Regulatory and Tariff Review for Distributed Generation in the Commercial and Industrial Sectors in Southern Africa

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Front Cover: *A row of solar panels basking in the sun to generate electricity.*

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Windmill energy at sunset in the Western Cape, South Africa.

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Farmworkers sorting tomatoes in a greenhouse. Operations such as these could be powered by renewable energy self-supply options, reducing reliance on often unreliable grid electricity.

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Abbreviations and Definitions

BWP	Botswana Pula
CENORED	Central North Regional Electricity Distributor
COCT	City of Cape Town
Cost-recovery tariff	An average tariff level that allows an electricity supplier to recover the efficient costs of operation from its customers.
Cost-reflective tariff	A tariff structure that allows an electricity supplier to recover revenues from its customers that reflects the structure of its costs of supply, i.e. network and energy costs.
DFI	Development Finance Institutions
BERA	Botswana Energy Regulatory Authority
BPC	Botswana Power Corporation
C&I	Commercial and Industrial
COSS	Cost of Service Study
DG	Distributed Generation. DG is electricity generation from a power plant that is connected to a distribution network, rather than the transmission network. Such plants are not dispatched by national control centers, but operate on a "must take" basis (applies to the excess power not used by the owner/operator of the DG facility). Distributed Generation is therefore also referred to as 'embedded generation' or 'captive power'.[1]
ECA	Economic Consulting Associates
ECB	Electricity Control Board (Namibia)
ECC	Error Connection Code
ECRE	Energy Conservation and Renewable Energy (Zimbabwe)
EGENCO	Electricity Generation Company of Malawi
EIA	Environmental Impact Assessment
ESCOM	Electricity Supply Company of Malawi
ERB	Electricity Regulation Board (Zambia)
ESI	Electricity Supply Industry
FiT	Feed-in Tariffs
HH	Household
HV	High Voltage
IDC	Industrial Development Corporation
IFC	International Finance Corporation
IPP	Independent Power Producer
IRP	Integrated Resource Plan (Botswana, Malawi, South Africa)
K	Zambian Kwacha
kVA	Kilo-volt-ampere
kW	Kilowatt
kWh	Kilowatt hour
kWp	Kilowatt peak
LV	Low Voltage
MAREP	Malawi Rural Electrification Program
MBS	Malawi Bureau of Standards

[1] In principle there could be DG in mini-grid systems, but mini-grids are not the focus of this assessment.

MCC	Millennium Challenge Corporation
MERA	Malawi Energy Regulatory Authority
MK	Malawian Kwacha
MME	Ministry of Mines and Energy (Namibia)
MoEPD	Ministry of Energy and Power Development (Zimbabwe)
MSBM	Modified Single Buyer Model (Namibia)
MV	Medium Voltage
MW	Megawatt
NAD	Namibian Dollar
NDP	National Development Plan
NEP	National Electrification Policy
NERSA	National Energy Regulator of South Africa
NIRP	National Integrated Resource Plan (Namibia)
NGO	Non-Governmental Organisation
OGEMP	Off-grid Energization Master Plan
pcm	Per calendar month
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
SSDG	Small-scale Distributed Generation. SSDG generally refers to electricity generation from small-scale systems, such as PV modules, small wind turbines and micro-hydro schemes that are located close to the end user and are intended to be primarily used for self-supply. What constitutes 'small-scale' is related to the excess power which may be sold to the main grid. In large, developed national systems DG plants of MW scale can be accepted as embedded, while in a small system, a limit of as low as 50 kW may be deemed appropriate. As a working definition, in this study, "small-scale" will generally be regarded as a DG project with a capacity of between 200 kW and 1 MW.
TA	Technical Assistance
TCA	Transmission Connection Agreement
ToU	Time-of-Use (in reference to tariffs)
US$	United States Dollars
USAID	United States Agency for International Development
USc	United States Dollar cents
WB	World Bank
WTP	Willingness to Pay
ZAR	South African Rand
ZERA	Zimbabwe Energy Regulatory Authority
ZETDC	Zimbabwe Electricity Distribution Company

Executive Summary

Most countries in Southern Africa currently face power shortages, resulting in load shedding.[2] Such poor-quality electricity supply presents challenges to businesses which are producing and supplying goods and services. The weakness or absence of such thriving businesses is detrimental to these countries' development through lost employment and tax revenues, among other aspects.

Southern Africa's high solar Photovoltaic (PV) power potential, coupled with decreasing solar equipment costs, provides an opportunity for investments in Small-Scale Distributed Generation (SSDG) to mitigate unpredictable supply. SSDG provides higher reliability of supply due to generation taking place at the point of consumption. SSDG, which usually comes from clean renewable sources, also provides additional benefits to society by reducing carbon emissions relative to centralized thermal power plants.

In the Commercial and Industrial (C&I) sector, rising electricity prices, more stringent environmental policies and government support programs to support the growth of the solar PV market, have led only to moderate SSDG uptake. This is despite the significant potential benefits for C&I firms, notably improving security of supply and lowering energy costs. This report provides a review of the frameworks for SSDG, focused specifically on the C&I sectors, in six Southern African countries: Botswana, Malawi, Namibia, South Africa, Zambia and Zimbabwe. It presents the economic and financial drivers for SSDG investments and explores whether, and in which cases, SSDG could provide more reliable, less costly power to C&I businesses.

Grid unreliability provides incentives for SSDG in some countries, but the opposite is true in others.

Most countries in the region experience regular load shedding. This has led to many electricity consumers seeking alternative energy supply through SSDG, where the costs of interrupted electricity supply or diesel-based self-supply are greater than the costs of SSDG. While this stimulates SSDG development, it is clearly detrimental for national development. Conversely, Botswana's sector recovery and more reliable supply (combined with subsidized electricity prices) has removed much of the incentive for SSDG. Grid impact studies can address utility concerns about the capacity of SSDG that grids can absorb.

Utility tariffs are almost all below cost-recovery levels and should be increased to send the right price signals for SSDG.

Only Namibia has utility tariffs at cost-recovery levels. Low tariffs are not only detrimental to utility financial performance but also send the wrong price signals to C&I customers interested in SSDG. As electricity prices increase, the business case for self-supply strengthens as costs can be avoided. Cost of Service Studies (COSS) can support tariff increases.

Utility tariffs broadly follow cost-reflective structures, although accurate pricing is difficult to determine.

All countries have tariff structures that combine fixed network charges and variable energy charges, which reflect to some degree the costs imposed on the electricity system by C&I customers. Similarly, all countries except Botswana, have Time-of-Use tariffs that price energy differently depending on the time of day. The impact of such pricing structures has nuanced impacts on SSDG business cases for C&I businesses depending on the timing of their peak load vis-à-vis the peak energy charges, and the daylight hours within which solar PV SSDG can allow self-supply. Without COSS, it is difficult to determine how accurate utilities' cost structures are, and whether they are sending accurate price signals to C&I customers.

SSDG frameworks are at varying degrees of development and implementation.

SSDG frameworks, including licensing requirements, establish the environment for SSDG investments from the C&I sector. While all the countries have made some progress towards developing frameworks for SSDG for the C&I sector, in some of the countries progress has been muted (e.g. Botswana, Zambia, Malawi). At the other end of the spectrum, Namibia has embraced SSDG and developed a robust regulatory framework

[2] In South Africa's case, despite apparently having adequate capacity, operational problems nonetheless lead to load shedding. This reinforces motivation for a more conducive environment to encourage investment in distributed generation.

which now needs only more sophisticated upgrades as its electricity market develops. Regional support to develop robust SSDG frameworks will enhance the business case for C&I investment.

Net metering frameworks are mixed across the region.

Net metering frameworks can prove additional incentives for C&I SSDG, even with utilities in poor financial health, as they don't require cash payment obligations to customers from utilities with weak ability to meet them. While Namibia has a strong net metering framework in operation, other countries are lagging, despite promises in some cases to develop these. Additionally, some of the frameworks have maximum thresholds which exclude C&I customers, e.g. Zimbabwe. While it is important to create a level playing field for SSDG investments, the financial impact on utilities should also be considered.

FiTs are an inappropriate tool for stimulating SSDG investments.

Each of the focus countries has considered Feed-in Tariffs (FiTs), with implementation to different degrees. Standardized FiTs are becoming increasingly unattractive to countries, particularly because of the additional financial burden they place on utilities that are already in poor financial health.

Utilities require convincing that SSDG need not be loss-making.

Research was hampered by a lack of engagement from utilities and stakeholders reported strong reluctance from them to support SSDG framework development. A properly developed SSDG framework, combined with tariffs that are both at cost-recovery levels and with cost-reflective structures, should leave utilities neutral on financial performance, but the arguments for this need to be clearly spelled out to the utilities.

Financial support and sector-wide technical assistance will assist SSDG development.

Sourcing appropriately-priced finance and knowledgeable installers and technicians is a barrier to sector development across all countries. The latter barrier can be addressed through technical assistance to support vocational training through local training institutions. Financial support can also be provided, although it should be careful to be catalytic and additional to local financial systems.

Recommendations

The following recommendations should be applied to each of the countries, but to different degrees depending on their SSDG market development. The order of recommendations reflects their priority; the recommendations may not all be required for every country. Specific country-level recommendations are presented below this using the same numbering system.

1. **Support market awareness-raising activities and financial support to C&I companies and/or installers.**
2. **Develop streamlined licensing frameworks for SSDG that support the efficient development of C&I SSDG. This includes setting levels of complexity in licensing requirements that are appropriate for the size of the system. Technical assistance may be required to ensure frameworks are properly understood.**
3. **Promote tariff levels that allow full cost-recovery, tariff structures that reflect the costs imposed on electricity networks by each customer category, and Time-of-use Tariffs that send efficient price signals on energy consumption and supply at different times of day.**
4. **Develop net metering frameworks that can provide additional incentives for SSDG through offering a net revenue stream from surplus energy fed back into the grid.**
5. **It is not recommended using FiTs as an additional incentive for SSDG.**

Country	*Recommendation(s)*				
	Market awareness and financial support	Streamlined frameworks	Cost-recovery and cost-reflective tariffs	Net metering frameworks	Remove FiT frameworks (or plans for frameworks)
Botswana	✓	✓	✓	✓	✓
Malawi	✓	✓	✓	✓	✓
Namibia	✓				✓
South Africa	✓				✓
Zambia	✓	✓	✓	✓	✓
Zimbabwe	✓	✓	✓	✓	✓

Introduction

1.1 Background and objectives of the assignment

All countries in Southern Africa are currently facing power shortages, resulting in electricity imports or load shedding.[3] The generation and demand gap will widen if the countries do not invest in the development of new power plants.

The high solar PV power potential in Southern African countries, coupled with decreasing solar equipment prices, provides an opportunity for investment in SSDG. SSDG increases efficiency and provides higher reliability of supply, due to generation taking place at the point of consumption. SSDG from renewable sources can provide additional benefits to society by reducing the amount of pollutants that are emitted from centralized power plants.

In the C&I sector, rising electricity prices, more stringent environmental policies and government support programs to support the growth of the solar PV market, have led to the development of several rooftop solar SSDG projects. However, despite a growing market in South Africa and Namibia, growth in other Southern African markets has been limited and largely untapped. Even in South Africa, the potential for more growth in this segment is enormous.

There are several challenges that prevent the growth of Small-Scale Distributed Generation (SSDG) projects,[4] including a lack of coherent policy and regulatory frameworks, tariff levels and structures that send distorted price signals to SSDG investors, and governments without strong focus on SSDG framework development and implementation. SSDG has significant potential benefits for C&I firms, notably improving security of supply and lowering energy costs and improving private sector competitiveness. There are also benefits for constrained national power systems through increased generation capacity on networks, distributed to balance network loads and reduce losses.

Recognizing that regulations and clarity on tariffs creates obstacles for distributed generation, IFC commissioned Economic Consulting Associates (ECA) to carry out this assignment and develop this report. The objective of the assignment is to **"review the existing legal and regulatory frameworks for small-scale distributed generation deployment and tariff regime focused primarily on solar PV in the Commercial and Industrial (C&I) sector in the following countries: Botswana, Malawi, Namibia, South Africa, Zambia and Zimbabwe (target countries)."**

1.2 Approach and methodology

The assignment focused on three key tasks:

Task 1

Review existing policies and regulatory framework related to SSDG in the C&I sectors utilizing Renewable Energy (RE).

Task 2

Review existing tariff regimes and net metering policies for C&I customers considering SSDG, identifying key challenges and barriers.

Task 3

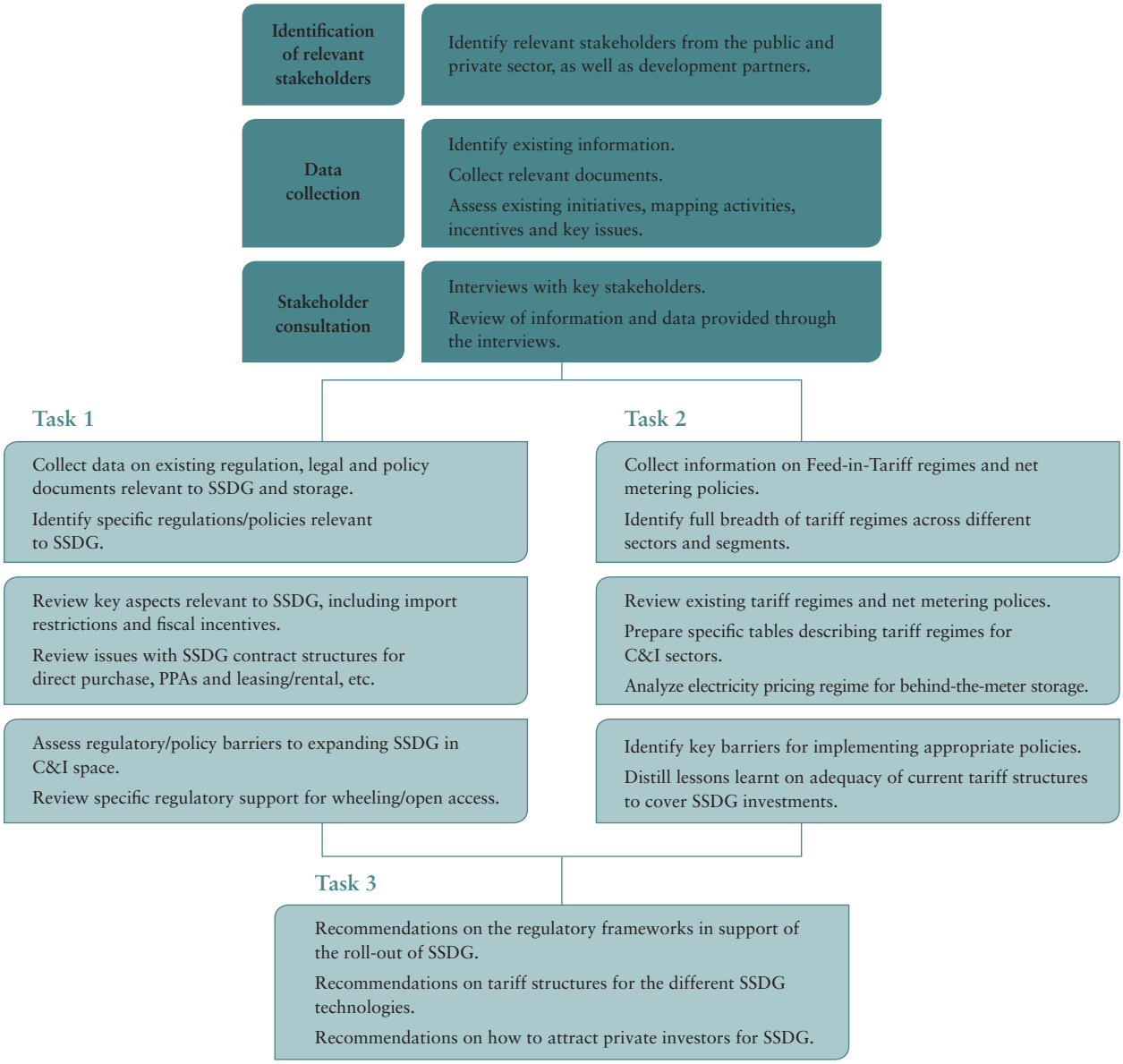
Provide regulatory and policy-related recommendations to support private investment and operations in C&I SSDG.

Figure 1 shows the step-by-step approach for completing this assignment.

[3] In South Africa's case, despite apparently having adequate capacity, operational problems nonetheless lead to load shedding. This reinforces motivation for a more conducive environment to encourage investment in distributed generation.

[4] A definition of small-scale distribution is provided in the Abbreviations and Definitions at the beginning of this report.

Figure 1: Approach to the assignment



1.3 Objective and structure of this report

This report presents findings for the assignment tasks. Stakeholders will review it, under supervision of IFC, with feedback provided to ECA for inclusion in the Final Report. This Report is structured as follows:

- Section 2 presents Part One – Key Findings for the Region. This section summarizes the findings for Tasks One and Two, for all six countries and identifies regional trends, patterns and outliers. It concludes with Task Three recommendations that can be applied at the regional level. The primary intended audience for this section is policymakers, developers and investors operating at a regional level.
- Section 3 presents Part Two – Detailed Findings by Country. This section provides further detail of the Tasks One and Two analysis for each of the focus countries. Each section also provides Task Three recommendations for the countries. The analysis follow a consistent structure so that the reader can easily compare findings across countries. The primary intended audience for this section is national policymakers, country program managers and investors looking for information on specific countries' progress towards development of SSDG frameworks for C&I customers.
- Annex A1 provides extensive detail of the documents reviewed and the stakeholders consulted for the assignment's research.

Part One: Key Findings for the Region

This first section of the report presents an overview of the findings in the report. It provides information on regional trends, comparing and contrasting the findings of the focus countries. It offers recommendations of interventions that can be made across the region for more than just one or two countries.

2.1 Policies and regulations

Policies and regulations set a framework for SSDG development in a country. The Ministry with policy oversight for the electricity sector typically will develop the policy, while the Regulator of the electricity sector will develop and implement the regulations. All activities in the sector require consistent oversight from formal documents that have been developed through public consultation and which are available for public reference. Robust frameworks also provide certainty to investors in, and developers of, SSDG that their investments will retain their value.

The analysis has found that the development of policies and regulations can be relatively smooth, or become a drawn-out process, depending on political will and government and national stability. When they perceive that proposed frameworks may disadvantage them, **major stakeholders have an incentive to delay their development and implementation.** This is particularly the case for incumbent utilities and their support of SSDG frameworks. Utility profits can be reduced by customers turning to self-supply and utility obligations to take power from small-scale generators, particularly when frameworks are poorly designed. If policymakers have enough influence over the utilities, new frameworks should be developed without significant delay.

For other countries, **a lack of stability in the political system**, caused by economic conditions or political uncertainty, e.g. that brought on by an impending election, may also delay framework implementation. In such instances, what might appear to be somewhat minor policy and regulatory frameworks are unlikely to carry enough weight to demand the attention of policymakers focused on evidently more critical issues.

The focus countries for this assignment have each reached different stages in their development of frameworks to support C&I SSDG development. Table 1 presents a summary of the current status of SSDG policy and regulatory frameworks for the six focus countries of C&I SSDG market activity and some recommended actions.

Table 1: Policy and regulatory frameworks for SSDG

Country	*Status of SSDG policy and regulatory frameworks*
Botswana	Nothing in place specifically for SSDG, although discussions are taking place on net metering. Currently possible to register (<100 kW) or obtain a license (>100 kW) for SSDG, but the process for this is not formalized. There has been very limited C&I SSDG activity and the country could benefit from targeted support to develop a clear policy and regulatory framework for SSDG as a starting point for more detailed market development discussions.
Malawi	The Integrated Resource Plan (IRP) does not consider SSDG, reducing its profile in energy planning activities. Contrastingly, the National Energy Policy contains guidance on specific actions that appear to support SSDG, although these have not yet been implemented. There is a general perception in Malawi that the government is focused only on large-scale generation, with little interest in SSDG. According to the Electricity Act, SSDG operators need to have a generation license from MERA, which dissuades development. However, Malawi's Grid Code includes technical requirements for Connection of Variable Renewable Energy, which include SSDG. A FiT policy was adopted in 2012, defining energy tariffs for different RE sources for plants ranging from 500 kW to 10 MW, but implementation has been slow. C&I SSDG activity has been very limited, with the largest project being a donor-funded demonstration project. Support to the key public institutions (Ministry, ESCOM and MERA) to explain the benefits of C&I SSDG could help unlock the latent potential and interest in the market.

Namibia	The National Energy, Renewable Energy and Off-Grid Electrification policies all support the implementation of SSDG. The National Integrated Resource Plan and all other national plans make ample provision for the implementation of SSDG. The regulatory standards and rules are well-developed to ensure sustainable installations of quality and protect grid safety and security. C&I SSDG investment has been strong and minimal framework developments are needed for market stimulation.
South Africa	The policy on SSDG is still evolving. SSDG below 1 MW can be registered with NERSA and is not required to be licensed if the supply is for own use. Licensing is required if the supply is connected to the grid. SSDG projects between 1 MW and 10 MW require a license but under the new IRP2019 a ministerial exemption is not required, as was previously the case under the draft IRP2018. Any other SSDG capacity higher than 10 MW requires the investor to request an exemption from the IRP allocation. SSDG below 100 kW does not need to register with NERSA but with municipalities. C&I SSDG development has been strong and widespread. However, a lack of clear policy and regulatory direction, particularly in the alignment between national and municipal authorities, is delaying further market growth. The existing frameworks should only require minor revisions and clear promotion to municipalities for more extensive sector development.
Zambia	Policies and regulations related to SSDG are still evolving and current ones are not well-implemented; regulatory processes are lengthy and not streamlined. Zambia has been a strong leader in grid-scale RE development but lacks direction for SSDG and little C&I SSDG investment has taken place. While progress to address this is being made, particularly by ERB, additional support in market analysis, utility profitability assessments and process streamlining could support sector growth.
Zimbabwe	No current policy or regulation specifically for SSDG exists. The new Draft Renewable Energy Regulation will waive licensing fees for installation and operation of micro-grids and mini-grids with an installed capacity of less than 1 MW. ZERA extends light-handed regulation to community-based mini-grids and solar PV systems whose generation capacity is below 100 kW. The direction of this new regulation provides some guidance of the acceptability of a similarly light-handed framework for SSDG. Zimbabwe's very weak electricity sector is limiting C&I SSDG development and there are few examples of successfully implemented projects. Some effort has been made to develop appropriate frameworks but the completion and implementation of these is hampered by the current critical electricity and political situations. Technical support could potentially target simplified framework development to relieve some of the pressure on the strained electricity system.

Technical assistance to ministries and regulators can help to develop coherent and transparent SSDG policy and regulatory frameworks. Simultaneous stakeholder consultation is vital to ensure major stakeholders, e.g. utilities, understand the benefits of SSDG and aren't dissuaded by their inaccurate perceptions of its risks. Working with entities such as SADC RERA can assist in regional-level framework design, development and implementation.[5]

2.2 Drivers and impediments of SSDG investments

The primary drivers of C&I SSDG investments are the increased security of supply in countries with load shedding and the reduction of the cost of power consumed. For the former, SSDG can engage automatically (or be engaged manually) when the main supply fails, ensuring continuity of supply. It can also replace more expensive back-up power supplies, e.g. diesel generators. For the latter, the cost of power consumed from the main grid may be higher than the cost of power consumed from SSDG. In South Africa, for example, SSDG is now cost-competitive with electricity tariffs from Eskom.

Additional revenue (or reduced costs) from surplus power fed back to the main grid provides a secondary driver of C&I SSDG, as it is possible to sell back power on days when not needed by the end-customer (e.g. weekend days, holidays, etc.). This is typically observed in net metering.

Determining the importance of each driver in achieving commercial viability of SSDG is very specific to individual businesses, based on their load profile (volume, voltage, daily timing, weekday operation, seasonality), sunshine hours and the costs of SSDG equipment. For some, SSDG may be viable solely be addressing load shedding, while for others, additional drivers may be required.

[5] SADC RERA's function is to work with the regulators from all SADC counties, including the target countries, in a range of initiatives to align regulatory frameworks and increase the capacity to implement them. They provide a single point of contact with strong credibility to enact recommendations. Designing the regulations at regional level will also ensure consistency of approaches across the region. SADC RERA promotes interaction between regulators with different levels of SSDG framework development.

2.2.1 LOAD SHEDDING

Shortages of generation capacity and weak networks in most target countries have led to imbalances between electricity demand and supply, resulting in load shedding. Since all C&I businesses depend on power, frequent load shedding can lead to significant revenue losses and/or cost increases. Bloomberg estimates that power cuts experienced in South Africa in February 2019 cost the country US $68 million a day.[6] Similarly, in Zambia, the reported loss in turnover from load shedding of small business was US $1,400 a year.[7]

Many C&I businesses have invested in their own power generation to reduce this risk, including diesel generators and SSDG solar plants. For example, Rivonia, a large agriculture business in Zambia, installed 300 kW of solar PV to prevent revenue loss from load shedding. In Malawi, load shedding became more problematic in mid-2016 because of a shortage of available generation capacity. At the peak of the crisis, industrial users were left without power for 1-2 days per week; tea factories consumed 38% more diesel per kg of tea.

Load shedding was the main driver for many of the C&I companies and other institutions investing in SSDG. In addition to reducing diesel costs, SSDG solution can be more convenient to operate than diesel generators since there is no need to store or top-up diesel and they can engage automatically in case of power cuts (unlike some diesel generators).

2.2.2 TARIFF LEVELS AND STRUCTURES IMPACT ON SSDG VIABILITY SIGNIFICANTLY

A part of the financial case for SSDG for C&I customers is the savings from energy no longer consumed from the national grid off-setting the costs of the installed SSDG. Therefore, the tariffs for main grid electricity purchases have a large impact on SSDG viability. Table 2 presents a selection of the relevant C&I energy charges across the focus countries. No fixed/demand/capacity charges are presented here; these are given in more detail in Section 3.x.4 of each of the country analysis. Where a country has multiple electricity retailers, the tariffs for an example retailer are presented (City of Windhoek for Namibia and City Power Johannesburg for South Africa). Similarly, where a retailer has multiple closely-related tariff categories (City of Windhoek), a selection of these is presented. Figure 2 presents the same data from Table 2 in graphical form.

Table 2: Comparison of C&I energy charges across the focus countries[8]

Customer tariff category[9]	*Energy charge (US$/kWh)*
Botswana (from 1 April 2018)	
Small business up to 500 kWh	0.086
Small business 500+ kWh	0.127
Medium business	0.065
Large business (11kV)	0.059
Malawi (from 1 October 2018)	
General, Prepaid, Single Phase Supply	0.137
General, Post-paid, Single Phase Supply	0.131
General, Prepaid, Three Phase Supply	0.152
General, Post-paid, Three Phase Supply	0.139
400V peak	0.171
400V off-peak	0.058
11 kV peak	0.167
11 kV off-peak	0.055
Namibia (City of Windhoek; from July 2019)	
Business high season	0.169
Business low season	0.136
Business ToU, high season - Peak	0.211
Business ToU, high season - Standard	0.143

[6] https://www.fin24.com/Economy/lights-out-load-shedding-and-the-impact-on-local-business-20190215
[7] http://www.erb.org.zm/downloads/erbImpactOfLoadSheddingReport.pdf
[8] Conversions to US$ have been made at the prevailing spot exchange rates on 8 August 2019.
[9] Definitions of seasonal and peak periods are provided in the country analysis, and in further discussion to follow.

Customer tariff category[9]	*Energy charge (US$/kWh)*
Business ToU, high season - Off-peak	0.099
Business ToU, low season - Peak	0.144
Business ToU, low season - Standard	0.124
Business ToU, low season - Off-peak	0.093
Business Prepaid	0.209
Industrial ToU, max demand, high season - Peak	0.189
Industrial ToU, max demand, high season - Standard	0.121
Industrial ToU, max demand, high season - Off-peak	0.072
Industrial ToU, max demand, low season - Peak	0.125
Industrial ToU, max demand, low season - Standard	0.105
Industrial ToU, max demand, low season - Off-peak	0.074
South Africa (City Power, Johannesburg; from 1 July 2019)	
Business, high season	0.139
Business, low season	0.177
Industrial LV, high season	0.114
Industrial LV, low season	0.098
Industrial MV, high season	0.108
Industrial MV, low season	0.091
Industrial ToU, high season - Peak	0.256
Industrial ToU, high season - Standard	0.098
Industrial ToU, high season - Off-peak	0.067
Industrial ToU, low season - Peak	0.107
Industrial ToU, low season - Standard	0.081
Industrial ToU, low season - Off-peak	0.062
Zambia (from 1 September 2017)	
Commercial	0.037
Industrial 16-300 kVA	0.024
Industrial 16-300 kVA, ToU - Peak	0.030
Industrial 16-300 kVA, ToU - Off-peak	0.018
Industrial 301-2,000 kVA	0.021
Industrial 301-2,000 kVA, ToU - Peak	0.025
Industrial 301-2,000 kVA, ToU - Off-peak	0.016
Industrial 2,001-7,500 kVA	0.017
Industrial 2,001-7,500 kVA, ToU - Peak	0.021
Industrial 2,001-7,500 kVA, ToU - Off-peak	0.012
Industrial 7,500+ kVA	0.014
Industrial 7,500+ kVA, ToU - Peak	0.017
Industrial 7,500+ kVA, ToU - Off-peak	0.011

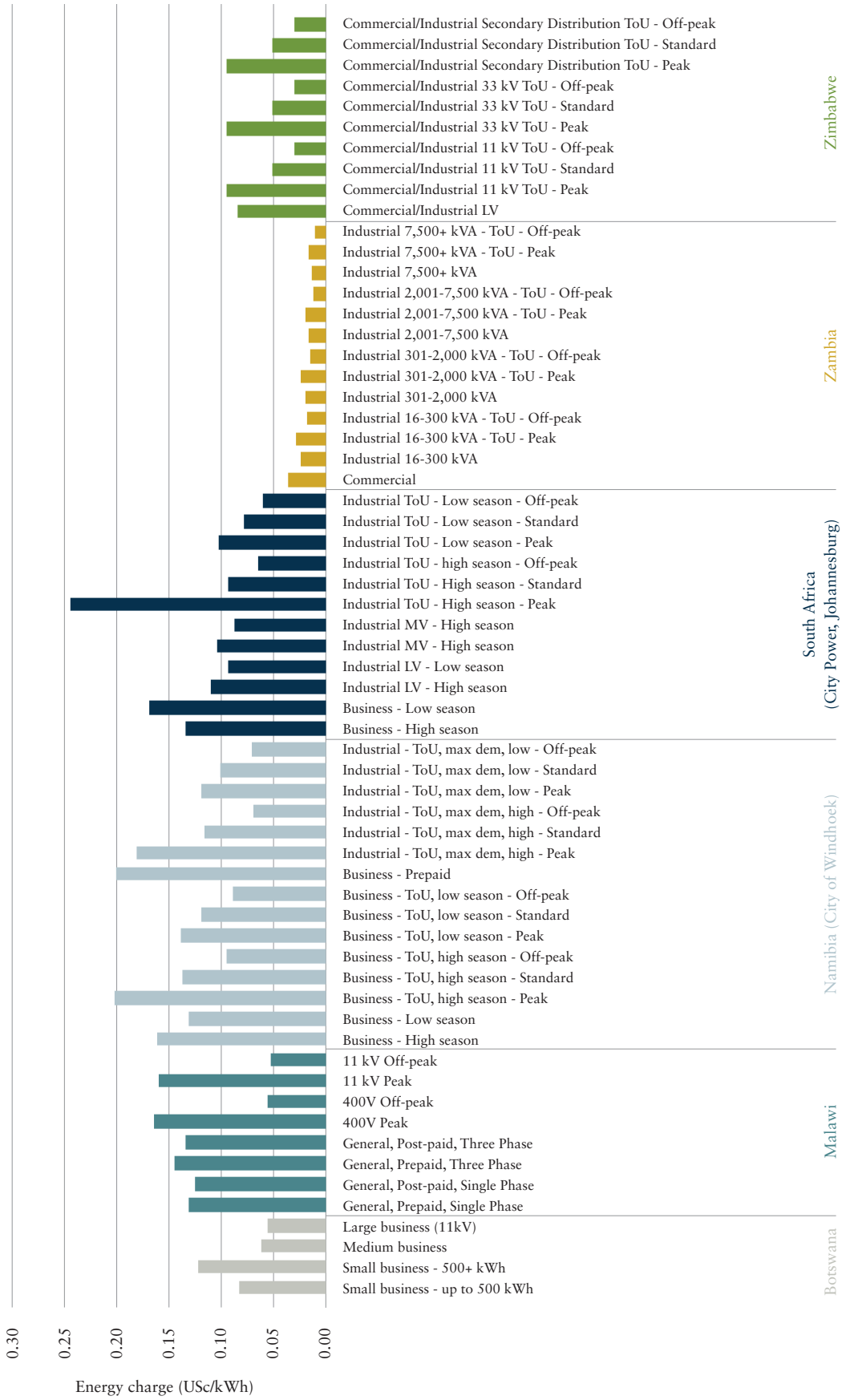
Customer tariff category[9]	*Energy charge (US$/kWh)*
Zimbabwe (from 3 October 2019)[10]	
Commercial/Industrial LV	0.088
Commercial/Industrial 11 kV ToU - Peak	0.099
Commercial/Industrial 11 kV ToU - Standard	0.053
Commercial/Industrial 11 kV ToU - Off-peak	0.030
Commercial/Industrial 33 kV ToU - Peak	0.099
Commercial/Industrial 33 kV ToU - Peak	0.053
Commercial/Industrial 33 kV ToU - Peak	0.030
Commercial/Industrial Secondary Distribution ToU - Peak	0.099
Commercial/Industrial Secondary Distribution ToU - Standard	0.053
Commercial/Industrial Secondary Distribution ToU - Off-peak	0.030

Source: BPC, MERA, ERB, City Power Johannesburg, ECB, ZETDC

Multiple solar panels in a rural pasture.

[10] While Zimbabwe's tariffs have recently increased, they have also been converted to Zimbabwe Dollars (from US Dollars). With the current high levels of inflation, presenting these tariffs in USD values today is somewhat misleading as they will likely be inaccurate soon after publishing. They are recognized as now being significantly below true costs, many of which are not denominated in Zimbabwe Dollars.

