Commercial and Industrial Renewable Energy Market for South Africa

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Commercial and Industrial Renewable Energy Market Study

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ACRONYM LIST

Acronym	Definition
AREP	Association for Renewable Energy Practitioners
BUSA	Business Unity South Africa
C&I	Commercial and Industrial
CO2	Carbon Dioxide
CSIR	Council for Scientific and Industrial Research
DG	Distributed Generation
DMRE	Department of Mineral Resources and Energy
DNC	Distribution Network Code
DSO	Distribution System Operator
EAC	Energy Attribute Certificate
EAF	Energy Availability Factor
EPP	Electricity Pricing Policy
EIUG	Energy Intensive Users Group
ERA	Electricity Regulation Act
ESI	Electricity Supply Industry
GW	Gigawatt
HV	High Voltage
IEP	Integrated Energy Plan
IFC	International Finance Corporation
IPP	Independent Power Producer
IRENA	International Renewable Energy Agency
IRP	Integrated Resource Plan
LV	Low Voltage
MTSAO	Medium Term System Adequacy Outlook
MV	Medium Voltage
MVA	MegaVolt Amperes
MW	Megawatt
MYPD	Multi-Year Price Determination
NDC	Nationally Determined Contribution
NERSA	National Energy Regulator of South Africa
NSP	Network Service Provider
O&M	Operations and Maintenance
PPA	Power Purchase Agreement
PV	Photovoltaic
RE	Renewable Energy
REC	Renewable Energy Certificate
REIPPPP	Renewable Energy Independent Power Producers Procurement Programme
RSA	Republic of South Africa
SANEDI	South African National Energy Development Institute
SDG	Sustainable Development Goals
SSEG	Small-scale Embedded Generation
TOU	Time-of-Use
TSO	Transmission System Operator
TWh	Terawatt hour
UGPP	Utility Green Procurement Programmes
UOS	Use-of-System
WPEP	White Paper on Energy Policy
WPRE	White Paper on Renewable Energy

EXECUTIVE SUMMARY

The South African electricity sector has been facing several challenges in supply, with the main utility Eskom struggling to meet the country's demand. These challenges have been driven by the energy supply insecurity and unreliability resulting in planned outages in the form of loadshedding, declining renewable energy costs, above inflation increases in electricity generation tariffs, and mounting pressure on the electricity sector to decarbonise as the largest emitter of greenhouse gases on the African continent. Furthermore, Eskom has an aging coal fleet with declining energy availability factors (EAF) resulting in poor operational performance and reaching the end of life in due course.

To achieve reliable and cost efficient energy supply, commercial and industrial (C&I) consumers are looking for alternative sources of energy which are more reliable for their operations. To foster growth in the market and allow the RE distributed generation to partly fill the energy supply shortage, the government has embarked on implementing policies that will effectively reduce the barriers in the market. The enabling policy changes is evidenced by the inclusion of DG on the 2019 IRP, wherein from 2023, DG can contribute up to 500MW p.a. until 2030. In the latest development, President Cyril Ramaphosa announced that the licensing threshold for DG would be increased from 1MW to 100MW, and this is in the process of being approved and gazetted[1]. This announcement was welcomed by industry as a notable step in the development of the C&I distributed generation market. However, more is needed to ensure the market grows to assist Eskom and IPPs to fill the gap and help the country recover from the impact the poor performing energy sector is having on the economy. With this context, the RES4Africa Foundation in partnership with the Council for Industrial and Scientific Research (CSIR) collaborated to produce this report which assesses the current C&I landscape in South Africa, the key regulations, the economics and tariffs, and the benefits and challenges from the point of view of the C&I consumer and as well as Eskom and the distribution utilities. Best practices were also drawn from Chile, Spain and Vietnam in establishing their own C&I markets.

The sector in brief

The C&I market provides corporate and industrial customers with a double opportunity for organisations by providing them with costs savings, long-term price stability and security of energy supply, but also allowing for decarbonisation of their operations and thus reducing their environmental footprint. The latest World Bank Enterprise Survey indicated that 90% of South African firms experience electrical outages – the impact of the outages increases operational costs, disrupts production and reduces profitability[2]. Considering this about 63% of firms have opted for town or share a generator. The electricity consumption from the C&I market segment however has not grown at the same levels as other global market, as a result of unreliable supply, in fact it has slightly decreased since 2010.

