

**STATUS OF SMALL SCALE
EMBEDDED GENERATION (SSEG)
IN SOUTH AFRICAN MUNICIPALITIES**

NOVEMBER 2020



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1. INTRODUCTION

Small- Scale Embedded Generation: In the South African context refers to a generator with a maximum of 1 MW production capacity, and is installed by electricity customers on residential, commercial, agricultural or industrial properties. It is connected to the customer's electrical network behind the electricity meter – and is thus 'embedded' in, and synchronized with, the distribution network. The number of Small-Scale Embedded Generation SSEG installations in South African distribution network areas is accelerating (for municipal distributors and Eskom Distribution), driven by increasing Eskom wholesale and retail tariffs, system reliability concerns (load shedding) combined with steadily decreasing SSEG technology costs. Solar PV SSEG is also a low-carbon energy source, and thus supports climate change mitigation and green economy policy objectives.

The majority of energy generated through SSEG in South Africa is from solar photovoltaic (PV) systems. The previous SSEG in South African Municipalities publication showed growing numbers of municipalities allowing SSEG onto their networks (SALGA 2018a). This trend is still evident, as presented in this report, and is expected to continue into the future in line with the decentralization of electricity generation across the globe. At a national level, regulatory frameworks relevant to SSEG have also matured since 2018.

This report covers the following:

- Regulatory framework and institutional update relevant to SSEG in municipal electricity distributor networks
- Quantitative overview of SSEG uptake in municipal electricity distributor networks (Eskom supply areas are not reported on in this publication)

2. UPDATE ON REGULATORY FRAMEWORKS AND KEY INSTITUTIONAL DEVELOPMENTS

2.1 Electricity Regulation Act (ERA) Schedule 2: Licensing exemption and Registration notice

The amendment of Schedule 2 of the Electricity Regulation Act 2006 (DoE 2020), gazetted on the 26th March 2020, is a critical legislative document for SSEG in South Africa. It specifies the conditions for SSEG license exemption and registration with NERSA. Key requirements for different generator capacities are summarized below:

- **0-100 kW:** NERSA license is not required and NERSA registration is not required, but systems must be registered with the distributor and comply with conditions the distributor puts in place.
- **0.1 – 1 MW:** NERSA license is not required, but systems must be registered with NERSA and comply with conditions of the distributor and enter into an agreement with the distributor
- **> 1 MW:** a NERSA license is required

Schedule 2 also specifies that SSEG power may be wheeled across the network, but only to 'related customers', and in such circumstances a connection agreement must be in place with the distributor.

NERSA has specified the process for registering SSEG systems (NERSA 2018), and is currently working on the development of SSEG Regulatory Rules, which will likely clarify SSEG application processes and tariffs, amongst other areas.

2.2 SALGA Energy Summit Declaration

The South African Local Government Association has called for a proactive response to the energy transition taking place in South Africa. The Declaration from the 2018 SALGA Energy Summit (SALGA 2018b), which included participation from the majority of municipalities and key government stakeholders around the country, recognizes:

- The inevitable trend towards decentralised generation,
- The need to revise municipal distribution business models,
- The need to place customers at the centre of energy solutions
- That embracing the transition is no longer a choice but a necessity

Further, the Declaration commits local government to:

- Supporting the Department of Energy in providing leadership to the sector to develop the necessary policy and legislative frameworks to embrace and accelerate the energy transition, and
- Changing their processes, by-laws and tariffs to allow for decentralized generation (small scale embedded generation) in a manner which is safe and adequately covers the cost of using the electricity grid.

Further, it also:

- Agrees that customer own supply (commercial, industrial and household SSEG), if properly managed can be an important asset to the electricity distributor and the South African power system, as this allows for load balancing and optimum use of own supply that also alleviate national or local system constraints, and
- Calls on the Minister of Energy, with the cooperation of NERSA, to gazette a new regulation exempting power projects under 10 MW from the requirement of licensing so that the local distributed and embedded power markets can grow to their potential



2.3 Integrated Resource Plan (IRP) 2019

The IRP 2019 allocated a significant role for new renewable energy generation (solar PV and wind) by 2030, as well as a growing distributed generation allocation. This 'distributed generation' category covers embedded generation between 1 and 10 MW, and is allocated 500MW per year. Coal remains important in the energy mix in 2030, although with a reducing role. SSEG (<1MW) is not quantitatively included, but is considered to be included in the demand forecasts used.

