deutsche Gesellschaft fuer Internationale Zusammenarbeit (GIZ) GmbH through the South African - German Energy Programme (SAGEN)

6.1. Resources available to Municipalities



Figure 14: Summary of EG Support Resources

Websites

- **Municipal Embedded Generation Resource Portal (www.sseg.org.za)**
Contains numerous documents, guides and other information related to EG.
- **SSEG Municipal Training Portal (www.training.sseg.org.za)**
Portal provides training courses aimed at capacitating municipal distributors on EG.
- **Online SSEG Application Platform (www.apply.sseg.org.za)**

This platform allows municipal customers and installers to submit embedded generation applications to participating municipalities.

Guide Documents

- SSEG Guide for Municipal Distributors
www.sseg.org.za/distributors-guide
- Guide for Municipalities on Assessing EG Applications 1MW and Larger
www.sseg.org.za/guide-for-municipalities-on-assessing-eg-applications-1mw-and-larger/
- SSEG Metering Guide for Municipalities
www.sseg.org.za/metering-for-small-scale-embedded-generation/
- Billing System Guide for Municipalities
www.sseg.org.za/guide-to-integrating-embedded-generation-and-wheeling-in-municipal-electricity-billing-systems/

7. Appendices

Embedded Generation Status per Municipality

The following table provides details on the EG status of municipalities where information could be obtained. It is based on a survey undertaken by SALGA in September 2023, and complemented with telephonic interviews with municipal officials and information that is publicly available³⁰.

		Allow SSEG onto network		Have an official SSEG application process		Have an approved SSEG tariff		Installed Capacity (registered MWp)	
Province	Municipality	2020	2023	2020	2023	2020	2023	2020	2023
Eastern Cape	Amahlathi	No data	No data	No data	No data	No data	No data	-	-
	Blue Crane Route	No data	No data	No data	No data	No data	No data	-	-
	Buffalo City	Yes	Yes	Yes	Yes	Yes	Yes	0.2	8.8
	Dr Beyers Naude	No	No	Yes	Yes	No	No	0	0
	Elundini	No data	No	No data	No	No data	No	-	0
	Emalahleni Local	No data	No data	No data	No data	No data	No data	-	-
	Enoch Mgijima	No data	No data	No data	No data	No data	No data	-	-
	Inxuba Yethemba Local	No data	No	No data	No	No data	No	-	-
	King Sabata Dalindyebo	No	No	No	No	No	No	0	0
	Kouga	Yes	Yes	Yes	Yes	No	Yes	0.4	4
	Kou-Kamma	No data	No data	No data	No data	No data	No data	-	-
	Makana	Yes	Yes	Yes	Yes	No	No	0.115	0.46
	Matatiele Local	No data	Yes	No data	Yes	No data	No	-	0.5
	Ndlambe	No data	No data	No data	No data	No data	No data	-	-
	Nelson Mandela Bay	Yes	Yes	Yes	Yes	Yes	Yes	10	26.8
	Raymond Mhlaba	No data	No data	No data	No data	No data	No data	-	-
	Sakhisizwe Local	No data	No	No data	No	No data	No	-	0
	Senqu	No data	No data	No data	No data	No data	No data	-	-
	Sundays River Valley Local	No data	Yes	No data	Yes	No data	No	-	0.024
	Winnie Madikizela-Mandela	No data	No data	No data	No data	No data	No data	-	-
Free State	Dihlabeng Local	No data	No data	No data	No data	No data	No data	-	-
	Letsemeng	No data	No data	No data	No data	No data	No data	-	-
	Mafube	No data	No data	No data	No data	Yes	Yes	-	-
	Mangaung Metropolitan (Centlec)	No data	Yes	No data	Yes	No data	No	-	3.9
	Mantsopa Local	No data	No data	No data	No data	No data	No data	-	-
	Masilonyana Local	No data	No	No data	No	No data	No	-	0
	Matjhabeng	No data	No data	No data	No data	No data	No data	-	-
	Metsimaholo	No data	No data	No data	No data	No data	No data	-	-
	Moqhaka Local	No data	No data	No data	No data	No data	No data	-	-
	Nala	No data	No data	No data	No data	No data	No data	-	-
	Ngwathe	No data	No data	No data	No data	No data	No data	-	-
	Nketoana	No data	No data	No data	No data	No data	No data	-	-
	Phumelela Local	No data	No data	No data	No data	No data	No data	-	-
	Setsoto Local	No data	Yes	No data	Yes	No data	No	-	0
	Tokologo	No data	No data	No data	No data	No data	No data	-	-
	Tswelopele Local	No data	No data	No data	No data	No data	No data	-	-