The main technology used in the market has been onsite solar PV, with wind projects remaining low. Official numbers on the number of C&I installations and the equivalent capacity is not available, however estimates have been pulled together from different sources – placing the market size at over 1.15 GW as of 2020. Outside of developed countries, South Africa had the largest share of companies actively sourcing renewable energy[3].

Corporate sourcing models and trends

Several sourcing models are available to companies that want to invest in renewable generation for their operations, including power purchase agreements (PPAs), energy attributable certificates (EACs), corporate direct investments and utility green procurement programmes (UGPP).

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[1] *Republic of South Africa, "President Cyril Ramaphosa on amendment to Schedule Two of the Electricity Regulation Act." 2021*
[2] *The World Bank Group, "Enterprise Surveys. South Africa 2020. Country Profile*
[3] *Data refers to the companies included in the survey carried out in the IRENA publication "Corporate Sourcing of Renewables: Market and Industry Trends".*

There are several power purchase agreements (PPA) models including physical PPAs, sleeved PPAs and virtual PPAs. In South Africa, the National Energy Regulator of South Africa (NERSA) requires the submission of PPAs between contracting parties as a supporting document to a generation license application or for registration if the generation facility has been exempted. NERSA however does not set standard PPAs and for C&I customers the corporate PPAs are generally drafted by the parties involved with only physical and sleeved PPAs allowed. Due to the lack of specific regulation for corporate clients, corporate PPAs are regulated by the same rules as regular PPAs. NERSA's Regulatory Rules on Network Charges for Third Party Transportation of Energy regulation allows any load customer to go into bilateral arrangements with any third-party generator, enabling bilateral PPA with non-Municipal and non-Eskom generators[4].

The corporate PPAs market in South Africa has reached about 16 MW (2018), almost entirely covered by solar PV technologies. The corporate PPAs market in South Africa is still limited and mainly due to the lack of a specific regulation for business clients which makes the authorization process slow and complex, especially for medium and large-scale generation.

Boosting the growth of the South African PPA market could alleviate pressure on Eskom to supply demand, however, they require a high level of financial security compared to other sourcing models.

Spain and Chile provide PPA market benchmarks for South Africa, with Spain accounting for 31% of all PPAs signed in Europe and Chile recording 2GW of clean energy under PPAs in 2019.

EACs are contractual instruments proving the origin of a pre-set amount of renewable electricity consumed. EACs represent a currency trading in the renewable market and allow consumers to make credible claims of renewable energy use.