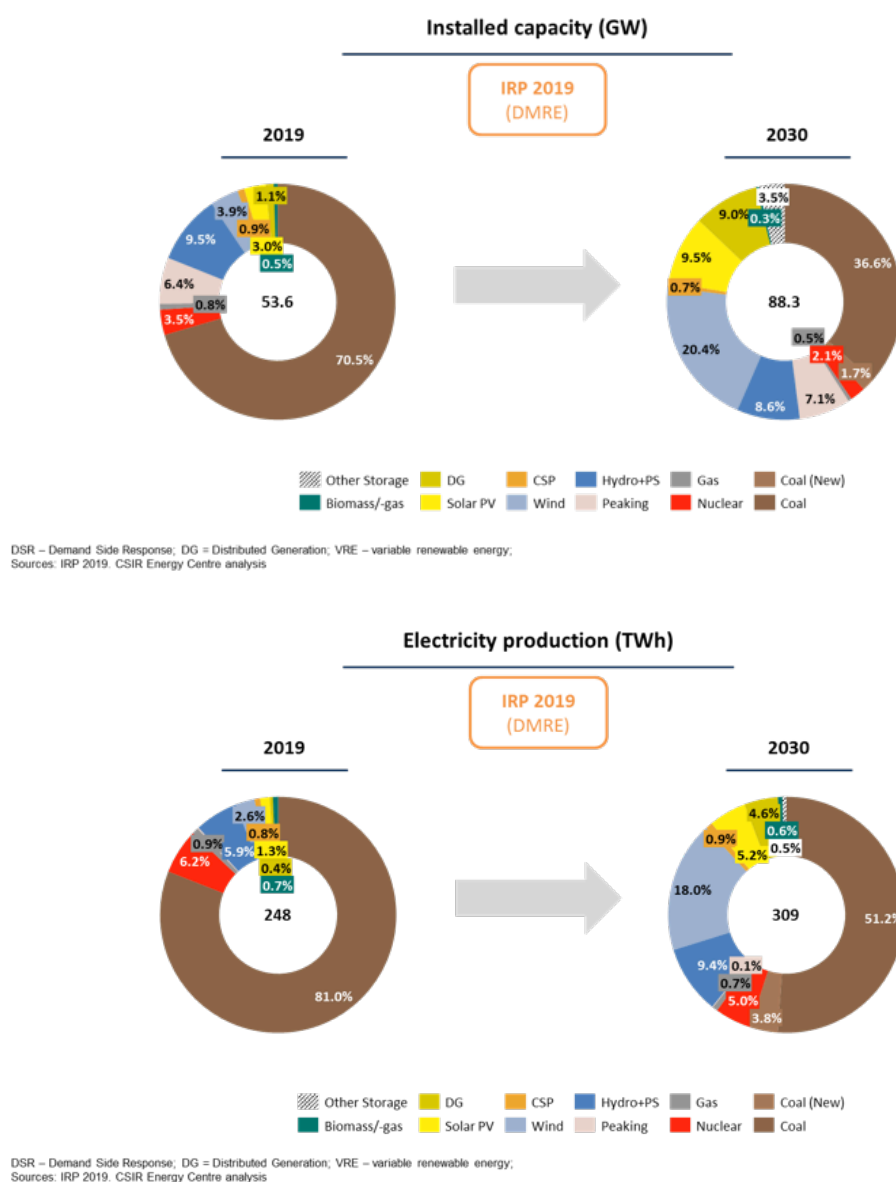


Figure 1: Integrated Resource Plan 2019 installed capacity in 2030

The limitations of the IRP from a municipal distributor and SSEG viewpoint include that the potential increased SSEG contribution to the energy mix was not explored fully and cost implications for distributors were not considered, including potential impacts of storage within distribution networks.

2.4 SONA 2020

In the State of the Nation address (SONA2020), President Cyril Ramaphosa announced measures that government will take to rapidly and significantly change the trajectory of energy generation in the country, including:

- Bringing more renewable energy, natural gas, hydro power and battery storage into the energy mix through the Integrated Resource Plan 2019.

- Procuring emergency power from projects that can deliver electricity into the grid within 3 to 12 months of approval.
- Generating own-use power. NERSA will continue to register small-scale distributed generation for own use of under 1 MW, for which no licence is required.
- Enabling municipalities to procure their own power directly or from independent power producers (IPPs)

2.5 Role of SSEG to address the electricity crisis

The CSIR, in independent modelling, has noted important steps to address the power crisis in the country (Wright & Calitz, 2020). As highlighted, embedded and distributed generation (above and below 1 MW) is one of the few generation options that can be deployed rapidly, and is thus a critical first step in responding to the crisis. Estimates are that the total SSEG capacity can at least double by 2022, and this should be expedited in the national interest (Wright & Calitz, 2020).

2.6 NERSA approval of SSEG tariffs

The number of municipal distributors with SSEG tariffs approved by NERSA has increased since 2018, including export credits for customers who export excess self-generated power back onto the municipal distribution network. This export credit component of overall SSEG tariff setting is shown in context to related retail tariff components in Figure 2 below.

NERSA has also specified that Cost of Supply studies from municipal distributors are now a requirement, when future SSEG tariffs are applied for. NERSA will outline the SSEG tariff setting principles in their forthcoming SSEG Regulatory Rules.



Figure 2: Main components of a typical SSEG tariff

2.7 Municipal SSEG Support Programme

SALGA is a partner in the Municipal SSEG Support Programme, which capacitates municipalities in developing processes to accommodate SSEG onto their networks safely and in a technically sound manner, as well as with appropriate SSEG tariff setting. The programme has been underway since 2017, and currently has 40 municipal partners that have been through SSEG training, have developed the necessary documentation and processes to assess SSEG applications, and receive ongoing technical support. Training provided includes processing SSEG applications, tariff setting and revenue impact, grid impact studies, and bi-directional metering for SSEG.

The programme is further described later in this publication, including how municipalities can participate in future support activities.

3. STATUS OF SSEG ROLL-OUT – A QUANTITATIVE PICTURE

The information in this section is based largely on a SALGA survey of municipal distributors' undertaken mid-2020, and provides an estimate of the status of SSEG amongst distributors to the best of SALGA's knowledge¹.

3.1 National Overview

The number of municipal distributors allowing SSEG onto their networks has been rising steadily since 2016, showing a significant annual growth rate from 10 in 2016 to 56 in 2020, with a similar pattern with SSEG tariffs (Figure 3).