Figure 2: Comparison of C&I energy charges across focus countries



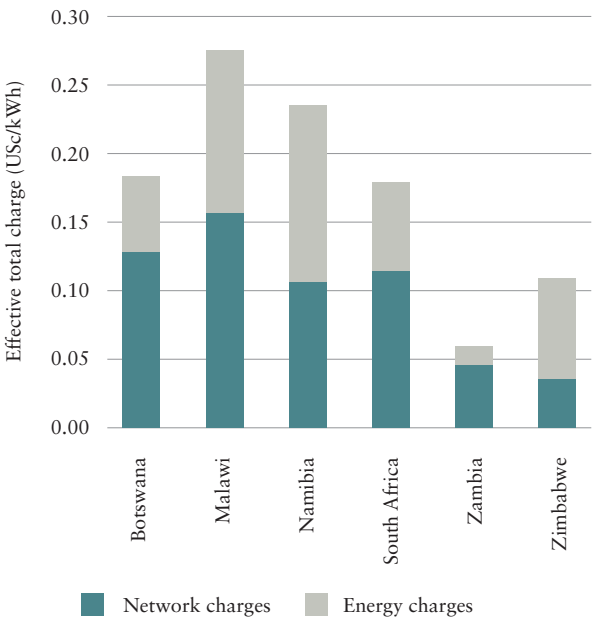
Source: BPC, MERA, ERB, City Power Johannesburg, ECB, ZETDC

Energy charges could be included with a simulation of what a "typical" energy bill per average unit consumed might look like for a C&I business that may consider investing in SSDG, in each of the countries. This includes all fixed, network, capacity, etc., charges, and accommodates variation in tariffs by time of day, day of week and season, where applicable. The assumptions for this are for a business:

- that operates from 7am to 7pm, Monday to Friday, 52 weeks/year;
- with a peak load of 500 kW, or 556 kVA at an assumed 0.9 power factor and assumed reactive power of 29 kVArh; and
- an average load of 50%, resulting in average hourly consumption of 250 kWh.

With these assumptions and the tariffs presented above, an annual electricity bill, averaged over all hours of consumption for one year is presented in Figure 3.

Figure 3: Average electricity bill per kWh for notional C&I customer in each country



Source: BPC, MERA, ERB, City Power Johannesburg, ECB, ZETDC, ECA analysis

The information presented in Figure 3 shows the differences in average charges across all countries, with the stark contrast of the very low charges in Zambia and the somewhat distorted charges in Zimbabwe. The differences between the other four countries are comparatively much less pronounced.

The tariff data presented can lead to some conclusions regarding the potential for SSDG and recommendations of how this may be enhanced, as discussed further on.

Cost-recovery tariffs can aid SSDG investment

Tariffs across the region are typically well below cost-recovery levels (Namibia is the exception). It is not possible to show the full extent of this with the data available; COSS for each country will give a more accurate explanation of the degree to which tariffs are below cost.

Low tariffs provide price signals that encourage the use of main grid electricity even if it is costly to produce. These same signals reduce the savings from SSDG, and therefore lower the financial incentive to self-supply through SSDG.

Increasing tariff levels to cost-recovery levels has obvious benefits to the commercial viability of national utilities. In addition, tariff level increases, even if not to fully cost-recovery levels, will increase the potential savings to investors from self-supply through SSDG. Tariffs at cost-recovery levels also give a greater incentive for utilities to purchase power from SSDG through FiTs, if the FiTs are also at cost-recovery levels. Fully-priced FiTs that are higher than consumer tariffs from the utility lead to negative margins for each unit purchased.

Tariff levels should be increased to cost-recovery levels. This will enhance the commercial viability of utilities and increase the financial viability of SSDG investments.

Cost-reflective tariffs may reduce SSDG potential

Contrastingly, if tariff structures were more cost-reflective, i.e. structured such that they reflected the balance between largely fixed network charges and largely variable energy charges and between different customer categories, the incentives for SSDG would likely reduce. Tariff structures observed in Southern Africa tend to be weighted towards variable energy charges over fixed network charges and towards large consumers over households.[11] Cost-reflective tariffs would likely increase the weighting of fixed network charges over energy charges and decrease the energy charges faced by large customers as compared with those faced by households.

All countries have network charges for at least some C&I customers, in most cases based on the peak demand of the customer.[12] Without full COSS for each country, it is difficult to give a definitive perspective on the extent to which these are cost-reflective; that is, do they accurately reflect the costs a particular customer or category of customers impose on the network?

Stakeholder feedback voiced common issues about fixed charges as a deterrent to SSDG but this may be short-sighted. While it is true that reducing electricity consumption through self-supply from SSDG should reduce energy bills, in many cases the C&I customer will want to retain access to the same capacity of supply from the network, should they need it. The cost of this access

[11] This view is based both on the feedback from stakeholder interviews, the consultant's research of each country's tariff structures and the consultant's own experience of undertaking electricity COSS in Southern Africa.
[12] More detailed tariff information is presented in each country analysis section in Section 3 – Part Two.

is largely fixed, regardless of electricity consumption. Therefore, fixed network charges are likely to be incurred by C&I customers even after installing SSDG.

As tariff structures with a more cost-reflective weighting towards fixed network costs will reduce the total energy charge, the financial benefits of self-supply through SSDG will be reduced. Furthermore, tariffs that reduce the energy charges paid by C&I customers to be more cost-reflective relative to other customer categories will further reduce the potential savings from self-supply through SSDG.

However, cost-reflective tariff structures may be beneficial to certain C&I customers if they can reduce their peak demand through self-supply from SSDG, if their network charges are based on their maximum demand. This will reduce both their peak demand charge and their energy consumption.

While tariff structures that reflect the costs incurred will enhance the commercial viability of utilities, they may decrease the financial viability of SSDG investments. Recommending cost-reflective tariff structures supports improved sector viability though not necessarily for SSDG investment. Recommending a structure favorable to SSDG (low fixed network charges, higher variable energy charges) may be detrimental to utility financial health.

C&I customers should be supported to find solutions that allow them to reduce their peak demand by investing in SSDG.

Time-of-Use tariffs produce a more nuanced view

Some of the costs incurred by utilities can vary by the time of day because of the peak loads on the network and the availability of different types of generation. In Southern Africa, peak loads are in the evening when households are using lighting and cooking. At these times, utilities are more likely to use more expensive sources of generation to meet the relatively short spike in energy consumption. This is also likely to occur when many C&I customers have stopped operating and when the sun has gone down (meaning large-scale solar power and solar SSDG are not generating).

Rather than having the same energy charge across a day, Time-of-Use (ToU) tariffs provide incentives to customers to shift load away from peaks and towards off-peak times when the costs of supplying energy are lower. The data presented in Table 2 and Figure 2 show that all countries currently use ToU tariffs for some categories of C&I customers, with the exception of Botswana.

The impact of ToU tariffs will vary depending on the timing of the peak and off-peak periods. The ToU periods currently adopted by the focus countries are presented in Table 3.

Table 3: Time periods adopted for ToU tariffs

Country/retailer	*Off-peak*	*Standard*	*Peak*
Botswana		N.A.	
Malawi	00:00 – 07:00, 12:00 – 17:00, 20:00 – 00:00, (M-Fr); all weekends and public holidays		07:00 – 12:00, 17:00 – 20:00 (M-Fr only)
City of Windhoek[13]	22:00 – 06:00 M-Fr; 20:00 – 07:00, 12:00 – 18:00 Sat; all Sun	06:00 – 08:00, 13:00 – 18:00. 21:00 – 22:00 (M-Fr); 07:00 – 12:00, 18:00 – 20:00 Sat	08:00 – 13:00, 18:00 – 21:00 (M-Fr only)
City Power Johannesburg	22:00 – 06:00 M-Fr; 12:00 – 18:00, 20:00 – 07:00 Sat; all Sun	06:00 – 07:00, 10:00 – 18:00, 20:00 – 22:00 (M-Fr); 07:00 – 12:00, 18:00 – 20:00 (Sat)	07:00 – 10:00, 18:00 – 20:00 (M-Fr only)
Zambia	22:00 – 06:00 (assumed M-Fr, plus weekends)	06:00 – 18:00 (assumed M-Fr)	18:00 – 22:00 (assumed M-Fr)
Zimbabwe	22:00 – 07:00 every day	12:00 – 17:00, 21:00 – 22:00 (M-Fr); 11:00 – 17:00, 20:00 – 22:00 (Sat), 07:00 – 17:00. 20:00 – 22:00 (Sun)	07:00 – 12:00, 17:00 – 21:00 (M-Fr); 07:00 – 11:00, 17:00 – 20:00 (Sat); 17:00 – 20:00 (Sun)

Source: BPC, MERA, ERB, City Power Johannesburg, ECB, ZERA

[13] All times are in summer time; they shift one hour earlier during winter time.

The data presented in Table 3 shows that, other than Botswana, all countries have an evening weekday peak period from around 17:00 or 18:00 until somewhere between 20:00 and 22:00. In addition, except Zambia and Botswana, all countries also have a morning peak from around 07:00 or 08:00 until somewhere between 10:00 and 13:00.

ToU tariffs will lead to higher energy charges during the peak periods, lower charges in the standard period and lower charges still in the off-peak periods (Figure 2 shows graphically how these charges can vary between periods). Higher daytime energy charges (typically standard periods but may also include peak periods) will likely correspond with the time when SSDG (from solar) can provide an alternative power supply. C&I customers may be able to use SSDG to off-set the highest peak period charges and even some of the standard period charges, particularly if they also have battery storage available. However, if peak periods correspond neither with C&I consumption nor sunshine hours (in the case of solar SSDG), ToU tariffs won't provide any incentive for C&I self-supply from SSDG.

Tariff designs should include cost-reflective ToU structures to reflect the costs of energy supply at different times of day. ToU tariffs should provide incentives to C&I consumers to shift their load to off-peak times and to self-supply with SSDG. Botswana is the only country that doesn't currently have ToU tariffs.

Summary of tariff recommendations

Each of the recommendations made above should enhance the commercial viability of incumbent utilities and should therefore not be resisted. The role of tariffs in enhancing both utility and SSDG potential is summarized in Table 4.

Table 4: Impact on utility and SSDG viability from changes in tariff regimes

Possible changes to tariffs	*Impact on utility*	*Impact on SSDG potential*
Increases to cost-recovery levels	Positive	Positive
Changes to cost-reflective tariff structures	Positive	Positive/negative (depends on operating hours of the business)
Adoption of cost-reflective ToU tariffs	Positive	Positive/negative (depends on a given customer's load profile, a utility's peak period timing and the sunshine hours of that country)

- The **first recommendation**, increasing tariffs to cost-recovery levels, should increase the financial business case for self-supply from SSDG for all countries not currently with cost-recovery tariff levels (all except Namibia). This should also have a positive impact on the utility's commercial viability.

- The **second recommendation**, adjusting tariffs to be more cost-reflective, is a good economic policy and will also help improve the financial liability of the utility, as well as spur interest in self-supply from SSDG. It could be helpful for C&I customers operating outside peak times (e.g. a factory vs a hotel) which can reduce their peak demand with SSDG.

- The impact of the **third recommendation**, ToU tariffs, is difficult to determine on a cross-country basis. While there should be benefits for utilities, any increase in the viability of self-supply from solar SSDG will depend on a given customer's load profile, a utility's peak period timing and the sunshine hours of that country.

2.2.3 PROPERLY IMPLEMENTED NET METERING REGULATIONS INCREASE THE INCENTIVES FOR SSDG

While load shedding and high electricity tariffs are the key drivers for investments in SSDG in Southern Africa, net metering provides an additional incentive for SSDG by off-setting energy charges through feeding surplus electricity from SSDG back into the grid. This is particularly important for businesses that operate only during certain periods within a year, such as tobacco and tea companies, or businesses that are not operational during certain days of the week.

If the energy fed back is priced efficiently, it should increase the supply of energy for the utility without resulting in them incurring losses (through a discount on energy fed in compared with energy consumed; the discount is to account for network charges added to wholesale energy prices).

Analysis shows that few countries have operational net metering regulations, although some have documented frameworks not yet properly implemented and others have indicated an interest in designing frameworks. Table 5 summarizes the status of net metering frameworks in the focus countries.

Table 5: Status of net metering frameworks in the focus countries

Country	*Status of net metering framework*
Botswana	No net metering policy yet, but draft guidelines are being developed under leadership of BERA and have already been commented on by BPC.
Malawi	No net metering policy in place in Malawi although net metering is one of the strategies for renewable energy promotion highlighted in the NEP.
Namibia	The net metering policy has been in place since 2016 and is well-implemented.
South Africa	No national net metering policy and there are currently no plans for developing one. However, certain municipalities allow a limited amount of surplus power generated by solar systems to be off-set against energy usage, while others are allowing bi-directional metering (in the City of Cape Town and in Tshwane).[14]
Zambia	Nothing currently in place, but the Regulator is apparently developing one.
Zimbabwe	Net metering regulations were gazetted in early 2018, but are not yet properly implemented, owing in part to the overall sector instability and a lack of adequate promotion.

Source: ECA research

Net metering is a useful framework for supporting SSDG in countries where the national utility is in a difficult financial situation (which applies to five of the six focus countries; NamPower in Namibia is the exception). Unlike FiTs, net metering doesn't require cash transfers from the utility to the C&I SSDG customer for energy fed back into the grid as units are simply off-set against consumption. Provided the framework is developed appropriately, i.e. units fed back are discounted appropriately against the tariff paid for units consumed and networks are strong enough to absorb energy fed in, net metering should not disadvantage utilities.

Robust net metering frameworks can be developed in all countries that don't currently have them. If priced appropriately, energy fed back to the utility should not cause additional financial distress, but rather strengthen their generation and network capacity. Careful business cases should be developed for countries, in association with ministries, utilities and regulators. Regional bodies such as SADC RERA could assist in standardizing advice on net metering pricing and frameworks.

2.2.4 FiTS ARE AN INAPPROPRIATE POLICY FOR INCENTIVIZING SSDG INVESTMENTS

- Falling technology prices can make prices agreed for RE under a FiT calculated yesterday appear unfairly high for customers today.
- Competitive auctions (as shown most strongly in Zambia and South Africa) can lead to very low prices for RE capacity, dissuading fixing FiTs.
- Utilities with tariffs for consumers below cost-recovery levels are likely to face negative margins and make losses on every unit of energy purchased at standardized FiTs that are benchmarked to market prices.
- FiTs require cash payments to generators. Outside Namibia, utilities in Southern Africa are typically cash-strapped, making payment of FiTs a challenge.
- The total transaction costs of sourcing a given capacity of RE generation through multiple small RE generation projects under standardized FiTs and contracts are much higher than the equivalent costs of a competitive tender for a single large RE project.

FiT frameworks for SSDG are likely only to have limited benefit to C&I businesses. The reluctance of utilities to implement standardized pricing and contracts for RE generation is understandable given their financial state, and the potential to source much greater RE capacity through competitive tenders. Pursuing the development of FiT frameworks is not recommended.

Behind-the-meter storage

There is no specific pricing for behind-the-meter storage in any of the focus countries. However, all the focus countries, apart from Botswana, have Time-of-Use (ToU) tariffs, which should incentivize investments in behind-the-meter storage solutions. If the ToU tariffs are at both cost-recovery levels and cost-reflective in structure and, therefore, provide the right price signals on energy costs, a C&I customer with solar generation would use the electricity generated to charge the battery during the day, and use it during peak hours to avoid higher charges.

[14] Power consumed is billed at a pre-determined rate and power surplus fed back into the grid is reimbursed at a separate energy rate.

Alternatively, if net metering regulations are in place, they can also choose to export it back to the grid during peak hours to maximize their compensation.

Cost-recovery and cost-reflective ToU tariffs should incentivize the development of behind-the-meter storage solutions.

2.2.5 WHEELING

Out of the six study countries, only South Africa and Namibia have wheeling policies in place that allow generators to sign bilateral contracts with customers for the sale of power.

Generally, wheeling regulations are not relevant to SSDG in the C&I sector as they typically require facilities with a larger and constant generation capacity.

2.3 Other recommendations

In addition to the primary recommendations on policies and regulations and on tariffs net metering regulation, the following are provided:

- **Greater clarity regarding the relevant policies and regulations governing SSDG investments in each country.** Potential C&I SSDG investors often have limited access to the policies and regulations guiding their investment. Regulators should consider developing a handbook outlining all the relevant policies and steps that potential SSDG investments need to take to get approval.
- **Facilitation of approval process for SSDG investments.** Obtaining approval for SSDG investments is not always a straightforward process. To overcome this, regulators should consider streamlining the approval process to ensure that it is efficient and less bureaucratic.
- **Business case development and education on SSDG for both public and private sector stakeholders.** C&I customers can be informed of the technology options and potential cost savings. Public institutions, particularly utilities, should have the myths of SSDG dispelled, particularly that SSDG will lead to financial losses.
- **Grid impact studies to assess the grid absorption levels.** Another concern of utilities is that an influx of SSDG will weaken their grid and particularly their ability to absorb Variable Renewable Energy (VRE) with the control on dispatch. Grid impact studies will identify national, regional and local caps on installed capacity and offer solutions for grid management. Such studies should not only focus on high voltage levels (above 110 kV), but also consider lower voltage levels that are more relevant to DG.
- **Training of local suppliers and technicians.** In order to support larger-scale roll-out of SSDG, markets will need to provide many more skilled suppliers and technicians. Vocational training programs in the focus countries should be supported, either as part of broader RE support programs or as stand-alone programs.
- **Financing for SSDG.** There is a range of approaches to support SSDG investment for C&I businesses, including credit lines for local banks, support to equipment financing and leasing businesses, and the removal of import duties and taxes on SSDG components.[15]

[15] Applicable Southern African Customs Union (SACU) regulations should be addressed when considering any tax or duty reduction proposals.

With increased electricity costs and poor reliability across various markets, agri-processing companies may benefit from electricity self-supply options utilizing renewable energy.

Part Two: Detailed Findings by Country

In this section, detailed findings for each of the assignment's focus countries are provided. For those countries with more activity in SSDG and sector stakeholders willing to engage, the analysis is more extensive. However, for other countries, the depth of engagement and understanding was more limited and as such the analysis presented is more brief.

Each country's section begins with a summary of the findings for that country. These summaries draw on the more detailed analysis that follows. In those sections, we address for each country:

- **Current institutional arrangments.** The institutions which both lead and support the development and implementation of SSDG frameworks which support C&I customers need to have clear buy-in for the frameworks to be productive.
- **Existing policies and regulatory framework.** Each of the countries has embraced SSDG to different degrees. For some, there are dedicated frameworks, while others give limited effect to SSDG in sector-wide documents. Clear policies and frameworks are necessary to frame the investment potential for C&I customers.
- **SSDG experience.** Stakeholders in each of the focus countries have engaged in SSDG to varying degrees. It is difficult to get comprehensive country-wide views of SSDG experience and even where these exist, they are not thought reliable by stakeholders. Instead, these sections provide information on stakeholder activity as identified and, where possible, issues raised by stakeholders on this experience.
- **Current tariff frameworks and approach.** The analysis of the tariff frameworks for both C&I consumption and the sale of surplus energy are provided, where these exist. The analysis discusses efforts by regulators and other public sector stakeholders to address deficiencies in tariff regimes.
- **Existing policy and regulation on net metering.** Countries have addressed net metering to different degrees. For some, frameworks are extensive and detail is provided on the success (or not) of their implementation. Other countries have very little to offer on net metering.
- **Barriers to expanding SSDG.** The barriers presented cover the two main focus areas: Policy and regulatory barriers, and tariff and net metering barriers. Other identified barriers are presented for some countries.
- **Recommendations.** Each country section concludes with national-level recommendations, points or areas that the IFC and/or other development partners could support. These include technical assistance to public institutions, to C&I customers and other private sector stakeholders and more direct interventions, such as SSDG financing.

3.1 Botswana

Table 6: Summary of findings in Botswana

Are current policies and regulations supportive of SSDG?	The Ministry of Minerals, Energy and Water Resources has requested the preparation of high-level policy and technical guidelines for the development of rooftop solar for the C&I sector. These should be ready in 2020. SSDG projects below 100 kW require registration with the Botswana Energy Regulatory Authority (BERA), but no license. For large projects, licensing is done after SSDG installation, but prior concept approval is required. Increasing the share of Renewable Energy (RE) in Botswana's power mix to 15% by 2020 is one of the Government's policy priorities, as stipulated in the Integrated Resource Plan (IRP) under development. The Draft National Energy Policy (2016) and the RE Strategy (2017/2018) also present the inclusion of RE in the electricity mix.

Does the current tariff regime incentivize investments in SSDG?	Electricity tariffs are subsidized in Botswana and subsidies tend to benefit the large C&I consumers in order to sustain investments and employment. Hence, if grid supply is reliable, movement to SSDG will be slow for these C&I customers. BPC tariffs currently have a capacity charge (P/kW) but no demand charge (P/kVA). The introduction of such a tariff may reduce the incentive for C&I customers to implement SSDG. Botswana does not have ToU tariffs, so there is no daytime timing incentive towards SSDG. There is no formal plan to implement ToU tariffs. The REFiT drafted in 2011 has not been implemented to date and the Government is not considering taking any further action due to the heavy burden that the Government is already subsidizing tariffs for the potential users of SSDG. There are few SSDG users. Any tariffs to trade electricity with BPC (sale and purchase) are on a case-by-case basis. BERA indicated that tariffs for energy fed back into the grid will be lower than the utility retail tariffs.
Does the country have a net metering policy in place?	Botswana does not have a net metering policy yet, but draft guidelines are being developed under the leadership of BERA and have already been commented on by BPC. BERA will develop the guidelines further.
Have many SSDG projects been implemented?	BERA has received several applications from universities, schools and farms, that are still to be processed. More than five applications were received in 2019 alone. SSDG uptake has been restricted by previously high costs of solar equipment. As the costs of solar decline, SSDG is becoming a more attractive option.
What are the current barriers to SSDG expansion?	*Policy/regulation barriers:* The main policy/regulation barrier is the lack of dedicated SSDG and net metering policies that can create a business case for potential SSDG customers. The IRP under development has no stipulated quota for SSDG. *Tariff barriers:* BPC tariffs are not at cost-recovery levels for C&I consumers, giving little incentive for self-supply. No tariffs are set for feeding power back into the grid. A cost of supply study to guide tariff design is required. *Other barriers:* BPC's grid supply is now generally reliable (after load shedding in previous years), reducing the need for reliability through self-supply. However, the use of diesel generators as backups is also entrenched, hence there is inertia to migrate to SSDG. Other key barriers are lack of familiarity and uncertainty related to reliability of the technology and lack of skilled technicians to design, install and maintain SSDG systems.
How can the country attract investments in SSDG?	Government should stipulate a share of SSDG in the IRP. A clear policy framework for SSDG should be developed. BPC tariffs should be at cost-recovery levels, based on a COSS. A grid capacity assessment could show what the grid network can absorb, while a transparent grid code could outline roles and responsibilities of grid users. Government incentives and guarantees for private investors will facilitate financing of SSDG. An approved roster of accredited service providers for SSDG in Botswana will assist industry development.

3.1.1 CURRENT INSTITUTIONAL ARRANGEMENTS

Table 7 lists the stakeholder institutions that have roles and responsibilities with respect to SSDG in Botswana. The information provided shows that the institutions necessary to develop and expand the SSDG framework in Botswana are in place and should have the capacity to fulfil this.

Table 7: C&I SSDG institutional roles and responsibilities in Botswana

SSDG roles	*Institutions*	*Responsibilities*
Policy formulation and approvals	Cabinet and Parliament	Policy and legislation approvals.
	Ministry of Minerals, Energy and Water Resources	Development of policy.
	Department of Energy*	Implementation of policy and development of the Integrated Resource Plan for the country. Can create regulations and notices related to SSDG. Give direction and set targets for Botswana's energy vision. Draft and drive the national energy policy and renewable energy strategy.
SSDG regulation	Botswana Energy Regulatory Authority (BERA)*	Mandate to develop regulatory frameworks for grid and off-grid including for SSDG in terms of permitting and licensing. Approves tariffs currently for grid, but not yet for off-grid systems. Inspection and licensing of SSDG users. Registration of SSDG applications and users.
	Botswana Bureau of Standards	Development of standards for SSDG equipment, particularly solar equipment that BERA uses for enforcement.
SSDG implementation	Botswana Power Corporation (BPC)	Will advise on grid network capacity and SSDG absorption. Develop SSDG retail tariffs (wheeling in future) for approval by the regulator.
SSDG users	Airport Junction	Can provide SSDG drivers and lessons.
Potential users	Game shopping centers*	Private sector shopping mall with interest to adopt SSDG soon.
	Gaborone* Francistown, Sowa* Municipalities	Public potential users. Some experiences with SSDG projects.
	Kgalagadi Breweries*	As part of the global parent company, the brewery has targets of 100% RE generation by 2025, but tariffs are not encouraging investments to date.
	Cresta Marakanelo*	Chain of hotels in the country in areas amenable for solar SSDG.
	Coca-Cola Distributors*	International entity with interest in green power but has not yet adopted SSDG.
	Debswana	Has set group-wide RE and EE targets after conducting baseline studies and EE opportunity mapping. SSDG is an opportunity but tariffs remain too low for SSDG adoption.
	Botswana Meat Commission	Has a large electricity demand and has investigated self-generation from biogas in the past.
	Sefalana Wholesalers*	Commercial facilities in Botswana with potential to accommodate rooftop solar installations and other forms of self-generation.
Service providers	Solar Industries Association Botswana (SIAB)*	Grouping of private sector service providers in solar PV and solar water heaters that can build capacity for SSDG design, installation and maintenance. SIAB contributes to national energy policy development.
	Botswana Renewable Energy Association.	Contributes to national energy policy and RE market development.
	Solar Power*	Member of SIAB with a long history in the country on development and deployment of solar energy equipment.

Research	Botswana Institute of Technology Research and Innovation (BITRI)*	RE research institute for development and promotion of RE innovative technologies.
	UNDP	The organisation is mandated to build capacity for deployment of clean energy-related projects in the country and globally. UNDP has resource mobilization capacity that can support SSDG.
Financiers	Stanbic*	Previous experience with financing SSDG projects for companies and has in-house experience concerning SSDG. Provides debt, letters of credit and trade finance.
	Citizen Empowerment Development Agency (CEDA)	Provides venture capital and can create SSDG financing packages and/or provide government guarantees.

* Institutions interviewed for this assignment

Discussion

Botswana has the necessary institutions and institutional framework to support the development of C&I SSDG investments.

3.1.2 EXISTING POLICIES AND REGULATORY FRAMEWORK

Table 8 lists Botswana's policies and regulations relevant to SSDG. These start at the highest level with national energy policies and renewable energy targets and move down progressively to areas more focused on SSDG. As noted earlier, Botswana does not yet have a dedicated policy and regulatory framework for SSDG. Such a framework would provide strong guidance towards more extensive adoption of SSDG.

Table 8: Policy and regulatory frameworks relevant for C&I SSDG in Botswana

Document	*Description*	*Relevance to SSDG*[16]
National Development Plan #11	A comprehensive national development plan with 5-year horizon, including all sectors and budget allocations.	Presents Energy Policy and targets for RE.
Botswana Energy Master Plan (1985, 1997, 2004)	A planning tool that guides Botswana's energy sector.	This has served the country well over an extended period, but in the light of recent national, regional and international developments, a new National Energy Policy (NEP) is required.
National Energy Policy (NEP)(Draft)	The NEP's overall goal is "to provide affordable, reliable and adequate supply of energy for sustainable development, as well as to improve access to and efficient use of energy resources."	In draft form, but already guiding energy sector development in the country. The NEP advocates for development of an Integrated Energy Plan, Private Sector Participation, cost-reflective energy pricing, on-grid and off-grid RE applications with potential for introducing FiTs, demand-side energy management and conservation with minimum environmental impact.
RE Strategy and Action Plan 2017/18	Focused on resource assessment and quantification of the country's RE potential, particularly for solar, wind and biomass for on-grid systems. Emanating from that, a priority RE investment program was recommended.	Provides a target of 20% on-grid RE connections; the SE4ALL target is 15%. Contract structures are considered in the strategy, but at time of development, no net metering, FiT or captive power were recommended unless under prolonged load shedding, higher tariffs and minimum revenue losses from high rate consumers.

[16] This column provides an explanation as to why the documents listed are relevant for this study. It does not provide the scope of the analysis that will be conducted.

Action Agenda[17]	An SE4ALL document prescribing energy sector reforms required to meet the three SE4ALL goals.	Presents reforms that will lead to meeting the SE4ALL goals.
Investment Prospectus	A SE4ALL document that presents projects that can be implemented in Botswana to meet the SE4ALL goals.	Identifies possible SSDG projects.
IRP (under development)	A document that will present national electricity demand and supply options.	Under development and is not clear if it will stipulate SSDG allocation.

Below is a description of relevant existing policy, legal and regulatory frameworks, and procedures with relevance for SSDG in Botswana.

Local content requirements

There is currently no stipulation for local content requirements as most solar equipment is imported (perhaps apart from some batteries) mainly through South Africa and, more recently, from China.

Import restrictions

There are no import restrictions as there is minimal solar equipment manufacturing in the country. Most solar equipment developers/manufacturers have been involved in solar water heaters but none in solar PV manufacturing. Botswana Bureau of Standards (BOBS) has been instructed to ensure development and enforcement of solar equipment standards as the market grows, to avoid dumping of substandard solar equipment. BOBS standards cover equipment, design and installations of solar PV and solar thermal systems. In the absence of specific technical standards for SSDG, BOBS standards are being used.

Fiscal incentives

There are no specific incentives for SSDG equipment, but the government provides renewable energy tax incentives (waiving of import duty) that could be applied to the purchase of solar PV panels and inverters. Otherwise there are no subsidies or tax relief available; VAT of 12% for all SSDG equipment is to be paid even for items sourced within the Southern African Customs Union.

Tariff deregulation, net metering and cost-reflective tariffs

Tariffs are regulated by BERA, but the policy of subsidization remains and tariffs are not at cost-recovery levels. Development of cost-recovery tariffs will thus not be implemented until that subsidization policy is liberalized. A COSS needs to be done to guide this change. This will guide further retail and wheeling tariffs and net metering arrangements, with relevance to SSDGs.

Licensing and approval process

The current permitting/licensing process for SSDG is relatively straightforward. However, without a very developed market for SSDG nor detailed policy framework and capacity to implement, the process could cause bottlenecks for SSDG developers.

Pending development of SSDG policy as requested through the Ministry responsible for Energy, SSDG permitting and licensing can go ahead on a case-by-case basis. Potential SSDG developers will apply through BERA in two phases. Phase 1 is submission of a concept note that is approved by the BERA Board, after which the SSDG developer can construct the plant. Phase 2 sees BERA verify specifications and standards to issue a license.

SSDG projects below 100 kW require registration with BERA, but no license. For large projects, licensing is done after SSDG installation, but prior concept approval is required.

Other content relevant to entities considering SSDG

Entities considering SSDG want an evidence-based business case for SSDG and access to secure financing. Botswana's capacity for design, installation, and maintenance of SSDG, and reliability of the technology are some of the concerns of the potential users. Coupled with BPC's low retail tariffs, reduced load shedding compared with recent years reduces the benefits from reliable supply that SSDG can provide. In addition, C&I customers are already familiar with diesel generators as back-up, so shifting to alternatives may be difficult.

In the absence of ToU tariffs, SSDG with storage could assist BPC's concerns of peak demands by storing energy from off-peak times to be used during the evening peak period. Currently there are no incentives in place for storage solutions.

[17] On SE4ALL website, this is still listed as 'under development' and same with Investment Prospectus.

Discussion

Despite the low electricity tariffs and the lack of load shedding, the Government of Botswana supports rooftop solar for the C&I sector and has requested the preparation of high-level guidelines to be ready in 2020.

The current licensing requirements provide an exemption for SSDG projects below 100 kW. For large projects, licensing is done after SSDG installation.

3.1.3 SSDG EXPERIENCE

Botswana's C&I consumers have very little experience of SSDG. However, interest is currently growing and this year alone, BERA has received more than five applications for SSDG projects ranging from universities, farms and the Reserve Bank. In past two years, BPC often failed to supply power reliably, forcing C&I businesses to resort to diesel generators for back-up supply. As BPC is now supplying power without major interruptions, interest in SSDG has reduced.

The benefits of SSDG in terms of cost savings and improvements in the reliability of supply seem to be well-understood by C&I businesses. Potential users paying large electricity bills are considering SSDG, as diesel generators are also costly to run and sometimes fail to supply all the needed power.[18]

Most C&I consumers still have no SSDG experience; they may have considered solar but have not made investment decisions due to the low savings from avoided tariffs for large customers, uncertainty around the value of feeding power back to BPC and investment payback periods, unfamiliarity with the technology and maintenance requirements. Potential users are limited in capacity to install their own SSDG systems and would require third parties for design, installation, and maintenance. The opportunity to sell excess power to the grid is considered an incentive to install larger SSDG systems.

Some C&I consumers with sustainability mandates (e.g. Coca-Cola, Kgalagadi Breweries) have not started investigating SSDG viability, although are aware of its potential for cost reduction and contribution to a "green" mandate. Their monthly electricity bills are relatively small and BPC supply is reliable, but they note utility supply voltage fluctuations can cause challenges. Such C&I consumers may engage their group consultants to assist in SSDG adoption when required.

SSDG has been provided largely for homes, water pumping and lighting in public institutions, some with battery storage. The Service Providers (SPs) exist within the Solar Industries Association of Botswana (SIAB), with supplies of solar equipment coming from China, USA and Europe for some members.

Awareness of SSDG and associated skills are improving, but need enhancement. Potential users may have interest but cannot afford costs of development and hence need financing support. Although some banks (e.g. Stanbic) indicated familiarity with financing SSDG through debt financing, letters of credit and trade finance, the market is still small and financier unfamiliarity with the sector leads to terms and conditions that the market sometimes fails to meet.

Discussion

While there has been very little experience in the development of SSDG projects among C&I businesses, the adoption of guidelines for such projects and the reduction in the price of solar equipment are likely to make such SSDG investments more attractive to C&I customers.

3.1.4 CURRENT TARIFF FRAMEWORKS AND APPROACH

Botswana electricity tariffs are subsidized and below the true cost to serve. The electricity energy tariffs for large consumers, such as mines, are lower than the tariffs applicable to other sectors. Table 9 shows the low energy charges for C&I consumers. The subsidized tariff regime in that regard does not encourage SSDGs for such customers.