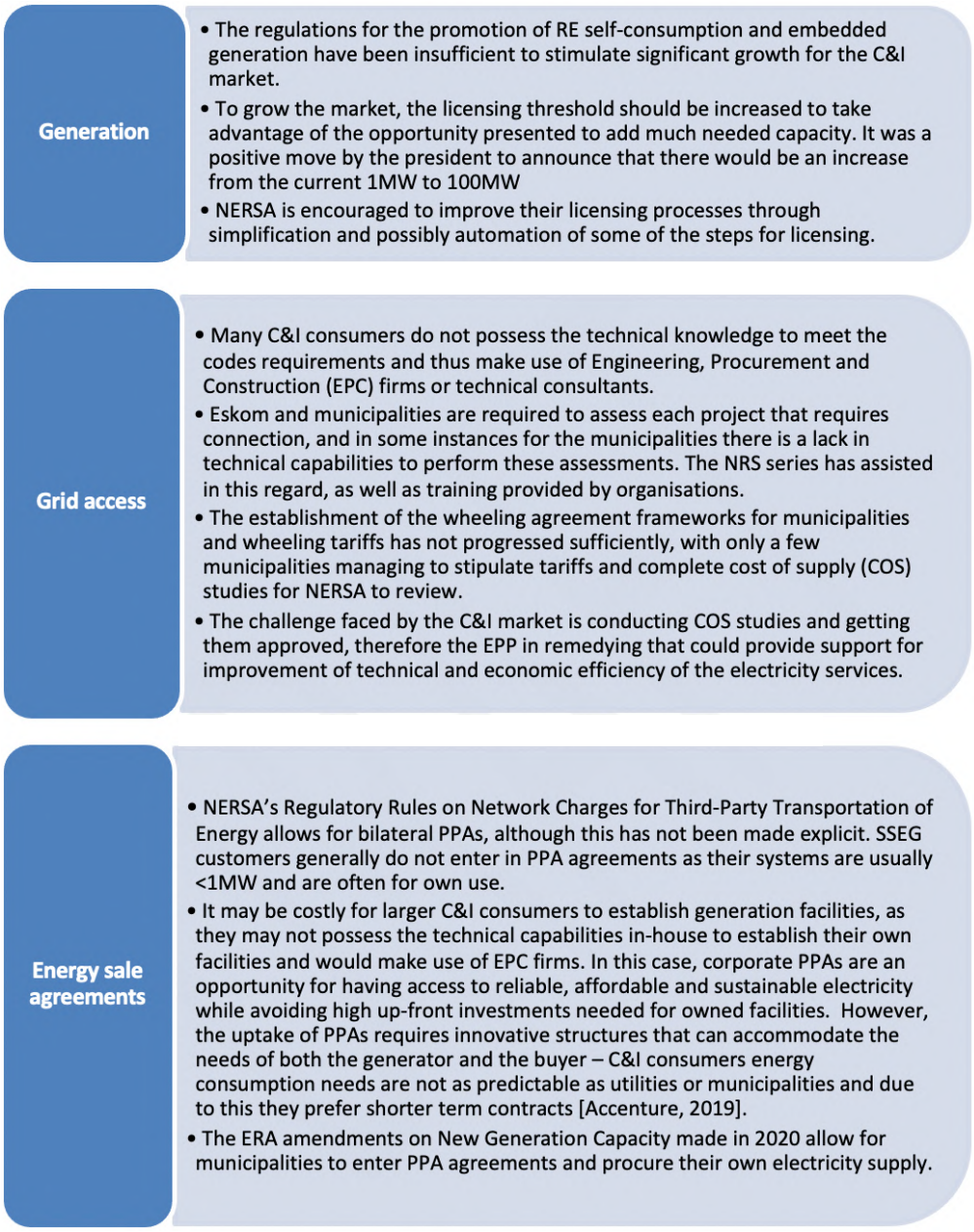
Beyond the PPAs and EACs sourcing models, companies have their own potential to directly invest in self-generation through ownership and leasing. The market volume of the self-consumption model is steadily growing with more municipalities allowing embedded generators on their networks through the connection agreements for self-consumption by providing net metering schemes and favourable feed-in-tariffs. Vietnam's self-consumption regulations have allowed for 11,855 rooftop PV projects installed by C&I customers, for a total of about 2GW[5] (November 2020).

UGPP procurement is a tool allowing the buyer to purchase renewable energy through specific products or through tailored renewable energy tariffs offered by certain utilities. Types include green premium products and green tariff. However, South Africa does not have any UGPP as yet.

Implications of regulations on C&I market development

The current regulation in place for generation, grid access, and energy sale agreements have an important impact on the growth of the C&I market in South Africa, and as such were discussed.

[4] *NERSA Regulatory Rules on Network Charges for Third-Party Transportation of Energy, 2012, clause 6.7*
[5] *1H 2021 Corporate Energy Market Outlook*



Economics and Tariffs

The cost of electricity is a driving factor in future market growth. Electricity tariffs paid by C&I consumers in the mining, manufacturing and wholesale and retail trade sectors are investigated by providing a detailed overview of current tariff structures. The average wholesale electricity tariff[3] in SA has been increasing steeply for the last decade as shown in **Figure S.1.**

[6] *Average wholesale electricity tariff = Eskom total electricity sales (ZAR) / total electricity sold (kWh)*