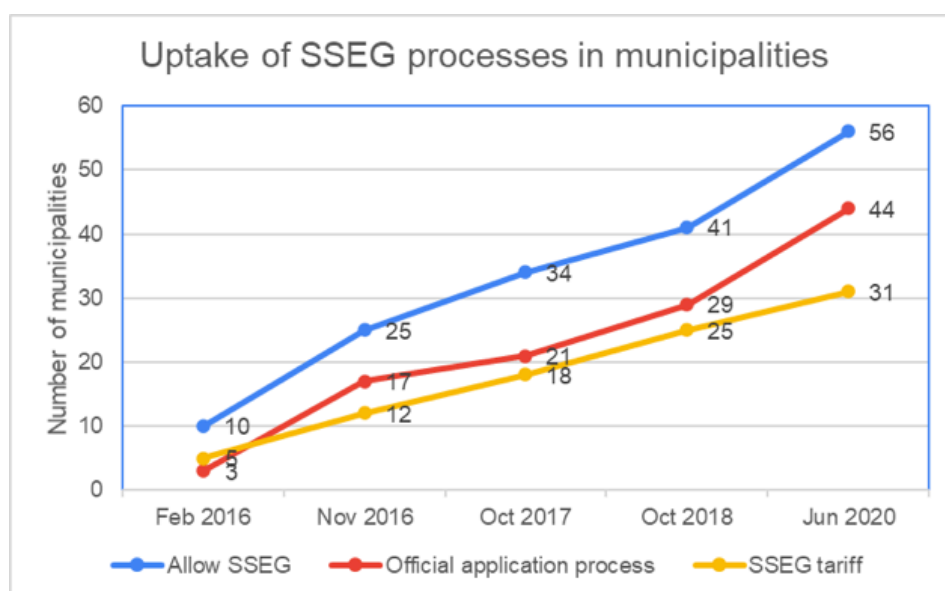


Figure 3: Overview of National SSEG Uptake in Municipalities

The growth trajectory has been influenced by specific capacity building efforts to support municipalities in accommodating SSEG², legislative frameworks which have facilitated SSEG roll-out at municipal level, as well as an increased willingness of many municipalities to embrace the energy transition taking place in the country.

3.2 Provincial Overview

The table below gives a provincial breakdown of municipalities that:

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

¹ For more information on the data collection approach, see Annex A

² Including SALGA's Municipal SSEG Support Programme (described in this publication) and GreenCape's work with Western Cape municipalities.

The table also shows the capacity of registered SSEG systems in place in each province.

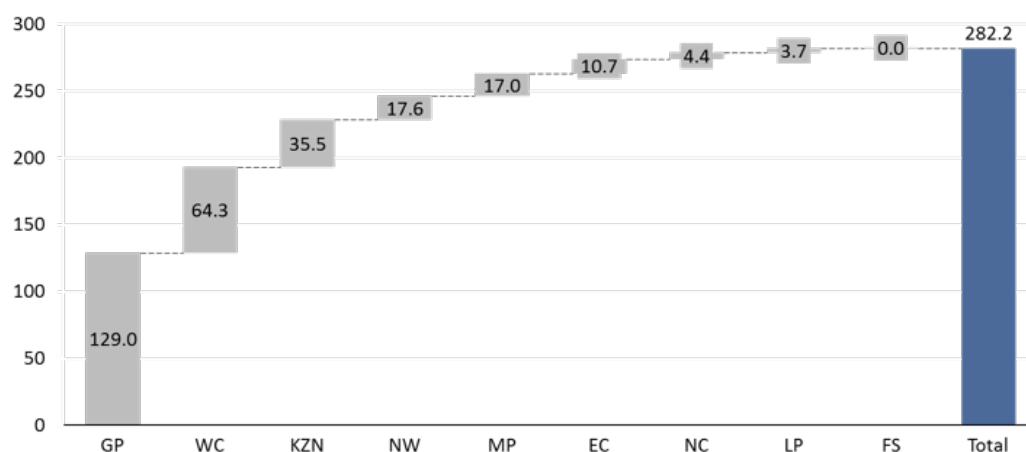
Table 1: Provincial SSEG Uptake Summary

	Number of municipal electricity distributors in province	Number of municipalities allowing SSEG installations	Number of municipalities with official application processes	Number of municipalities with SSEG tariffs	Estimated capacity (MW) of registered SSEG systems
Eastern Cape	22	6	6	2	10.7
Free State ³	17	No data	No data	No data	0.0
Gauteng	9	4	3	2	129.0
Kwazulu-Natal	25	3	2	1	35.5
Limpopo	16	6	5	1	3.7
Mpumalanga	14	4	4	3	17.0
Northern Cape	24	9	4	3	4.4
North West	13	2	2	0	17.6
Western Cape	25	22	18	19	64.3
TOTAL	165	56	44	31	282.1
% of licensed distributors:		34%	27%	19%	

Western Cape has the highest proportion of municipalities allowing SSEG. This is largely due to support provided by the provincial government around SSEG, through GreenCape as their implementing agent. Numbers of municipalities with SSEG tariffs tend to lag behind those allowing SSEG, partly because of uncertainties regarding the NERSA application and approval processes, as well as internal municipal revenue concerns and billing system integration issues. In addition, NERSA is increasingly requiring Cost of Supply studies with new tariff applications, which some municipalities have not yet completed.

Figure 4 shows the predominance of registered SSEG installed capacity in Gauteng, followed by the Western Cape.