Table 9: Tariffs regime for 2018/19 for Botswana[19]

Sector	*Fixed charge (US$/month)*	*Energy charge (US$/kWh)[20]*	*Demand charge (US$/kW)*
Domestic	2.46	0.071 - 0.099	n.a.
Small business	7.63	0.086 - 0.127	n.a.
Medium business	7.63	0.06	18.21
Large business (11kV)	7.63	0.06	17.14
Government	7.63	0.18	n.a.
Water pumping	7.63	0.13	n.a.

[18] e.g. Game City is using three diesel generators for back-up, but can only light corridors.
[19] Conversions to US$ have been made at the prevailing spot exchange rates on 8 August 2019: 1 USD = 10.2 BWP.
[20] Lower range for <200 kWh units and top range for >200 kWh.

Only two customer categories have demand charges and these are based on kW rather than kVA, which is more conventional. There are no ToU tariffs. Without a COSS, it is difficult to determine how far below true cost these tariffs are, what the appropriate network and fixed charges should be, or how ToU tariffs could be implemented. A COSS is due, but this is not expected to lead to cost-recovery or cost-reflective tariffs due to political reasons. **This is despite the backdrop that all SADC Member States have a target to have cost-reflective tariffs by 2019/2020.**

Botswana does not have FiTs. With low energy tariffs for consumers, there is an awareness in the Government that fully-priced FiTs will place a high burden on BPC, which the Government is likely to be required to cover.

Discussion

The subsidization of electricity tariffs in Botswana has benefited C&I consumers who, in the absence of load shedding, are reluctant to invest in SSDG. The lack of ToU tariffs further reduces the incentive towards SSDG.

3.1.5 EXISTING POLICY AND REGULATION ON NET METERING

There are currently no policies and regulations on net metering and net metering rules are under development.

3.1.6 WHEELING REGULATIONS

Wheeling regulations are not in place and an approach to this has not yet been decided.

3.1.7 OPPORTUNITIES AND BARRIERS TO EXPANDING SSDG

Policy and regulatory barriers

While increasing the share of Renewable Energy (RE) in Botswana's power mix is one of the Government's priorities, **policies have no targets for either on-grid and off-grid SSDG opportunities**. Such stipulation is necessary so that potential investors can read the extent of investment opportunities in SSDG.

The Minister responsible for energy has **requested the development of guidelines for the development of rooftop solar PV for C&I consumers**. Until the policy guidelines are adopted, there is also no clear guidance on promotion of SSDG. The purpose of these guidelines is to motivate C&I businesses to understand the benefits of SSDG. Once these are approved, technical guidelines for licensing, tariffs and standards will also be required.

Unless the policy guidelines being prepared stipulate incentives for SSDG, FiTs and net metering for SSDG will only be attractive in situations of prolonged load shedding and higher existing tariffs. Load shedding experienced in the recent years combined with the continued decline in solar PV costs have increased interest in SSDG, although with reduced load shedding more recently, this interest has diminished.

BPC is participating in development of the policy and regulatory framework, but there is market perception that the utility monopoly will prevent negotiations on policies towards SSDG. The SIAB and Botswana RE have been assisting with drafting and reviewing of national energy policies, but their knowledge and skills for SSDG is considered limited. The support for facilitating financing of SSDG is also unclear, coupled with a lack of evidence-based policy on the SSDG business case.

Until a **grid code and grid capacity assessment** have been undertaken BPC will have concerns that SSDG will affect its network stability. Additionally, BPC is concerned for its profitability and whether SSDG will force it to downscale its operations, leading to a loss of jobs unless an impact analysis proves otherwise. No study of the impact of SSDG on revenue loss for the utility has been conducted.

SSDG projects below 100 kW do not require a license, but just registration with BERA. For projects with a capacity of higher than 100 kW, a license is required. To obtain a license, the potential developer must present the concept to BERA and if its board approves it, the developer can go ahead and install the SSDG plant. After the plant is installed, the BERA technical team will inspect the plant to ensure that RE standards developed by BOBS are met. Only then a license is issued to the developer. There are no stipulated timelines and requirements for both registration and licensing and therefore the process is open to delays. A clear framework should provide timelines for this process.

There is no FiT for selling power to BPC and findings of the 2010/11 REFiT study will not be implemented.

Tariff and net metering

Botswana's subsidized and non-cost-recovery tariff regime does not encourage SSDG for C&I customers. Any interest in SSDG by C&I customers will be in response to load shedding and voltage fluctuations rather than the financial benefits of avoided utility tariffs.

Net metering is not being practiced under the current regulatory framework and awaits setting of appropriate rules and tariffs. BERA has developed draft net metering rules that have now been reviewed by BPC. There is however no timeline when these rules will be adopted and implemented. The guidelines and net metering rules are expected to provide clarity regarding the tariffs paid to SSDG producers, but it is not clear whether wheeling tariffs will immediately be established. The lack of net metering, combined with the current subsidized tariffs, have slowed adoption of self-generation.

3.1.8 RECOMMENDATIONS

Policy and strategy aspects, including the level of private-sector participation, should be determined to guide sector development

- The policy and technical guidelines are required to guide future policy direction for SSDG in Botswana, specifically including net metering arrangements; these are currently under discussion, but the timelines for implementation are unclear.
- The IRP under development should stipulate what SSDG capacity can be accommodated within the national grid network, including behind-the-meter options and associated impact. This should be guided by a robust grid capacity assessment and evidence-based analysis of the impact of SSDG on BPC profitability and other socio-economic concerns.
- Commercial banks have little understanding of the economics behind such investments. Financial incentives (e.g. in the form of government guarantees) and mechanisms (bank packages blended with other sources of financing) can catalyze the potential market for SSDG financing.
- Fiscal incentives, in the form of VAT and import duty exemptions, can improve the affordability of SSDG investments.

The regulatory frameworks in support of the roll-out of SSDG should be enhanced and implemented

- A grid code (currently using the RSA one) is needed to provide clear guidance how the private sector will cooperate with the utility and that they are not prejudiced by the utility for their investments.
- A streamlined registration and licensing procedure for SSDG should be adopted, including timelines for approvals to remove the potential for bottlenecks at BERA. This should include standardized contracts and application procedures.
- A COSS is also required to guide tariffs towards cost-recovery levels and cost-reflective structures (including ToU tariffs) that can send efficient price signals to guide SSDG business case development.

Support for C&I businesses will increase their capacity to implement SSDG projects

- C&I businesses need support to undertake an investment analysis to understand the cost savings and return on investment that can be realized by investing in SSDG.
- Creating an accredited pool of service providers for design, installation and maintenance of SSDG systems in Botswana.

3.2 Malawi

Table 10: Summary of findings in Malawi

Are current policies and regulations supportive of SSDG?	National Energy Policy (NEP): Under the third policy statement of the NEP "Government will support small-scale renewable energy initiatives by communities or entrepreneurs", three out of five foreseen strategies could support SSDG: • *"Developing appropriate regulations for specific small-scale technologies under the Renewable Energy Act."* • *"Reviewing the feed-in tariffs to ensure that all technologies including mini-grids are sustainably accommodated."* • *"Equipping all stand-alone renewable source powered mini-grids and privately-owned installations with net metering to ensure their continued use upon connection to the grid."* The Integrated Resource Plan (IRP) that guides the development of the Power Sector in Malawi does not consider SSDG. This is a hindrance to the development of the SSDG sector in Malawi. Under the Electricity Act 2004 (amended by the Electricity Amendment Act 2016), a SSDG project developer needs to obtain a generation license from MERA. This is a hindrance to the development of the SSDG sector in Malawi. Section 8 of the Grid Code on Technical Requirements for Connection of Variable Renewable Energy (VRE) Generators was recently added to the grid code. This should reduce the uncertainty around technical standards to use for SSDG projects and hence support such projects.

Does the current tariff regime incentivize investments in SSDG?	Grid electricity tariffs have increased steadily in Malawi since 2012 driven by the need for ESCOM to start charging cost-reflective tariffs. While this should, over time, make SSDG investments more attractive, the energy tariff is still relatively low. ESCOM's tariff structure for the C&I sector comprises both a tariff on the energy consumed (kWh) and demand charges.[21] Because of intermittent supply and ESCOM not meeting customers' total energy demands, these demand charges, which are increasing at a high rate, can represent more than 50% of the energy bills paid by companies in the C&I sector. While this may be driven by efficient pricing, this is a major barrier to SSDG investments, especially solar, since demand charges are unlikely to be reduced by a solar system. This tariff structure could, however, incentivize SSDG investments which reduce peak demand, such as behind-the-meter solutions comprising solar with storage capacity. A FiT policy was adopted in 2012, defining energy tariffs for firm and non-firm generation from different renewable energy sources (hydro, solar, biomass, wind, geothermal and biogas) for plants ranging from 500 kW to 10 MW. While in theory this should have incentivized SSDG investments it has never been implemented in practice.
Does the country have a net metering policy in place?	There is currently no net metering policy in place in Malawi although net metering is one of the strategies for renewable energy promotion highlighted in the NEP. Despite the lack of such a policy, the only SSDG project currently operating in Malawi has a net metering arrangement with ESCOM.
Have many SSDG projects been implemented?	Currently, there is only one 830 kW grid-connected solar system in Malawi. It is located at Lilongwe Airport and was funded entirely by a donor (JICA). It is unlikely that the number of SSDG projects will increase soon (see below the barriers described).
What are the current barriers to SSDG expansion?	*Policy/regulation barriers:* No net metering policy. SSDG project developers need to obtain a generation license from MERA and sign a PPA and connection agreement with ESCOM, both of which would need to be negotiated on a case by case basis. Regulations for solar with storage capacity has not yet been considered in the current regulations. *Tariff barriers:* Low (although increasing steadily) energy tariff charged by ESCOM to its C&I customers. High demand charges for the C&I sector. Lack of implementation of the FiT policy. *Other barriers:* Currently the Government, MERA, ESCOM and their development partners focus on large-scale power generation and interconnection with neighboring countries to address the challenges currently faced by the power sector (limited generation capacity). Promoting SSDG is therefore currently not a priority because the benefit of SSDG (increased stability of the power grid and reduction of transmission losses) has not been studied in Malawi. ESCOM has signed PPAs with solar PV IPPs for a total of 240 MW; ESCOM now says that it does not have sufficient base load capacity to safely connect additional non-dispatchable sources such as solar PV (regardless of size and location) before its power grid is fully integrated with the Southern African Power Pool (SAPP); this is planned for 2022. Most local solar companies lack technical capacity to design and install SSDG projects. Furthermore, many companies in the C&I sector do not trust local companies or find them too expensive. The high prices could be due to the lack of ability of local companies to import and create inventory in large quantities. Solar equipment in Malawi is not VAT exempted. There is a lack of a business case for SSDG or behind-the-meter solar plus storage systems and a lack of understanding of these systems by companies in the C&I sector. ESCOM lacks screening processes and does not have the capacity to engage with SSDG project developers.

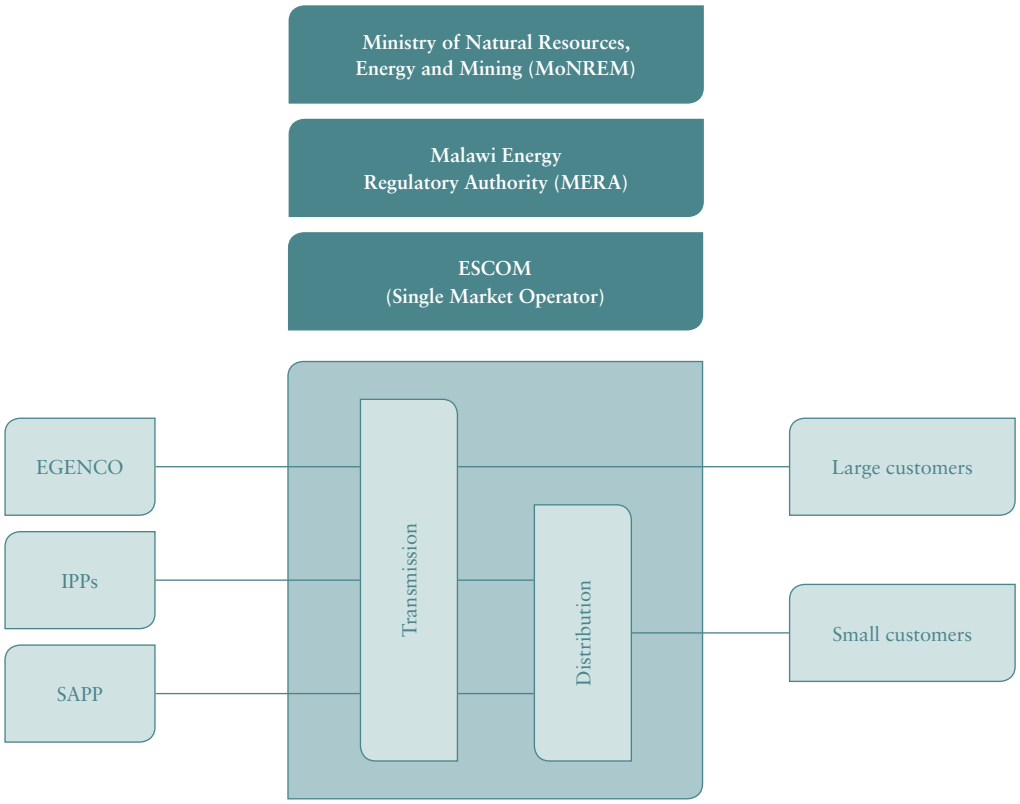
[21] Based on the amount of power needed by the C&I customer (declared at the beginning of the year) and the maximum amount of power actually consumed by the C&I customer during a given month.

How can the country attract investments in SSDG?	Before the policy/regulatory recommendations can be implemented, a business case for C&I SSDG and behind-the-meter solar plus storage solutions highlighting the benefits of SSDG should be conducted. This would force the utility to think about connecting such systems to its grid and the Regulator to develop the appropriate framework. Develop simplified regulations to allow SSDG projects to connect to the grid without needing a generation license from MERA nor negotiate PPAs and connection agreements with ESCOM on a case-by-case basis. Review and implement the FiT policy and include specific tariffs for SSDG projects with storage capacity.[22] This should only be done after the framework has been implemented and once behind-the-meter solutions are starting to be more widely used by C&I companies. Develop and implement a net metering policy. This should be considered once behind-the-meter storage solutions are more widely adopted by C&I companies. A net metering policy would be particularly important for companies with seasonal activities, e.g. tea or tobacco businesses. Review of ESCOM tariff structure in the C&I sector to tariffs at cost-recovery and cost-reflective levels. Study tours to neighboring countries with policies supporting SSDG could also raise awareness.

3.2.1 CURRENT INSTITUTIONAL ARRANGEMENTS

The structure of the power sector in Malawi is presented in Figure 4.[23]

Figure 4: Structure of Malawi's power sector



[22] The second and third points are already included in the NEP, but are currently not a priority of the Government.

[23] Taken from: http://documents.worldbank.org/curated/en/313871549533419539/pdf/Concept-Project-Information-Document-Integrated-Safeguards-Data-Sheet-Malawi-Electricity-Access-Project-P164331.pdf

The power sector has undergone important reforms which, in January 2017, led to the unbundling of the state-owned national utility, the Electric Supply Company of Malawi (ESCOM) and the establishment of the Electricity Generation Company of Malawi (EGENCO). EGENCO currently owns and manages four hydro-power plants that provide power to the ESCOM-owned and -managed grid. As the four hydro-power plants are on the same stretch of the Shire River downstream of lake Malawi, EGENCO must sometimes limit its production, typically during the dry season when the flow in the Shire River is low. To overcome these challenges, EGENCO runs diesel generators during peak hours as needed, up to a maximum of 51.7 MW. However, only 33.3 MW is currently operational. In addition, the IPP Aggreko has diesel generators with a capacity of 78 MW connected to the ESCOM network. To overcome the power shortage challenge, Malawi is also importing 20 MW from Zambia; this could be increased to up to 50 MW in the future. Discussions for a similar interconnection deal are currently on going with Mozambique.

According to ESCOM, currently, the total available capacity in Malawi is around 400 MW. In September 2017, ESCOM launched a tender to identify four Independent Power Producers (IPPs) to supply a total of 70 MW of solar PV produced electricity to the national grid. As a result, three PPAs[24] were signed with two companies, adding about 100 MW (without storage) to the national grid (more that the initially planned 70 MW). These plants are expected to be commissioned by December 2019. In addition, since the initial tender, the planned target of 70 MW has been exceeded considerably with PPAs for solar PV now signed with several additional developers in April 2019 amounting to around 240 MW.[25] However, the commissioning date of these different projects remains unclear. Some stakeholders doubt that all these projects are bankable and will ever become operational.

Table 11 gives an overview of the primary public institutions and organisations involved in SSDG in Malawi.

Table 11: C&I SSDG institutional roles and responsibilities in Malawi

Institution	*Role*
Ministry of Natural Resources, Energy and Mining (MoNREM) Department of Energy Affairs (DoE)	Functions include the formulation and coordination of energy policies, planning, information communication and technology. The provision of rural electrification services; and the provision of alternative energy and energy conservation services. DoE is also technically responsible for ESCOM, MERA and ENGENCO. Role with respect to SSDG: Developing and implementing policies supporting SSDG.
Malawi Energy Regulatory Authority (MERA)	Statutory corporation created under the Energy Regulation Act, 2004, which mandates MERA to regulate all activities in the energy industry including licensing, approving tariffs, monitoring and enforcing compliance, developing standards, etc. Role with respect to SSDG: Developing and implementing a regulatory framework favorable for the development of the SSDG sector, including technical standards, tariffs and standard agreements between the producer and the utility. MERA recognizes the importance of SSDG in improving the reliability of the grid. They also acknowledge the fact that the current regulatory framework does not incentivize SSDG investments. However, its capacity is limited and currently developing a regulatory framework to support SSDG investments is not one of their priorities. This could change if either the Government or ESCOM expressed interest in the development of such a framework.
Electricity Supply Corporation of Malawi (ESCOM)	State-owned power-producing company with responsibility for transmission and distribution of electricity. Formerly in charge of generation, but was unbundled in January 2017 as part of the energy reforms aimed at improving the efficiency of energy provision in the country. Role with respect to SSDG: Approving and signing required agreements with a SSDG project (including tariff, technical standards, etc.).

[24] Two PPAs were signed in September 2018 with the company JCM Matswani Solar Limited for a total of 80 MW of installed capacity in two locations (60 MW in Salima District and 20 MW in Dedza District). One PPA was signed with the company Phanes Energy Renewables Nkhotakota Limited for a total of 21 MW installed capacity was signed in February 2019.

[25] ESCOM interview.

Discussion

Malawi has the necessary institutions and institutional framework to support the development of C&I SSDG investments.

3.2.2 EXISTING POLICIES AND REGULATORY FRAMEWORK

Malawi's electricity policy and regulatory framework is almost entirely focused on large-scale generation, with little consideration of SSDG. Consequently, any SSDG developments will need to comply with onerous procedures with transaction costs that are very high relative to the size of the investment. A targeted SSDG framework will benefit the development of the sector.

Malawi's power sector is guided and structured by the **National Energy Policy (NEP) updated in 2018** and the **Electricity (Amendment) Act of 2016**. The NEP 2018 together with a **Renewable Energy Strategy** aims to improve the transparency of Malawi's regulatory framework, increasing predictability and generate investor confidence.

Under the third policy statement of the NEP, "Government will support small-scale renewable energy initiatives by communities or entrepreneurs", three out of five foreseen strategies directly relate to SSDG:

- *"Developing appropriate regulations for specific small-scale technologies under the Renewable Energy Act."*
- *"Reviewing the feed-in tariffs to ensure that all technologies, including mini-grids, are sustainably accommodated."*
- *"Equipping all stand-alone renewable source powered mini-grids and privately-owned installations with net metering to ensure their continued use upon connection to the grid."*

The regulations for SSDG are developed and implemented by MERA. These include regulations around technical standards for interconnection with the national grid and tariffs. In particular, legislation that has been produced by MERA in recent years and that relates to, or could have an influence on SSDG, include the **Feed-in Tariff Policy** (2012); see Section 3.2.4 for more details, the **Grid Code** (2016) and the **Mini-Grid Framework** (2019). As described in more detail in Section 3.2.7, it is relevant to discuss the mini-grid framework when analyzing the regulatory framework for SSDG because the newly finalized mini-grid framework could help to address some regulatory issues hampering the development of SSDG projects.

The mini-grid framework also has a provision for interconnection between mini-grids and the national grid:

> ***Grid interconnection of the mini-grid shall be allowed under terms and conditions specified in the Grid Code, or as shall be discussed and agreed upon between the mini-grid operator, the Single Buyer (SB) and the System and Market Operator (SMO) in the light of any provisions of the FiT policy. Where a mini-grid is allowed to connect to the national grid, a PPA shall be signed between the mini-grid operator and the SB guided by the Independent Power Producer Procurement Framework (2017).***

Such references to PPAs and the IPP framework suggest a reluctance to standardize connection agreements for SSDG. For the smallest scale SSDG projects, an argument should be made to reduce transaction costs through a specific SSDG framework.

A summary of the main policy documents and regulations governing the distributed generation sector in Malawi is provided in Table 12.

Table 12: Policy and regulatory frameworks relevant for C&I SSDG in Malawi

Document	*Relevance to distributed generation*
Malawi National Energy Policy (NEP) 2018	Under the third policy statement of the NEP "Government will support small-scale renewable energy initiatives by communities or entrepreneurs", three out of five foreseen strategies directly relate to SSDG: *"Developing appropriate regulations for specific small-scale technologies under the Renewable Energy Act."* *"Reviewing the feed-in tariffs to ensure that all technologies including mini-grids are sustainably accommodated."* *"Equipping all stand-alone renewable source powered mini-grids and privately-owned installations with net metering to ensure their continued use upon connection to the grid."*
Malawi Renewable Energy Strategy 2017-2022 (MRES)	MRES sets objectives and strategic directions to achieve the vision of universal access to renewable energy and a sustainable biomass sector. It touches upon grid-scale renewables, clean energy mini-grids, off-grid solar and bio-energy. The strategy calls for an upgrade of the existing power infrastructure, a restructuring of the power market and the creation of a Malawi Renewable Energy Agency.

Integrated Resource Plan 2017 (IRP)	Provides a least-cost investment plan in generation, transmission and demand side measures covering the 20-year period 2017 to 2037 and updated every few years. The 2017 study indicates that the generation investments identified by the IRP study may be implemented by the private sector (as IPPs) or by ESCOM, however it does not elaborate further the role of SSDG.
IPP Framework 2017	Provides guidance on the legal and transaction arrangements for IPPs, including solicited procurement and unsolicited process, tariff structure, due diligence, risk assessment, license application, Environmental Impact Assessment processes, etc. In the absence of specific regulations for SSDG, SSDG projects should comply with the IPP Framework. This is considerably onerous for SSDG and highlights the need for a specific SSDG framework.
Electricity (Amendment) Act 2016	This document amends the Electricity Act 2004, mainly to provide for the unbundling of licensing provisions for generation, transmission and distribution of power. The amendment removes monopoly in power generation by providing for participation of IPPs. It does not amend the need for an electricity generator to obtain a license from MERA (see Electricity Act 2004 below).
Malawi Grid Code 2016	This document provides administrative and technical guidance for generators connecting to the national grid. These include in particular "generating companies with power stations connected to the transmission system" and "generating companies with power stations where the total installed generating capacity is greater than 10 MW, regardless of their point of connection." It has recently been updated to include a section on the Technical Requirement for Connection of Variable Renewable Energy (VRE) Generators. This should streamline the technical approval of standards to use for SSDG projects and hence support such projects. Finding the right balance between requirements that are strict enough to ensure operational security but do not create a barrier to investment can be difficult when a country, such as Malawi, has such limited experience in the field. These standards have not been widely publicized yet. For example, on the MERA website, the version of the grid code that can be downloaded does not include section 8 on VRE generators.[26] Also, these standards have not been implemented in practice yet; the only commissioned IPP project selling power to ESCOM was approved before these standards were released and the technical standards used for this project were discussed directly between the IPP and ESCOM.[27]
Malawi Energy Africa Compact 2016	The Energy Africa Compact provides a list of policy actions to investment in the household solar market, while also ensuring coordination between the Government and other development partners to promote the uptake of the off-grid solar sector. Policy actions include removing VAT for household solar products and creating licenses specific for importers/installers of household solar products. If implemented, this Compact could set a precedent for policy reforms that could support SSDG projects.
Malawi Feed-in Tariff Policy 2012	This document sets tariffs for private renewable-based technologies feeding between 500 kW and 10 MW of electricity to the grid. The renewable energy sources targeted are small hydro, solar, biomass, wind, geothermal and biogas. For each technology, a firm and non-firm tariff is defined, depending upon whether the power produced is dispatchable or non-dispatchable. This policy has not been properly implemented and no projects have been developed under it.
Malawi Electricity Act 2004	This Act stipulates the conditions for issuing licenses for generation, transmission, distribution, sales and use of electricity in Malawi, with less onerous requirements regarding applications for rural electrification, such as off-grid extension of distribution lines and solar photovoltaic systems installation. Section 3 stipulates that generation of electricity for sale requires a license; this suggests that SSDG will require a generation license.
Energy Regulation Act 2004	This Act establishes the Malawi Energy Regulatory Authority (MERA), defines the functions and powers of MERA on issues related to licensing.

[26] During the study, a hard copy of the version of the Grid Code including Section 8 was briefly reviewed during the interview with MERA. However, neither a hard nor soft copy of the version of the Grid Code including Section 8 could be collected. As such, no analysis of the standards is provided in this report and at this stage it is not possible to state whether or not the standards described in the Grid Code could create a barrier for SSDG projects (for example, if they were unreasonably high).

[27] Interview with Lujeri Tea Company.

In terms of fiscal incentives for SSDG, solar PV equipment (panels, batteries, LED bulbs, etc.) are free of import duties but VAT remains payable at 16.5%. VAT is removed if solar equipment is imported to be used specifically in the health and education sector.[28]

Licensing and approval process

Under the Electricity Act 2004 (amended by the Electricity Amendment Act 2016), a SSDG project developer needs to obtain a generation license from MERA. The requirements for obtaining such a license are too stringent for SSDG projects and most companies in the C&I sector would be reluctant to apply for one. Such a requirement would likely hinder the development of the SSDG sector in Malawi.

Discussion

The current policy and regulatory environment in Malawi does not support investments in SSDG. The main policy obstacles include the non-inclusion of SSDG in the IRP, which creates uncertainty regarding the available capacity for such investments and the need for a generation license from MERA, even for small projects.

3.2.3 SSDG EXPERIENCE

Although private sector participation in the power sector (in particular generation) is one of the key priorities of the Government, and introduction of a net metering policy and revision of the FiT policy are listed as activities in the National Energy Policy, there is currently only one operational solar-based SSDG plant feeding into the grid in Malawi, at Lilongwe Airport, as detailed in Box 1.

Box 1: Lilongwe Airport SSDG Project

Inaugurated in September 2013, this is an 830 kW solar system built at Lilongwe International Airport as a demonstration project. It was entirely funded by a donor (JICA) and built by a Japanese company. It operates under a net metering agreement negotiated directly between the Airport and ESCOM, however no PPA has been signed.[29] According to airport management, the plant cost at the time was close to US$ 8 million. This cost, representing close to 10 US$/W seems to be on the high side, especially because it does not have storage capacity.

The peak production of the system (830 kW) is higher than the maximum demand of the airport (about 500 kW). In addition, the airport does not function at night and hence has a limited consumption of energy when the solar system is not producing. As such, the airport is a net producer of electricity. However, due to the fact that it produces mainly during off-peak hours and needs electricity from ESCOM during peak hours, and still incurs demand charges, the airport still owes ESCOM at the end of the month (see more detail below on the tariff structure for the C&I sector). According to airport management, the solar system has allowed it to reduce its electricity bills by more than 50%.[30] According to ESCOM, "The plant [at the airport] has had no major impact on ESCOM, as the airport still largely depends on grid power for its operation".[31]

Indications are that the plant functions well but has had problems with some of its invertors in the past. Since the system was built in 2013 by a Japanese company, it means that finding spare parts is often difficult. For the invertors, a Japanese engineer had to be called on site to help to identify compatible invertors that could be installed to replace them.

Examples of SSDG solutions not connected to the grid in the C&I sector include two fully solarized service stations operated by Total Malawi and two sugar cane bagasse-based plants owned by Illovo. The solar service stations have capacity of 43 kW plus 86 kWh storage in Lilongwe and 26.5 kW plus 24 kWh storage in Blantyre and are part of a plan to solarize all Total Malawi service stations by 2022. Illovo's two sugar cane bagasse-based power generation facilities total 18 MW (11 and 7 MW).

In other sectors, there are increasing numbers of smaller rooftop solar systems designed to reduce reliance on the national grid due to the unreliability of supply. Examples include the 50 kW solar system at St Gabriel Hospital in Namitete, a 100 kW system powering the premises of an NGO (Bee Hive) in Blantyre and a 23 kW solar system installed at Saint Andrew's International School in Blantyre. These systems are isolated from the grid. These types of small investments are an effective solution for improving the reliability of supply in Malawi.

[28] Tax incentive in Malawi, Volume 1.
[29] The only example of a private company feeding into the National Grid with a PPA is the Lujeri Tea Company that operates a 2 MW run-of-the-river hydro scheme, soon to be upgraded to 8 MW by the end of the year. The tariff negotiated with ESCOM for this project is 12.5 US$ cents/kWh.
[30] Airport interview.
[31] ESCOM interview.

Cash crops, such as tea, are a sector of the economy that could potentially be interested in investing in decentralized generation, particularly solar rooftop systems. There are currently some 15 tea factories operating in Malawi, each with a demand of 300 - 900 kVA. Part of the peak tea season (November-May) coincides with the time when there is a power generation shortage in Malawi. As a result, tea factories must rely on their back-up generators to keep their production running. This adds to their production cost in a market that is very competitive and difficult for Malawian producers. Investing in solar rooftop systems with the right type of incentives could be a good move for the tea sector. At least two companies, Eastern Produce Malawi (ETP) and Satemwa, were interested and starting to make plans to invest in solar energy (about 500 kW per company). However, these projects did not materialize because of barriers described in Section 3.2.7.

It is important to note that although the only operational SSDG project in Malawi was funded by a grant, there are C&I companies in Malawi that can fund their own solar projects. For example, Total funded its projects through its balance sheet. ETP was planning to do the same if it had been able to continue with its idea. Satemwa would have been able to get a grant from a donor. It is also important to point out that an insurance and investment company from South Africa, Old Mutual, is interested in investing in solar energy in Malawi to help C&I companies reduce their energy bills. They see opportunities in several sectors including mining and brewing. Within the tea sector, they have also been discussing potential investment with Lujeri and ETP, however discussions have not yet moved forward in part due to the barriers described in Section 3.2.7.[32]

Finally, banks are also interested in the energy sector in Malawi. Standard Bank, for example, has an energy department although it is not yet active in Malawi. Financial products tailor-made for energy projects have been developed in other countries, like South Africa, and could be adapted to Malawi.[33] However, this has not happened yet. The lack of involvement of local banks in the SSDG sector in Malawi so far is due to some factors acting as barriers described in Section 3.2.7 below. The evidence from large companies and consultation with financiers suggests that financing is not a major barrier for SSDG in Malawi.

Discussion

There is currently very little experience with SSDG projects in the C&I sector in Malawi. This is unlikely to change soon due to the different barriers that prevent C&I businesses from investing in rooftop solar projects (discussed further in Section 3.2.7).

3.2.4 CURRENT TARIFF FRAMEWORKS AND APPROACH

ESCOM Tariff structure

ESCOM has 11 different tariff categories, including two for the C&I sector which differentiate by the voltage at which they receive their power (400V or 11 kV). For both these categories, in addition to the energy tariff (amount to be paid per kWh consumed), customers pay demand charges broken down into declared demand and actual demand. Paying for the declared and actual demands does not guarantee that an industrial customer will receive continuous power supply from ESCOM and, as such, demand charges can make up a large proportion of total energy bills when the supply is regularly interrupted and energy purchases are not possible; these charges must be paid even if the customer has faced blackouts during a given month. Finally, there is no difference in demand charges if the maximum demand occurs during on or off-peak hours. On the other hand, for energy charges, a distinction is made between peak and off-peak hours.

Table 13 summarizes the tariff charges by ESCOM for companies in the C&I sector.

Table 13: Summary of ESCOM tariffs for the C&I sector[34, 35]

Tariff category	*Fixed charge (US$/month)*	*Demand charge (US$/kVA)*		*Energy charge (US$/kWh)*	
		Declared	*Actual*	*Peak[36]*	*Off-peak*
General, Prepaid, Single Phase					0.137
General, Post-paid, Single Phase	11.04				0.131
General, Prepaid, Three Phase					0.152
General, Post-paid, Three Phase	16.56				0.139
400V		7.17	12.42	0.171	0.058
11kV		6.48	12.00	0.167	0.055

Source: MERA

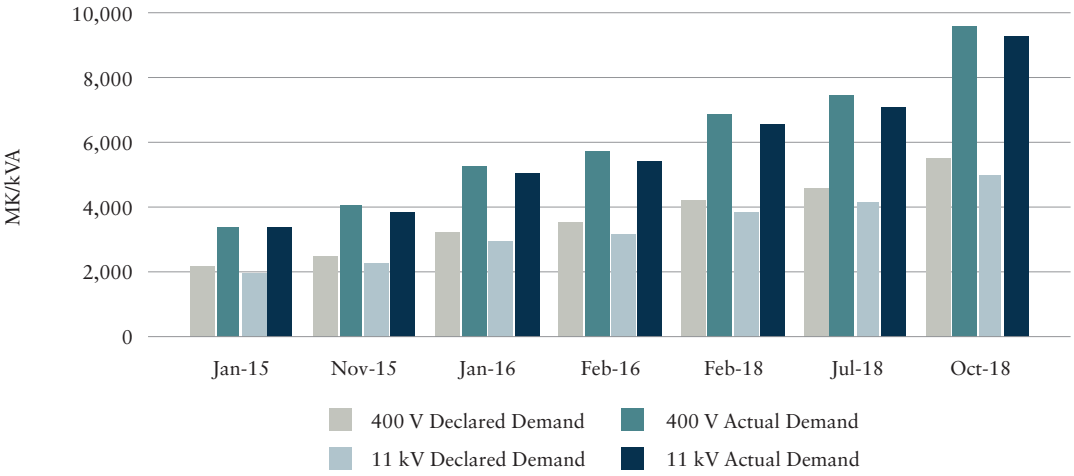
[32] Old Mutual interview.
[33] Standard Bank interview.
[34] http://www.escom.mw/current-tariffs.php
[35] Conversions to US$ have been made at the prevailing spot exchange rates on 8 August 2019: 1 MK = 0.0014 USD
[36] Off-peak hours are from Monday to Friday from 00:00 to 07:00, from 12:00 to 17:00 and from 20:00 to 24:00. Peak hours are from Monday to Friday from 07:00 to 12:00 midday and from 17:00 to 20:00. All Saturdays, Sundays and public holidays are off-peak.