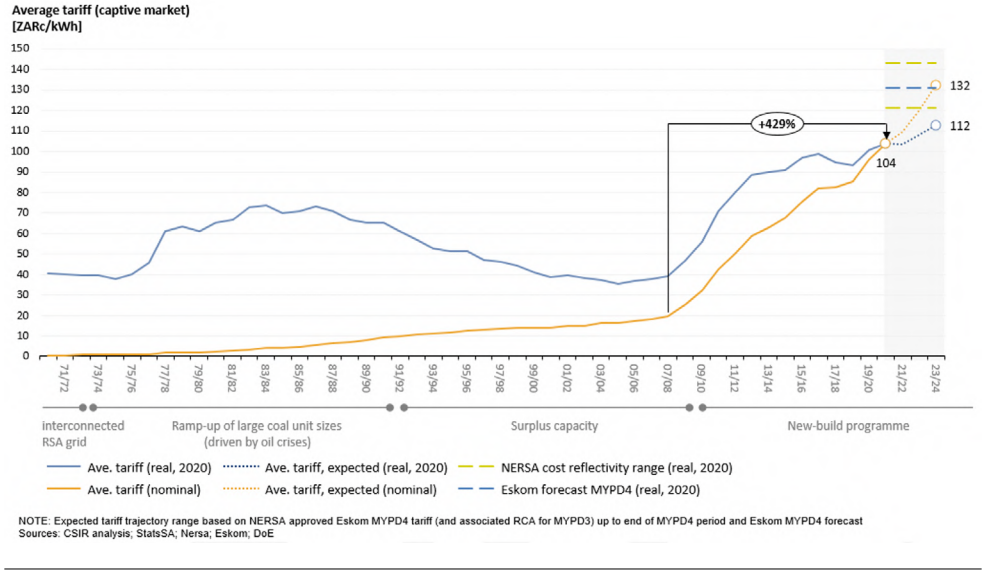


Figure S.1: *Average wholesale tariff trajectory (Real and nominal) 1970 to 2020. Source: CSIR Analysis*

Eskom and the municipalities currently have several electricity tariff structures for different customer categories. C&I customers with a notified maximum demand (NMD) greater than 1 MVA who are supplied directly by Eskom are typically on a Time of Use (TOU) tariff structure, namely the Megaflex tariff [7], while the relevant municipalities apply their own tariffs. All other customer segments who install small scale embedded generation (SSEG) are required to move to a TOU tariff structure. There are several fundamental components of the Eskom Megaflex[8] electricity tariff namely:

- *Fixed Charges (R/month)*
- *Transmission, Network and Distribution Demand Charges (R/kW/month)*
- *Energy Charges (R/kWh)*
- *Ancillary service charges (c/kWh)*
- *Reactive energy charges (c/kVArh)*

Presently, Eskom tariffs for large C&I customers are recovering fixed costs mostly through variable usage charges. The actual cost split between variable and fixed costs incurred by Eskom were determined in a COS study and are shown in **Figure S.2**. The average cost structure across various size municipalities, showed that variable costs form roughly 74% of municipal electricity costs[9]. When customers install SSEG, municipal/Eskom revenue is reduced due to reduced sales volumes sold to these customers as well as potentially compensating them customers for excess electricity fed into the grid. This has ultimately led to Eskom publishing their strategic direction and objectives for their electricity tariff structures[10] in 2017. After this, in 2020, Eskom submitted an application to NERSA for structural tariff changes based on an updated COS study[11], these have not been implanted as yet.

Municipalities are considering similar structural changes to their electricity tariffs. Several municipalities have already introduced SSEG tariffs. If over the coming years Eskom do apply for significant structural changes to the electricity tariffs the business case for installing solar PV for self-generation may become unfavourable.

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[7] An electricity tariff for Urban customers connected at medium voltage, high voltage and transmission voltages that consume energy (importers of energy from the Transmission and Distribution System) and generate energy (exporters of energy to the Transmission and Distribution System) at the same point of supply (or metering point).
[8] Eskom Holdings SOC Ltd, "Tariffs & Charges Booklet 2020/2021
[9] NERSA, "Municipal Tariff Guideline Increase , Benchmarks and Proposed Timelines for Municipal Tariff Approval Process for the 2019 / 20 Financial Year
[10] Eskom Holdings SOC Ltd, "Eskom's Retail Tariff Plan 2020/21 Submission
[11] Department of Mineral Resources and Energy, "Integrated Resource Plan (IRP 2019)