Installed capacity estimate,
per province [MW]



NOTES: No data for Free State
Sources: SALGA

Figure 4: Estimated installed capacity of registered SSEG in each province (in municipality distribution networks)

3.3 Overview by municipality

Table 2: Municipal SSEG status (those that allow SSEG onto their networks)

Province	Municipality	Allow SSEG onto network?	Have an official SSEG application process?	Have a NERSA approved SSEG tariff?	Installed capacity in Munic (MWp)	Total No. of registered SSEG systems	PV SSEG installed on municipal property (kWp)
E Cape	Buffalo City	Yes	Yes	Yes	0.17	17	60
E Cape	Dr Beyers Naude	Yes	Yes	No	0	0	0
E Cape	King Sabata Dalindyebo	Yes	Yes	No	0	0	0
	Kouga	Yes	Yes	No	0.42	122	0
	Makana	Yes	Yes	No	0.115	8	0
	Nelson Mandela Bay	Yes	Yes	Yes	10	451	19
Gauteng	Ekurhuleni	Yes	Yes	No	60	83	2000
	Johannesburg	Yes	Yes	Yes	44	224	32
	Tshwane	Yes	Yes	Yes	25	77	220
	Rand West City	Yes	No	No	0	0	0

Province	Municipality	Allow SSEG onto network?	Have an official SSEG application process?	Have a NERSA approved SSEG tariff?	Installed capacity in Munic (MWp)	Total No. of registered SSEG systems	PV SSEG installed on municipal property (kWp)
KZN	Umhlathuze	Yes	No	No	No data	No data	11
	eThekweni	Yes	Yes	Yes	35	83	250
	Greater Kokstad	Yes	Yes	No	0.5	2	0
Limpopo	Ba-Phalaborwa	Yes	Yes	No	0.25	17	0
	Elias Motswaledi	Yes	Yes	No	0	No data	0
	Ephraim Mogale	Yes	Yes	Yes	0.35	15	0
	Greater Tzaneen	Yes	Yes	No	2.27	4	0
	Polokwane	Yes	Yes	No	0.8	20	0
	Thaba Chweu	Yes	No	No	0	0	0
Mpumalanga	Mbombela	Yes	Yes	Yes	15	235	0
	Emalahleni	Yes	Yes	Yes	2	5	0
	Govan Mbeki	Yes	Yes	Yes	0	0	0
	Msukaligwa	Yes	Yes	No	0	0	0
N Cape	!Kheis Municipality	Yes	No	No	1.8	60	No data
	Gamagara	Yes	Yes	Yes	1.95	9	0
	Hantam	Yes	No	No	0.208	8	0
	Kai!Garieb	Yes	No data	Yes	No data	No data	No data
	Karoo Hoogland	Yes	Yes	No	0.15	5	100
	Nama Khoi	Yes	No	No	0	0	0
	Sol Plaatjie	Yes	No data	Yes	No data	No data	No data
	Thembelihle	Yes	Yes	No	0.3	19	0
	Ubuntu	Yes	Yes	No	0	0	0
NW	Matlosana	Yes	Yes	No	14	125	0
	JB Marks	Yes	Yes	No	3.6	5	0

Province	Municipality	Allow SSEG onto network?	Have an official SSEG application process?	Have a NERSA approved SSEG tariff?	Installed capacity in Munic (MWp)	Total No. of registered SSEG systems	PV SSEG installed on municipal property (kWp)
W Cape	Beaufort West	Yes	Yes	Yes	0.753	17	0
	Bergervier	Yes	No data	No	No data	No data	No data
	Bitou	Yes	Yes	Yes	0.004	1	0
	Breedee Valley	Yes	Yes	Yes	3.013	100	0
	Cape Agulhas	Yes	Yes	Yes	1.14	29	0
	Cederberg	Yes	No	Yes	No data	No data	No data
	Cape Town	Yes	Yes	Yes	41.59	976	160
	Drakenstein	Yes	Yes	Yes	2.6	230	0
W Cape	George	Yes	Yes	Yes	5	57	0
	Hessequa	Yes	Yes	Yes	0.11	2	30
	Knysna	Yes	Yes	Yes	0.4	40	0
	Langeberg	Yes	Yes	Yes	2.413	71	0
	Matzikama	Yes	No	Yes	0.7	No data	0
	Mossel Bay	Yes	Yes	Yes	1.235	23	40.5
	Oudtshoorn	Yes	Yes	Yes	No data	No data	No data
	Overstrand	Yes	Yes	Yes	0.187	22	0
	Prince Albert	Yes	No	No	No data	No data	No data
	Saldanha Bay	Yes	Yes	Yes	1.2	8	0
	Stellenbosch	Yes	Yes	Yes	No data	No data	No data
	Swartland	Yes	Yes	Yes	0.163	43	10
	Theewaterskloof	Yes	Yes	Yes	0.246	23	0
	Witzenberg	Yes	Yes	No	3.5	20	0
TOTALS		56	44	31	282.137	3280	2932.5

3.4 Numbers of SSEG systems installed

3.4 1 Registered SSEG systems

Numbers of SSEG systems registered with municipal distributors is shown below for different system size categories.