While some C&I customers are unhappy with the large demand charges, ESCOM justifies the use of them as follows: "the capacity charge is intended to provide for the cost of the infrastructure and commitment to meet the declared demand, whether the demand is utilized or not". In addition, ESCOM believes that this structure incentivizes investments in energy efficiency and renewable energy.[37]

This tariff structure also explains why Lilongwe Airport still pays ESCOM for electricity, despite being a net electricity producer with its solar system.[38] The solar plant mainly produces during off-peak hours, while the airport needs electricity from ESCOM during peak hours when the solar production can be low and energy charges are high. In addition, Lilongwe Airport pays demand charges regardless of its energy consumption.

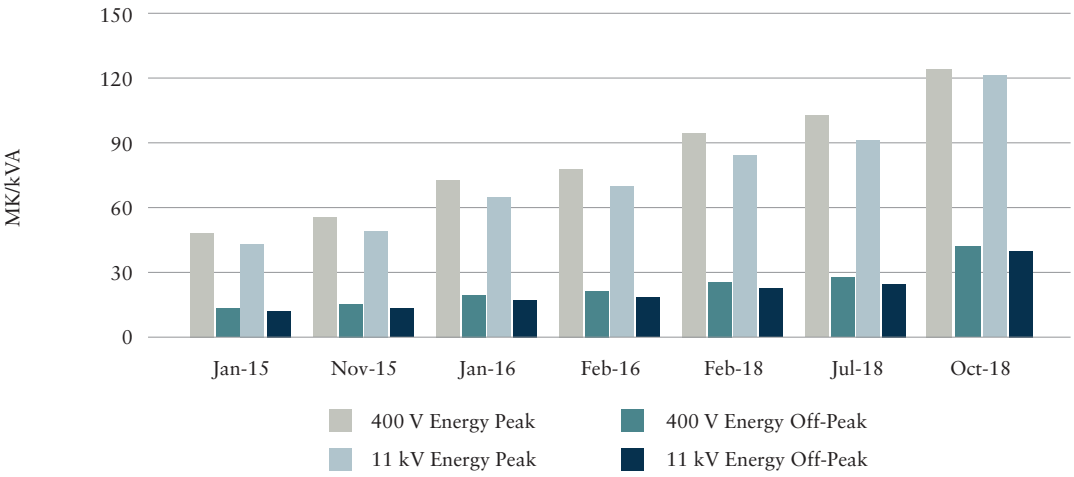
ESCOM tariffs have increased steadily since 2012, driven by ESCOM's need for and obligation to recover costs with cost-reflective tariffs. Such increases will raise the potential for viable SSDG investments, as the costs from such payments (for energy charges) can be off-set with self-supply from SSDG. The changes in each charge type for the maximum demand C&I customer categories over the period from January 2015 to October 2018 are presented in Figure 5 and Figure 6.

Figure 5: Change in ESCOM demand charges for C&I customers since January 2015



Source: MERA, ESCOM, ECA calculations

Figure 6: Change in ESCOM energy charges for C&I customers since January 2015



Source: MERA, ESCOM, ECA calculations

The gross percentage increases for each tariff over the same period are presented in Table 14, with the annual equivalent increase shown in brackets.

[37] ESCOM interview.

[38] The peak production of the system (830 kW) is higher than the maximum demand of the airport (about 500 kW). In addition, the airport does not function at night and hence consumption of energy is limited when the solar system is not producing.

Table 14: Change in ESCOM tariffs for the C&I sector since January 2015[39]

Tariff category	*400 V*	*11 kV*
Demand charges (MK/kVA)		
Declared	151% (26%)	151% (26%)
Actual	183% (30%)	174% (29%)
Energy charges (MK/kWh)		
Peak[40]	154% (26%)	178% (29%)
Off-peak	207% (32%)	227% (34%)

Source: MERA, ESCO, ECA calculations

FiT Policy

A FiT policy was adopted in 2012, defining energy tariffs for firm and non-firm generation from different renewable energy sources (hydro, solar, biomass, wind, geothermal and biogas) for plants ranging from 500 kW to 10 MW. According to ESCOM, the lower limit of 500 kW was set because "proliferation of numerous smaller power generators lower than 500 kW would present operational challenges to the isolated power system in Malawi and hence not provide the expected benefits". This signals a reluctance to engage with small systems such as SSDG.

The FiTs as presented in the policy document are shown in Table 15.

Table 15: FiTs in Malawi

Technology	*Firm tariff (USc/kWh)*	*Non-firm tariff (USc/kWh)*
Hydro (0.5-1 MW)	14.0	13.0
Hydro (1-5 MW)	12.0	10.0
Hydro (5-10 MW)	10.0	8.0
Solar PV (0.5-10 MW)	20.0	10.0
Biomass (0.5-10 MW)	10.0	8.0
Wind (0.5-50 MW)	13.0	
Geothermal (0.5-50 MW)	10.5	
Biogas (0.5-50 MW)	10.0	8.0

However, as of May 2019 these tariffs have not been implemented in practice. A number of barriers explored further on can potentially explain why this innovative policy has not yet been implemented in Malawi, including lack of understanding of the policy and lack of resources for its implementation by the Government and ESCOM, lack of awareness of the policy amongst the private sector, lack of trust in ESCOM amongst the private sector, low reliability of the national grid, lack of definition of technical standards to be used for interconnection, inadequate FiT levels and industrial electricity tariff structure. According to ESCOM, the reason why the policy has not been implemented is as follows: "due to possible economies of scale, most prospective developers have not been interested in developing power generation plants of less than 10 MW. Thus, the signing of PPAs covering power generation of less than 10 MW or indeed any other quantum above 10 MW is not solely driven and controlled by ESCOM".

Discussion

The current tariff structure in Malawi disincentivizes C&I businesses from investing in SSDG. Energy tariffs are relatively low, while high demand charges, which cannot be avoided through SSDG self-supply, represent more than half of the energy bills paid by companies. However, Time-of-Use tariffs might provide an incentive to businesses to invest in behind-the-meter solutions.

[39] Gross increase presented. Annual equivalent increase in brackets (assumed four-year period from January 2015).

[40] Off-peak hours are from Monday to Friday from 00:00 to 07:00, from 12:00 to 17:00 and from 20:00 to 24:00. Peak hours are from Monday to Friday from 07:00 to 12:00 midday and from 17:00 to 20:00. All Saturdays, Sundays and public holidays are off-peak.

3.2.5 EXISTING POLICY AND REGULATION ON NET METERING

There is currently no net metering policy in Malawi, although developing one is one of the strategies highlighted in the NEP. Also, as mentioned above, the only operating SSDG project in Malawi negotiated a dedicated net metering agreement with ESCOM.

3.2.6 WHEELING REGULATIONS

Wheeling power is currently not allowed in Malawi. From ESCOM's perspective, the provision within the amended Electricity Act regarding direct sale of electricity by generators to some customers has the potential to defeat the effectiveness of the Single Buyer Model, as most power generators would prefer to bypass the Single Buyer in the market chain and sell directly to consumers. This has the potential to slow down the integrated growth of Malawi's electricity system, as the potential customer base would be fragmented amongst various power generators instead of being consolidated under one system, thus losing the leverage for bigger investments in the sector.[41]

3.2.7 OPPORTUNITIES AND BARRIERS TO EXPANDING SSDG

Load shedding

C&I businesses cite load shedding as the main driver for SSDG investments in Malawi. Load shedding has become very problematic since 2016 due to a shortage of available generation capacity. At the peak of the crisis, industrial users were left without power for 1-2 days per week. During that period, tea factories consumed 38% more diesel per kg of tea.

In order to prevent load shedding, ESCOM and the Government have worked with EGENCO, IPPs and neighboring countries to increase the availability of power in the country. This has resulted in EGENCO and the IPP Aggreko investing in diesel generators and signing PPAs with ESCOM for the supply of power during peak hours, ESCOM signing PPAs with several solar IPPs, and the construction of a 20 MW interconnection line between Zambia and Malawi. According to ESCOM, "there has not been load shedding due to general insufficient generation capacity since December 2018. Load shedding for very short periods has been undertaken during this period due to scheduled maintenance works primarily at some of EGENCO's hydropower plants. This is normal in any power system. ESCOM has worked tirelessly to make sure that the situation last year is not repeated, hence the various strategies that have been and are being implemented". However, according to C&I users, the likelihood of load shedding, especially during the period between September and December, is relatively high, which provides an opportunity for SSDG investments.

Policy and regulatory barriers

The energy market in Malawi is still in its infancy and whilst there are several relevant policies and regulations in place, there are also several gray areas which lead to an overarching environment that is not coherent or supportive of growth in SSDG.

While the third policy statement of the NEP states that "Government will support small-scale renewable energy initiatives by communities or entrepreneurs" and defines three strategies that refer to a Renewable Energy Act (to be developed), developing a net metering policy, and revising the FiT policy, a number of regulations do not support the deployment of SSDG. For example, the Electricity Act 2004 amended by the Electricity Amendment Act 2016 stipulates that:

> *A person shall not carry on or be engaged in any activity for the supply of electricity, including the export of electricity from, and import of electricity into, Malawi, without a generation, transmission, importation, exportation, system and market operation, Single Buyer or distribution license, as the case may be, issued by the Authority" and that "the activities in the electricity supply industry for which a license is required are: (a) generation of electricity for sale; […].*

This means that a SSDG project developer needs to obtain a generation license from MERA. Such a requirement would likely hinder the development of the SSDG sector in Malawi.

Furthermore, whilst the recently approved but not yet gazetted Regulatory Framework for Mini-Grids has a provision for interconnection between mini-grids and the national grid, it states that a PPA shall be signed between the mini-grid operator and the SB guided by the Independent Power Producer Procurement Framework (2017) and conforming to MERA's standard PPA. MERA currently uses one standard PPA for IPPs and this format, as MERA itself recognizes, is not appropriate for SSDG. This, again, implies discussions between the mini-grid developer and ESCOM, the Single Buyer. This is something companies in the C&I sector would not be equipped to do. However, one area where the mini-grid framework could help SSDG developers is with licensing. Indeed, the Mini-Grid Regulatory Framework states, "All mini-grids with generation and/or distribution capacity of 150 kW or more developed for commercial purposes shall be licensed. A single license shall be issued for combined activities of generation, distribution and retailing." Below 150 kW no license is required and the mini-grid developer must only register with MERA. The mini-grid license is supposed to be less stringent than the generation one and hence easier to obtain for small-scale power producers.

[41] ESCOM interview.

However, as of June 2019, none have been issued so far, although the company MEGA operating a 220 kW hydro mini-grid in the Southern Region has applied for one. SSDG does not fall, strictly speaking, in the mini-grid category, but according to MERA, the absence of more appropriate SSDG regulation could be used as an argument to use the Mini-Grid Regulatory Framework to regulate SSDG, while waiting for specific SSDG regulation to be developed and implemented. MERA recognizes however that this is a gray area and more work is needed.

In addition to their lack of expertise, C&I companies think that ESCOM would not be interested in negotiating a SSDG project with them. This belief is based on the experience of a few companies that have unsuccessfully negotiated SSDG deals with ESCOM; two companies that have tried have described the experience as "hitting a wall".

Stakeholders indicate that many believe that the lack of regulatory framework for SSDG and the lack of interest of ESCOM in discussing SSDG projects is because the Ministry, MERA and ESCOM, as well as their main technical and financial partners, do not believe that SSDG can play an important role in addressing the current power crisis in Malawi. All eyes are set on large projects, such as the 300 MW Mpatamanga Hydro Project developed by the Government and the private sector with support from the World Bank and IFC, and the large-scale solar IPPs that should come online and add about 100 MW of installed capacity by the end of 2019. The Ministry and ESCOM want the Mpatamanga Hydro Project to succeed and to become operational as soon as possible, and MERA has worked to develop the regulatory framework to achieve this objective. MERA admitted that without the Government's interest in SSDG, it would be difficult for MERA to develop an appropriate regulatory framework for SSDG and the Department of Energy Affairs has confirmed that SSDG is not a priority for the time being.

This current lack of interest is also probably because SSDG has never been considered in the power sector development plans (e.g. the IRP) developed by the Government. In addition, some of the main technical and financial partners of the Government for the development of the power sector, such as the Millennium Challenge Corporation (MCC) or the United States Agency for International Development (USAID), do not believe that SSDG could be part of the least-cost electricity supply options. The issue of grid stability remains if the number of SSDG projects suddenly started to increase because of a favorable regulatory framework; this is further detailed in the sub-section on other barriers below. Until these questions are addressed, it is unlikely that an appropriate regulatory framework for SSDG will be developed in Malawi.

Tariff and net metering barriers

The main tariff issue affecting SSDG potential in the C&I sector is ESCOM's tariff structure. As explained above, C&I tariffs are weighted heavily towards demand charges and intermittent supply results in a disproportionately high percentage of total billed amounts rising from demand charges. A survey of tea factories showed that in 2016, on average, demand charges represented almost 60% of the total billed amount or US$ 80,000 per year on average for a factory. This amount of money can only be reduced by SSDG investments that reduce peak loads during the day, e.g. for factories, but is more of a challenge for C&I customers with evening peaks, e.g. hotels.

While the tariff structure is a barrier to SSDG development, it is not necessarily something that should be removed to stimulate SSDG projects. As ESCOM points out, the structure is in place to ensure the costs that customer demand places on the network that are recovered from those responsible. A recent COSS for ESCOM guided the calculation of this tariff structure and proposed replacing demand charges with equivalent peak energy charges. However, as ESCOM's supply becomes more reliable, this imbalance towards demand charges should reduce. This barrier may be counteracted somewhat by the continued increases in tariff levels towards cost-recovery levels, as higher energy charges can be off-set by self-supply from SSDG.

C&I companies could get around the high demand charges in two ways – establishing a dedicated energy company, or through installing behind-the-meter storage that off-sets their peak demand:

- A C&I company could set up a dedicated energy company that would be treated as an IPP. This is what Lujeri Tea Company did with its run-of-the-river mini-hydro scheme. However, most companies in the C&I sector would not have the capacity to do this.
- Storage capacity could reduce the demand of companies in the C&I sector and hence reduce demand charges. However, the fact that demand charges are linear means that the installed storage capacity would need to be significant to achieve substantial savings. For example, to save about US$ 500/month on both declared and actual demand charges, a company in the C&I sector would need more than 160 kWh of storage capacity. This is about twice what Total has installed for its larger service station and probably larger than any storage capacity ever installed in Malawi. The required investment, only for storage, could be more than US$ 40,000.

As referred to above, a FiT policy has existed on paper since 2012, but it has never been implemented and is now outdated. According to ESCOM, investors were not interested in investing in projects in the 500 kW - 10 MW range (see above) due to poor economies of scale. However, the solar system at Lilongwe Airport appears not to have used the FiT because of a lack of an adequate regulatory framework (in particular adapted standardized PPAs).

A further issue is that the FiT policy applies only for capacity over 500 kW, excluding SSDG in the range of 200-500 kW.

The fact that this FiT policy has not been implemented and that ESCOM has been unwilling to discuss SSDG with the C&I sector means that companies potentially interested in investing in solar SSDG have not been able to design projects with a satisfactory return. This is especially true for companies operating in sectors that are seasonal, such as tobacco or tea. For example, the tea company Satemwa has a tea factory that runs at full capacity only during the tea season (about 5 months of the year). Satemwa was ready to install a 500 kW solar system and had found financing (a grant from the EU) for it. However, in the absence of interest from ESCOM in buying electricity from this system during the 7 months remaining in the year, the project had to be abandoned. In addition, companies or institutional buildings operating behind-the-meter solar plus storage systems indicated that they would be willing and able to sell their surplus electricity to the grid. Some indicated a FiT or net metering policy could be an incentive to install a larger system than the current installation.

Other barriers

Low priority of SSDG: Currently the Government, MERA, ESCOM, EGENCO and their development partners focus on large-scale power generation and interconnection with neighboring countries to address the challenges faced by the power sector (in particular limited generation capacity).

Lack of sufficient baseload to accommodate more solar generation: According to ESCOM, it has signed PPAs with solar IPPs for a total of 240 MW; ESCOM now says that it does not have sufficient baseload capacity to connect additional non-dispatchable sources such as solar (regardless of size and location) safely before its power grid is fully integrated with the Southern African Power Pool (SAPP); this is planned for 2022. The benefits of SSDG for the stability of the power grid and reduction of transmission losses has not been studied in Malawi, hence the current lack of interest in promoting SSDG.

Lack of expertise and capacity of local solar companies: Whilst there has been an increase in the number of local solar companies in recent years, only a few have the technical capacity to deliver quality projects. C&I companies have stated that this lack of capacity together with high prices has deterred them from considering SSDG projects or has led them to seek the services of foreign companies.

High costs of solar components in Malawi: Most of the C&I companies interviewed complained of the prices of solar equipment in Malawi, especially those sold by local companies. Foreign companies seem to be able to offer better prices. This is perhaps because local companies are not able to stock up inventory in large quantities but import small quantities at a time. The solar industry in Malawi has long complained about the fact that solar equipment is not VAT exempted.

The lack of a business case for SSDG and behind-the-meter solar with storage solutions: Some companies in the C&I sector are not aware of the returns that they could get from a SSDG project or a solar project behind-the-meter. Due to the lack of reliability of the grid, SSDG or behind-the-meter solar projects can become quite complex with the possibility of installing solar plus storage plus generator hybrid systems. Depending on the size of the different components of the hybrid systems, investments and returns will likely be very different. The optimal sizing of these different elements will depend on the project developer's main interest (e.g. quick returns, high returns, maximum savings) and will require the development of a model using appropriate software.

ESCOM's lack of screening process: In addition to a lack of interest in SSDG, probably fuelled by a lack of understanding of SSDG projects (see below), ESCOM is overwhelmed by several private developers coming to present projects to them. Most of these projects will never materialize, but ESCOM still needs to dedicate resources to discuss these with several project developers who do not have the capacity to develop quality projects. Starting discussions with SSDG promoters is therefore not high on their priority list.

Lack of understanding of SSDG: The stakeholders interviewed during the project sometimes mentioned conflict over land use or other irrelevant concerns as a reason not to promote SSDG.

It has often been assumed that financing is a key barrier hampering the development of SSDG in Malawi. However, consultations indicated that this was not necessarily an important issue. Indeed, several companies indicated that they would be able to raise the required funds for a SSDG project through their balance sheet, development grants, or commercial loans if the regulatory framework and the tariff structure allowed for quick deployment of these projects and 5-7 year returns. A tea company even mentioned having been approached by several investors that were ready to invest their own money for a SSDG project using the company's land or roof area. However, this project failed to materialize due to the lack of appropriate regulatory framework and conducive tariff policy.

It is also important to note that local banks have not yet been involved in SSDG or solar projects because they lack information and awareness about these sectors. Interest rates charged by these banks are also very high and usually prohibitive for this kind of project (about 30% per annum). However, they are currently becoming more attractive.

3.2.8 RECOMMENDATIONS

The analysis discussed above informed the following recommendations.

Development of a business case for SSDG and behind-the-meter solar plus storage solutions

Given the reluctance, justified or not, of ESCOM to engage with SSDG project developers and the general lack of interest in SSDG shown by the Ministry and ESCOM, which prefer to focus on large-scale solutions, developing an appropriate regulatory framework will be difficult and time-consuming. We therefore suggested starting with behind-the-meter solutions comprising solar, storage and most probably small diesel gensets. Such systems are likely to provide returns within 7 years if they are properly designed.

Several companies have indicated that they would be ready to invest in the range of US$ 50-100,000 on behind-the-meter solutions provided a return was generated within 7 years (ideally 5 years). This seems possible if the system is well-designed. Designing such a system is not a trivial exercise and requires skills and experience to consider Malawian specificities, especially with regards to the tariff structure. Most companies in the C&I sector are not aware of the investment opportunities in behind-the-meter solutions. On the other hand, only a limited number of local companies would be able to design such a system and optimize the savings and returns. These companies would also have trouble presenting a clear business case to C&I companies in the sector.

This first recommendation is therefore to support local solar companies to develop a business case for SSDG solar solutions (with storage and behind-the-meter options likely to be the most attractive) for companies in the C&I sector. The solar companies should also be supported to raise awareness of companies in the C&I sector about these solar solutions. Support could be provided through capacity building, technical support to conduct studies, study tours in countries where behind-the-meter solar plus storage solutions are being implemented, and organisation of business forums on SSDG and behind-the-meter solutions.

Review and implementation of the FiT policy and the inclusion of specific tariffs for SSDG projects with storage capacity

Once behind-the-meter solar plus storage solutions become more widely used in the C&I sector, ESCOM will be compelled to look at these systems and how ESCOM could benefit from them. It would be important to consider SSDG with storage since currently the main concern of ESCOM about solar SSDG projects is their non-dispatchable nature, or the fact that these projects will provide power when ESCOM does not necessarily require it.

The use of storage capacity in SSDG would address this concern. As such, the FiT policy should be reviewed and updated and include realistic firm and non-firm tariffs. Firm FiTs between 13 and 15 USc/kWh should ensure viability of C&I investments. Provided ESCOM is convinced of the benefit it can get from these projects, this seems to be a realistic range.[42]

Development and implementation of a net metering policy

Like the FiT policy, a net metering policy would support the development of C&I SSDG. The net metering policy could be particularly useful for seasonal businesses, such as tea or tobacco, that operate only during certain times of a year.

Development of simplified regulations for SSDG grid connection

The other key aspect to include in the introduction of net metering is licensing. There ought to be easy and streamlined ways for C&I companies to be allowed to feed electricity into the grid up to a certain level (say 1 MW) without having to negotiate a complex PPA with ESCOM and to obtain a license from MERA. As mentioned below, for such drastic changes to happen in the regulatory framework, ESCOM, the Ministry, and MERA should be convinced of the benefits of SSDG projects.

Review of ESCOM energy charges, decreasing of demand charges and introducing categories for demand charges

The current tariff structure for companies in the C&I sector is poorly understood and may put too much emphasis on demand charges and not enough on energy charges. The current tariff structure also makes it difficult for SSDG projects to be financially viable unless they include large storage capacity. A recent COSS suggested increasing the peak energy charge and reducing demand charges, although the recommendation was made under assumed continued intermittent supply; as the reliability of supply increases, demand charges should become more of a component of a cost-reflective tariff.

[42] As a reminder, ESCOM is paying Lujeri 12.5 US¢/kWh for electricity from a run-of-the-river (hence non-dispatchable) hydro scheme and the current level of form FiT for solar is 20 US¢/kWh.

3.3 Namibia

Table 16: Summary of findings in Namibia

Are current policies and regulations supportive of SSDG?	The National Energy, Renewable Energy and Off-grid Electrification policies all support and enhance the implementation of SSDG in Namibia. The National Integrated Resource Plan and all other national plans all make ample provision for the implementation of SSDG projects. The implementation of the net metering rules has resulted in high levels of consumer-level SSDG and the implementation of the Modified Single Buyer Market Model will further liberate the market to allow for deeper SSDG penetration in Namibia. The regulatory standards and rules are well-developed to ensure sustainable installations of quality and protect grid safety and security.
Does the current tariff regime incentivize investments in SSDG?	Namibia's customer tariffs are at cost-recovery levels, with a cost-reflective structure, including ToU tariffs. Most of the SSDG options are already at or below grid parity, at any level for the grid-based consumer. The Off-grid Electrification policy foresees potential subsidies to support SSDG in off-grid applications.
Does the country have a net metering policy in place?	The net metering policy has been in place since 2016 and is well-implemented. The level of SSDG penetration is restricted by the ability of the distributors' various grids to absorb integration of intermittent supplies into the grid without breaching stability standards. The introduction of battery storage could further enhance SSDG penetration at distribution level.
Have many SSDG projects been implemented?	SSDG on net metering level (distribution) is in excess of 50 MW, spread over the NamPower and the larger REDs' customer bases. SSDG at transmission customer level is expected to increase with the introduction of the Modified Single Buyer Model (MSBM) phases 1 and 2.
What are the current barriers to SSDG expansion?	*Policy/regulation barriers:* The limit for net metering installations leaves some distribution customers above the 500 kVA installation at a disadvantage. Grid integration and grid stability studies are neither well-defined nor standardized. This is partly due to the lack of coordination between the various distribution grid owners and operators when it comes to setting standard terms of reference for grid integration studies and standards defining grid stability levels. The limitation of the roll out of MSBM to only transmission-connected customers or suppliers further disadvantages distribution level connection above the net metering level. *Tariff barriers:* Tariff structure changes for grid-connected customers and applications improve the business case for self-sufficient generation and disconnection from the grid unless a decent ancillary market is developed to incentivize grid-connected dispatchable storage solutions behind-the-meter. *Other barriers:* Off-grid support to private investment entities is lacking.
How can the country attract investments in SSDG?	• Include distribution customers above the net metering level in either the net metering rules or in the roll out of the MSBM. • Standardize on-grid stability studies and standards. • Develop a robust ancillary services market to incentivize behind-the-meter participation in support of grid stability services. While this is not easy to implement, having a smart grid with smart meters installed will make this possible. Business models to keep affluent grid-connected customers connected will become critical. • Develop risk support mechanisms to attract off-grid investment from all funding sectors. • Develop robust sustainability targets, with appropriate associated monitoring, evaluation and reporting, to attract impact and angel investors in the off-grid arena. • Develop FiT structures for off-grid applications.

3.3.1 CURRENT INSTITUTIONAL ARRANGEMENTS

Table 17 describes the current institutional arrangement with regards to SSDG in Namibia, identifies key institutions and organisations involved in SSDG and describes each institutions' roles and responsibilities with regards to SSDG.

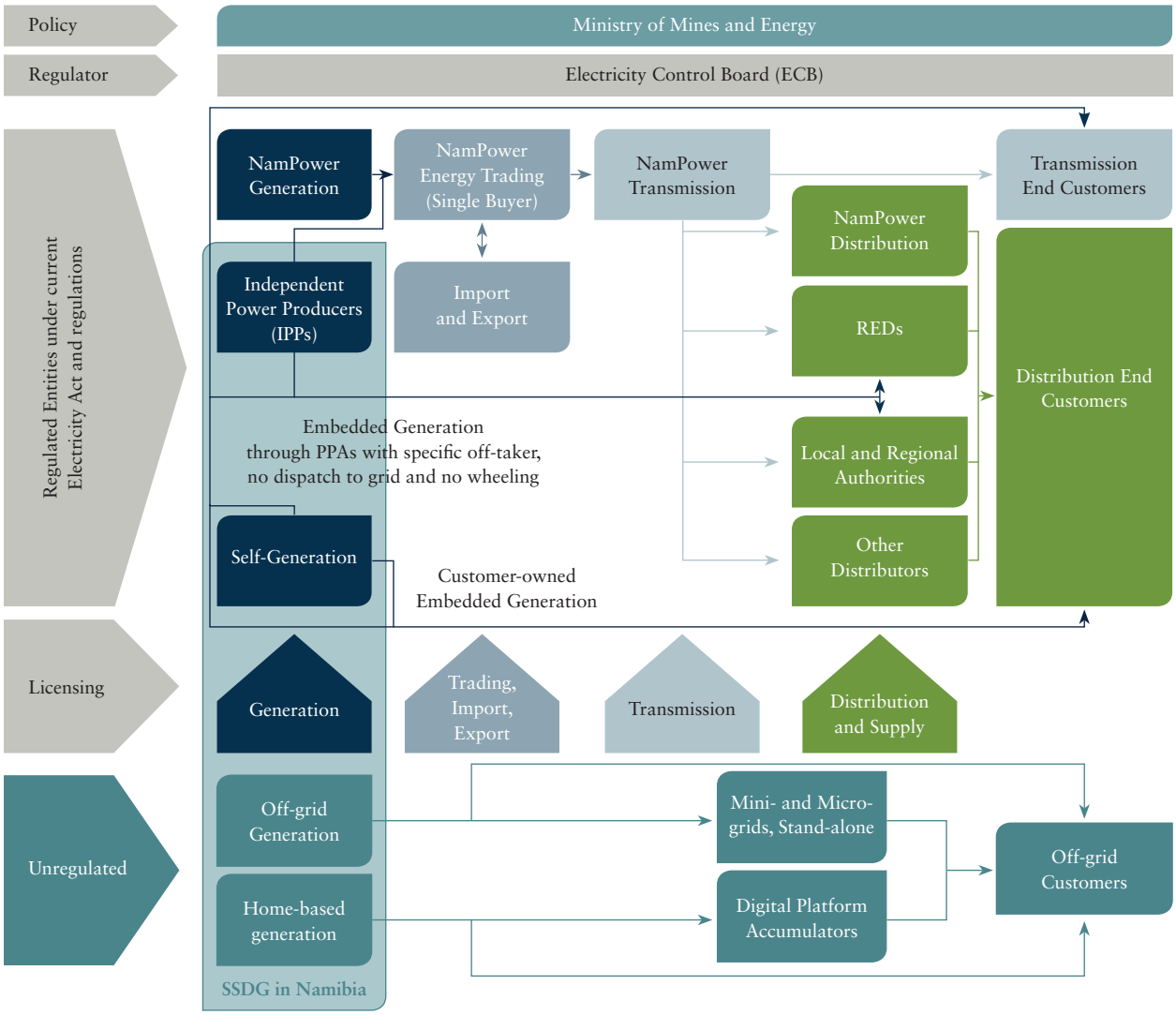
Table 17: C&I SSDG institutional roles and responsibilities in Namibia

Type	*Entity*	*Roles and responsibilities*
Government	Ministry of Mines and Energy (MME)	Among other areas responsible for the following: Developing policies and undertaking planning to ensure national energy security; approval of licenses under the Electricity Act; rural electrification planning; funding and implementation; planning for sufficient electricity generation capacity to meet demand; and defining procurement and off-take responsibilities for new generation projects.
Regulator	Electricity Control Board (ECB)	Recommends and implements the Electricity Supply Industry (ESI) regulation and regulatory framework. Assesses license applications and makes recommendations to MME. Issues, monitors and suspends licenses. Provides regulatory oversight over key agreements including PPAs. Recommends tariff level and tariff structure changes, including for SSDG.
SOE utility: NamPower[43]	NamPower Generation	Owns and operates current and future NamPower-owned plants.
	NamPower Transmission	Contains (i) System Operator – responsible for system security and dispatch of generation units to maintain grid integrity in meeting demand; (ii) Supply and Wires – responsible for supplying to and connecting transmission customers; (iii) Network Owner – owns, operates and maintains the transmission grid.
	NamPower Trading	Includes the Trader and Single Buyer, procuring all power dispatched to the transmission grid, as well as managing all imports and exports. Responsible for least-cost scheduling of supply in meeting demand.
	NamPower Distribution	Owns, operates, and maintains the distribution network in licensed areas and supplies to end customers.
Distributors	Regional Electricity Distributors (REDs)	Owns, operates, and maintains the distribution network and supply to end customers or the local and regional authorities. Also responsible for rural electrification.
	NamPower Distribution – see above	Owns, operates and maintains the distribution/reticulation network and supply to end customers in areas where REDs are not yet operational, i.e. in central and southern Namibia.
SSDG suppliers	Alternative technology suppliers (equipment and installation) to customers	Provides the equipment and install alternative SSDG solutions to customers (including the required design and sizing of the systems in accordance with customer load profiles).
	Alternative solution suppliers (equipment, installation and funding) to customers	In addition to the above, provides the funding for the installation, as well as the maintenance of the system, whilst under lease agreement.

Figure 7 presents the electricity sector highlighting the key institutions involved in SSDG in particular.

[43] NamPower's business units are ringfenced from one another, meaning that there is some degree of operational unbundling.

Figure 7: Namibia's ESI with reference to SSDG in particular



Discussion

The Namibian ESI institutional development for grid-based services is well-advanced and established. This is evidenced by the high levels of SSDG already commissioned and in operation in Namibia. Emerging markets delving into off-grid electrification will hopefully benefit from the implementation of new policies in this space.

3.3.2 EXISTING POLICIES AND REGULATORY FRAMEWORK

Table 18 summarizes the specific regulation, legislation, policies, plans and studies related to SSDG in Namibia, and especially those involving permitting, licensing, contract structures, local content requirements, market liberation, rules and standards.

Table 18: Policy and regulatory frameworks relevant for C&I SSDG in Namibia

Framework document type	*Description*	*Relevance to small-scale distributed generation*
Acts	Environmental Investment Fund, 2001	Funding of SSDG accessing concessional funding options through the EIF. Stipulates size of plant/installation requiring an Environmental Impact Assessment (EIA) and Error Correction Code (ECC).

Framework document type	*Description*	*Relevance to small-scale distributed generation*
Acts (continued)	Electricity Act, 2007	Establishes and defines the mandate of ECB, provides for its powers and functions. Provides for the requirements and conditions for obtaining licenses for the provision of electricity; the powers and obligations of licensees; and incidental matters.
	Environmental Management Act, 2007	Issuance of Environmental Clearance Certificates for any SSDG.
	Public Procurement Act, 2015	Procurement by state-owned entities – discussed elsewhere.
	Public Private Partnership Act, 2017	Ownership opportunities of larger SSDG installations.
Bills	Electricity Bill, 2018	Will replace the Electricity Act 2007 – discussed elsewhere.
	Namibia Energy Regulatory Bill, 2017	New bill impacting the Regulator – discussed elsewhere.
	National Equitable Economic Empowerment Bill	Ownership of privately-owned entities in Namibia.
Regulations	Quality of Supply and Service Standards, 2004 The Namibian Distribution Grid Code, 2018 The Namibian Transmission Grid Code, 2005 The Administrative Electricity Regulations, 2011 The Namibian Electricity Safety Code, 2011 The Technical Rules, 2016	All these standards and codes will impact the specifications and design of SSDG plants connected to the transmission grid, as well as their operational compliance.
	Net Metering Rules Gazette No 471 of 2016	Sets the rules for net metering in Namibia.
Policies	National Connection Charge Policy (approved 2015)	Governs the connection of new SSDG to the transmission grid.
	National Renewable Energy Policy (approved 2017)	Provides for Namibia's ambitions and policy to introduce renewable and specific distributed renewable generation options. The RE Policy supports the adoption of a market structure in Namibia that enables IPPs to generate and sell electricity to off-takers other than the Single Buyer and enables SSDG from various technologies and resources.
	National Energy Policy (approved 2017)	This is the overarching policy for the energy industry and highlights the need to reduce Namibia's reliance on imported energy, enhance distributed generation and expand the ownership of new generation beyond that of large-scale utility-owned solutions.
	National Independent Power Producer (IPP) Policy (Final Draft)	This policy is not yet approved, but it addresses specific issues relevant to privately-owned generation plants.
	Draft Mini-Grid and Off-Grid Policy (July 2019)	This policy addresses Namibia's intention in advancing mini-grid and off-grid electrification, regulation thereof, as well as grid encroachment aspects.
	Draft Smart Grid Policy (July 2019)	This policy communicates Namibia's intent, direction and undertakings regarding the efficient and effective development of a smarter grid in Namibia.