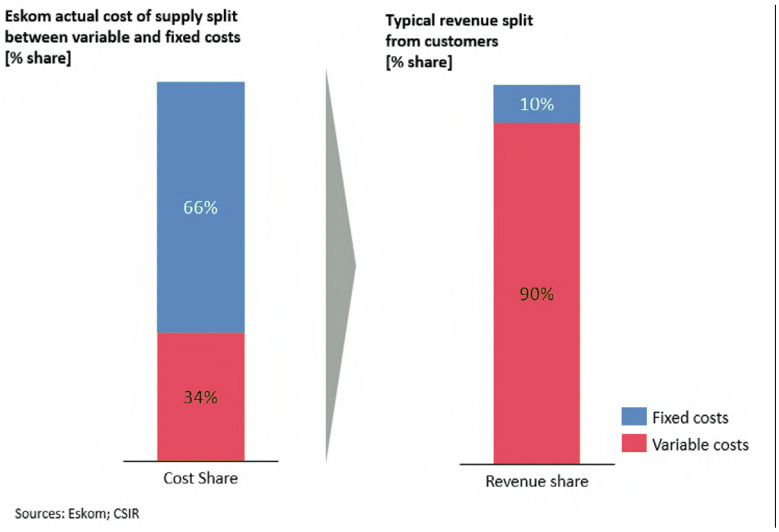


Figure S.2: *Current Eskom cost and revenue share between variable and fixed costs/revenue demonstrating Eskom's financial risk to declining energy volume sales. Source: Eskom & CSIR*

A high level overview of the wholesale tariff trajectory which could evolve based on the anticipated future generation mix within the power sector was explored. The projected electricity price path resulting from the IRP plan is shown in **Figure S.3**. As can be seen, electricity tariffs are expected to continue increasing over the next decade (in real terms).

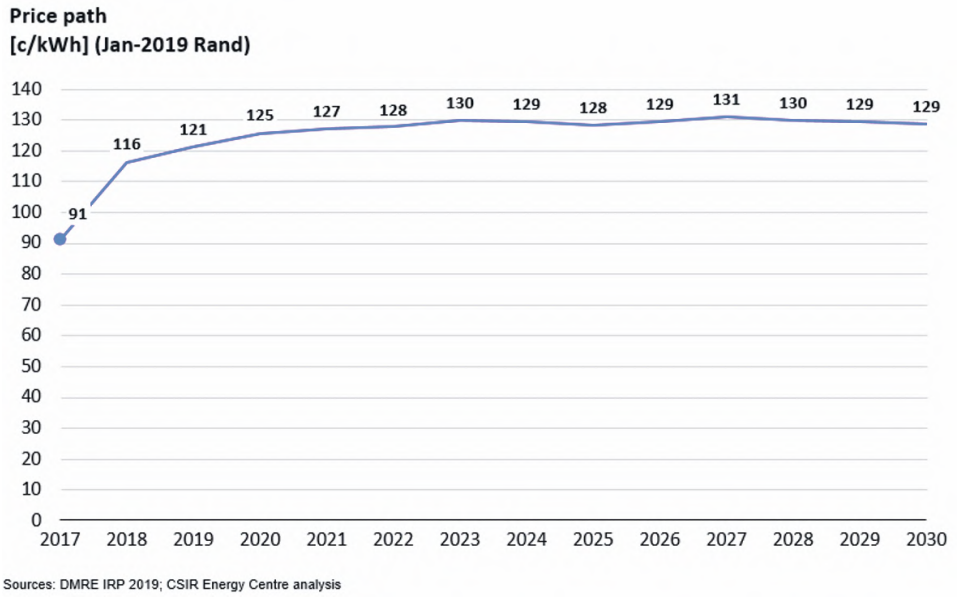


Figure S.3: *IRP 2019 projected electricity price path 2017 - 2030 (Real terms) Source: DMRE & CSIR Analysis*

The Levelised Cost of Electricity (LCOE) for utility-scale and rooftop solar PV installations (0.5-1.0 R/kWh) in South Africa is already today, considerably lower than the average price path and is expected to continue declining. However, the business case for installing solar PV is dependent on the actual unbundled tariff the customer pays to Eskom or municipalities. Although the LCOE is 0.5-1.0 R/kWh, these customers are also charged fixed demand charges, which are not off-set by solar PV generation. Some municipalities offer a feed-in tariff for excess solar PV generation but this is likely to be of benefit to residential customers who tend to have a lower electricity demand during the day.