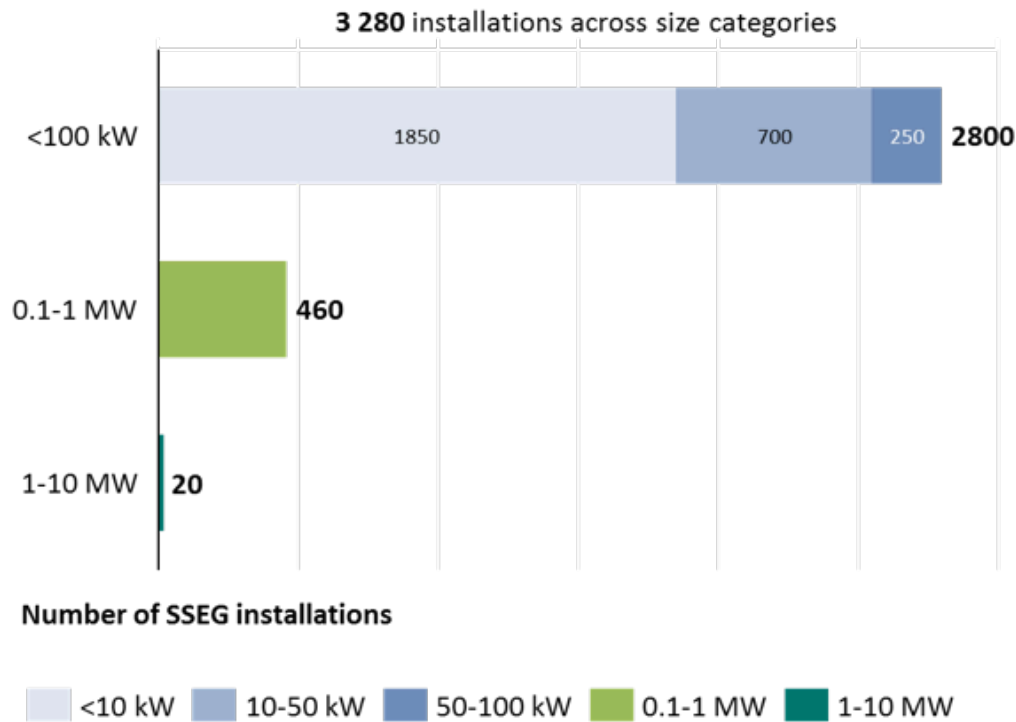


Figure 5: Total Number of registered SSEG installations for different generator size categories in all municipalities

The graph shows that, predictably, small systems are in the majority, with numbers decreasing as generator capacity (and SSEG system cost) increases. The exception is the 100 kW to 1 MW range, because systems over 1 MW require a NERSA license according to Schedule 2 of the Electricity Regulation Act, and thus customers wishing to install systems in this size range will often choose not to exceed 1 MW in system size to avoid the license application process.

3.4.2 Unregistered systems

By definition, the data for unregistered SSEG systems is far from clear. Two metropolitan municipalities where aerial surveys have been undertaken are Cape Town and Johannesburg. Data from these two surveys show very different outcomes, as can be seen below.

Table 3: Unregistered SSEG system aerial surveys in Cape Town and Johannesburg

Metro	Registered PV SSEG data	Total registered and unregistered PV SSEG (from aerial survey)	% of systems unregistered	Notes
Cape Town	976 (41.6 MW)	Over 4000* (~50 MW)	76% (~17% of MW)	Cape Town has undertaken a drive to encourage systems to register, including an amnesty period.
Johannesburg	224 (44 MW)	33 803**	99%	Total SSEG installation survey data is part of ongoing research, and thus may change.

* - from the 2019 aerial survey of Cape Town's rooftop solar systems

** - Source: aerial survey data reported in PEETS (2020)

Cape Town's experience is that, while the majority of systems are not registered, the majority of generation capacity is accounted for in registered systems, as larger systems tend to register while smaller, typically residential systems often do not.

Based on the above, a conservative estimate may place the total number of systems – registered and unregistered – at **about 13 000 SSEG systems and 330 MW installed capacity in municipal distribution areas**⁴. These figures are speculative, however, and need verification. They may be significantly higher if Johannesburg's survey data is found to be common across other metropolitan municipalities.

An additional data source is the General Household Survey undertaken by StatsSA (2018), which reports on solar PV ownership. It estimates about 180 000 PV systems on urban households nationally (municipal and Eskom distribution areas), allocating around 16 000 systems to Cape Town and 59 000 to Johannesburg. These figures are clearly much higher than other estimates. The survey meta-data suggests that this data be 'approached with caution'⁵, and it will therefore not be used in presenting formal data with respect to SSEG at this stage.

The above points to the need for clarity on unregistered SSEG in the country. The 2021 national census may help in this regard.

3.5 How municipalities developed their SSEG processes

Municipalities have used different routes to establishing their SSEG processes. The figure below reflects municipal responses regarding the main routes followed in this regard.

⁴ Using Cape Town's situation of 76% of systems being unregistered, and 17% of installed MW being unregistered

⁵ The survey only covered 20 000 households, and received 184 positive responses to owning a PV system, from which it extrapolated nationally. The meta-data does not regard this as reliable.