		Allow SSEG onto network		Have an official SSEG application process		Have an approved SSEG tariff		Installed Capacity (registered MWP)	
Province	Municipality	2020	2023	2020	2023	2020	2023	2020	2023
Gauteng	Ekurhuleni	Yes	Yes	Yes	Yes	No	Yes	60	170
	Emfuleni	No data	No data	No data	No data	No data	No data	-	-
	Johannesburg	Yes	Yes	Yes	Yes	Yes	Yes	44	86
	Tshwane	Yes	Yes	Yes	Yes	Yes	Yes	25	25
	Lesedi	No data	No data	No data	No data	No data	No data	-	-
	Merafong City Local	No data	Yes	No data	Yes	No data	No	2	2
	Midvaal Local	No data	Yes	No data	Yes	No data	No	-	0.5
	Mogale City	No data	No data	No data	No data	No data	Yes	0	0
	Rand West City	Yes	Yes	No	No data	No	No data	0	-
KZN	Abaqulusi	No data	No data	No data	No data	No data	No data	-	-
	Alfred Duma Local	No data	Yes	No data	Yes	No data	No	-	2.4
	City of Umhlathuze	Yes	Yes	No	Yes	No	No	-	0
	eDumbe Local	No data	No data	No data	No data	No data	No data	-	-
	Endumeni	No data	No data	No data	No data	No data	No data	-	-
	eThekweni	Yes	Yes	Yes	Yes	Yes	Yes	35	80
	Greater Kokstad	Yes	Yes	Yes	Yes	No	No	0.5	10
	KwaDukuza Local	No data	Yes	No data	Yes	No data	No	-	3.3
	Mandeni Local	No data	No data	No data	No data	No data	No data	-	-
	Mpofana Local	No data	No data	No data	No data	No data	No data	-	-
	Msunduzi Local	No data	Yes	No data	Yes	No data	Yes	-	20
	Mthonjaneni Local	No data	No data	No data	No data	No data	No data	-	-
	Newcastle	No data	No data	No data	No data	No data	No data	-	-
	Nkandla	No data	No data	No data	No data	No data	No data	-	-
	Nquthu Local	No data	No data	No data	No data	No data	No data	-	-
	Ray Nkonyeni	No data	No data	No data	No data	No data	No data	-	-
	Ulundi Local	No data	No	No data	No	No data	No	-	0
	uMfolozi	No data	No	No data	No	No data	No	-	0
	uMkhanyakude	No data	No data	No data	No data	No data	No data	-	-
	uMlalazi Local	No data	No data	No data	No data	No data	No data	-	-
uMngeni Local	No data	Yes	No data	Yes	No data	No	-	0.08	
Umtshezi Local	No data	No data	No data	No data	No data	No data	-	-	
Umuziwabantu Local	No data	No data	No data	No data	No data	No data	-	-	
Umvoti Local	No data	No	No data	No	No data	No	-	0	
Uphongolo	No data	No data	No data	No data	No data	No data	-	-	
Limpopo	Ba-Phalaborwa	Yes	Yes	Yes	Yes	No	No data	0.3	0.3
	Bela-Bela	No data	No data	No data	No data	No data	No data	-	-
	Blouberg	No data	No data	No data	No data	No data	No data	-	-
	Elias Motsoaledi	Yes	Yes	Yes	Yes	No	No data	0	-
	Ephraim Mogale	Yes	Yes	Yes	Yes	Yes	Yes	0.4	1.2
	Greater Letaba Local	No data	No data	No data	No data	No data	No data	-	-
	Greater Tzaneen	Yes	Yes	Yes	Yes	No	No	2.3	7.2
	Lephalale Local	No data	No data	No data	No data	No data	No data	-	-
	Makhado Local	No data	No data	No data	No data	No data	No data	-	-
	Modimolle-Mookgophong	No data	No data	No data	No data	No data	Yes	-	-
	Mogalakwena Local	No data	No data	No data	No data	No data	No data	-	-