Framework document type	*Description*	*Relevance to small-scale distributed generation*
Plans	National Integrated Resource Plan (NIRP) (approved 2016)	This plan sets the procurement allocation to supply options to meet the demand and demand growth in Namibia.
	The Fifth National Development Plan (NDP 5)	The National Development Plans sets the priorities for the Namibian Government for the next five years.
	Harambee Prosperity Plan	This plan is a subset of the NDP 5 and aims to bring focus to key developments to eradicate poverty.
	Vision 2030	This document has guided Namibia's development since its independence and informs all national development plans.
	Off-Grid Master Plan, 2007	The underlying objective of the Off-Grid Energisation Master Plan (OGEMP) is to provide access to appropriate energy technologies to everyone living or working in off-grid, pre-grid and "gray" areas.
Other	NRS-097-2-3-final-2014: Grid interconnection of embedded generation	The specification sets out the technical requirements for the utility interface, the embedded generator, and the utility distribution network with respect to embedded generation. The specification applies to embedded generators smaller than 1,000 kVA connected to low-voltage networks.
	CRSES2017_04_Nam_RE_ Grid Integration_DRAFT_2-1	The study assessed the impact of grid integration of intermittent RE, developed and implemented a plausible methodology to quantify the optimal RE capacity that can be integrated into the grid in the Namibian Electricity Supply Industry reliably.

Namibian SSDG installations can be grouped into five categories:

- **Below 500 kVA installations, grid-connected** – these SSDG units are classified as net metering.
- **Above 500 kVA, grid-connected and exporting to grid** – these are SSDG units that are developed by NamPower or private investors with the intention of meeting local demand, as well as feeding any excess generation back into the grid.
- **Above 500 kVA, grid-connected and not exporting to grid** – typically, these are embedded generators providing supply to their associated demand center only and not contributing to NamPower's supply mix. This category still requires a generation license from ECB.
- **Above 500 kVA, not grid-connected but supplying to a grid-connected customer/customers** – embedded generators that have no grid connection and cannot synchronize with the grid.
- **Not grid-connected and supplying a customer/ customers who is/are not grid-connected** – generator that is providing electricity to off-grid, adjacent to the grid or under-the-grid customers.

The regulatory treatment and license conditions for each of these SSDG categories will be different and are summarized in Table 19; those that do not fit the SSDG definition are excluded.

Table 19: Options for SSDG in the Namibian ESI and regulation mandate

Option description	*Technical parameters*	*Pricing and regulation*	*Agreements*
Grid-connected, synchronized and exporting to grid			
Net metering – typically developed by end-user	<500 kVA	Considered as part of the net metering rules - allowed to export excess power to the grid at net metering tariffs determined by ECB. No generation license required, not regulated yet. ECB has strong views on the lease agreement to ensure it is not a "supply agreement".	Net metering application form, offer and agreement with grid supplier. Agreements for supply and installation of equipment with SSDG supplier. If not self-funded, lease (or rent-to-own) agreement with SSDG supplier.

Option description	*Technical parameters*	*Pricing and regulation*	*Agreements*
Embedded generation grid-connected, synchronized but NOT exporting to the grid			
End-user owned	>500 kVA	ECB evaluates the plant information (cost, funding, revenue requirement, tariff return) and comments on the tariff. Generation license required for self-generation. ECB has strong views on the lease agreement to ensure it is not a "supply agreement".	Transmission Connection Agreement (TCA) including the transmission connection offer letter with NamPower Transmission.
Embedded generation NOT grid-connected			
End-user owned, far from the grid, or adjacent to the grid but never connected (i.e. no infrastructure to complete final connection is yet in place)	Any size	No regulation currently, but the ECB is considering in its off-grid and mini-grid policy "light regulatory" application soon.	Procurement arrangements with a SSDG supplier and installer.
End-user owned, under-the-grid, i.e. was connected but opted to disconnect from the grid	Any size	No regulation currently, but the ECB is considering in its off-grid and mini-grid policy "light regulatory" application soon.	Procurement arrangements with a SSDG supplier and installer. Could attract an "availability" charge from previous grid supplier regardless.

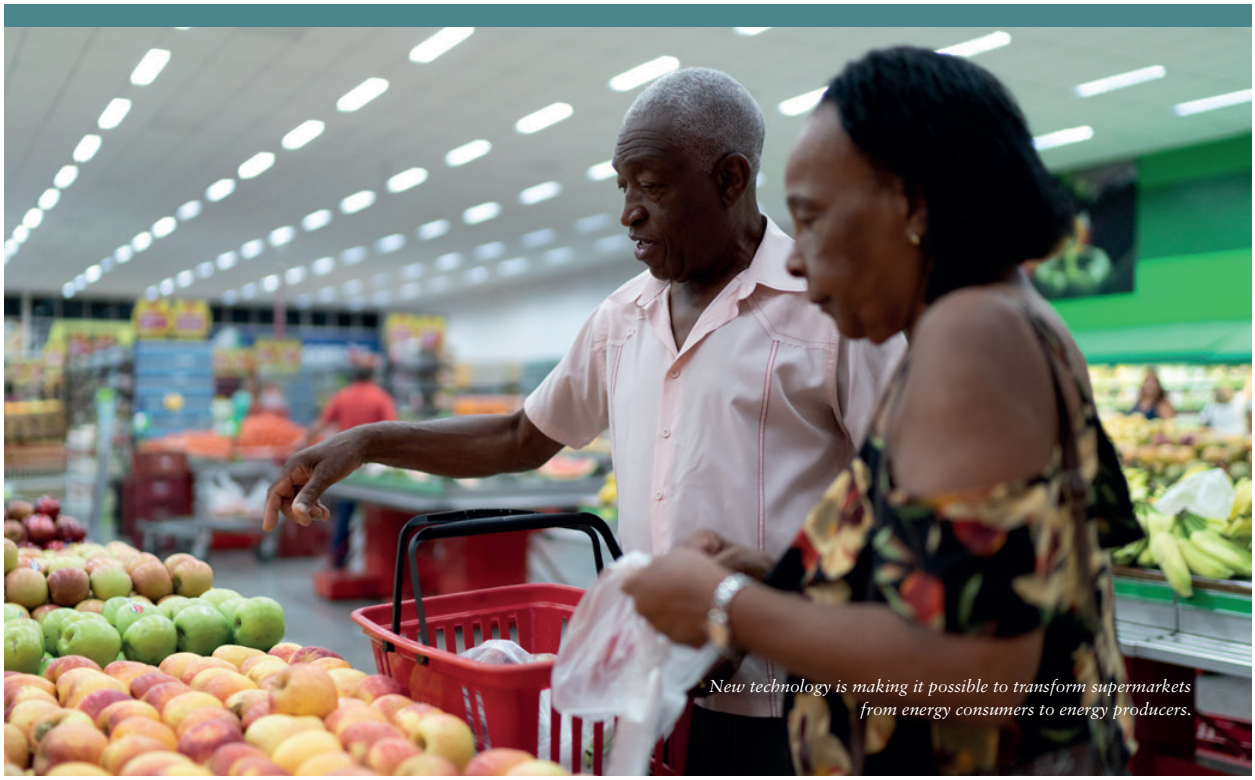
Key changes to Namibia's policy and regulatory framework

Recent legal and regulatory changes that will significantly impact the further development of the SSDG market are presented in Table 20.

Table 20: Key changes to Namibia's policy and regulatory framework

Key changes	*Description*
Legislation changes	The Electricity Bill, 2017 The Namibia Energy Regulatory Authority Bill, 2017 (NERA) The Public Procurement Act, 2015 and its regulations Public Private Partnership Act, 2017 Under the Electricity Bill, ECB will become the Namibia Energy Regulatory Authority (NERA). As part of this reform, ECB's role in relation to MME will also change substantially as follows: The Minister decides the allocation and procurement of the projects in the NIRP, whereas the Regulator licenses and approves tariffs. This implies that the approval of licenses will now fall under the mandate of the Regulator and not the Minister. The Minister can comment on the license and license conditions prior to issuance. The new Electricity Bill also sees the introduction of licensing for: the storage of electricity; system operator; and market operator.

Key changes	*Description*
Policy changes	The newly published Off-Grid Electrification Policy is expressing *"Government's intent to recognize, commit to, promote and support the provision of modern energy services throughout Namibia by means of, amongst others, off-grid applications"*.[44] The key objectives of interest to the development of SSDG as an off-grid solution are to: • promote long-term investment certainty and sector-wide growth; • balance technology neutrality in off-grid electrification programs; • develop, establish and apply *"light-handed, cost-effective and principle-centered regulations, licensing, tariffs and technical standards"*; • foster collaboration between electricity providers and off-grid end-users; • create socially acceptable off-grid service tariffs and charges that balance the upfront and ongoing costs to provide services with the end-user's ability to pay; and • ensure that off-grid electrification initiatives are well-communicated, follow transparency of process and are readily and speedily implemented. Please see below for a more in-depth discussion on the changes expected as a result of the introduction and implementation of this new policy.
Market changes	The availability of technology that renders SSDG options competitive to centralized options is a disruptive force in the Namibian ESI model. The Single Buyer Market Model has been eroded by the implementation of embedded generators in the system seeing consumers reduce their electricity costs. Therefore, the ECB recently launched a process to convert the market to a MSBM. Under the MSBM the role of the Single Buyer changes and transactions between project owners and off-takers, other than the Single Buyer, beyond the scope of embedded generation, is allowed. Please see below for a more in-depth discussion on the changes expected as a result of this change in market model.
Tariff structure changes	The introduction of the MSBM results in unbundling of supply tariffs and introduces new service charges such as a reliability service charge and a losses charge for wheeling of energy. Please see section 3.3.4 for a more in-depth discussion on the changes expected as a result of this changes in the tariff structures.



New technology is making it possible to transform supermarkets from energy consumers to energy producers.

[44] Draft Off-Grid Electrification Policy, July 2019

Wind energy turbines.

Off-grid Electrification Policy

The policy defined five levels (tiers) of electrical services for households and institutions along the availability of electricity (hours per day) for different levels of appliance penetration (lights, essential equipment, etc.) at defined utilization levels.

Seven policy statements are defined, each with a set of sub-statements, as presented in Figure 8.

Figure 8: Off-grid Electrification Policy Statements

The implementation of the Off-Grid electrification policy will require additional legal and regulatory changes. The main changes foreseen to be of impact in the SSDG market are:

- The **levelling** of the legal, regulatory, funding and institutional **playing fields** between on- and off-grid electricity supplies;
- The **harmonization** of the development of national electrification strategies, planning, implementation and **regulation** by treating on- and off-grid electricity supplies on an **equal footing**;
- **Enacting** a system of **quality and technical standards** for off-grid technologies;
- Developing and providing **incentives** for off-grid electrification **investors**, which includes the development of **public-private partnerships**;
- Developing and implementing the legal requirements to offer **exclusive area supply contracts**, off-grid **concessions** and similar arrangements to enhance off-grid investment conditions; and
- Encouraging innovative operational and **service provision models** that result in the accelerated delivery of off-grid electricity services at **affordable tariffs.**

The policy's action plan is divided into a short-term implementation period up to 2022, a medium-term implementation period up to 2027 and a long-term implementation period up to 2032.

Licensing and approval process

Any SSDG project that is under 500 kVa does not require a generation license and is treated according to net metering rules. Projects above 500 kVa face a much more cumbersome process, including a generation license and a Transmission Connection Agreement (TCA) with NamPower.

Under the Electricity Bill, the ECB will become the Namibia Energy Regulatory Authority (NERA) and will be responsible for the approval of licenses. Also, under the new Electricity Bill licenses will also be required for the storage of electricity.

Discussion

The legislation and regulatory framework to support and encourage SSDG penetration for grid-connected applications and customers is well-developed. The changes to further liberate the market will enhance deeper penetration but may also initially bring some uncertainty and confusion. However, it is unlikely that it will impact the majority of C&I SSDG developers.

The introduction of the Off-grid Electrification policy should further enable SSDG implementation to bring modern, safe and affordable electricity to Namibians located in off-grid areas.

3.3.3 SSDG EXPERIENCE

SSDG development in Namibia over the last five years has been extensive and is expected to continue to grow.

The City of Windhoek as a case study of the impact implementing MSBM phase 1

The City of Windhoek indicated that their day-load is currently at 100 MW and that NamPower (as the city's supplier) restricted them to 50% of their day-load for intermittent embedded or net metering penetration. They have 19 MW in net metering penetration and planned an embedded PV of 25 MW. This left room for 6 MW of further net metering installations on their distribution grid.

However, with the introduction of MSBM, these limitations can change drastically. Their consumption for 2018 was 1,000 GWh, of which 30% provides for 300 GWh of energy that can be sourced from alternative suppliers. The energy replaced by current net metering and rooftop installations (at a 20% capacity factor) is about 33 GWh per annum, or just more than 10% of their allowed replacement under phase 1 of the MSBM. This leaves them (at a 20% capacity factor) with just over 150 MW of new opportunity for either net metering or embedded generation installations. This opportunity will require grid upgrades in strategic locations, and storage and ancillary services to support grid stability.

Experienced SSDG suppliers in Namibia

Namibia has attracted an increased number of SSDG suppliers and installers over the last five years. One of the biggest players with 100 MW market share is HopSol. HopSol participate in the market as IPP, EPC or key subcontractors and suppliers to projects, from rooftop level to utility-scale level. They are operative in both the grid-connected, as well as off-grid market, providing self-sufficient solutions to remote lodges and villages in the latter.

There are several similar companies in the market and competition is stiff.

Unfortunately, Namibia is also plagued with overnight and unreliable market entrants, as well as with an influx of second-hand or inferior equipment. The average net metering client does not necessarily have the technical acumen to evaluate the standard or origin of equipment proposed by its supplier and considers initial installation cost as the only decision driver. Hence, a number of poor-quality installations are evident. There are insufficient mechanisms to control these opportunistic market entrants and to regulate or enforce minimum standards.

Grid integration study conducted by ECB

The grid integration study conducted for the ECB in 2018 had the following findings after evaluating the impacts of new intermittent renewable energy generation in the Namibian power system using load flow analysis, contingency analysis, fault levels, grid strength assessment, power quality, QV analysis and reliability assessment:[45]

- The **low load demand and long-distance transmission** lines and hence high impedance of the network will limit intermittent renewable energy penetration.
- Renewable energy power should be **consumed at local distribution level** to avoid long distance power transmission losses in the system.
- The recommended intermittent renewable energy power in Namibia should **not exceed the minimum load demand during the day** (~300-350 MW in 2018).
- **Exporting** the renewable energy power to neighboring countries will **increase line losses**.
- Due to **low fault levels in the Namibian network** intermittent renewable connections should be **less that 10 MW** to avoid power quality violations.
- Detailed **grid studies** should be conducted, and relevant solutions should be implemented for **larger intermittent renewable energy** solutions.
- **Renewable energy grid codes** should be developed considering the specific characteristics of the network.

Discussion

The aggressive penetration of renewable energy in Namibia is evident in the installed capacity and supply mix as of 2019. It is expected that further penetration will continue under the existing net metering rules and potentially accelerate under the liberation of the market implementing the MSBM.

End-users of net metering and rooftop installation require additional, better quality information and education when selecting a supplier/installer or equipment to avoid poor-quality installations. Standards and better control are required to enhance suppliers' and installers' ability to implement sustainable solutions and offer products of acceptable quality.

The development of a renewable grid code has been launched by the Regulator (tender closing date is 31 July 2019), which could address some of the issues and challenges identified in the grid integration study.

[45] Conducting a study on grid integration of intermittent renewable energy in Namibia, by Stellenbosch University's Centre for Renewable and Sustainable Energy Studies, April 2018.

3.3.4 CURRENT TARIFF FRAMEWORKS AND APPROACH

Consumer tariffs

Under the MSBM, larger consumers will have the option to purchase power directly from producers.

Tariffs are currently accepted to be at cost-recovery levels, with cost-reflective structures, including ToU charges for customers with the appropriate meters. An example of the current tariffs for C&I customers is presented in Table 21, from the City of Windhoek.

Table 21: C&I tariffs from the City of Windhoek[46, 47]

Tariff category	*Capacity charge (US$/Amp)*	*Network access charge (US$/kVA)[48]*	*Penalty charge (US$/kVA)*	*High season energy (US$/kWh)[49]*			*Low season energy (US$/kWh)*		
				Peak[50]	*Std.*	*Off-peak*	*Peak*	*Std.*	*Off-peak*
Business									
Prepaid					0.21			0.21	
EL20 (not ToU)	0.88				0.17			0.14	
EL30 (not ToU)	1.47				0.17			0.14	
EL20 (ToU)	0.88			0.21	0.14	0.10	0.14	0.12	0.09
EL30 (ToU)	1.47			0.21	0.14	0.10	0.14	0.12	0.09
EL40 (ToU)		13.08	13.08	0.20	0.14	0.09	0.14	0.12	0.09
Industrial									
EL60 (ToU)		12.74	12.74	0.19	0.12	0.07	0.12	0.10	0.07
EL86 (ToU), with own 11kV equipment		12.46	12.46	0.19	0.12	0.07	0.12	0.10	0.07

Source: City of Windhoek, ECB

The tariff structures currently in place in Namibia provide efficient price signals to consumers regarding their costs to serve, in both energy and network charges. The price schedule presented above highlights the large differences between the high and low seasons, and between peak and off-peak periods. C&I customers with more exposure to high season and peak periods will benefit most from self-supply through SSDG.

Grid-connected end-user embedded/captive SSDG options

The costs of implementing an SSDG solution for grid-connected customers go beyond that of the cost of the SSDG system and costs typically not considered during the Cost Benefit Analysis (CBA) could include the cost of the grid supplier to inspect and commission the net metering installation; costs to replace outdated meters with four quadrant smart meters, costs to convert from a prepaid to post-paid customer and potentially, an increase in the deposit to the grid supplier.

Another aspect frequently understated is the charges and payments to the grid supplier that cannot be avoided by the supplementary SSDG installation at the end-consumer. These include rental charges, service charges, maximum demand charges, capacity charges, ECB and NEF levies, etc. These charges under the various tariff regimes in Namibia are different for:

[46] Additional levies payable to ECB and NEF have been excluded from this table.
[47] Conversions to US$ have been made at the prevailing spot exchange rates on 8 August 2019: 1 NAD = 0.066 USD.
[48] Also includes a Demand Charge.
[49] High season is from 1 June to 31 August.
[50] The periods for ToU tariffs are presented fully in Table 3 on page 19 of this report.

- Transmission connected customers (re-distributors, water pumping, commercial; miscellaneous, export, agricultural, farmers, mines, etc.).
- Customers connected to NamPower's distribution network (small power users and large power users each with a sub-category for farmers, agriculture, etc.).
- Customers connected to REDs or local/regional authorities' distribution networks (small or medium business, institutional, domestic, etc.).

Thus, a CBA for the same installation at different locations for different consumer-types, supplied by different distributors, will provide vastly different results.

Table 22[51] provides an illustration of the cost and benefit drivers evaluating the CBA of SSDG installations at grid-connected end-users, using NamPower's tariff regime.

Table 22: Illustration of CBA analysis for an on-grid C&I SSDG installation in Namibia

CBA components	*Small power users*	*Large power users*
Cost/tariff to customer from SSDG installation	CAPEX of installation (if self-owned); or	
	Rental/lease charge if rent-to-own or lease agreement (NAD/month); and	
	Net metering installation cost charged by grid supplier (NAD); and	
	Net metering meter cost (if replacement of meter is required) charged by grid supplier (NAD); and	
	Increase in deposit (if annual estimated bill from supplier increases).	
Cost/tariff to customer from grid connection	Energy (NAD/kWh); and	
	Service (NAD/month); and	
	Capacity depending on the circuit breaker size (NAD/month or NAD/Amp/month); and	Reserved capacity (NAD/Amp/month); and
	N/A	Maximum demand (NAD/kW or NAD/kVA); with penalty charges if actual monthly maximum demand is consistently above nominated maximum demand; and
	Rental (NAD/month); and	
	ECB Levy (NADc/kWh); and	
	NEF Levy (NADc/kWh).	
Avoided cost elements (by installing SSDG)	Reduced energy payments for replaced energy payment at energy charge levels (NAD/kWh)	
	If installation results in a lowering of connection capacity: Reduced capacity charge and payment on new connection capacity (NAD/month or NAD/Amp/month).	If installation results in a lowering of connection capacity: Reduced reserved capacity payment on new connection capacity (NAD/Amp/month) but with a 12-month notice period.
	N/A	If installation results in lower maximum demand: Reduced maximum demand payment (NAD/kW or NAD/kVA) with penalty charges if actual monthly maximum demand is consistent above nominated maximum demand.

[51] The analysis is based on a hypothetical SSDG connection to the distribution network, with NamPower used as an example of the electricity provider.

CBA Components	*Small power users*	*Large power users*
Tariffs for export of excess SSDG energy into the grid		Net metering installations at <500 kVA: Net metering energy tariffs determined by ECB (NAD/kWh)
		Embedded generation above 500 kVA: Under SB regime, none. Under MSBM regime: per unbundled tariff discussion in this document.

On the positive side, for installations lower than 500 kVA (net metering) the net metering tariffs are well-published and relatively simple to understand. The net metering tariffs differ slightly for different supply license holders, and some are based on ToU structures as well. The net metering (non ToU-based) tariffs for the different supply license holders in 2018 ranged between NAD 1.18 and NAD 1.24. Below is an illustration of the differences between distributors and as can be seen, the differences are small. It should be noted that both NamPower and the Central North Regional Electricity Distributor's (CENORED) tariffs decreased slightly for the 2019/2020 year, as presented in Table 23. The other distributors are expected to follow the same trend as NamPower's wholesale tariffs to them decreased by 2.5% for the 2019/20120 financial year.

Table 23: Selected net metering tariff regimes for 2018/2019[52]

Supply Licensee	*Non-ToU net metering tariff (US$/kWh)*	*ToU net metering tariff (US$/kWh) (2018/2019)*			
NamPower	0.08 (2018/19) 0.08 (2019/20)	No ToU on Dx level			
City of Windhoek	0.08 (2018/19)	*Season*	*Peak*	*Std*	*Off-peak*
	0.08 (2019/20)	High	0.16	0.10	0.07
		Low	0.10	0.08	0.05
ErongoRED	0.08	*Season*	*Peak*	*Std*	*Off-peak*
		High	0.17	0.10	0.07
		Low	0.10	0.08	0.05
CENORED	0.08 (2018/19) 0.08 (2019/20)	*Season*	*Peak*	*Std*	*Off-peak*
		High	0.17	0.10	0.07
		Low	0.10	0.08	0.05
NORED	0.08	*Season*	*Peak*	*Std*	*Off-peak*
		High	0.16	0.10	0.07
		Low	0.10	0.08	0.05
Okahandja Local Authority	0.08	*Season*	*Peak*	*Std*	*Off-peak*
		High	0.17	0.10	0.07
		Low	0.10	0.08	0.05

Source: ECB

[52] Conversions to US$ have been made at the prevailing spot exchange rates on 8 August 2019: 1 NAD = 0.066 USD.

However, the implementation of the net metering payment for excess energy into the network is more complex and not clear from the invoice details supplied by the various supply license holders. Payment for excess net metering is governed by the following principles:

- The payment for excess net metering delivered to the supply utility (from the end-customer) is off-set against the payment due to the supply (to the end-customer) for energy delivered, i.e. against the energy payment.
- Net metering "credit" is calculated on a monthly basis and if off-set is in "credit", the amount is brought forward to the next month.
- The annual off-set cannot result in a net payment to the end-customer and therefore, aggregated over a year and at the end of the financial year, any remaining "credit" is lost.
- As the energy charge to the consumer is higher than the net metering tariff, more units of excess energy can be fed back to the grid supplier than is drawn from the grid supplier.

Not grid-connected end-user SSDG options

Traditionally off-grid implied options for consumers where the grid has not reached, i.e. far away and remote from the grid or grid expansion soon. However, with the selection of competitive technologies, "off-grid" customers are now found adjacent to the grid, or even under-the-grid as customers might select not to pay the "rental or connection fee" to the grid supplier for the connection, or even elect to disconnect from the grid supplier's network and become self-sufficient. Table 24 summarizes the cost and benefit drivers for an off-grid C&I SSDG development.

Table 24: Illustration of CBA analysis for an off-grid C&I SSDG installation in Namibia

CBA Components	*Off-grid, i.e. grid expansion is not yet near location of customer*	*Adjacent to the grid, i.e. has option to affect the connection to the grid with a dedicated shallow connection*	*Under-the-grid, i.e. was connected and choses to disconnect and become self-sufficient*
Cost/tariff to customer from SSDG installation	CAPEX of installation (if self-owned); or		
	Rental/lease charge if rent-to-own or lease agreement (NAD/month); and		
	Optional, meter cost (if end-consumer anticipates near future connection to the grid supplier (NAD)	Meter cost (NAD)	None
Cost/tariff to customer ESI industry	None	ECB Levy (NADc/kWh)[53]; and	
		NEF Levy (NADc/kWh); and	
		Potential "availability charge" (NAD/month) – under consideration of distributors for customers under or adjacent to the grid.	
Avoided cost elements (by installing SSDG)	Avoided cost of energy sources used for light, heat, pumping, etc., now supplied by electricity (diesel, kerosene, candles, etc.)		None
	N/A	Difference in energy costs for SSDG energy compared to energy charge levels (NAD/kWh); and	
		Avoided service payments (NAD/month); and	
		Avoided (reserved) capacity payment on new connection capacity (NAD/Amp/month); and	
		Avoided maximum demand payment (NAD/kW or NAD/kVA);	
		Avoided rental payments (NAD/month)	

[53] The ECB's intention to have levies on supplied electricity and not only on grid-connected, metered supplies was confirmed in the Government Gazette for the 2019 levies. Therefore, the levies are considered to be "non-escapable" chargers for all electricity consumers, connected to the grid or not. It is not clear which mechanism will be used to bill and gather these fees, as there is no relevant supporting regulation in place yet. It is expected that this will be addressed in the execution of the supporting regulation for the newly drafted off-grid and mini-grid policies.

CBA Components	*Off-grid, i.e. grid expansion is not yet near location of customer*	*Adjacent to the grid, i.e. has option to affect the connection to the grid with a dedicated shallow connection*	*Under-the-grid, i.e. was connected and choses to disconnect and become self-sufficient*
Avoided cost elements (by installing SSDG) (continued)		N/A	But, all the above with a notice period of up to 12 months
		Avoided deposit payments (equivalent to three months estimated bill) (NAD)	Return of deposit payment (equivalent to three months estimated bill) (NAD)
Tariffs for export of excess SSDG energy into the grid	N/A, unless the connection is converted to a grid-connection.		N/A, unless the connection is reverted to a grid-connection.

Electricity pricing regime for behind-the-meter storage applications

The Regulator has recognized the importance of the development of an ancillary market that can support and reward technologies in front, as well as behind-the-meter, that contribute to grid stability and security. The various ancillary services are defined, but no clear tariff structure has been implemented, including a tariff structure for rewarding battery storage solutions. It is the intention to address these during the rollout and implementation of the MSBM, as discussed elsewhere in this document.

Discussion

The avoided costs for net metering and other SSDG installations are sometimes overstated, as not all the grid-connected charges can be avoided and some additional costs related to the implementation of the SSDG solution are ignored in the CBA analysis.

It is of great concern that the only option to avoid the fixed charges for being connected to the grid is to disconnect from the grid. The foreseen changes in the tariff structure, as well as the reduction in SSDG technology costs (battery storage, energy management equipment) will strengthen the business case for consumers to abandon the grid for self-sufficient supply. Such actions will leave distributors in a vulnerable position, as installed infrastructure will be underutilized, revenues will decrease, and the quality of the revenue base will deteriorate (longer debtor days and more bad debts). This phenomenon is already visible in the analysis of the financial and annual reports of the utilities in Namibia.

3.3.5 EXISTING POLICY AND REGULATION ON NET METERING

The ECB published in 2016 the net metering rules. The objectives of the rules were documented as:

a) "the generation of additional power into the national grid, reducing the investment requirements of licensees and conventional independent power producers;

b) to allow customer-generators to reduce their imports from distribution networks through generating for own consumption;

c) to allow customer-generators to export to the distribution network up to the imports of the customer-generators from the distribution network;

d) the promotion of sustainable renewable energy sources, small-scale investments, value addition and electricity market development; and

e) to contribute towards reducing unemployment."[54]

It further stated that *"all distribution licensees must offer net metering to customer-generators subject to these rules and other applicable laws, rules and regulations of Namibia."* Table 25 presents further detail of the net metering framework and its implementation.

Table 25: Description of components of Namibia's net metering framework

Items	*Descriptions*
Net metering capacity defined	The limit for any net metering installation is set as the lower of the main electricity supply circuit breaker current rating (converted to kVA) and 500 kVA. The rules further allow the distributor to set additional limits on the aggregate of installations considering the electrical supply infrastructure upstream of specific nodes and the stability of the distribution network.

[54] Net metering rules, Government Gazette 471 of 2016.

Items	*Descriptions*
Licensing	Net metering installations are exempted from getting a generation license.
Codes and standards	The net metering installations must adhere to the Distribution Grid Code where all single-phase installations with circuit breaker ratings of 60 A and less are classified as small renewable feed-in and the rest as embedded generation. The rules further stipulate technical rules, in addition to those in the Distribution Grid Code, to be adhered to for the installation and metering of net metering applications. It precludes prepaid meters and references the Standard Specification for Medium and Low Voltage Electricity Distribution Works for Namibia as relevant meter standards. The distributors are required to install power quality measurement points at strategic locations close to distributed generation concentration areas in accordance with the Namibian Quality of Supply and Service Standards.
Tariffs, compensation and billing	The rules stipulates compensation for excess energy fed into the grid at the avoided cost rates of the distributor, as well as capacity compensation "*at the avoided capacity cost of the distribution licensee if the generation facility can, with a 99% degree of certainty, contribute towards meeting the daily peak demand in the license area of the distribution licensee*." The avoided cost methodology and rate must be submitted to the ECB for approval. On the other hand, shallow connection charges[55] will be paid by the customer as determined in the connection charge policy of the distribution licensee or the National Connection Charge Policy for Load Customers and Generators. The rules stipulate that net metering compensation can only be billed against the energy-related charges. Credits from one month can flow to another until one billing cycle, i.e. year, is completed. The rules are explicit in that no physical compensation is payable to the customer for net metering exports. All tariff applications, adjudications and approvals will be conducted in line with the standard procedures of the ECB and Economic Rules.
Monitoring and control	The distributors are required to keep a register with prescribed information on net metering installations and customers and submit these annually to NamPower and the ECB.
Carbon credits	The rules make provision for the collaboration with other entities for realizing carbon credits.
Third party ownership and consolidation of net metering accounts	The rules make provision that, subject to Board approval, after two years (i.e. from 2018) third party ownership of net metered installations, as well as aggregation of many electricity accounts to one or more net metered installations, will be allowed.
Standard forms and agreement	The rules include the standard forms to be used for small renewable feed-in and a standard net metering connection agreement.

Discussion

The application of the rules is consistent over the different distributors, however, there are some discrepancies creating confusion:

- Different distributors are setting different limits on a specific node, e.g. NamPower set it to 20% of the load on a node; City of Windhoek limits their net metering to 25% of their day load, i.e. 25 MW based on their 2018 day load.
- Distributors conduct their own grid integration studies to confirm and inform limitations of intermittent generation on their systems for stability purposes. Such grid integration studies are done in distribution level voltages, i.e. lower than 33 kV, and their outcome is used to constrain further connections on some nodes. Some aspects of concern of these studies are:
  - There are no common terms of reference, so different distributors, procuring different consultants, all use their own terms of reference for these studies.
  - There is no common standard to be followed or applied in defining, modeling, execution of or setting of stability limitations in these studies.
- The rules do not address the costs charged by the distributors to conduct the inspection and commissioning of the net metering installation, nor the meter installation costs.

[55] The SSDG investor will only pay the cost of connection assets.

- Implementation was initially constrained by lack of processes, procedures and technical capacity of the distributors.
- The software being used to calculate the credit for net metering exports and the interface with the billing programs pose challenges to distributors.

3.3.6 WHEELING REGULATIONS

Wheeling regulations are now being developed as part of the MSBM. Wheeling is only payable if a supplier crosses two networks or exports power to other countries.

Currently, wheeling is estimated at NAD 0.22 c/kWh. The final MSBM rules should be published early in 2020.

3.3.7 OPPORTUNITIES AND BARRIERS TO EXPANDING SSDG

Policy and regulatory barriers

The policy and regulatory regime in Namibia in place and under development are very conducive to C&I SSDG installation. The regulatory framework for net metering is clear. The areas that can benefit improvement are:

- The net metering limit of 500 kVA excludes several larger, but still small, embedded generators and required them to follow a much more cumbersome process (generation license required), with no opportunity for feed-in of excess energy into the system. A net metering level of 1 MW would be much more favorable.
- The issues around lease agreement terms, i.e. what the Regulator will allow, is not clear to the installers nor the end-customers. The Regulator could provide more information on the typical clauses that would render the lease agreements valid and not in breach of the ESI regulations.
- The standards for conducting grid integration studies and setting "stability" levels are not clearly defined and common to all utilities.

Tariff and net metering

The net metering tariff regime is clear. It is of concern that the tariff paths from 2019 to 2020 are reducing slightly. This is a result of the net metering tariff being tied to the avoided costs of the suppliers for the net metering customers.