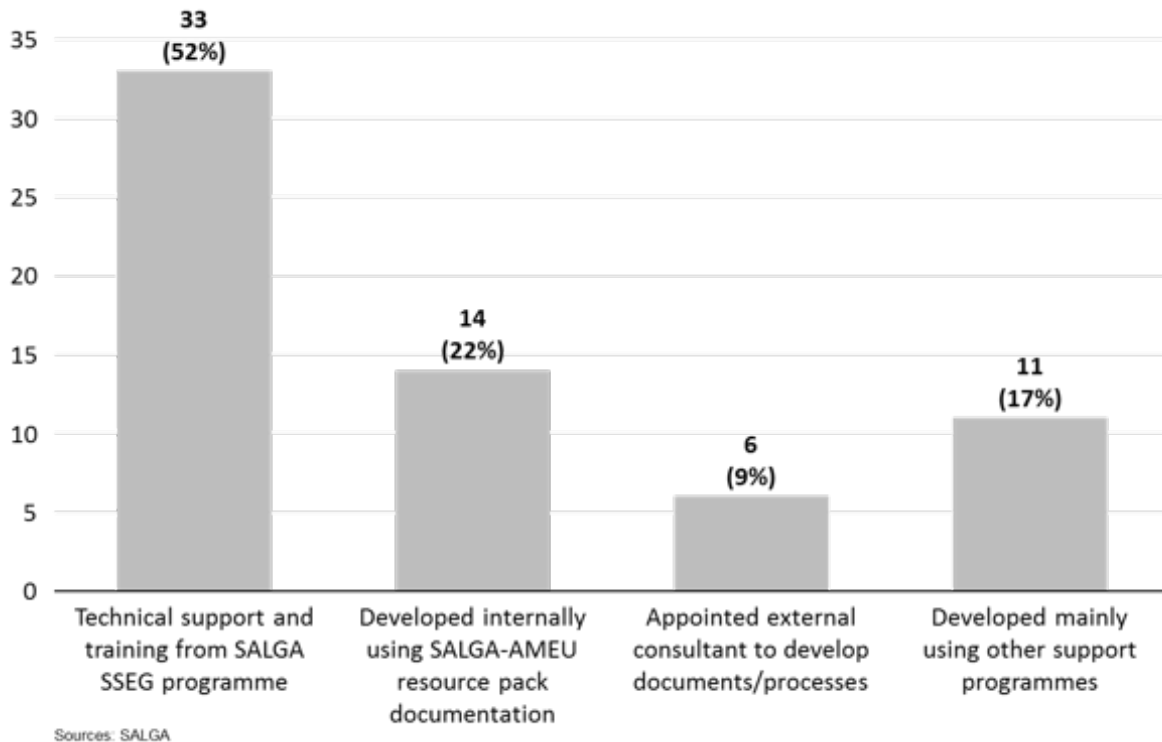


Figure 6: Main route followed in developing SSEG application processes (municipalities could list more than one option)⁶

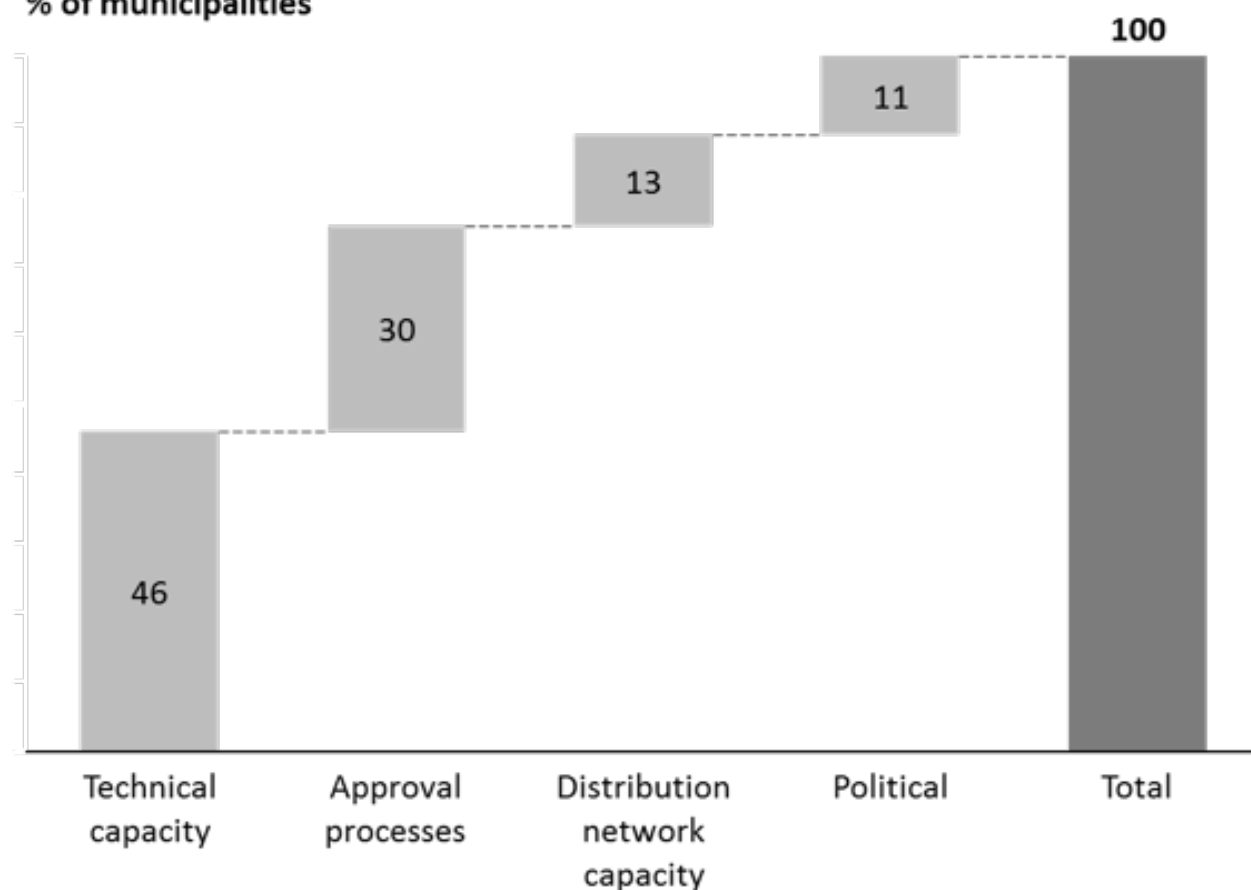
The value of support programmes in assisting municipalities to develop their SSEG processes is apparent from Figure 6 – either to provide them with the necessary documentation and resources to undertake this themselves, or via direct participation in SSEG support programmes.