Wheeling charges in the South African context

i. Eskom wheeling charges

Eskom wheeling charges are referred to as UOS charges. These charges recover the transmission and distribution licensees' regulated costs associated with retail, capital, operations, maintenance, and return on assets[12]. In addition to the UOS charges, there are charges related to the load and generators sides. The charges levied for wheeling follow the NERSA guidelines. It should be noted that Eskom does not enter into long-term wheeling agreements at a fixed rate. Therefore, C&I customers should be aware that they may be subject to changes in tariffs and tariffs structures.

ii. Municipal wheeling charges

A few municipalities have entered into wheeling agreements and have wheeling tariffs in place such as the City of Cape Town, City of Tshwane, and Nelson Mandela Bay Municipal Metro[13]. For wheeling tariffs to be approved by NERSA the municipalities/distributor licensees are required to conduct a COS study. This will allow for the resulting tariff to be fair for all parties. However, at present very few municipalities have conducted these studies and their UOS charges are not unbundled i.e., the tariffs are bundled and include the grid system and energy costs[14]. According to an analysis conducted by the South African Wind Energy Association (SAWEA), wheeling charges differ significantly between municipalities.

Conclusion

Through the assessment of **the regulations, policies and codes**, the following was concluded:

- *Although progress is being made in regulations that will allow for the development of the C&I market, the consensus is that the regulations have been insufficient to allow for growth.*
- *In addition, regulations around wheeling and bilateral PPA agreements remain unclear, and net-metering regulations have not gained traction, although some municipalities do allow it.*
- *C&I consumers are required to ensure that they meet the relevant grid code requirements to be able to connect their generation facilities to the distribution network.*

Through the assessment of **the economics and tariffs**, the following was concluded:

- *According to the IRP2019, the procurement of new generation capacity will result in electricity tariffs increasing over the next decade (in real terms),*
- *The cost of rooftop and utility-scale solar PV has decreased substantially, to the extent that there is a strong business case for deploying distributed generation*
- *Current C&I tariffs are structured with a high portion of variable energy charges which can be avoided by reducing energy usage*
- *With the anticipated increase in distributed generation, and the resulting decrease in revenues for Eskom and municipal distributors, they have indicated their intention to restructure their electricity tariffs to be more cost reflective. This includes transitioning to higher fixed charges. This will have a direct impact on the economic business case for C&I consumers.*
- *Furthermore, challenges with COS studies were highlighted as a challenge for municipalities to get wheeling frameworks and tariffs in place.*

[12,14] Eskom Holdings SOC Ltd, "Generator Tariff Charges," pp. 1–11, 2013
[13] South African Wind Energy Association (SAWEA), "Decentralised Generation Study: An Analysis of the Value Proposition for Renewable Energy Distributed Generation in South Africa," South African Wind Energy Assoc

Drawing upon the high-level analysis carried out during this study, it was concluded that the creation of a C&I market in South Africa would bring the following **benefits and challenges to C&I consumers, municipalities, and Eskom:**

- *For C&I consumers RE market development:*
  - *The main benefits highlighted: reduced electricity bills, reduction in carbon tax liability, tax benefits and more reliable electricity supply.*
  - *The main challenges highlighted: cumbersome application processes, lack of skilled labour and accredited installers to develop and install projects.*
- *For Eskom and the municipalities:*
  - *The main benefits highlighted: the potential tariff adjustment to reduce the impact of increased embedded generation, government guarantees to Eskom to allow for growth of RE, reduced technical losses on distribution networks and increased security of supply for customers with the connection of more embedded generation and their excess generation being injected into the grid.*
  - *The main challenges highlighted: reduced municipal revenues, complex technical requirements for network connection, lack of in-house technical capabilities to connect C&I embedded generators and challenges in balancing on the network.*

Real-world examples from the CSIR and the international cases illustrate that there are gaps remaining within the regulatory and operational environment within South Africa. The CSIR experience highlighted challenges with regulatory processes and procurement. The international cases highlighted the need for clear and supportive PPA regulations. The benefits and challenges presented by the brief analysis of the environmental, social and political lenses illustrate that the development of renewable energy by C&I consumers has more beneficial outcomes despite the challenges.