- The national tariff path sets the net metering tariff path. The influences on the national tariff path are many and provide for mixed messages. At this stage the net metering tariff level of above 8 USD cents is investor friendly.
- Customers benefiting (or suffering) from ToU tariffs will see changes in the ToU periods and differentials that will penalize PV without storage.
- As the energy-only tariff is used to determine the net metering and net metering off-set limit, the foreseeable unbundling of the energy tariff will reduce the value of intermittent energy and increase the value of reliable and dispatchable energy. This will penalize PV or wind-only installations and incentivize storage. It is expected that at least 25% of the current energy-only tariff will be transferred to other tariffs; this implies that the 8 USD cents referenced above move closer to 6 USD cents.
- ECB announced the new unbundled tariff regime will include a "balancing penalty". SSDG investors will be required to submit a day-ahead schedule to the Modified Single Buyer (MSB or market operator). If, on the day, the SSDG delivers less energy than the schedule, it will be charged the applicable ToU tariff for the hour. On the other hand, it will not get recognized for producing more energy than the schedule, i.e. it will not get paid for it. This mechanism will not only incentivize the inclusion of storage, but it will also create a market for storage or "balancing power". The need to reward fast response load is becoming more important in Namibia.
- The customer's avoided cost components are largely dependent on the tariff regime it is subjected to by its grid service supplier. These tariff structures differ between NamPower, the REDs and the local authorities. It is therefore not clear to end-users that self-generation cannot avoid some charges whilst being grid-connected and many times this leads to an overstatement of the benefit of SSDG for them. On the other hand, the fixed cost or unavoidable components are already incentivizing customers to migrate away from the grid to self-supply, benefiting from the cost reduction in PV/Wind with storage options.
- It is expected that at embedded generation levels (i.e. above net metering levels) the tariff path will come down as the technology becomes more competitive. This will be re-enforced during the regulator's consideration of the tariff in the license application.

3.3.8 RECOMMENDATIONS

Based on the findings and constraints identified, the following recommendations have been provided to remove the constraints and/or address the key issues and challenges.

Regulatory frameworks in support of the roll-out of SSDG	Distribution customers above the net metering threshold are excluded as they do not benefit from the net metering rules nor from the new MSBM roll out. It is recommended that the net metering limit be increased to accommodate these customers as well. Develop a standard terms of reference for grid integration studies and standards defining grid stability and grid stability levels.
Policy and strategy to attract private-sector participation, enhance and enable investment of SSDG in the off-grid sector	The Regulator's decision to implement regulations for off-grid electrification should be treated with caution. The private players in the off-grid sector take more risks than those in the grid-sector as these investments have different risk profiles. In addition, Namibia should package its off-grid opportunities such that it attracts angel and impact investors. This will require a proper identification of measurable socio-economic and sustainable investment targets, and the implementation of the appropriate monitoring, evaluation and reporting against these targets.
Incentivizing storage	The existing tariff regime is not yet structured to provide for a sufficient ancillary market that will incentivize customers who consider storage (and moving away from a grid-connected solution) to remain grid-connected and supply from their dispatchable solutions, i.e. fast response storage, to the grid.
Tariff structure differences	Educate Namibians on the avoided and unavoidable cost components for the various type of installations in the different utilities' license areas. Harmonize tariff structures between the different utilities.
Quality control	Educate Namibians on the different standards and quality of equipment and installations. Impose restrictions or controls on the import or labelling of second-hand equipment for SSDG installations.

3.4 South Africa

Table 26: Summary of findings in South Africa

Are current policies and regulations supportive of SSDG?	South Africa's policy on SSDG has been dynamic through the evolution of schedules/notices that defined how SSDG must be registered and licensed. The revised integrated resource plan (IRP), issued in 2019 allocates 500 MW of distributed generation capacity annually during the period 2023-2030. Allocation to SSDG developers for the 500 MW/year will be on a "first come, first served" basis. For the period 2019-2022, there is no prescriptive allocation for DG capacity. Instead, this will be determined by "the extent of the short-term capacity and energy gap", which is estimated at 2,000 MW. This has the potential to unlock significant investment in C&I SSDG. According to the IRP, distributed generation projects with a generating capacity less than 10 MW no longer require ministerial deviation from the IRP. NERSA has already stipulated registration and licensing processes and requirements. This is also to normalize those SSDG users that developed their supply before the Schedule 10 November 2017. Network service providers such as municipalities can agree with SSDG developers on technical requirements and tariffs before approaching NERSA for registration and licensing.
Does the current tariff regime incentivize investments in SSDG?	Industrial customers enjoy a lower tariff than their commercial counterparts, limiting the viability of SSDG unless it offsets high costs and reliability of electricity supply. Current C&I energy, basic and demand charges can facilitate viable SSDG investments, especially where energy demand is during the day for solar. Municipalities are increasing fixed charges and lowering energy charges, so they are not prejudiced on revenue collection. This however does not create a business case for SSDG developers as the lower energy charge provided by municipalities will limit savings from SSDG self-supply. Municipalities have developed their own FiTs based on their bylaws and tariff guidelines (www.sseg.org). These tariffs have been lower than Eskom retail tariffs. For example, City of Cape Town (CoCT) FiT is a standard flat rate of 50% of the applicable customer tariff and based on prices paid by municipalities for Eskom supply.

Does the country have a net metering policy in place?	At the national level, South Africa does not have a net metering policy and regulatory framework and there is no national initiative to develop one. Other sector stakeholders are considering the technical and administrative implications of introducing net metering and experience from other countries has indicated the need for comprehensive preparedness in infrastructure for net metering to work smoothly. For example, the CoCT experience suggests just having a bi-directional meters costs ZAR11,000 and if consumers buy their own meters, then coordination and harmonization of systems is lost.
Have many SSDG projects been implemented?	Many SSDG projects have been installed in South Africa, particularly within municipalities, but due to lack of up-to-date registration and licensing, especially prior to Notice of November 2017, precise capacity installed is not known. An estimate of about 400 MW has been presented by CSIR but there is a general agreement that these estimates and those in the IRP are not based on proper evaluation. The future estimates by CSIR is 6 GW of SSDG by 2030. A total resource capacity for South Africa of 100 GW with technical potential of 70 GW has also been estimated. Although SSDG activities started as far back as 2011 and continue with support of GIZ/SALGA /CSIR in municipalities, an element of policy uncertainty has limited growth. Drivers have been security of supply and off-setting high costs of electricity when the utility could not reliably supply. Of the SSDG installed, a significant share of the penetration is of <1 MW that does not require licensing. There is a call (e.g. from City of Cape Town) that the range that does not require licensing should be increased to <10 MW to allow larger C&I customers to invest. With the clear registration and licensing procedures and requirements streamlined by NERSA, clear policy direction and SSDG allocation in the IRP should lead to greater uptake. As costs of electricity are increasing, and Eskom still cannot be fully depended on to supply power reliably, C&I SSDG uptake should increase.
What are the current barriers to SSDG expansion?	*Policy/regulation barriers:* Lack of net metering policy limits investments in SSDG. Harmonization of NERSA and municipalities regulatory frameworks is needed for smooth registration and licensing of SSDG. *Tariff barriers:* Cost of supply studies that should guide municipalities to set realistic tariffs are not being submitted to NERSA. *Other barriers:* Long approval timelines for registration and licensing by NERSA and low capacity of municipalities to process applications slows uptake. Some municipalities have poor infrastructure to absorb SSDG technically (grid network management) and administratively (processing applications and billing systems). Limited availability of accreditation engineers, having to import SSDG equipment and limited access to financing also constrain uptake of SSDG.
How can the country attract investments in SSDG?	With policy/registration and licensing being streamlined, what is required are a smooth running and simple systems to ensure that SSDG developers are assisted quickly. Further policy and legislation are required for outstanding systems such as battery storage/behind-the-meter systems and other technologies. While extending the license exemption to projects up to 10 MW might not be optimal, a "lighter" license approach compared to utility level projects is needed. Impact analysis of SSDG on the grid especially at the municipality levels is required. Grid stability analysis is required for >25% SSDG penetration but that is not taking place especially for the small municipalities. Government guarantees for financing SSDG especially in public buildings can be an incentive for further uptake of SSDG. Accreditation of more engineers and including qualified electricians to sign off SSDG installations will speed up application and registration processes. Continued capacity building as provided by GIZ, SALGA, CSIR, etc., to municipalities and other network service providers to manage grid network, process applications, put systems in place and creating human skills will be required.

3.4.1 CURRENT INSTITUTIONAL ARRANGEMENTS

Table 27 lists the stakeholders that are key with regards to SSDG and some of them were targeted for interviews and made inputs to the study. South Africa has the necessary institutions to develop its C&I SSDG market, and with stronger policy direction, appropriate frameworks and market conditions could be developed. The Government's current focus on Eskom could create opportunities for C&I SSDG development, although the requirement to focus on Eskom creates a somewhat overwhelming priority in the minds of policymakers.

Table 27: C&I SSDG institutional roles and responsibilities in South Africa

SSDG Roles	*Stakeholder*	*Relevance to this assignment*
Policy formulation	Department of Energy**	Policy (Notices and IRP development) for SSDG. The DoE issues all policies before any regulatory frameworks are developed.
	Department of Trade and Industry (DTI)	Promotes industrial development and supports energy saving technologies. DTI will be instrumental in creating incentives for local manufacture of SSDG equipment.
	South African Local Government Authority (SALGA)**	Oversees municipalities in South Africa including their policy framework. Has been active in supporting and evaluating SSDG performance in the past.
Regulation	NERSA**	Regulates the conditions for registration and issuing licenses for generation, transmission, distribution, sales and use of electricity in South Africa including for SSDG. In charge of the sector tariff regime and would develop net metering rules when policy comes up.
Utilities/ implementation	Eskom*	Responsibility for generation, transmission and distribution and related infrastructure. Has control of grid network including its capacity assessment. Develops retail and wheeling tariffs. Main off-taker of IPP power generation. Involved in battery storage research and adoption.
	Association of Municipal Electricity Utilities (AMEU)	Network service providers/electricity distributors at municipal level. Would be responsible for grid capacity stability and technical requirements for SSDG at municipal level.
	SANEDI	Responsibility for small-scale RE/EE promotion in the country.
	Municipalities/Metros: Western Cape**, Ekurhuleni, Nelson Mandela Bay, Johannesburg	Responsible for power supply within their jurisdiction, approval of SSDG applications, sets/agrees on tariffs for SSDG, potential SSDG public users.
Financing	Industrial Development Corporation**	Provides credit lines for industrial RE and EE projects. A potential SSDG public user.
	DBSA**	Financing of RE projects and main stakeholder in REIPPPP.
	Property Assessed Clean Energy	Can finance ESCOs for SSDG.
Service providers	South African Solar PV Industry Association (SAPVIA)*	Service providers for solar PV investments and installations.
	AcuDee Projects	Install turnkey SSDG in the country mainly in Bloemfontein. Has PV GreenCard engineers.

SSDG Roles	*Stakeholder*	*Relevance to this assignment*
Service providers (continued)	Distributed Power Africa (DPA)	Provided solar systems for Econet in Zimbabwe, but also has offices in South Africa.
	IBC Solar South Africa	Technology provider, installer and service provider for solar PV including for commercial users.
	Liquid Telecom	DPA (above) is currently providing commercial solar PV solution to Liquid Telecom's data center in Cape Town.
	SOLA Future Energy*	Installer of the system at Cedar Mill Mall.
SSDG users	Mall of Africa*	Large SSDG development, above 1 MW
	Cedar Mill Mall (Clanwiliam)*	851 kW of solar installed on mall roof. Mall can operate independently of Eskom.
	Northgate Mall*	Rooftop solar project with a capacity of 960 kW.
	Arbeidsvreugd Fruit Packers	Installed a 450 kWp rooftop PV to power their cold storage facilities.
	Marlenique Estate (Farm)	Floating solar park owner in Marlenique Estate, plus adjacent fixed solar park installation. Floating solar park built by New Southern Energy.
	Agri SA	A federation of agriculture organisations. Have mentioned that they want to promote more use of solar PV for farms.
	MTN South Africa Johannesburg Office	MTN Head Office with 330 kW solar PV installation.
Research	Council for Scientific and Industrial Research (CSIR)**	SSDG overall research activities and specialized activities related to battery storage. 558 kW solar PV plant for distributed generation.
Development Partners/ NGOs	GIZ**	Supported SSDG revenue impact modeling for City of Tshwane. Active on supporting SSDG policy options. Supporting several municipalities on SSDG adoption and activities.
	USAID Southern Africa Energy Program	Southern Africa-wide program to increase the supply of and access to electricity in Southern Africa, including through SSDG.
	Greencape**	Experience throughout market evolution of SSDG.

*Approached but interview/consultation not secured.

**Stakeholders that provided inputs

Discussion

South Africa's institutional development for grid-based services is well-established. This is evidenced by the large number of SSDG users that currently operate in South Africa. Institutional support for smaller-scale electricity services are less developed, which has led to considerable uncertainty for SSDG developers and C&I businesses.

3.4.2 EXISTING POLICIES AND REGULATORY FRAMEWORK

Table 28 provides a summary of the policy and legal documents with relevance to SSDG in South Africa.

Table 28: Policy and regulatory frameworks relevant for C&I SSDG in South Africa

Document	*Description*	*Relevance and implication*
National Climate Change Policy 2008	Developed to meet South African domestic and international commitment targets	Has set targets for reduction of carbon emissions for South Africa and has RE mitigation policies and strategies.

Document	*Description*	*Relevance and implication*
IRP 2050 under development[56]	Proposed revision includes significant roll out of SSDG	The standing target of 500 MW SSDG per year based on the Ministers Blanket deviation is what is under NEDLAC consideration.
Licensing guidelines for embedded generation	NERSA procedures and requirements for registration and licensing	Governing current registration and licensing of SSDG pending any future changes to the DoE Notices/schedules.
Registration procedure for small-scale embedded generation	NERSA published this document in August 2018 to provide processes and procedures for registering generation facilities below 1 MW	Different municipalities seem to publish different guidelines for registering or applying to be an SSDG in their municipality.
Integrated Energy Plan	The development of a National Integrated Energy Plan (IEP) was envisaged in the White Paper on the Energy Policy of the Republic of South Africa of 1998 and, in terms of the National Energy Act, 2008 (Act No. 34 of 2008), the Minister of Energy is mandated to develop and publish the IEP in the Government Gazette.	The IEP analyzes energy consumption trends within different sectors of the economy (i.e. agriculture, commerce, industry, residential and transport) and uses this to project future energy requirements, based on different scenarios. This will also inform future SSDG demand in the C&I sectors.
Carbon tax	Enacted to fight climate change and reduce carbon footprint of the country. The tax is now in effect in 2019.	The Government introduced a carbon tax and this will collectively induce polluters to invest in RE projects, including rooftop solar, in order to reduce their carbon footprint and avoid paying the carbon tax.
Electricity Regulation Act, 2006 (ERA),	Establishes a national regulatory framework for the electricity supply industry, makes NERSA the custodian and enforcer of the national electricity regulatory framework, provides for licenses and registration for generation, transmission and distribution.	Requires all generation activities to obtain a license from NERSA including for SSDG.
	Standard Conditions for Small-Scale (less than 100 kW) Embedded Generators in Municipal Boundaries in 2011, provides guidance on licensing and other matters regarding SSDG. NERSA has set timeframes regarding the approval of licensing for SSDG investments, but has no control on whether these are met by municipalities.	Power generation of less than 1 MW does not need to apply for a license from NERSA.[57] This is confirmed and strengthened by the new Schedule 2 of the Electricity Regulation Act issued in 2017 below.

[56] It is expected to be finalized in 2020.
[57] SAMSET, 2014, Small-Scale Embedded Generation in South African municipalities (solar PV focus), Sustainable Energy Africa, March 2014.

Document	*Description*	*Relevance and implication*
New Schedule 2 of the Electricity Regulation Act, issued November 2010 and Notice of 10 November 2017	Exempts power generation facilities less than 1 MW for own use in size to have a generation license.	Power generation of less than 1 MW will need to register with NERSA, instead of applying for a license. Registration can be made to a municipality or Eskom, who will then forward the registration to NERSA[58] (not mentioned in the NERSA procedure for registration but indicated at consultation meeting). An update to Schedule 2 is in progress. June 2018 Draft SSDG Regulation to amend Schedule 2 issued by Ministry of Energy, NERSA has concluded public consultation, started in April 2019 but DoE has responsibility to issue any amendments required. The updated notice exempts projects below 100 kW from any form of registration and instead directs municipal distributors to keep a register of such facilities. Plants between 100 kW and 1 MW in size are required to register with NERSA and pay a ZAR200 registration fee.[59] The letter from the Energy Minister allows SSDG of up to 10 MW to be included in the 'blanket deviation' from the IRP allocation.

Contract structures

- FiT arrangements do not currently involve exchange of money but a reduced consumption charge for the SSDG owner.[60] This is also the case with municipality tariffs set by NERSA. This effectively makes FiTs a form of net metering, although this is not formally the case.
- Wheeling tariffs exist for Eskom. PowerX is the only private company that has received a license from NERSA to use the existing infrastructure of Eskom or municipalities at a fee.[61]
- Although REFiT studies were conducted, REFiT was never applied in South Africa and the common practice is competitive bidding.
- Contract structures currently working are largely a combination of competitive bidding followed by PPA. In the case of SSDG, developers apply to municipalities for installation of the plants, followed by registration and licensing.

Local content requirements

The REIPPPP has included awarding for local content and involvement of community participation. Some international equipment suppliers eventually set up manufacturing plant for solar and wind plants in SA. Due to sluggishness in the REIPPPP in the last few years, some of those equipment providers have relocated. South African Independent Power Producers Association (SAIPPA) is of the view that incentives are required to attract manufacturers of SSDG equipment in SA.

Import restrictions

There is no import restriction on SSDG equipment, but local solar PV manufactures are calling, not for the first time, for Government to impose import tariffs to protect the local market.[62] Counter-arguments suggest that imposing import tariffs will make SSDG expensive and reduce demand, and that it would be better to provide incentives for establishment of local manufacturing of the equipment to make SSDG affordable while contributing to economic growth.

Fiscal incentives

There are no fiscal incentives in place.

Retail market liberalisation

The SSDG market is liberalized and any SSDG developers and service providers can compete in the market. The only requirement is registration and licensing per the SSDG policy and legal and regulatory framework.

Licensing and approval process

Under the current legislative framework, any potential power producer needs to apply for and hold a generation license by NERSA in order to operate a generation facility, unless otherwise exempt.

According to the Electricity Regulation Act, an applicant must demonstrate that it complies with the IRP2019 by demonstrating that there are available MWs allocated in the IRP2019 to the specific technology of the facility.

[58] South African Local Government Association (SALGA), 2017, Status of Small-Scale Embedded Generation (SSEG) in South African Municipalities, October 2017.
[59] Creamer, T., 2019, Policy and regulatory malaise undermining efforts to address power deficit, Engineering News 16 April 2019, available from: https://www.engineeringnews.co.za/article/policy-and-regulatory-malaise-undermining-efforts-to-address-power-deficit-2019-04-16
[60] Presented by NERSA.
[61] https://www.esi-africa.com/industry-sectors/generation/powerx-applies-for-amendments-to-existing-license/
[62] https://www.pv-magazine.com/2019/05/24/south-africa-considers-petition-calling-for-tariffs-on-imported-solar-modules/

Failing to show available capacity in the IRP2019, the applicant must obtain an exemption from the Minister from the obligation to comply with the IRP2019 before applying to NERSA for a generation license. Historically, applicants have been unable to get such ministerial exemptions, resulting in significant delays.

With the introduction of a predetermined MW allocation for distributed generation projects up to 10 MW, an SSDG investor will no longer have to obtain ministerial exemption prior to applying for a generation license from NERSA. This is expected to facilitate the process of issuing generation licenses and unlock the potential for investments in SSDG in the C&I sector.

In order to encourage investment in SSDG even further, industry representatives are currently lobbying the Government to gazette an amendment to Schedule 2 of the Electricity Regulation Act to allow for licensing exemptions for SSDG projects with a generating capacity less than 10 MW.

The permitting/licensing process includes:

- Permitting and licensing of SSDG in South Africa is streamlined in the Schedule 2 Notice of 10 November 2017 and continues to be revised to address additional issues. Permitting covers those SSDG installations that are to be registered by NERSA, municipalities and those that require Ministerial approval. Registration can start before project construction, but licensing is effective after plant operation. Licensing for demonstration of new technology takes effect after 36 months of operation.
- For purpose of registration, NERSA requires network service providers such as municipalities and SSDG developers to agree on technical requirements and tariffs before approaching NERSA for registration and licensing.
- Stakeholders believe that registration and licensing takes too long and a simple online registration system is required.

Currently, according to NERSA the licensing process can take up to 120 days to complete.

Discussion

The regulatory framework in South Africa is generally supportive of SSDG investments, even though there are several delays in the processing of applications either by NERSA or Eskom. Before the release of the IRP2019, there was a lot of confusion among solar companies and potential investors alike regarding the licensing requirements for the development of SSDG projects. The new IRP provides a predetermined allocation of capacity to SSDG projects of less than 10 MW, meaning that potential developers no longer need to seek for Ministerial exemption in order to apply for a NERSA license.

3.4.3 SSDG EXPERIENCE

Due to a lack of comprehensive registration and defaulting prior to the Notice of November 2017, no precise capacity installed for SSDG is known. According to NERSA there are currently 51 registered SSDG systems in the country, however the total capacity of these facilities is not known.[63] The latest figure provided by CSIR is 390 MW (CoCT estimates much more than that for own buildings). SAIPPA and CSIR also agree that SSDG capacity figures reflected in the IRP are not based on proper evaluation methods. Future estimates by CSIR is 5-6 GW of embedded generation by 2030. The estimated resource capacity for SSDG is 100 GW and technical potential 70 GW, which is much higher than the current total capacity for Eskom.

SSDG has been increasing but not rapidly due to policy uncertainty. The main driver behind SSDG investments has been increasing energy access, security of electricity supply and offsetting the high prices from Eskom. Larger C&I consumers have also been limited by the small threshold of 1 MW for registration.

Implementation of SSDG at the provincial level has been evident since 2011. GIZ has been working with over 20 municipalities on various aspects of SSDG adoption since 2013. SALGA has trained 35 municipalities on tariff-setting and development of processes for SSDG registration. SSDG is regarded by SALGA as a means to ensure municipalities incur lower wholesale generation prices compared to Eskom, contribute to electricity capacity of the country, promote industrial development and economic growth, and reduce carbon footprints (and potentially benefit from carbon credits).

A number of municipalities such as CoCT are focusing on implementation and have FiTs (import and export tariffs, in addition to fixed/demand charges) developed in accordance with tariff setting guidelines (www.sseg.org.za). CoCT believes there were gaps in legislation, e.g. interpretation of "Own Use", and have created their own rules for SSDG. They feel exemption for licensing should also cover 1 to 10 MW category to accommodate larger C&I customers. So far PV penetration is largely for 1 MW and below and hence grid constraint is not yet an issue except in areas of low grid capacity and high solar resource. Since registration started in CoCT in September 2014, there are now 800 SSDG installations. Many more illegal connections are still estimated. CoCT believes battery storage will change the landscape for C&I SSDG and the network as a moderator of peak demand profiles. Battery storage will also reduce voltage fluctuations that are a concern due to intermittent solar resource availability. CoCT is facing administrative constraints for processing SSDG applications as in May 2019, 1,000 applications for registration were received after registering only 800 in five years.

[63] Interview with NERSA.

View of a solar farm at the Savannah of Samburu National Park, Kenya.

SAIPPA believes that municipalities, especially the smaller ones, have weak capacity to manage their distribution networks and recommends that NERSA should monitor this closely. However, compliance with safety standards should only require a certificate issued by a qualified electrician and proof of registration by a municipality. They recommend creating an environment for manufacturing SSDG equipment in the country. There is a belief that some of the international solar PV players that were establishing in South Africa following REIPPPP have relocated because of policy uncertainty. SAIPPA is also of the view that battery storage with decreasing prices will change the landscape for SSDG. Eskom is working to be a battery storage champion and has battery research going on in their laboratories.

CSIR is supporting training at municipalities on grid impact assessment and SSDG procurement and is also undertaking research into battery storage through its battery research center cooperating with HySA and North West University Hydrogen Research Facility. Although trained municipalities are eager to have their own SSDG, capacity and funding are a constraint. CSIR is planning to provide training on feasibility studies and assisting municipalities to develop their own mini IRPs. The delay in issuing the National IRP2050 is considered a big hindrance for SSDG.

Box 2: AcuDEE Projects' experience of SSDG in Bloemfontein, South Africa

Service Provider (AcuDEE Projects) has been involved in installations of SSDG in Bloemfontein using its PV GreenCard accredited engineers who are dealing directly with municipalities on technical compliances. AcuDEE has managed to promote its services through real estates which is their core business. They provide turn-key projects sometimes partnering with other service providers. They are however not tracking how much capacity they have installed but they agree the importance of doing that to assist with registration of SSDG capacity. They use both local and imported SSDG equipment but allow clients to choose what equipment to use, based on cost and quality. AcuDEE offers a mobile application for SSDG owners to track their generation and consumption. They have management and maintenance contracts with their SSDG clients. They realize that after IRP determination many competitors have come up. AcuDEE still believes that Government should reduce red tape and address utility monopoly to allow other players to provider power.

Source: ECA interview with AcuDEE

While some C&I businesses have the capacity to use their own balance sheets to support SSDG investments, DFI financing can play a catalytic role in stimulating interest in project development. DFIs can offer financing packages to accommodate C&I SSDG but have challenges around minimum investment thresholds, e.g. IDC's threshold is ZAR1 million, while DBSA's is ZAR100 million. One way to manage this barrier is to adopt a programmatic approach to funding multiple projects under the same investment, rather than on a project-by-project basis. Some financing packages tend to be linked to cross-sectoral productive use such as smart irrigation, mining, telecommunications and water capture/purification. So far support is strongest in more active municipalities such as CoCT.

Discussion

Investments in SSDG have been increasing steadily in South Africa, mainly driven by a lack of security of supply. Total SSDG capacity is currently estimated at 500 MW and it is projected to increase to 5-6 GW by 2030.

The experience among SSDG users has generally been positive, with most of them reporting short payback periods.

3.4.4 CURRENT TARIFF FRAMEWORKS AND APPROACH

Eskom's average tariff has increased from US$ 0.01/kWh in 2002 to US$ 0.06/kWh in 2019, an increase of more than 500%. Recently NERSA approved a 13.9% average increase on Eskom tariffs (implemented from 1 April 2019) and a 15.63% average increase for municipalities (implemented from July 2019). However, it is thought that tariffs are still not at cost-recovery levels. The issue is clearly complicated by Eskom's current difficult financial situation, brought on by multiple factors, the inclusion of which in customer tariffs is a nuanced issue.

The process for migrating to full cost-recovery tariffs at the municipality level requires COSS. While the submission of COSS to NERSA is a requirement for municipalities, most municipalities have not met this and

have based their tariff calculations on benchmarking; this is not acceptable to NERSA. COSS can better inform municipalities on structuring of their tariffs and guide them on approaches to incentivize SSDG while protecting municipality revenues.

In March 2019, NERSA issued a consultation paper for municipal electricity tariff guidelines, which is complemented by the guidelines from SSEG (www.sseg.org). Municipalities have proposed to NERSA that costs incurred by them in undertaking a COSS can be recouped from tariffs since this is a significant cost (R1-1.5 million). The ability to implement full cost-recovery tariffs remains dependent on the cost of supply from Eskom.

Eskom wholesale electricity prices (WEPS) have the same rates and structure as the Megaflex tariff and represent the wholesale costs in the most unbundled format. Table 29 presents the applicable tariffs to municipalities and non-municipal customers.

Table 29: Eskom WEPS Local authority and non- local authority tariff[64]

Trans. zone	*Voltage*	*High demand season - Peak (US$/kWh)*	*High demand season - Standard (US$/kWh)*	*High demand season - Off-peak (US$/kWh)*	*Low demand season - Peak (US$/kWh)*	*Low demand season - Standard (US$/kWh)*	*Low demand season - Off-peak (US$/kWh)*
Local authority tariffs							
<300 km	<500V	0.258	0.073	0.040	0.078	0.054	0.034
	>500V& <66kV	0.235	0.071	0.039	0.077	0.053	0.034
	>66kV & 132 kV	0.228	0.069	0.037	0.074	0.051	0.032
	>132kV	0.215	0.065	0.035	0.070	0.048	0.031
>300 and < 600 km	<500V	0.241	0.073	0.040	0.079	0.054	0.034
	>500V& <66kV	0.238	0.072	0.039	0.078	0.053	0.034
	>66kV & 132 kV	0.230	0.070	0.038	0.075	0.052	0.033
	>132kV	0.217	0.066	0.036	0.071	0.049	0.031
Non-local authority tariffs							
<300 km	<500V	0.230	0.070	0.038	0.075	0.052	0.033
	>500V& <66kV	0.226	0.068	0.037	0.074	0.051	0.032
	>66kV & 132 kV	0.219	0.066	0.036	0.071	0.049	0.031
	>132kV	0.206	0.062	0.034	0.067	0.046	0.029
>300 and < 600 km	<500V	0.232	0.070	0.038	0.076	0.052	0.033
	>500V& <66kV	0.228	0.069	0.038	0.074	0.051	0.033
	>66kV & 132 kV	0.221	0.067	0.036	0.072	0.050	0.031
	>132kV	0.208	0.063	0.034	0.068	0.047	0.030

Source: Eskom[65]

[64] Conversions to US$ have been made at the prevailing spot exchange rates on 8 August 2019, i.e. 1 ZAR= 0.066.

[65] Eskom, Schedule of tariffs, available at: http://www.eskom.co.za/CustomerCare/TariffsAndCharges/Documents/Eskom%20schedule%20of%20standard%20prices%202019_20%20Rev00%20%28full%20version%20excl%20Transflex%29.pdf.

Farmers can produce their own energy to power agri-processing and other operations, thereby allowing them to become more self-reliant and mitigate supply risks.

Table 30 shows how electricity tariffs in the WEPS and Megaflex categories vary depending on the season.

Table 30: WEPS/Megaflex tariffs by season[66]

US$/kWh	*Energy charge - Peak*	*Energy charge - Standard*	*Energy charge - Off- peak*
High demand season (Jun-Aug)	0.255-0.275	0.076-0.083	0.041-0.045
Low demand season (Sept-May)	0.083-0.090	0.057-0.062	0.036-0.040
Weighted average per month	0.125-0.136	0.062-0.067	0.038-0.041

Table 31 presents the current tariff regime for City Power of Johannesburg[67] as an illustration of tariffs for C&I customers in operation in municipalities. C&I energy and demand charges are high enough to warrant self-generation, especially where energy demand is high during peak charging periods, and during the day where solar PV SSDG can reduce main grid consumption.

Table 31: Selection of current C&I tariff regime for City Power Johannesburg[68, 69]

Customer	*Energy charge (US$/kWh)*	*Basic charge (US$/month)*	*Demand charge (US$/kVA)*
Business conventional meter (< 100 kVA)	0.139 – 0.176	68.43	
Industrial LV, conventional meter	0.098 – 0.114	121.58	14.57
Industrial MV, conventional meter	0.091 – 0.108	369.48	13.62
Industrial ToU tariffs[70]			
Peak	0.107 – 0.256		
Standard	0.081 – 0.098		
Off-peak	0.062 – 0.067		
LV		145.79	14.58
MV		400.20	13.62
HV		1,488.00	12.67

Source: City Power Johannesburg

NERSA approves tariffs for each Municipality separately, so there is no blanket uniform tariff mark-up that municipalities add on top of the electricity rates charged by Eskom. This is because tariffs for each municipality are based on the cost of supply studies that the municipalities are obliged to submit to NERSA.[71]

However, comparing the City Power of Johannesburg tariffs (Table 31) with the Eskom tariffs shown in Table 30, the highest mark-up is on off-peak tariff (62%), followed by on peak demand tariffs (40%).

NERSA does not have a tariff regime that accommodates behind-the-meter energy as no policy exists for that.

Discussion

Tariffs for industrial customers are relatively low, which together with foreseen increases in fixed charges, weakens the business case for SSDG development.

3.4.5 EXISTING POLICY AND REGULATION ON NET METERING

At the national level, South Africa does not have a net metering policy and regulatory framework, and there is no national initiative to develop one.

Other sector stakeholders are considering the technical and administrative implications of introducing net metering.

[66] Conversions to US$ have been made at the prevailing spot exchange rates on 8 August 2019, i.e. 1 ZAR= 0.066.
[67] Introduced July 2019.
[68] This summary is not comprehensive, but illustrative.
The energy charge range presented is due to summer and winter energy/power demand, and changes between low and high consumption blocks.
[69] Conversions to US$ have been made at the prevailing spot exchange rates on 8 August 2019: 1 ZAR = 0.066 USD.
[70] Same energy charges across the LV, MV, and HV categories.
[71] NERSA, however, noted that the majority of municipalities have not been submitting COSS regularly and their requests for tariff approvals are based on benchmarking.

Experience from other countries has indicated the need for comprehensive preparedness in infrastructure for net metering to work smoothly. Certain municipalities are now allowing a limited amount of surplus power generated by solar systems to be off-set against energy usage, while others are allowing bi-directional metering (in the City of Cape Town and in Tshwane). With bi-directional meters, power consumed is billed at a pre-determined rate and power surplus fed back into the grid is reimbursed at a separate energy rate.

Discussion

While there is no nationwide net metering policy and regulatory framework, some municipalities are already implementing it.

3.4.6 WHEELING REGULATIONS

The current regulatory framework (NERSA's rules for third party transportation of energy) permits any licensed generator to use the distribution network (Eskom's or municipal grid) for the purpose of selling power to a customer at that customer's point of supply.