3.6 Challenges faced by municipalities around SSEG

Municipal responses from the survey regarding the main challenges they face in accommodating SSEG onto their distribution networks are shown in the figure below.

⁶ Note that several organisations and SALGA partners have had a strong role in providing support to municipalities in these areas, including GreenCape (initial Resource Pack development, support for Western Cape Municipalities), Sustainable Energy Africa (SSEG documentation development, technical support and training for municipalities around the country), Solar Training Centre (convening training of municipalities around the country and providing technical support), and CSIR (grid impact study and PV procurement support).

% of municipalities



Sources: SALGA

Figure 7: Main Challenges in accepting SSEG onto municipal distribution networks

Technical capacity and approval processes are considered the main problem areas around accepting SSEG onto municipal networks with over 75% of municipal responses indicating such. These typically would revolve around being short staffed, and staff being unfamiliar with SSEG technology and assessment. Further rollout of municipal SSEG support programmes should help alleviate these issues. In some cases, grid capacity to accept SSEG and political issues are noted near equally as challenges. Political issues might point to some remaining misunderstandings around technical and revenue impacts of SSEG on municipal distribution networks.

3.7 Support needs of municipalities

The vast majority of municipalities noted areas where they still require support, even where they have existing SSEG processes and tariffs in place. This reflects the fact that SSEG is relatively new, and technical and administrative staff often lack experience dealing with associated issues that emerge.

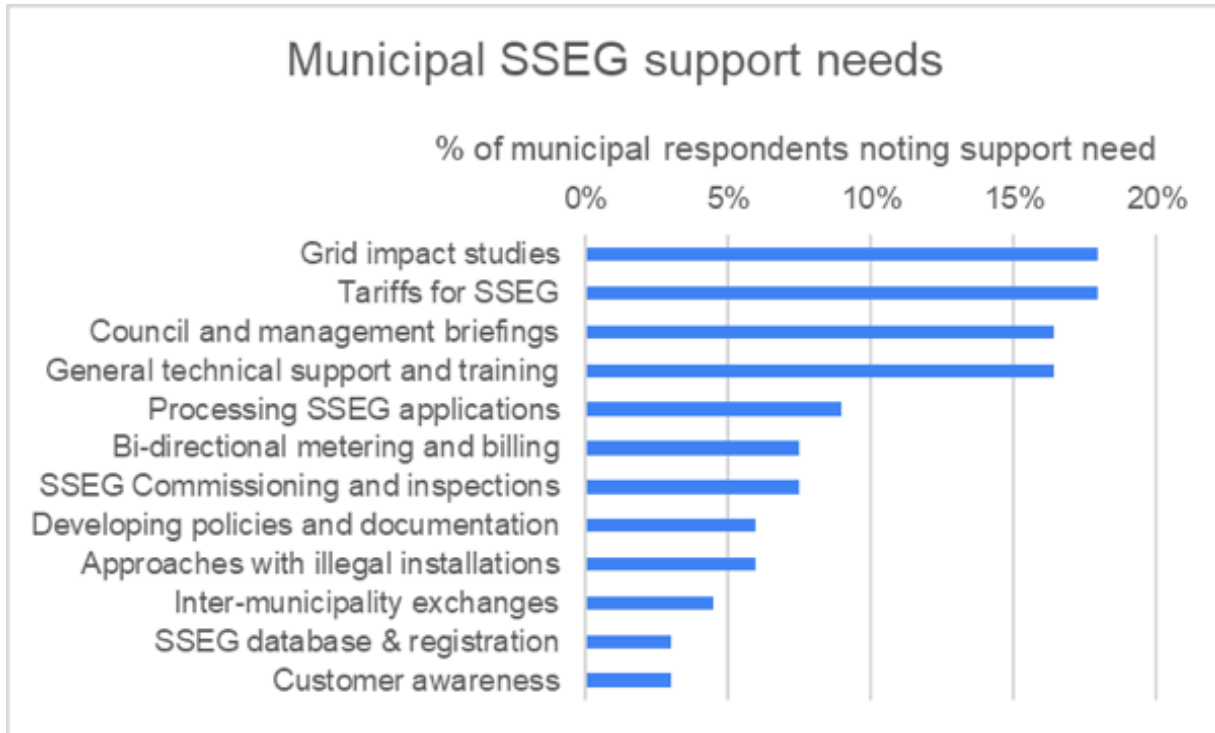


Figure 8: SSEG support needs of municipal respondents

The need for ongoing support around SSEG for municipalities is clear. Support offered to municipalities through SALGA's SSEG Support Programme, in partnership with other organisations, is discussed below. GreenCape also provides support to Western Cape municipalities.