Recommendations

The below provides the recommendations based on the analysis conducted in this report:

- *Simplify the generation licensing requirements and automate some aspects of the licensing processes to unlock full potential of the embedded market for RE*
- *Increase the threshold for exemption from generation licensing while still ensuring integrity of technical requirements and ensuring continuous tracking of installation to assist with grid planning and security*
- *Increase NERSA's institutional capacity in order to efficiently and timeously process generation license applications and COS studies*
- *Increase the technical capabilities for municipalities for them to efficiently assess distributed generation applications and implications for the operation of their network*
- *Careful consideration of all of the tariff components and how they are expected to evolve over time is necessary to determine the economic business case of SSEG for C&I customers.*
- *Innovative funding models could be developed and implemented to allow for the growth of the PPA market*
- *Clarify regulations for wheeling to allow for more uptake by C&I customers who want to diversify their electricity supply options without building their own facilities.*
- *Clearer regulations around bilateral PPAs and net-metering will also foster development of the C&I RE market. PPAs should be tailored for the C&I business case and allow for shorter term PPAs, provided the developer recoups their investment.*
- *Lastly, attention should be given to regulation around technical compliance and safety and assurance mechanisms to ensure the quality of systems*

INTRODUCTION

This report is an analysis of the status of the commercial and industrial (C&I) renewable energy (RE) market in South Africa and provides a contribution to the discussion about the untapped opportunities presented by the market segment. It considers the challenges to facilitate investments in this market segment which has the potential to accelerate the energy transition and contribute to ensuring the availability of reliable and sustainable electricity to small, medium, and large enterprises.

Chapter 1 of this analysis provides an overview of the global and South African C&I market, presenting data about electricity demand, market segments, market penetration and trends. **Chapter 2** identifies the main sourcing models available to companies that want to invest in RE generation for their operations: from self-consumption to energy attribute certificates (EACs) to power purchase agreements (PPAs) and utility green procurement programmes (UGPPs). Overall, the report gives particular emphasis to self-consumption and PPAs as the most relevant models for South Africa.

Chapter 3 provides an overview of the current legislative and regulatory framework in South Africa that governs different RE technologies in the C&I market segment. The policies and regulations reviewed are further analysed to identify potential gaps that may hinder future growth of RE in the C&I market as it pertains to generation, grid access and energy sale agreements. Key project risks for C&I consumers who opt for self-consumption and those who opt for PPA agreements are discussed. The chapter concludes with an analysis of the cost of electricity in South Africa by unpacking tariff structures and trends and a high-level overview of wheeling charges in South Africa.

Chapter 4 highlights benefits and challenges for C&I consumers who procure and maintain RE projects as part of their business as well as municipalities and utilities that must regulate and structure tariffs accordingly. The section includes the outcomes and learnings from the CSIR's self-generation solar deployments as well as from other C&I consumers that installed and maintained RE technologies in two different nations. Lastly, the chapter includes a high-level assessment on the environmental, social, and political benefits and challenges.

Throughout its chapters, the report integrates international experiences of Chile, Vietnam and Spain. From their market growth to their development regulations and policies, the report outlines the lessons learned that can be useful for the discussion about the C&I market in South Africa.

Chapter 5 highlights main challenges, opportunities and key lessons learnt for RE development in the C&I market in South Africa. The report concludes by providing recommendations to foster growth of the market in South Africa.

South African Context

The global electricity transition has been driven by climate change commitments that governments have made as part of the Paris Agreement. In 2019, the global annual capacity additions of onshore wind and solar photovoltaics (PV) were 54 GW and 97 GW respectively[1]. Between 2010 and 2019 there has been a global cost decline of approximately 82% and 40% in solar PV and onshore wind respectively[2]. Global distributed generation (DG) installations are expected to grow by 10 percent until 2025, driven by solar PV and growth in the C&I market [3].

In South Africa (SA), the Department of Mineral Resources and Energy's (DMRE) successful Renewable Energy Independent Power Producers Procurement Programme (REIPPPP) has resulted in significant socio-economic benefits. The success seen on the large scale and in the utility space has prompted interest by C&I consumers to further invest in RE self-consumption generation facilities to lower their costs while becoming more self-sufficient and reducing their greenhouse gas emissions (GHG).