The contractual arrangements for wheeling include:

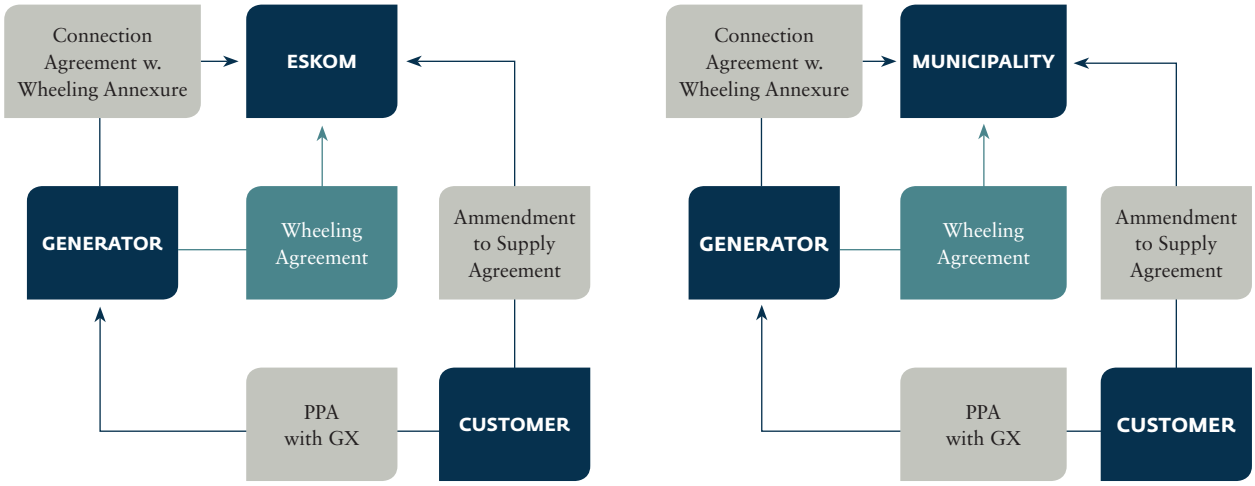
- PPA between customer and generator
- Connection/Use-of-System Agreement between generator and the distribution owner (e.g. Eskom), with a wheeling annexure

Also, depending on the location of the generator and that of the customer:

- Electricity supply agreement between the customer and the distribution network operator at the point of supply (e.g. municipality or Eskom) amended to reflect private delivery of power.

The above contractual arrangements are illustrated in Figure 9 below.

Figure 9: Wheeling arrangements, Eskom and municipality networks



Source: SAIPPA 2019. Legal Framework and Wheeling of Electricity

While in principle wheeling enables renewable energy investors to develop projects at places where the resource potential is the highest and supply clients located in other provinces, there has been very little interest in the scheme. The two main reasons for that are:

- **High wheeling charges:** Eskom has developed a wheeling charge sheet, which can be used to determine the applicable wheeling charges for each project. However, not all distributors have wheeling policies that can be used to determine wheeling charges. Eskom's current wheeling charges differ depending on the location of the generator and the customer, as well as the time of the day that the electricity is generated and consumed. Generally, wheeling charges are relatively high, according to industry representatives,[72] while they differ significantly from one project to another.
- **Duration of PPAs:** Consumers are usually reluctant to commit to a 15 to 20-year PPA, which is usually the period necessary for the developer to make a project bankable.

Wheeling is also less relevant for SSDG investors, as it is unlikely for customers to express interest in signing bilateral contracts to procure energy from projects with capacity less than 1 MW.

[72] https://citizen.co.za/business/1634333/wheeling-the-new-frontier-for-renewables/

3.4.7 OPPORTUNITIES AND BARRIERS TO EXPANDING SSDG

Load shedding

Shortages of generation capacity, coupled with a weak transmission network has led to imbalances between electricity demand and supply, resulting in prolonged periods of load shedding.

Frequent load shedding has led to significant revenue losses and/or cost increases in the country. Bloomberg estimates that power cuts experienced in South Africa in February 2019 cost the country US $68 million a day.[73]

While a few years ago local businesses thought that load shedding would be a temporary phenomenon, it soon became clear that shortages in generation capacity will persist for several years. Fears of further load shedding have also contributed to Eskom's corporate credit rating to drop from 'B3' to 'B2', while its zero-coupon Eurobonds rating were revized from 'B3' to 'B2', according to Moody's.[74]

As a result of load shedding, more than 390 MW of SSDG has been installed in the country in the past couple of years and it is expected that more C&I customers will invest in SSDG solutions in the near future to protect their businesses from the negative implications of load shedding.

Policy and regulatory barriers

- Clarity is needed between NERSA and municipalities to address inconsistencies in guidelines and tariffs in operation for both grid-supplied electricity and FiTs, and around timeframes for approval of applicable SSDG licensing. NERSA licensing takes as much as 120 days plus 14 days for public consultation. Municipalities are overwhelmed when confronted by large numbers of SSDG applications.
- The minimum 1 MW threshold for licensing is considered too small for C&I customers.

Tariff and net metering

- The low FiTs offered by municipalities are insufficient to support a business case for potential SSDG investors. For instance, CoCT has a standard flat FiT of 50% of the applicable customer tariffs based on the prices paid by municipality for Eskom Supply.
- Municipalities are changing their tariff structures to be more cost-reflective by reducing energy charges and increasing fixed network charges, in part because of the awareness of potential revenue losses from SSDG. A study of City of Tshwane of the impact of SSDG on municipality revenues showed that if fixed charges are not reduced, impact of 20% SSDG penetration will only reduce revenue by 0.5% for C&I customers.[75]
- Stakeholders report that there is a delay in SSDG FiTs approval by NERSA that can take as much as 6 months to get feedback.
- Billing systems used by municipalities are often unable to cater for SSDG FiTs.

Other Barriers

Other barriers to C&I SSDG include technical, administrative, financial and capacity types, namely:

- There is poor technical capacity in municipalities to manage grid networks, particularly related to monitoring network stability and non-compliant installations. For secondary cities and metropolitan areas, SCADA systems are used to monitor their systems, but smaller municipalities use less sophisticated systems to monitor their SSDG growth. Significantly increased penetration will require grid impact studies.
- Municipalities have low capacity for processing SSDG applications.
- While technical guidelines exist and the PV GreenCard scheme ensures safe and high-quality solar PV installations, not many engineers are accredited. Having to depend on such accredited engineers to sign off SSDG installations causes delays.
- Depending on imports of SSDG equipment can result in inertia to adopt SSDG while landed costs can also be high. Some local suppliers/manufacturers of solar PV components are starting operations in South Africa, e.g. Artsola, but they must negotiate import tariffs which may make solar imports expensive.
- There is currently limited targeted financing for SSDG developers provided by some commercial banks to selected developers. The various credit lines in place should be explored, e.g. IDC/SUNREF, Green Growth, FIRST at RMB. IDC may consider financing C&I users and service providers as a commodity as they do with fibreoptic providers. IDC believes C&I customer repayment is credible.
- DBSA that has a high threshold of ZAR150-200 million (e.g. Clean Finance facility using GCF resources), and may find SSDG investments too small. A package is required for the <1 MW plants, unless a programmatic approach (e.g. breweries install SSDG at all their premises) is also adopted. BRICS Bank has also injected a fund for ZAR300 million to reduce greenhouse gases but also has high thresholds. Even in the case where feed-in is possible, a PPA of 12 years for 10-year loan will be required.

[73] https://www.fin24.com/Economy/lights-out-load-shedding-and-the-impact-on-local-business-20190215
[74] https://www.thesouthafrican.com/business-finance/eskom-downgraded-by-moodys-load-shedding-6-november-2019/
[75] GIZ 2017. Impact of Small-Scale Solar PV Embedded Generation (SSEG) on Tshwane's revenue.

- Eskom's current challenges make it a stumbling block, where its participation and approval are required. Unbundling may assist the uptake of SSDG at a large-scale.
- Municipalities use electricity payments as a major source of revenue and can struggle to make their necessary payments to Eskom. They can also then be a stumbling block to C&I SSDG if they lose revenue through SSDG due to tariff structures that are neither at cost-recovery levels, nor with cost-reflective structures, hence the move to adjust tariff structures by increasing fixed charges to limit revenue losses.
- Utility issues have been addressed to some extent but not fully. The risk is disorderly development of the SSDG: Installations increase at uncontrollable rates bringing a lot of unplanned capacity in the networks and associated voltage control issues. Risks must be mitigated by phasing an approach to limiting allocations of SSDG to be built. The limitation can be done through IRP allocation.
- Grid constraints will also depend on where SSDG is being absorbed. Some utilities from metropolitan municipalities can absorb higher SSDG but the smaller municipalities may have challenges and may need to upgrade their networks. Overall network strengthening may also be needed through guided planning by both utility and Association of Municipality Electricity Utilities (AMEU) members.

3.4.8 RECOMMENDATIONS

The Recommendations emanating from this analysis for the development of C&I SSDG in South Africa are presented in Table 32.

Table 32: Recommendations for South Africa

Target area for support	*Specific actions that could be taken*
Develop policy and strategy aspects for C&I SSDG, including the level of private sector participation	Consider increasing the minimum threshold for SSDG licensing to 10 MW to allow C&I customers to invest, something for which solar companies have been lobbying. Develop a clear, specific and targeted net metering policy that can be implemented by municipalities with minimal additional assistance. Provide more extensive monitoring of grid capacity/stability assessments in municipalities. Increase policy certainty regarding further adjustments to the Schedule of 10 November 2017, e.g. regarding how battery storage/behind-the-meter and back up diesel generators should be treated.
Enhance the regulatory frameworks in support of the roll-out of SSDG	Continue the path towards cost-recovery and cost-reflective tariffs to ensure transparency in the analysis of a business case for C&I SSDG investors. Create systems for fast-tracked SSDG registration and licensing platforms, with the necessary associated capacity enhancement at NERSA and municipalities.
Make the existing tariff regimes and net metering policies more attractive for the different SSDG technologies and categories	Ensure that municipal tariff setting is based on COSS and not only to save revenue of municipalities.
Areas of support to further enhance and enable private investment SSDG	Government incentives for local manufacture of SSDG equipment are required. Government guarantees for financing SSDG projects especially in public buildings. Accreditation of more engineers and electricians to sign off SSDG installations. Continued training support (as provided by GIZ, SALGA, CSIR) to municipalities, especially the small ones, to process SSDG applications.
Institutional arrangements, such as the potential role for dedicated agencies or teams in policy-making and regulation	Coherence of NERSA and municipal regulatory framework is required for registration, COSS and grid impact studies, to mitigate the cost implications of such studies.

3.5 Zambia

Table 33: Summary of findings in Zambia

Are current policies and regulations supportive of SSDG?	SSDG in Zambia has had a slow take-off due to low utility tariffs, unwillingness by the state-owned utility ZESCO to accept SSDG feeding into the national grid, lack of financing for RE (CAPEX is very high), slow processing of licenses, regulations that are not well-packaged, and lengthy PPA negotiations.
Does the current tariff regime incentivize investments in SSDG?	Current tariffs (between 1 - 4 USc/kWh) are extremely low, giving little incentive for private investment in SSDG as a cost-saving measure. Zambia has been trying to undertake a COSS for a few years, but its finalisation has been disrupted by political challenges.
Does the country have a net metering policy in place?	While net metering is referenced in the 2016 distribution grid code, it has never been implemented. The EU is currently supporting ERB in developing a net metering regulatory framework.
Have many SSDG projects been implemented?	There is currently a developer in Chisamba who has set up an SSDG project but due to unavailability of a policy and regulatory framework the developer is unable to sell the excess power to ZESCO. CEC has implemented a 1 MW solar plant on a pilot basis and transmits the excess electricity into their distribution network. With technical support from GIZ, Rivonia, an agri-business, has installed a 300 kW solar plant for its operations. The SSDG investment was necessitated by increased load shedding in 2015. Rivonia have shown interest to sell the excess power to the grid but due to lack of an appropriate framework it has been challenging to secure a PPA with ZESCO.
What are the current barriers to SSDG expansion?	*Policy/regulation barriers:* Absence of SSDG policy/regulatory framework. Net metering regulatory framework under development. *Tariff barriers:* SSDG in Zambia has had a slow take-off due to low tariffs for the consumption of electricity from the utility (1 - 4 cents/kWh). *Other barriers:* Unwillingness by the state-owned utility ZESCO to feed into the national grid, lack of financing for RE (CAPEX is very high), process for licensing, regulations are not well-packaged, PPA negotiations are lengthy and most do not yield any results.
How can the country attract investments in SSDG?	Ensure the COSS for ZESCO is completed and utility tariffs are set at cost-recovery and cost-reflective levels to ensure transparency in C&I SSDG business case development. Develop a transparent net metering policy and regulatory framework to ensure the regulatory process for net metering arrangements is clear for C&I customers. Assist ZESCO in its analysis of the potential impact and necessary mitigating actions around profitability and grid stability from increased SSDG. Support financing packages for C&I customers to pursue SSDG opportunities. Due to reduced water levels from the Kariba and Kafue hydro resources, electricity generation has been reduced dramatically, leading to prolonged load shedding. The 8 hours of load shedding has had an adverse impact on the revenues and financial viability of the C&I sector, something which created an opportunity for SSDG investments.

3.5.1 CURRENT INSTITUTIONAL ARRANGEMENTS

Zambia's key institutions have made few efforts to support SSDG development for the C&I sector. Much of their focus has been on increasing the supply of generation capacity to ZESCO's grid and on efforts to implement cost-recovery and cost-reflective tariffs.

Figure 10 presents a detailed list of the stakeholders in Zambia's electricity sector, while Table 34 presents more detail on the roles of some of the key stakeholders with respect to SSDG development.

Figure 10: Stakeholder map

Table 34: C&I SSDG institutional roles and responsibilities in Zambia

Institution	*Role*
Ministry of Energy	The principal institution with the mandate of carrying out energy planning and policy development. The development of specific SSDG frameworks will be led by the Ministry.

Institution	*Role*
Energy Regulation Board (ERB)	Responsible for regulating the energy sector, including economic regulation (tariffs), monitoring the application of the Zambia Grid Code and designing standards for the quality, safety and reliability of supply of energy in conjunction with the Zambia Bureau of Standards. Zambia's Grid Code, developed by ERB, allows for net metering by consumers connecting their own generation to the distribution system.
Rural Electrification Authority (REA)	REA's primary aim is to provide electricity infrastructure to the whole nation, targeting rural communities as mandated by Government. SSDG in rural communities, even by C&I customers, can be supported by REA.
Office for Promoting Private Power Investment (OPPPI)	OPPPI was set up to be a "one window operation" to reduce the complexity of procedures, rules and regulations associated with obtaining the required approvals, permits and licenses for investors in the electricity sector. However, OPPPI has never been allowed to operate properly and has therefore been ineffective. With increased support, OPPPI could play a supporting role in SSDG development.
ZESCO	State-owned electricity utility, producing 80% of all electricity consumed in Zambia. Though ZESCO does not have exclusive rights to be the single bulk trader of electricity under Zambian legislation, Zambia nevertheless currently operates a de facto Single Buyer Model, with ZESCO as the Single Buyer. ZESCO has its own generation and procures electricity from IPPs and from the Southern African Power Pool (SAPP) to satisfy the electricity demand of ZESCO's customers. There are currently no bilateral contracts between eligible grid-connected consumers and IPPs in Zambia. ZESCO is required under the REFiT Strategy 2017 to develop micro-generation connection guidelines, for approval by ERB. However, ZESCO is not keen on the implementation of SSDG projects, presumably due to its expected exposure to high tariffs charged by SSDG developers. Until completion and implementation of the current COSS, ZESCO will continue to be reluctant to receive power fed in by SSDG.
Copperbelt Energy Corporation (CEC)	Private electricity generation, transmission and distribution company, with 246 km of 220 kV lines and 678 km of 66 kV lines. CEC purchases bulk energy from ZESCO and supplies 8 Zambian mining companies with 520 MW of capacity. With ZESCO's reluctance to support SSDG, CEC could play a role in engaging C&I customers with SSDG ambitions, although its customers tend to be much larger than the scope adopted for this assignment.

Discussion

There are several institutions in Zambia that aim to promote private sector participation in the generation of electricity. In the case of SSDG, OPPPI can act as a "one stop shop operation" for potential SSDG developers in the C&I sector, to reduce the complexity of obtaining the required approvals and permits. However, the institution requires additional support to fulfil this role.

3.5.2 EXISTING POLICIES AND REGULATORY FRAMEWORK

Zambia has a range of policy and regulatory frameworks in place to support its energy sector. However, there is very little either in place or under development to provide specific support to C&I SSDG development. The key policy and regulatory frameworks currently supporting the electricity sector are summarized in Table 35.

Table 35: Policy and regulatory frameworks relevant for C&I SSDG in Zambia

Document	*Relevance to distributed generation*
Zambia National Energy Policy 2008	Sets out the Government's intentions to harness the energy sector's potential to drive economic growth, while also reducing poverty. The aim of this policy is to create conditions that will ensure the availability of adequate supply of energy from various sources, which are dependable, at the lowest economic, financial, social and environmental cost consistent with national development goals. The National Energy Policy is currently under revision and should incorporate aspects on SSDG and net metering; it is unclear at this stage whether there is any intention to make such an inclusion.

Document	*Relevance to distributed generation*
Renewable Energy Feed-in Tariff (REFiT) Strategy 2017	The aim of this strategy is to increase the national generation output through private sector investments in renewable energy technologies, increasing grid capacity through the development of small and medium-scale projects of up to 20 MW. This will ultimately contribute to a diversified energy mix in order to enhance energy security. The strategy provides some guidance for micro-generation projects with an initial total capacity of 5 MW, covering grid connection rules, simplified tariff structures and possible moves towards net metering. This should give scope to SSDG development, although little has been progressed in this area.
The Electricity Act No. 14 of 1995	The primary legislation guiding the operation of the electricity sector, to regulate the generation, transmission, distribution and supply of electricity, and associated matters.
The Energy Regulation Act Cap 436 (2003)	An Act to establish the ERB and to define its functions and powers; to provide for the licensing of undertakings to produce energy or the production or handling of certain fuels; and to provide for associated matters. According to the Act, 100 kW of own use generation is not regulated. For any own use generation above 100 kW and for commercial or industrial purposes, a developer requires a license.
The Zambian Grid Code 2006	The ZGC is applicable to the current structure of the Zambian ESI but will be updated as the industry evolves. The ZGC allows for a sizeable amount of electricity generated to be fed into the grid.

Other relevant plans and studies

Comprehensive **grid impact and stability studies** are currently being done by the Department of Energy in conjunction with ZESCO and ERB. Such studies are helpful in framing the potential market for SSDG, even if single SSDG projects, or even a moderate number of projects, are unlikely to have a significant impact on grid stability. ZESCO believes the grid can only absorb 600 MW of VRE, although CEC research and other case studies show that 1,000 MW is possible without the need for a major grid upgrade. CEC sees the need for grid stability studies to be completed; ZESCO has conducted a grid stability study but the report has not been shared with all stakeholders.

ERB is in the process of drafting an **Open Access Regulatory Framework** to help create a level playing field for generators of different sizes. With this regulation developers will be able to sell power to a third party without the involvement of ZESCO. While this is unlikely to affect C&I SSDG, it may provide direction to the market on the role of stakeholders beyond the utilities, IPPs and large customers (i.e. mines).

There is no regulatory framework in place yet for SSDG, although as noted above, it is referenced in the 2017 REFiT Strategy. CEC believes SSDG will have a slow uptake, particularly as there is currently no net metering framework and electricity tariffs are low.

Licensing and approval process

According to the Energy Regulation Act Cap 436 (2003), any generation facility up to 100 kW for own use generation is not regulated. For any own use generation above 100 kW and for commercial or industrial purposes, a developer requires a license from ERB.

Discussion

The current regulatory environment in Zambia is not conducive to SSDG investments, which coupled with low utility tariffs and a lack of financing for renewable energy projects, provides little incentive for SSDG investments.

3.5.3 SSDG EXPERIENCE

Currently there are very few C&I SSDG projects in Zambia. Timbuktu Holdings, as an EPC contractor, has implemented two projects and CEC has implemented a pilot 1 MW solar project for its own generation. CEC's aim from setting up the pilot project is to build local capacity for small-scale solar project development, in collaboration with Copperbelt University. The EPC cost US$ 1.3 million and the associated cost-recovery tariff for SSDG is estimated to be around 8 – 10 USc/kwh.

GIZ has been involved in providing technical advice on renewable energy in Zambia over recent years. It is currently implementing a project development program aimed at helping Zambian C&I companies connect with German energy companies through a 10-step project

development process. Under this program, energy profile and consumption analysis, for the companies involved is undertaken and the companies sign an NDA. For 4 weeks' energy data logger meters are placed on the electricity infrastructure to monitor energy consumption, undertake system design using Homer modeling, carry out cash flow and business models. The final output is a project dossier which they will use to link the end users of technologies with German energy companies. Currently GIZ has eight companies in its scope (maximum demand customers) and hopes that by end of December three companies could be linked to German companies.

Zambia has been a leader in the development of small to medium-scale renewable energy projects in sub-Saharan Africa through the GET FiT program. GET FiT has seen tariffs being bid for grid-connected solar projects below 5 USc/kWh, with the cheapest bid below 4 USc/kWh. While GET FiT projects are solely for grid supply and not own consumption, the prices achieved in the competitive tendering process set somewhat of a precedent for the prices the market may expect to receive for solar power fed in from C&I SSDG.

Discussion

The very few SSDG projects that were developed in Zambia were necessitated by increased load shedding in 2015. Most C&I businesses are reluctant to invest in SSDG given the current lack of a supportive regulatory framework.

3.5.4 CURRENT TARIFF FRAMEWORKS AND APPROACH

Tariffs for electricity consumption

Zambia comfortably has the lowest electricity tariffs of the six focus countries in this study. These are not at cost-recovery levels and therefore insufficient for ZESCO to operate a sustainable business without additional support, pointing to why ZESCO is in such a dire financial situation. ERB is currently undertaking a COSS to guide revision of the tariffs, but this has faced multiple delays because of political considerations. As such, tariffs remain low.

Table 36 presents ZESCO's C&I tariffs introduced by ERB in 2017. The increases from the previous tariff to the September 2017 tariffs are all approximately 75%, but tariffs are still assumed to be below cost.

Table 36: 2017 Electricity tariffs for C&I customers in Zambia[76]

Customer category		*Previous tariff*	*New tariff effective 15 May 2017*	*New tariff effective 1 Sep 2017*
Commercial (capacity ≤15 kVA)				
Commercial	Energy charge (US$/kWh)	0.021	0.032	0.037
	Fixed monthly charge (US$ pcm)	3.794	5.691	6.639
Maximum Demand (capacity >15 kVA)				
MD1 (16-300 kVA)	MD charge (US$/kVA pcm)	0.962	1.443	1.684
	Energy charge (US$/kWh)	0.014	0.021	0.024
	Fixed monthly charge (US$ pcm)	9.422	14.133	16.489
	Off-peak MD Charge (US$/kVA pcm)	0.481	0.721	0.842
	Off-peak energy charge (US$/kWh)	0.010	0.016	0.018
	Peak MD charge (US$/kVA pcm)	1.202	1.804	2.105
	Peak energy charge (US$/kWh)	0.017	0.026	0.030
MD2 (301-2,000 kVA)	MD charge (US$/kVA pcm)	1.799	2.700	3.149
	Energy charge (US$/kWh)	0.012	0.018	0.021
	Fixed monthly charge (US$ pcm)	18.843	28.265	32.976
	Off-peak MD charge (US$/kVA pcm)	0.900	1.350	1.575
	Off-peak energy charge (US$/kWh)	0.009	0.014	0.016
	Peak MD charge (US$/kVA pcm)	2.250	3.375	3.937
	Peak energy charge (US$/kWh)	0.014	0.022	0.025

[76] Conversions to US$ have been made at the prevailing spot exchange rates on 8 August 2019: 1 ZMW = 0.077.

Customer category		*Previous tariff*	*New tariff effective 15 May 2017*	*New tariff effective 1 Sep 2017*
MD3 (2,001-7,500 kVA)	MD charge (US$/kVA pcm)	2.875	4.313	5.031
	Energy charge (US$/kWh)	0.010	0.014	0.017
	Fixed monthly charge (US$ pcm)	39.924	59.886	69.868
	Off-peak MD charge (US$/kVA pcm)	1.437	2.156	2.515
	Off-peak energy charge (US$/kWh)	0.007	0.010	0.012
	Peak MD charge (US$/kVA pcm)	3.594	5.391	6.289
	Peak energy charge (US$/kWh)	0.012	0.018	0.021
MD3 (>7,500 kVA)	MD charge (US$/kVA pcm)	2.891	4.336	5.060
	Energy charge (US$/kWh)	0.008	0.012	0.014
	Fixed monthly charge (US$ pcm)	79.850	119.774	139.737
	Off-peak MD charge (US$/kVA pcm)	1.445	2.169	2.529
	Off-peak energy charge (US$/kWh)	0.006	0.010	0.011
	Peak MD charge (US$kVA pcm)	3.614	5.421	6.325
	Peak energy charge (US$/kWh)	0.010	0.014	0.017

Source: Energy Regulatory Board

When converted into USc/kWh at the current spot exchange rate (as at 8 August 2019), it can be observed that the energy charges range from 1.2 USc/kWh (for MD3 off-peak) to 4.2 USc/kWh (commercial). These rates are remarkably low, even after the 75% increase and show the challenge of avoiding energy charges through self-supply, even when benchmarked against the somewhat equally remarkably low prices observed from GET FiT's solar auctions.

It can also be observed from the tariff **structures** in place that commercial customers face only a fixed charge (without a capacity charge) and no ToU tariffs. When combined with the observations on tariff levels, a rather mixed picture for Commercial SSDG can be identified. For commercial customers that may operate primarily through the day, a lack of ToU tariffs may provide an incentive to self-supply through SSDG. Ultimately, however, the low tariffs dissuade any SSDG.

As ERB is still completing its COSS, it is difficult to draw too many conclusions from these tariffs. It's possible both that tariff levels will increase, and tariff structures (particularly those for commercial customers) may become more cost-reflective. Once this has taken place, and if tariffs are accepted as being both at cost-recovery levels and cost-reflective in their structure, the right price signals can guide C&I SSDG business case development.

Tariffs for electricity fed back into the grid

Zambia doesn't yet have standardized tariffs for energy being fed back into the grid. While it has made a lot of effort to support small and medium-scale RE projects through GET FiT, the tariffs are discovered through competitive auctions rather than established *a priori*. As noted above, Zambia's experience from competitive auctions for grid-scale solar PV may shape the market's expectations of FiTs for SSDG solar projects; this may be a considerable risk, as the nature of the two types of project are too different to allow a straightforward comparison.

Similarly to the FiTs, Zambia does not yet have an electricity pricing regime for behind-the-meter storage applications.

Discussion

Current tariffs (between 1 - 4 USc/kWh) are extremely low to incentivize private investment in SSDG as a cost-saving measure. The last revision of electricity tariffs in Zambia was done in 2017. Since then, the country has been trying to undertake a COSS, but this has not been completed.

3.5.5 EXISTING POLICY AND REGULATION ON NET METERING

The National Energy Policy is currently being revized and should incorporate aspects on SSDG and net metering, although it is currently unclear if this will happen.

In addition, the REFiT Strategy from 2017 includes the following objective, under measures to achieve Zambia's RE targets:

b) providing for a 3-year REFiT micro-generation allocation of initially 5 MW through:

iii) Preparation and issuing of a tariff for the micro-generation allocation. To make the micro-generation incentive administratively simple and effective, the micro-generation scheme for the first phase is based on energy savings corresponding to prevailing tariff levels (net-metering).

To date, this framework for micro-generation has not been developed and, as such, no specific net metering policy is in place. However, the EU is supporting ERB in formulating a net metering regulatory framework.

Discussion

While net metering is referenced in the 2016 distribution grid code, it has never been implemented. Given Zambia's low tariffs, a net metering policy might provide an additional incentive to C&I businesses to invest in SSDG.

3.5.6 WHEELING REGULATIONS

There are currently no policies or regulations regarding wheeling power in Zambia. ERB is in the process of drafting an Open Access Regulatory framework to support wheeling. With this regulation, developers will be able to sell power to a third party without the involvement of ZESCO.

3.5.7 OPPORTUNITIES AND BARRIERS TO EXPANDING SSDG

Load shedding

Zambia's power sector is dominated by hydro generation, which accounts for more than 90% of total installed capacity. Due to climate change, rainfall has dropped significantly since 2015 causing a drastic reduction in electricity supply. In 2015, the power deficit ranged from 560 to 1,000 MW.

Shortages of generation capacity have resulted in prolonged periods of load shedding (reaching at least eight hours a day) leading to significant revenue losses for C&I customers. According to the Energy Regulation Board (ERB), the reported loss in turnover from load shedding of small business is approximately US $1,400 a year.[77]

Load shedding is expected to continue affecting the economy despite the efforts of the country to increase its generation capacity. In October 2019, ZESCO announced that load shedding will be increased to 15 hours a day countrywide, due to shortage of dispatchable capacity.[78]

While the current situation causes financial distress to C&I businesses and the entire economy, it also presents an opportunity for investments in SSDG solar plants. To overcome load shedding, while reducing diesel costs, several businesses have considered installing rooftop PV systems.

Policy and regulatory barriers

Table 37 provides a summary of the policy and regulatory barriers to expanding SSDG in Zambia.

Table 37: Policy and regulatory barriers to expanding SSDG in Zambia

Barrier	*Explanation*
Guiding policy and regulation	No SSDG policy and institutional framework. The current review of the National Energy Policy should incorporate SSDG, although whether it will, is unclear. Aspects of regulatory framework such as net metering still under development.
Permitting and licensing	According to the Energy Regulation Act – 100 kW own-use generation is not regulated. For any own-use generation above 100 kW, or for commercial or industrial purposes, the developer is required to get a license.
Contract structures for SSDG	Zambia has no experience with contract structures for SSDG.
Regulatory support for wheeling/ open access and other areas	ERB is in the process of drafting an Open Access Regulatory framework to help create a level playing field. With this regulation, developers will be able to sell power to a third party without the involvement of ZESCO.

Tariff and net metering barriers

Table 38 identifies the key tariff and net metering barriers that currently hinder the development of C&I SSDG in Zambia.

[77] http://www.erb.org.zm/downloads/erbImpactOfLoadSheddingReport.pdf.
[78] https://www.lusakatimes.com/2019/10/30/current-load-shedding-of-15-hours-to-remain-zesco/

Table 38: Tariff and net metering barriers to expanding SSDG in Zambia

Barrier	*Explanation*
Customer tariffs	Current tariffs are not yet conducive for SSDG uptake. Customer tariffs are very low, providing little incentive to use self-supply from SSDG to reduce energy bills. Tariff structures for commercial customers are not yet cost-reflective, comprising just a fixed charge and variable energy charge, and they do not yet include ToU charges. The introduction of these should give transparent price signals for C&I customers interested in SSDG development.
Net metering policy	Currently there is no net metering policy. The REFiT Strategy recommends the development of net metering guidelines and ERB is currently developing regulations to support net metering.

3.5.8 RECOMMENDATIONS

The following recommendations are made for the development of a suitable environment to support the expansion of SSDG in Zambia:

- Cost-recovery and cost-reflective tariffs from ZESCO, supported by a comprehensive COSS. This should send reliable price signals to C&I consumers considering SSDG.
- The need for formulation of an SSDG institutional, policy and regulatory framework. This should include such things as target and maximum penetration levels based on grid absorption and IRP studies, interconnection guidelines, net metering pricing frameworks and relevant "light-handed" registration and licensing procedures with standardized documents, e.g. licenses, application forms, PPA.
- Work closely with ZESCO and ERB to develop an accurate business case for SSDG development, addressing any incorrect assumptions about the impact on ZESCO's finances. This relies to a large extent on the successful implementation of the COSS.
- Provide enabling financial market and tax incentives for development of C&I SSDG.

Dairy farms spend a considerable amount of operational costs on energy due to their cold chain needs. Dairy farmers can generate their own power by using leading technology, reducing operational costs.

3.6 Zimbabwe

Table 39: Summary of findings in Zimbabwe

Are current policies and regulations supportive of SSDG?	Zimbabwe's National Energy Policy (NEP) talks about adoption of a long-term, government-driven, renewable energy technologies (RETs) program, which encourages independent power producers (IPPs) and public-private partnerships (PPPs) to harness sustainable RETs in Zimbabwe. While this appears supportive of SSDG, the focus appears to be targeted more at grid-connected RE. Zimbabwe's Electricity (Net Metering) Regulations (SI 86 of 2018), which were introduced by the Ministry of Energy and Power Development (MoEPD) in consultation with the Regulator (ZERA), if launched, would accelerate market penetration of solar technology for existing and new grid-connected electricity customers. The Draft Renewable Energy Policy of 2017, which will be launched this year (2019), will promote the awarding of National Project Status to RE projects to enable projects to be exempted from the customs and general excise regulations. This will allow the developers to import certain RE systems used in the generation plants at competitive rates. Once launched the RE Policy will be expected to positively impact the roll out of SSDG.
Does the current tariff regime incentivize investments in SSDG?	ZETDC's customer tariffs are currently the subject of significant interference and mismanagement. It is widely accepted that they are significantly below cost-recovery levels as a result of political decisions, notably on Zimbabwe's currency. In early August 2019, ZETDC could increase its tariffs for the first time since 2014, but the new tariff levels remain significantly below cost and are priced in Zimbabwe Dollars. ZETDC's electricity supply is regularly interrupted with widespread load shedding, largely as a result of its inability to meet its payment obligations, which is in turn a result of its inability to collect sufficient revenues. The FiTs used during utility-supplier PPA negotiations of all RE technologies are much higher than the rates at which electricity is supplied to customers. The severe power shortages which have resulted in load shedding in both the domestic and productive sectors has forced many consumers to unlock themselves from the grid and seek SSDG solutions. However, financial constraints and limited technical know-how are the major barriers to more pronounced transition from grid electricity to solar power.
Does the country have a net metering policy in place?	Zimbabwe has net metering regulations, gazetted in early 2018, which are meant to govern the generation of electricity from small-scale, grid-tied RE generators like rooftop solar PV. They are planned to be launched this year.
Have many SSDG projects been implemented?	Both private and public sector institutions are now installing solar panels on rooftops. In 2017 ZERA received 17 electricity generation license applications, 12 of which were solar PV projects (200.8 MW) and 3 were for own consumption. The primary motivation for installing SSDG today is self-supply, given the largely absent supply from ZETDC.
What are the current barriers to SSDG expansion?	*Policy/regulation barriers:* Some of the necessary policies and regulations have been drafted, e.g. Renewable Energy Policy and net metering regulations. However, the time taken to implement these is too long and subject to regular delays owing to frequent changes in institutional arrangements. *Tariff barriers:* Utility tariffs that are not cost-reflective or subsidized are barriers to SSDG expansion as they make renewable energy projects look more expensive. Zimbabwe has a REFiT framework in place, but the state of the electricity sector makes its implementation largely meaningless – private businesses have little incentive to engage with the utility in its current financial distress. *Other barriers:* Lack of awareness and technical expertise on renewable energy technologies in general and solar PV in particular, are barriers to SSDG expansion.