4. OVERVIEW OF THE MUNICIPAL SSEG SUPPORT PROGRAMME

The Municipal SSEG Support Programme has been in existence since 2017, and is a partnership between SALGA, the Department of Mineral Resources and Energy, and GIZ. It is implemented by Sustainable Energy Africa NPC, with the Solar Training Centre and CSIR. Its objective is to capacitate municipalities to be able to allow SSEG onto their networks in a technically sound and safe manner, and to support SSEG tariff setting to protect both the interests of the municipality and SSEG investors. The programme provides training for municipal distributors, as well as a comprehensive set of documentation which can be used in municipal SSEG processes. There are currently 40 municipal partners in the programme, and each year invitations are sent to all municipalities to apply to join.

The following is offered to municipal distributors:

- Annual 5-day training courses on SSEG, enabling municipalities to develop the necessary documentation and start processing SSEG applications from customers
- Specialist trainings, including:
 - o grid impact studies
 - o tariff setting
 - o bi-directional metering
- A series of online SSEG training courses - available at www.training.sseg.org.za
- An ongoing technical support help desk when problems or queries arise
- Resource portal with all relevant documentation and training resources – www.sseg.org.za

The SALGA-AMEU SSEG Resource Pack is a complete set of documentation for municipalities establishing SSEG processes:









OVERVIEW of the AMEU-SALGA Small-Scale Embedded Generation Resource Pack

The electricity landscape is evolving rapidly and municipalities are having to accommodate increasing numbers of Small Scale Embedded Generators (SSEG) onto their distribution grids. The AMEU-SALGA SSEG Resource Pack provides the necessary documentation to establish an SSEG application and commissioning process in a municipality.

The Pack draws on the experience of pioneering municipalities as well as a range of additional expertise, and is designed to be easily customised and adopted by other municipalities.

CORE DOCUMENTS

Policy Requirements Document Specifies what SSEG the municipality allows, what's not allowed and the application process	Application Form To be filled in by customers wishing to install SSEG	Commissioning Report Testing and sign-off of installed SSEG to enable generation onto network	Public Information and Examples General information flyer/sheet for the public (e.g. can be included in rates bill)
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 MUNICIPAL PROCESS DOCUMENTS AND LEGAL FRAMEWORK			
Assessment Process Control Document Checklist of all steps in assessing the application by different departmental sections	Record Keeping Template Record of installed SSEG systems (facilitate submission to NERSA)	SSEG By-law Text to be used in municipal electricity by-law amendment to make policy legally enforceable	SSEG Contract Contract between municipality and SSEG customers to set obligations of parties and billing arrangements
 TECHNICAL SUPPORT DOCUMENTS			
Metering Guide Bi-directional meter options available, including 'smart' metering	SSEG Tariff Tool and Guide Tariff Setting guide and Revenue Impact check to enable tariff proposal for submission to NERSA	Grid Impact Studies Guide How to assess SSEG applications where they exceed criteria in "Simplified connection criteria" of NRS097-2-3	All these, as well as other supporting documents are available at https://www.sseg.org.za/ For support or further information: nngidi@salga.org.za Tel: 012 369 8000
RESOURCE PACK DEVELOPERS AND CONTRIBUTORS: <div>       </div>			

All of these documents and additional resources are available online at www.sseg.org.za.

How to join the Municipal SSEG Support Programme

Annual invitations to participate in the programme are circulated to all municipalities. To participate and receive SSEG capacity building support, send an email to smulaudzi@salga.org.za or support@sseg.org.za

For any additional support inquiries contact SALGA as follows:

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5. APPENDICES

5.1 ANNEX A: Data compilation approach

The primary data source for the tables and graphs presented in this report is a survey SALGA sent to all municipalities in early 2020. A total of 61 municipalities out of 165 licensed distributors responded. Based on SALGA technical team's experience, responses covered almost all municipal distributors that have SSEG processes in place or who are busy establishing these. Where other data sources were available (such as the table of Western Cape municipalities that allow SSEG or have SSEG tariffs – provided by GreenCape), these were cross checked and included in the totals where omissions were identified. While it is likely that the final data picture covers SSEG status in municipal distributors well, it is possible that some municipalities with SSEG processes have been omitted, along with SSEG installations in these distribution areas.

Municipal distributors having SSEG tariffs were cross-checked with the NERSA list of approved SSEG tariffs and adjusted where necessary. Two municipalities which had previous SSEG tariffs but whose new tariff was not approved by NERSA were also included.

For the first time the SALGA survey collected information on numbers of SSEG systems, installed capacity, challenges encountered, and support needs of municipal distributors regarding SSEG. This will enable closer tracking of developments in this space into the future, as well as more targeted support initiatives.

5.2 ANNEX B: Solar PV price benchmarks

The below table provides indicative SSEG pricing and tariffs. Note that these are likely to vary in practice.

System size	Typical application	Capital cost of system (per kWp)	Approx cost of energy (R/kWh)
1kWp to 10kWp	Residential	R18000 – R28 000	R1.50 – R2.50*
> 50 kWp and <100 kWp	Shop, small office	R12 000 – R15 000	R0.90 – R1.20**
> 100 kWp and < 500 kWp	Office block	R9 000 – R13 000	R0.80 – R1.00**
> 500 kWp	Factory, warehouse	R8 000 – R12 000	R0.60 – R0.90**

* - own calculations from installer prices

** - Power Purchase Agreement tariff (Source: GreenCape 2020)

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This image shows a single sheet of white paper with horizontal ruling lines. The lines are evenly spaced and run across the width of the page. There are no margins, text, or other markings on the paper.



This image shows a full page of a handwriting practice worksheet. It consists of multiple rows of horizontal dashed lines spaced evenly down the page, providing a guide for letter height and placement. The background is plain white, and there are no other markings or text present.



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