		Allow SSEG onto network		Have an official SSEG application process		Have an approved SSEG tariff		Installed Capacity (registered MWp)	
Province	Municipality	2020	2023	2020	2023	2020	2023	2020	2023
Limpopo	Molemole	No data	No data	No data	No data	No data	No data	-	-
	Musina Local	No data	No data	No data	No data	No data	No data	-	-
	Polokwane	Yes	Yes	Yes	Yes	No	No	0.8	4.0
	Thabazimbi Local	No data	No data	No data	No data	No data	No data	-	-
Mpumalanga	Chief Albert Luthuli	No data	No data	No data	No data	No data	No data	-	-
	Dipaleseng Local	No data	No data	No data	No data	No data	No data	-	-
	Govan Mbeki	Yes	Yes	Yes	Yes	Yes	Yes	0	1
	eMadlangeni Local	No data	No data	No data	No data	No data	No data	-	-
	Emakhazeni Local	No data	No data	No data	No data	No data	No data	-	-
	Emalahleni	Yes	Yes	Yes	Yes	Yes	Yes	2	2
	Lekwa Local Municipality	No data	No	No data	No	No data	No	-	0
	Mbombela	Yes	Yes	Yes	Yes	Yes	Yes	15.0	35
	Mkhondo	No data	No data	No data	No data	No data	No data	-	-
	Msukaligwa	Yes	Yes	Yes	Yes	No	No data	0	-
	Nkomazi	No data	No data	No data	No data	No data	No data	-	-
	Steve Tshwete Local	No data	No	No data	No	No data	No data	-	0
	Thaba Chweu	Yes	Yes	No	No data	No	No data	0	-
	Northern Cape	!Kheis	Yes	Yes	No	No data	No	No data	1.8
Dawid Kruiper		No data	No data	No data	No data	No data	No data	-	-
Dikgatlong Local		No data	No data	No data	No data	No data	No data	-	-
Emthanjeni		No data	Yes	No data	Yes	No data	Yes	-	0.8
Gamagara		Yes	Yes	Yes	Yes	Yes	Yes	2.0	3
Ga-Segonyana Local		No data	No data	No data	No data	No data	No data	-	-
Hantam		Yes	Yes	No	Yes	No	Yes	-	0.105
Joe Morolong Local		No data	No data	No data	No data	No data	No data	-	-
Kai! Garieb		Yes	Yes	No data	Yes	Yes	Yes	-	-
Kareeberg Municipality		No data	Yes	No data	Yes	No data	No	-	0
Karoo Hoogland		Yes	Yes	Yes	Yes	No	No	0	0
Kgatelopele Local		No data	No data	No data	No data	No data	No data	-	-
Magareng Local		No data	No data	No data	No data	No data	No data	-	-
Nama Khoi		Yes	Yes	No	Yes	No	Yes	0	2
Phokwane Local		No data	No data	No data	No data	No data	No data	-	-
Pixley Ka Seme District		No data	No data	No data	No data	No data	No data	-	-
Renosterberg Local		No data	No data	No data	No data	No data	No data	-	-
Richtersveld		No data	No data	No data	No data	No data	No data	-	-
Siyancuma Local		No data	Yes	No data	Yes	No data	No	-	0,0
Siyathemba Local		No data	No	No data	No	No data	No	-	-
Sol Plaatjie		Yes	Yes	No data	Yes	No data	Yes	-	2.066
Thembelihle		Yes	Yes	Yes	Yes	No	No	0.3	0.3
Tsantsabane Local		No data	No	No data	No	No data	Yes	-	0.033
Ubuntu		Yes	Yes	Yes	Yes	No	Yes	0	0
Umsobomvu Local	No data	No data	No data	No data	No data	No data	-	-	