How can the country attract investments in SSDG?	Zimbabwe's electricity sector is in dire need of support across the board. A transparent COSS could support and guide the design and implementation of a tariff framework that allows ZETDC to operate in a commercially sustainable manner. Cost-recovery and cost-reflective tariffs will provide the right price signals to guide C&I SSDG business case development. A solvent utility will provide additional value to C&I SSDG developers that may wish to feed surplus energy back to the grid, under net metering arrangements. Policy and regulatory frameworks designed to support the sector should be developed and implemented within an appropriate timeframe. Financial support and incentives, e.g. subsidies and tax and duty relief, should be channeled towards RE solutions rather than fossil fuel-based energy. Build capacity in RE financing, supply and technical servicing.

3.6.1 CURRENT INSTITUTIONAL ARRANGEMENTS

The energy sector in Zimbabwe is governed by the **Ministry of Energy and Power Development** (**MoEPD**). The vision of the ministry is to achieve universal access to sustainable energy in Zimbabwe by 2030. The mandate of MoEPD, through its departments, includes policy formulation, performance monitoring, research and promotion of new and renewable sources of energy, as well as energy conservation. MoEPD is responsible for setting policies related to SSDG, including net metering frameworks.

The **Energy Conservation and Renewable Energy** (**ECRE**) department, one of the ministry's six departments, is responsible for developing and promoting increased use of new and renewable sources of energy and ensuring efficient production and utilization of energy. ECRE sets national targets for RE generation, including establishing the extent to which SSDG will contribute to these targets.

Regulation of the sector is the responsibility of the **Zimbabwe Energy Regulatory Authority** (**ZERA**). ZERA regulates any person or private company that operates an electricity undertaking which generates, transmits, distributes, or retails electricity for commercial purposes in excess of 100 kW. ZERA is therefore responsible for setting regulations for SSDG, including net metering and FiT frameworks.

3.6.2 EXISTING POLICIES AND REGULATORY FRAMEWORK

The activity of the different stakeholders in Zimbabwe's energy sector is guided by various policy and regulatory frameworks. Zimbabwe does not currently have frameworks dedicated to SSDG, but some of the existing frameworks shape SSDG activity either directly or indirectly. Table 40 below summarizes the existing legislation, policies, and regulations relevant to SSDG development in Zimbabwe.

Table 40: Policy and regulatory frameworks relevant for C&I SSDG in Zimbabwe

Document	*Content relevant to SSDG*
Electricity Act	The primary legislation for the electricity sector, including its provision of the mandate for ZERA. The Act sets out the requirements for, and conditions of, electricity licenses. In 2017 ZERA approved tariffs (PPAs) for 6 different companies with solar PV projects, in accordance with its mandate contained in section 53 of the Electricity Act. Out of the 17 electricity generation license applications in 2017, 12 were solar PV projects, with a total capacity of 200 MW (ZERA Report 2017).
Electricity Licensing Regulation Amendment: 2015	The regulation amendment includes, among other things, the license fees associated with different types of electricity license. These include the Primary Electricity Generation Application fee = US$ 2,500 (Greenfield project) and US$ 2,000 for brown field project and the Primary Electricity (Generation) License fee = US$ 10,000 fixed for 1-10 MW.
Draft RE Policy, 2017	Not yet implemented, this document sets out objectives for the development of RE in Zimbabwe. There is limited reference to SSDG, although guidance for mini-grids may be an indication of how SSDG could be treated. For example, the Regulator can waive licensing fees for installation and operation of micro-grids and mini-grids with an installed capacity of less than 1 MW.

Energy Regulatory Authority Act (Chapter 13:23) of 2011 as read together with Electricity Act	ZERA regulates any person or private company that operates an electricity undertaking which generates, transmits, distributes, or retails electricity for commercial purposes in excess of 100 kW (ZERA 2017). ZERA extends light-handed regulation to community-based mini-grids and solar PV systems whose generation capacity is below 100 kW. While these thresholds are below the definition, they indicate a willingness to streamline licensing procedures for smaller RE generation.
Fiscal incentives	The Government has recently (July 2019) removed import duties on solar products, including batteries, panels and cables in order to promote the use of solar energy in the country.

Licensing and approval process

According to the Energy Regulatory Authority Act, any potential power investor must obtain a license from ZERA, with the exemption of generation facilities of less than 100 kW.

3.6.3 SSDG EXPERIENCE

There has been an increase in number of SSDG projects in the C&I sector in Zimbabwe, although not all fit within the definition (200 kW – 1 MW). Projects which do fit within the threshold include:

- 466 kWp Econet Willowvale Switch;
- 600 kWp Kefalos Foods (still under development); and
- 950 kWp Schweppes (still under development).

The perspectives on Zimbabwe's C&I SSDG market from market stakeholders are summarized in Table 41.

Table 41: Summary of stakeholder perspectives on Zimbabwe's C&I SSDG sector

Topic	*Views*
Overall sector view	Key concerns include security of supply, reliability of supply, the economics of tariffs and their impact on sector viability. C&I SSDG developments are allowed under existing laws. Policies and regulations are being implemented; licenses issued but project implementation has been limited because of financial challenges.
Perspective on current framework	ZETDC (and its viability) is a key player since it is the off-taker of the power. Grid interconnection of SSDG should be easy to manage; ZETDC develops PPAs, grid impact assessments and connections agreements; The country gazetted net metering regulations in 2018, although their application remains limited. The main objective of the regulations is to allow SSDGs to generate own power and export any surplus to the grid. This should reduce power demand from the grid. Zimbabwe has FiT and net metering regulations but is yet to introduce standardized PPAs. Tariffs are still negotiated between the off-taker and the supplier despite the framework. Safety of interconnection between the SSDG and grid is ensured through Grid Codes, Distribution Codes and prudent utility practices.
Motivations and Incentives for SSDG	Zimbabwe is failing to meet demand for power. Demand is currently around 1,800 MW, whereas supply is only between 600 to 1,000 MW, resulting in frequent periods of load shedding. This appears to be the main driver for SSDG investments. ZETDC unreliability is a driver towards SSDG; The pricing dynamics in Zimbabwe have minimal impact on SSDG. This is because grid electricity in Zimbabwe is highly subsidized and does not in any way provide justification for SSDG. Investment into SSDG is largely due to the unreliable nature of grid electricity, as well as its limited availability in remote areas. Existing tax holidays and duty exemption on renewable technology create positive incentives. Additional incentives will be provided for promoting third-party grid access for sale of electricity from renewable energy generators (Draft RE Policy). Awarding National Project Status to RE projects will enable projects to be exempted from the customs and general excise regulations.

3.6.4 CURRENT TARIFF FRAMEWORKS AND APPROACH

Tariffs for electricity consumption

Under the Energy Regulatory Authority Act, ZERA has the responsibility

> *"to ensure that the prices charged by licensees are fair to consumers in the light of the need for prices to be sufficient to allow licensees to finance their activities and obtain reasonable earnings for their efficient operation."*

At the present time, this requirement is not being followed and electricity tariffs are significantly below the cost to serve customers. This is despite major increases announced in early August. Given the major discrepancy between tariffs and the costs to serve, as well as the volatile changing nature of the tariff regime, no further information on ZETDC's current tariff framework is presented. This is in part because there is a reasonable likelihood that any values presented in this report will be outdated in short order.

Tariffs for electricity consumption

At present, ZERA conducts Power Purchase Agreement (PPA) negotiations on a project-by-project basis, using the existing REFiT for guidance. Table 42 shows Zimbabwe's tariffs for RE including solar PV for 2013, 2016 and 2018. The tariffs have been dropping due to technological improvements.

Table 42: Zimbabwe's REFiT charges for various technologies

Technology	*Generation capacity range*	*Tariff (US$/kWh)*		
		2013	*2016*	*2018*
Hydro	100 kW < x ≤ 1 MW	0.153	0.146	0.142
Biomass	100 kW < x ≤ 10 MW	0.137	0.123	0.098
Bagasse	100 kW < x ≤ 10 MW	0.111	0.102	0.079
Biogas	100 kW < x ≤ 10 MW	0.127	0.114	0.106
Solar PV	100 kW < x ≤ 1 MW	0.186	0.140	0.130
Wind	100 kW < x ≤ 5 MW	0.148	0.112	0.100

Source: ZERA

As noted above, there is currently little incentive to enter a PPA with ZETDC under these FiTs when the utility is in such financial distress. Similarly, with customer tariffs from ZETDC currently significantly below the level of the FiTs, ZETDC also has no incentive to enter a PPA.

3.6.5 EXISTING POLICY AND REGULATION ON NET METERING

Net metering regulations, gazetted by the Government of Zimbabwe in early 2018 are meant to govern the net trading of electricity consumed from the utility and generated and fed back from small-scale, grid-tied renewable energy generators like solar PV on rooftops. In July 2019, ZERA announced the launch of these regulations, with application up to a threshold of 100 kW. For any plant above this threshold the tariff code will apply. Therefore, the net metering framework is not yet applicable to C&I SSDG as defined, but it's possible that the threshold could be raised to include C&I customers with larger SSDG systems.

The pricing for net metering dictates that for every kWh that the customer exports to the grid, they shall receive a credit of 0.9 kWh in the billing period.

The Zimbabwe Energy Regulatory Authority (ZERA) has trained 270 Solar Equipment Technicians to ensure safe installation of solar equipment that meets specified standards across the country at household and industrial level. This should ensure Zimbabwe has sufficient capacity to develop further installations of SSDG beyond the 100 kW threshold.

Private sector stakeholders are not yet fully aware of the net metering regulations and the policymakers are acknowledging that policy awareness campaigns are necessary.

3.6.6 WHEELING REGULATIONS

There is currently no wheeling policy in place in Zimbabwe.

3.6.7 OPPORTUNITIES AND BARRIERS TO EXPANDING SSDG

Load shedding

Since 2007, Zimbabwe has experienced load shedding as a result of shortages in the power generation capacity. The country is currently depending on imports from South Africa to meet its electricity demand, thus being vulnerable to the power crisis that its neighboring country is facing.

According to ZESA, load shedding will continue to affect the country for the next five to eight years. This situation is affecting the financial viability of the local businesses and presents an opportunity for investments in SSDG, which would allow C&I customers to protect their income against the risk of load shedding.

Policy and regulatory barriers

- Most of the policies and regulation that can encourage the development of SSDG already exist. However, there are delays in their implementation, likely due in part to ongoing changes in government structures and personnel.
- Lack of clarity on policies such as exemption of duty on solar products, e.g deep cycle batteries, by ZIMRA officials is not good for SSDG and solar battery storage.
- The frameworks which do exist currently have a 100 kW minimum size threshold, which excludes C&I SSDG as defined. However, the willingness to adopt a minimum threshold for licensing and streamlined processing is encouraging, and efforts could be made to increase this to accommodate larger systems.
- Lack of clarity on policies such as exemption of duty on solar products such as deep cycle batteries and solar battery storage.
- There is little monitoring of SSDG projects which have been developed, meaning little learning is being passed back to other sector stakeholders, notably policymakers and ZERA.
- Feedback received from IPPs suggests that permitting and licensing by ZERA is being done very well. While this does not apply directly to procedures for SSDG, it does suggest both capacity and pragmatism within ZERA to ensure project progress.

Tariff and net metering barriers

- Subsidized grid electricity tariffs have a negative impact on SSDG development. Very low prices provide little incentive for cost saving through self-supply.
- FiTs negotiated for SSDG energy fed back into the grid are higher than grid tariffs and are therefore unappealing to ZETDC.
- C&I SSDG is motivated more by the cost of absent electricity supply than the price of the electricity that is supplied.
- Delays in the implementation of the net metering regulation and lack of understanding of the current draft is causing uncertainties for developers.

Other barriers

- The critical shortage of foreign currency is a major barrier to importing SSDG components. To some extent, C&I customers with foreign currency earnings can mitigate against this barrier.

3.6.8 RECOMMENDATIONS

Based on the above discussions, below are some recommendations:

- Addressing ZETDC's financial situation is critical for the development of Zimbabwe's energy sector. Adjusting the tariffs to cost-recovery and cost-reflective levels (including accounting for currency devaluation) will send the necessary price signals to C&I customers in their development of SSDG business cases.[79]
- ZETDC's financial viability will also determine any value from FiTs paid for energy fed back into its grid by C&I SSDG operators.
- ZETDC grid stability is necessary for stable interconnection of SSDG equipment and should be addressed. Once grid stability has been achieved, impact studies for RE penetration can be undertaken.
- All relevant policies and regulations should be properly implemented and promoted to stakeholders (e.g. RE Policy and net metering regulations). Implementing agencies, notably ZERA, should be supported with process design and capacity enhancement to ensure effective implementation.
- Award incentives such as National Project Status to SSDG projects to enable projects to be exempted from the customs and general excise regulations considering the high number of licensed companies which fail to raise the required funds.

[79] Noted again that the poor state of ZETDC is also a driver of SSDG development, as customers seek self-supply alternatives to unreliable grid supply. However, this is not a recommended approach for stable sector activity.

ANNEXES
A1. Documents reviewed and stakeholders interviewed

A1.1 BOTSWANA

A1.1.1 Documents reviewed

Document type	*Documents reviewed*
Plans, policies, strategies and action plans	National Development Plan #11
	Botswana Energy Master Plan (1985, 1997, 2004)
	National Energy Policy (NEP) (Draft)
	RE Strategy and Action Plan 2017/18
	Energy Efficiency Strategy and Action Plan 2016/17
Acts	Electricity Act
Regulations	Botswana Standards
Tariffs	Botswana Power Corporation Tariffs
Other	Action Agenda[80]
	Investment Prospectus

A1.1.2 Stakeholders interviewed

Stakeholder	*Name of person interviewed*
Public sector	
Botswana Energy Regulatory Authority*	Mr Paaelo Kgomotso Tel: +267 71 318 729 Email: pelaelo.kgomotso@bera.co.bw
City of Gaborone	Moagi Mojadife Tel: +267 313 3619 Email: mmmojadife@gov.bw
Department of Energy*	James Molenga Tel: +267 364 0200 Email: jjmolenga@gov.bw
Sowa Town Council	Olebogeng Kebaduetse Tel: +267 75 405 512 Email: okebaduetse@gov.bw
Private sector	
Coca-Cola Distributors*	Onewamang Letsatsi Tel: +267 77 875 757 Email: OLetsatsi@ccbagroup.com
Cresta Marakanelo*	Keikutlwetse Raboloko Tel: +267 391 2222 Email: projects@cresta.co.bw

[80] On SE4ALL website still listed as under development and same with Investment Prospectus.

Stakeholder	*Name of person interviewed*
Game shopping centers*	Comfort Rankgomo Tel: +267 371 9810 Email: comfort.rankgomo@turnstar.co.bw
Kgalagadi Breweries*	Olefile Apei Tel: +267 77 875 772 Email: olefile.apei@ab-inbev.com
Sefalana Wholesalers*	Mike Makin Tel: +267 71 761 397 Email: mmakin@sefcash.co.bw
Solar Industries Association (SIAB)*	Mr Abkenari Tel: +267 71 300 362
Solar Power*	Mr Abkenari Tel: +267 391 2915 Email: solarpower@solarpower.bw
Financial institutions	
Stanbic*	Mr Basimane Tshepe Tel: +267 72 816 929 Email: tshepeb@stanbic.com
Development partners	
Botswana Institute of Technology Research and Innovation (BITRI)*	Dr Edward Rakgati Tel: +267 360 7509 Email: erakgati@bitri.co.bw

*Interviewed remotely via WhatsApp call.

A1.2 MALAWI

A1.2.1 Documents reviewed

Document type	*Documents reviewed*
Acts	Electricity Act 2004
	Electricity Amendment Act 2016
	Energy Regulation Act 2004
Regulations	Electricity by Laws 2012
	Standard PPA
	Grid Code (2015)
	IPP Framework 2017
	Mini-Grid Regulatory Framework 2019
Policies	Feed-in-Tariff Policy (2012)
	National Energy Policy (2018)
Plans	Malawi Energy Africa Compact (2016)
	Malawi SE4All Action Agenda (2017)
	Renewable Energy Strategy (2018)

A1.2.2 Stakeholders interviewed

Stakeholder	*Name of person interviewed*
Public sector	
Department of Energy Affairs	Joseph Kalowekamo, Deputy Director

Stakeholder	*Name of person interviewed*
ESCOM	Michael C. Gondwe, Director of Planning & Development
MERA	Mr Welton Saiwa, Director of Technical and Renewable Energy Regulations
Private sector	
Amaryllis Hotel	Fayyaz Yosef, Owner
EPM Tea Company	David Meerhaeghe, Technical Director
Kamuzu International Airport	Sunganani Dzinkambani, Engineering Manager
Loadmore	Derreck Hakker, General Manager
Lujeri Tea Company	Jim Melrose, General Manager
Malawi Confederation of Chambers of Commerce and Industry (MCCCI)	Madalisto Kazembe, Director of Business Environment and Policy Advocacy
MEGA	Daniel Kloser, General Manager
Powered by Nature	Rodwell Kacheche, Technical Director
Renewable Energy Industry Association of Malawi (REIAMA)	William Nkhoma, Board President
Ryalls Hotel	Jan-Willem Roenhorst, General Manager
Saint Andrew's International School in Blantyre	Kieron Smith, Headmaster
Satemwa Tea Company	Robin Saunders, Former General Manager
Sky Energy	Shizzo Thomson, General Manager
Qwick Fit	John McGrath, Owner
Financial institutions	
Bankers Association of Malawi (BAM)	Violette Santhe, Chief Executive Officer
Standard Bank	Mphatso Tembo, Project Officer
Development partners	
MCC	Themba Chirwa, Director
USAID	Andrew Spahn, Power Africa Energy Advisor
World Bank	Paul Mikibii, Energy Specialist

A1.3 NAMIBIA

A1.3.1 Documents reviewed

Document type	*Documents reviewed*	*Relevance to small-scale distributed generation*
Acts	Environmental Investment Fund, 2001	Funding of DG options accessing concessional funding options through the EIF.
	Electricity Act, 2007	Legislation and Regulation of ESI.
	Net Metering Rules: Electricity Act, 2007	All distribution licensees must offer net metering to customer-generators subject to these rules.
	Environmental Management Act, 2007	Issuance of Environmental Clearance Certificates for any DG.
	Public Procurement Act, 2015	Procurement by state-owned entities – discussed elsewhere.
	Public Private Partnership Act, 2017	Ownership – discussed above.

Document type	*Documents reviewed*	*Relevance to small-scale distributed generation*
Bills	Electricity Bill, 2018	Will replace the Electricity Act 2007 – discussed elsewhere.
	Namibia Energy Regulatory Bill, 2017	New bill impacting the Regulator – discussed elsewhere.
	National Equitable Economic Empowerment Bill	Ownership of privately-owned entities in Namibia.
Regulations	Quality of Supply and Service Standards, 2004 The Namibian Distribution Grid Code 2018 The Namibian (Transmission) Grid Code, 2005 The Administrative Electricity Regulations, 2011 The Namibian Electricity Safety Code, 2011 The Technical Rules, 2016	All of these standards and codes will impact the specifications and design of DG plants, as well as their operational compliance.
Policies	National Connection Charge Policy, (Approved 2015)	Governs the connection of new DGs to the Transmission Grid.
	National Renewable Energy Policy (Approved 2017)	Provides for Namibia's ambitions and policy to introduce renewable and specific distributed renewable generation options. The RE Policy supports the adoption of a market structure in Namibia that enables IPPs to generate and sell electricity to off-takers other than the Single Buyer and enables distributed generation from various technologies and resources.
	National Energy Policy (Approved 2017)	This is the overarching policy for the energy industry and highlights the need to reduce Namibia's reliance on imported energy, to enhance distributed generation and expand the ownership of new generation beyond that of large-scale utility-owned solutions.
	National Independent Power Producer (IPP) Policy (Final Draft)	This policy is not yet approved, but it addresses specific issues relevant to privately-owned generation plants.
	Draft Mini-Grid and Off-Grid Policy (July 2019)	This policy addresses Namibia's intention in advancing mini-grid and off-grid electrification, regulation thereof, as well as grid encroachment aspects.
	Draft Smart Grid Policy (July 2019)	This policy communicates the Namibia's intent, direction and undertakings regarding the efficient and effective development of a smarter grid in Namibia.
Plans	National Integrated Resource Plan (NIRP), (Approved 2016)	This plan sets the procurement allocation to supply options to meet the demand and demand growth in Namibia.
	NDP 5	The National Development Plans sets the priorities for GRN for the next five years.
	Harambee Prosperity Plan	This plan is a subset of the NDP 5 and aimed in bringing focus to key developments to eradicate poverty.
	Vision 2030	This document provided for guidance to Namibia's development since its independence and informs all national development plans.
	Off-Grid Master Plan, 2007	The underlying objective of the OGEMP is to provide access to appropriate energy technologies to everyone living or working in off-grid, pre-grid and "gray" areas.

Document type	*Documents reviewed*	*Relevance to small-scale distributed generation*
Agreements	Power Purchase Agreement (between NamPower and IPPs)	The power purchase agreement between NamPower and IPPs of SSDG installations connected to NamPower's network.
	Transmission Connection Agreement (between NamPower and IPPs)	The connection agreement between NamPower and IPPs of SSDG installations connected to NamPower's transmission network.
	Rent-to-Own Agreement between SSDG supplier and end-user	Lease agreement between an SSDG supplier and end-user where the end-user is not expected to pay the CAPEX upfront, but benefits from alternative energy installation.
	Net Metering Application Forms (NamPower and NORED)	Net metering forms being used – as per the Gazetted guideline.
	Transmission Supply Agreement (NamPower and Transmission Customer)	The supply agreement between NamPower and larger power users setting out the capacity and charges for the connection.
	Power Supply Agreement (Small Power User)	The supply agreement between NamPower and small power users setting out the capacity and charges for the connection.
	Net Metering Offer Letter (NamPower)	The letter NamPower issues upon the receipt and approval of a net metering application.
	NamPower Net Metering Process	A flow diagram describing the process from application to testing and commissioning of SSDG at end-users (BHM installations).
Tariffs	NamPower Distribution tariffs (2018/2019/2020)	The tariffs applicable to net metering, as well as the tariffs setting the avoided cost calculations of installations below and above net metering.
	NORED, CENORED, NORED, ERONGORED and a number of local authorities' tariffs (2018/2019)	The tariffs applicable to net metering, as well as the tariffs setting the avoided cost calculations of installations below and above net metering.
Other	Small-scale embedded generation commissioning report (NamPower)	The report is used to test and commission SSDG and net metering connections to the NamPower distribution grid.
	NRS-097-2-3-final-2014: Grid inter-connection of embedded Generation	The specification sets out the technical requirements for the utility interface, the embedded generator and the utility distribution network with respect to embedded generation. The specification applies to embedded generators smaller than 1,000 kVA connected to low-voltage networks.

A1.3.2 Stakeholders interviewed

Stakeholder	*Entity*	*Relevance to this assignment*
Public sector		
The Ministry	Ministry of Mines and Energy, The Directorate of Energy	Policy maker and line ministry of the ESI, planning, national and political will.
The Regulator	Electricity Control Board (ECB) Technical, regulatory, economic and legal staff	Regulator, licensing and tariffing.
The Utility	NamPower Distribution and Rural Electrification business unit, Tariffing and Pricing section	Plans to connect SSDG, pricing and tariffing of SSDG, rural and off-grid opportunities.
Private sector and financiers		
Regional Distributors	Stampriet local authority, ERONGO RED, City of Windhoek	Plans to connect SSDG, pricing and tariffing of SSDG, rural and off-grid opportunities.

Stakeholder	*Entity*	*Relevance to this assignment*
SSDG customers	Rosh Pina, Meatco, Pierre van Niekerk, Robert Hopperdiezel, Farmers	Determine views on opportunities, barriers and requirements for purchasing energy from an alternative supplier.
Private SSDG Companies	HopSol, Energy Partners	Determine views on opportunities in Namibia, barriers and requirements for investment.
Commercial banks	Any of the leading banks active in the RE sector in Namibia: Standard Bank, First National Bank, Nedbank or Bank Windhoek	Determine funding options, barriers and requirements for funding.
Private Equity or Fund Managers for GIPF or Funds	HangalaPrecient, NamProFund	Determine products and opportunities to support the SSDG sector development in Namibia.
Development partners		
DFIs	Any of the representatives of the DFIs active in Namibia: EIB, KfW, ADB, DBSA	Determine opportunities for donor or concessional funding, or support of the risk profile for SSDG development to enable and unlock funding for SSDG.
Research and NGOs	HSF, (Desert Research Foundation of Namibia) DRFN and/or GIZ	Studies and plans to support the implementation of SSDG in Namibia.

A1.4 SOUTH AFRICA

A1.4.1 Documents reviewed

Document type	*Documents reviewed*
Policies/Plans/Strategies	National Climate Change Policy 2008
	IRP 2050 under development (under review)
	Integrated Energy Plan
	Energy Efficiency Strategy 2016
Regulations and Acts	Licensing guidelines for embedded generation
	Registration procedure for small-scale embedded generation
	Carbon tax
	Electricity Regulation Act, 2006 (ERA),
	New Schedule 2 of the Electricity Regulation Act, issued November 2010 and Notice of 10 November 2017
	NERSA Consultation Paper Small-Scale Embedded Generation: Regulatory Rules PUBLISHED ON 25 FEBRUARY 2015
	Tariffs & Charges Booklet 2019/2020 Charges for non-local authorities effective from 1 April 2019 to 31 March 2020 Charges for local authorities effective from 1 July 2019 to 30 June 2020 (Please refer to the 2018/19 tariff book for local authority tariffs 1 April 2019 to 30 June 2019)
	Schedule of Approved Electricity Tariffs for FY2019/20 City Power Johannesburg, July 2019
Other	Status of Small-Scale Embedded Generation (SSEG) In South African Municipalities October 2017. South African Local Government Authority (SALGA)
	Small-Scale Embedded Generation in South African Municipalities (solar PV focus) 1. SAMSET: Small-Scale Embedded Generation in South African Municipalities (Case Study) 2. March 2014. Sustainable Energy Africa

Document type	*Documents reviewed*
Other (continued)	Energy services 2018. Market Intelligence Report Greencape
	The Draft Integrated Resource Plan 2018: The Roadmap for Future Generation Capacity Energy Alert 28th August 2018. Cliffe Dekker Hofmeyr
	Consumer savings through solar PV self-consumption in South Africa. Co-benefits Study Assessing the co-benefits of decarbonising the power sector Executive report March 2019
	Solar PV Info Sheet #1: July 2018 SSEG Tariff City of Cape Town
	Small-Scale Embedded Generation (SSEG) Tariff Guidelines Summary: www.cityenergy.org.za It serves as a starting point to guide municipalities with setting initial SSEG tariffs.
	Metering for Small-Scale Embedded Generation Information to help municipalities understand and procure suitable SSEG metering systems. January 2019
	Impact of Small-Scale Solar PV Embedded Generation (SSEG) on Tshwane's revenue June 2017

Note: Many more reports were consulted, but these are the major ones.

A1.4.2 Stakeholders interviewed

Stakeholder	*Name of person interviewed*
Public sector	
City of Cape Town*	Allison Pieterse and Nikiwe Madonsela from Genesis Analytics Contact at Genesis on this project: anthonyf@genesis-analytics.com
Department of Energy**	Thabang Audat, Chief Director Policy and Planning
NERSA**	Dennis Seemela Email: dennis.seemela@nersa.org.za
	Brian Sechotlho Email: brian.sechotlho@nersa.org.za
South African Local Government Authority (SALGA)**	Nhlanhla Ngidi Tel: 012 369 8000 Email: Nngidi@salga.org.za
Private sector	
AcuDee Projects**	N. D. Fox Ndwandwe Mob: +27 722501951 Fax: +27 86 546 1921 Email: dudu@acudee.com
Crossboundary	Kathleen Jean-Pierre, Vision & Delivery Lead Email: kathleen.jeanpierre@crossboundary.com
Greencape**	Seraj Chilwan Email: seraj@green-cape.co.za
Juwi	Richard Doyle, Head of Sales Email: richard.doyle@juwi.co.za
Redavia Solar	Erwin Spolders, CEO Email: e.spolders@redaviasolar.com

Solarise Africa	Sakkie van Wijk, Co-founder and Director Email: svw@solariseafrica.com
South Africa Independent Power Producer Association (SAIPPA)*	Allison Pieterse and Nikiwe Madonsela from Genesis Analytics Email: anthonyf@genesis-analytics.com
South African Solar PV Industry Association (SAPVIA)	Davin Chown, Director
South African Wind Energy Association (SAWEA)**	Marilize Stoltz, Operations Manager Tel: +27 11 214 0664 Email: admin@sawea.co.za
Financial institutions	
DBSA**	Ms Tsitsi Musasike Email: Tsitsim@dbsa.org Tel: +27 11 313 3027 Mob: +27 83 254 5766 Fax: +27 11 206 3027
Industrial Development Corporation**	Dr Tapiwa Dube Email: tapiwad@idc.co.za
Development partners	
Council for Scientific and Industrial Research (CSIR)*	Allison Pieterse and Nikiwe Madonsela from Genesis Analytics Email: anthonyf@genesis-analytics.com
GIZ**	Jonathan Curren Tel: +27 12 423 5921 Mob: +27 82 615 9702 Email: jonathan.curren@giz.de
	Christopher Gross Tel: +27 12 423 5921 Mob: +27713884612 Email: christopher.gross@giz.de

*Interviewed via email or WhatsApp call.

**Shared interview notes from Genesis, who were part of the team, were shared in order to avoid stakeholder fatigue.

A1.5 ZAMBIA

A1.5.1 Documents reviewed

Document type	*Documents reviewed*
Acts	The Electricity Act No. 14 of (1995)
	The Energy Regulation Act Cap 436 (2003)
	Rural Electrification Act No. 20 of (2003)
Regulations	Zambia Grid Code, (2006)
Policies	National Energy Policy (2008)
	Renewable Energy Feed-in Strategy (2017)
	GETFiT Strategy (2018)
Plans	Seventh National Development Plan (2016)
	Vision (2030)
	Rural Electrification Master Plan (REMP) (2003)
Tariffs	Zambia Energy Regulation Tariffs (2016)
Other	National Climate Change Policy (2016)

A1.5.2 Stakeholders interviewed

Stakeholder	*Name of person interviewed*
Public sector	
Copperbelt Energy Corporation	Mr Obed J. Chishala, Senior Manager RE Email: chishalao@cec.com.zm
Department of Energy	Mr Marvin V. Mumba, Ag Energy Officer Email: marvinmumba@yahoo.com
	Mr Brian Sinkala Mainza, Senior Energy Officer Email: bsmainza@gmail.com
Energy Regulation Board	Mr Steven Mwiinga, Manager (Electricity Sector) Email: smwiinga@erb.org.zm
	Mr Eric Musama, Engineer (Electricity Sector) Email: emusama@erb.org.zm
Private sector	
Huawei Technologies	Ares Nan Email: nanxiaofei@huawei.com
Solar Association of Zambia	Mr Geoffrey Kaila Email: geoffreykaila@gmail.com
Timbuktu (EPC)	Nicole Marais Email: n.marais@timbuktu-holdings.com
Total Zambia	Ms Kutemba Zama Email: kutemba.zama@total.co.zm
Financial institutions	
Development Bank of Zambia	Ms Samantha Okpara Email: SMOkpara@dbz.co.zm
Development partners	
GIZ	Mr Martin Lyambai Email: martin.lyambai@giz.de
Swedish International Development Cooperation Agency (SIDA)/REEEP	Ms Sabera Khan, Fund Manager Email: skhan@africacce.com

A1.6 ZIMBABWE

A1.6.1 Documents reviewed

Document type	*Documents reviewed*
Acts	Electricity Act, 2002
	Electricity Amendment Act 2003 and 2007
	Energy Regulatory Authority Act, 2011
	Rural Electrification Fund Act [Chapter 13:20]
Regulations	Net Metering Regulations (SI 86 of 2018)
	Electricity Distribution Code Regulations (SI 47 of 2017)
	Electricity Grid Code Regulations (SI 91 of 2017)
	Electricity Licensing Regulations, 2008
Policies	National Energy Policy, 2012
	National Renewable Energy Policy Draft, 2017

Document type	*Documents reviewed*
Policies (continued)	National Climate Policy, 2017
Plans	Transitional Stabilisation Program (October 2018-2020)
	Vision 2030: TOWARDS AN UPPER-MIDDLE INCOME ECONOMY BY 2030
	Renewable Energy Master Plan, November 2018
Tariffs	Review of the Renewable Energy Feed-in Tariffs, 2018
	ZETDC Tariff Schedule, 2014
Other	Mini-Grid Framework (Draft)
	UNSE4ALL Rapid Assessment and Gap Analysis (2012, then updated 2015)

A1.6.2 Stakeholders interviewed

Stakeholder	*Name of person interviewed*
Public sector	
Ministry of Energy and Power Development, Department of Energy Conservation and Renewable Energy (ECRE)	Dr S. Ziuku Email: sostenziuku@gmail.com
Ministry of Energy and Power Development. Department of Power	Eng. B. Munyaradzi Email: bensonmunyaradzi@gmail.com
Rural Energy Fund. Energy Infrastructure Development Department	Cliff Nhandara Email: cnhandara@rea.co.zw
Zimbabwe Energy Regulatory Authority	Tobias Mudzingwa Email: tmudzingwa@zera.co.zw
Zimbabwe Electricity Transmission and Distribution Company	Ikhupuleng Dube Email: idube@zesa.co.zw
Private sector	
BOC Gases (member of Confederation of Zimbabwe Industries)	James Togara Email: James.togara@boc.com
Business Council for Sustainable Development Zimbabwe	Tawanda Muzamwese Email: tmuzamwese@gmail.com
Distributed Power Africa	Vuyisile Ndlovu Email: vndlovu@dpaafrica.com
Murowa Diamonds	Eng. Jonathan Mapisaunga Email: jonathan.mapisaunga@murowadiamonds.com
Riverside Power Station (Nyangani Renewable Energy)	Mckersie Email: iapm@nrezim.com
Schweppes Zimbabwe Limited	Eng. Smart Zongololo Email: szongololo@schweppes.co.zw
Financial institutions	
Infrastructure Development Bank of Zimbabwe	Mr Malunga Email: rmalunga@idbz.co.zw
ZB Financial Holdings Limited	Sam Mutamuko Email: smutamuko@zb.co.zw
Development partners	
Swedish Embassy	Dr Gareth Horsfield Email: ambassaden.harare@gov.se

Silhouette of a windpump
in the Klein Karoo, South Africa

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