		Allow SSEG onto network		Have an official SSEG application process		Have an approved SSEG tariff		Installed Capacity (registered MWp)	
Province	Municipality	2020	2023	2020	2023	2020	2023	2020	2023
Northwest	City of Matlosana	Yes	Yes	Yes	Yes	No	No	-	0.6
	Ditsobotla Local	No data	No	No data	No	No data	No	-	0
	Greater Taung Local	No data	No data	No data	No data	No data	No data	-	-
	JB Marks	Yes	Yes	Yes	Yes	No	No data	-	0.62
	Kgetlengrivier Local	No data	No data	No data	No data	No data	No data	-	-
	Lekwa-Teemane Local	No data	No data	No data	No data	No data	No data	-	-
	Madibeng Local	No data	Yes	No data	Yes	No data	No	-	2.4
	Maquassi Hills Local	No data	No data	No data	No data	No data	No data	-	-
	Naledi	No data	No data	No data	No data	No data	No data	-	-
	Ramotshere Moiloa	No data	No data	No data	No data	No data	No data	-	-
	Rustenburg Local	No data	Yes	No data	Yes	No data	No	-	1.8
	Tswaing	No data	No data	No data	No data	No data	No data	-	-
Western Cape	Beaufort West	Yes	Yes	Yes	Yes	Yes	Yes	0.8	1.6
	Berggrivier	Yes	Yes	No data	Yes	No data	No	-	1.8
	Bitou	Yes	Yes	Yes	Yes	Yes	Yes	0.0	1.2
	Breede Valley	Yes	Yes	Yes	Yes	Yes	Yes	3.0	3
	Cape Agulhas	Yes	Yes	Yes	Yes	Yes	Yes	1.1	4.7
	Cederberg	Yes	Yes	No	Yes	Yes	Yes	-	0
	Cape Town	Yes	Yes	Yes	Yes	Yes	Yes	41.6	80
	Drakenstein	Yes	Yes	Yes	Yes	Yes	Yes	2.6	5
	George	Yes	Yes	Yes	Yes	Yes	Yes	5.0	11.3
	Hessequa	Yes	Yes	Yes	Yes	Yes	Yes	0.1	1.7
	Kannaland Local	No data	No	No data	No	No data	No	-	0
	Knysna	Yes	Yes	Yes	Yes	Yes	Yes	0.4	0.9
	Laingsburg Local	No data	Yes	No data	Yes	No data	No	-	0.2
	Langeberg	Yes	Yes	Yes	Yes	Yes	Yes	2.4	4.1
	Matzikama	Yes	Yes	No	No data	Yes	Yes	-	0.08
	Mossel Bay	Yes	Yes	Yes	Yes	Yes	Yes	1.2	4.0
	Oudtshoorn	Yes	Yes	Yes	Yes	Yes	Yes	-	1.5
	Overstrand	Yes	Yes	Yes	Yes	Yes	Yes	0.2	0.4
	Prince Albert	Yes	Yes	No	No data	No	Yes	-	-
	Saldanha Bay	Yes	Yes	Yes	Yes	Yes	Yes	1.2	4.1
	Stellenbosch	Yes	Yes	Yes	Yes	Yes	Yes	-	5.4
Swartland	Yes	Yes	Yes	Yes	Yes	Yes	0.2	2.5	
Swellendam Local	No data	Yes	No data	Yes	No data	No data	-	0.665	
Theewaterskloof	Yes	Yes	Yes	Yes	Yes	Yes	0.2	0.6	
Witzenberg	Yes	Yes	Yes	Yes	No	No	3.5	13.2	



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