The African and South African C&I market for RE has seen some growth in recent years, but regulatory barriers have hampered further growth in the market. In SA, processes to get generation licenses are cumbersome which results in a slow rate of approvals, regulations around wheeling and bilateral PPA agreements remain unclear, while net-metering regulations have not gained traction, although some municipalities do allow it.

C&I consumers need reliable and affordable power to run their businesses. From the mining sector to agricultural-food processing and manufacturing facilities, industrial players are still affected by the unreliable and expensive electricity supply from the national grid. These players are paying indirect costs for their production (loss of production and damage to their equipment due to load shedding, fuel costs for back-up diesel generators, etc.) and cannot expand their operations due to current supply challenges and uncertainty about future supply. A combination of rising grid electricity costs, pressure to reduce GHG emissions, falling solar module prices and the potential of wheeling agreements are spurring sales of solar electricity directly to C&I consumers. This trend represents a solution to quickly overcome the unreliable electricity supply status which many Sub-Saharan African countries are experiencing.

Figure 1 depicts the current structure of the South Africa Electricity Supply Industry (ESI). The ESI is vertically integrated with the state-owned utility, Eskom, operating across the entire value chain and generating 93% (including 3% imports) of the current electricity production, with the balance being provided by municipalities and independent power producers (IPP)[4]. SA has an installed generation capacity of approximately 58 GW, of which 49.5 GW is owned by Eskom [5]. Most of this capacity comes from coal-fired power stations (80%), with the remainder coming from nuclear, hydro, diesel, wind and solar. Eskom owns and operates the transmission network and handles all transmitted electricity in SA. Electricity distribution is shared between Eskom, municipalities, and other licensed private distributors. There are 188 municipalities licensed by the National Energy Regulator of South Africa (NERSA) which distribute 40% of electricity sales to 60% of the customer base [6].

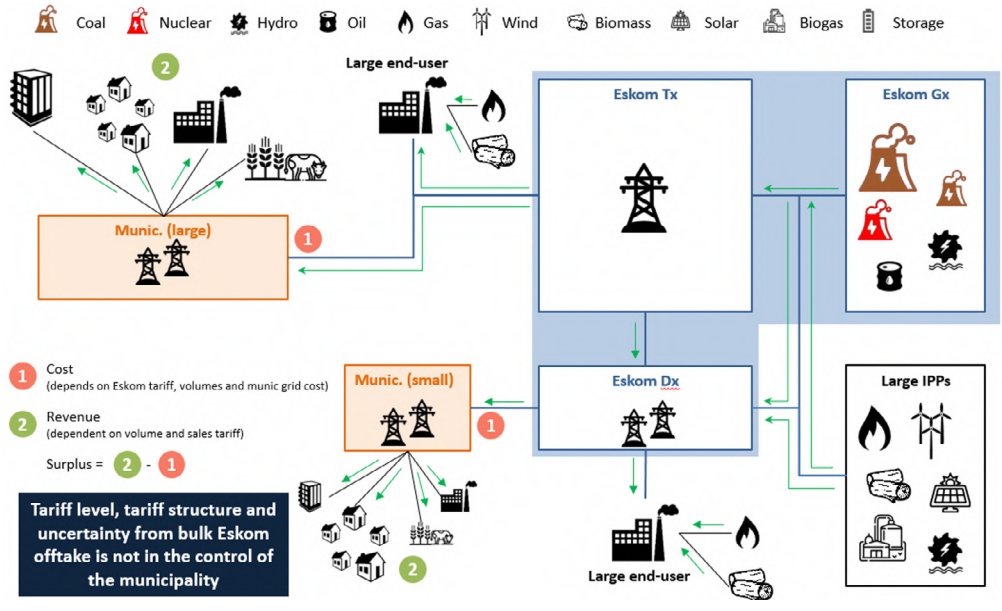


Figure 1: *Centralised utility scale power generation is supplying the electricity needs of South African municipalities and large end-users. Source: SAGEN-3, CSIR*

In late 2007, load shedding was introduced to SA as electricity supply was unable to meet demand. The insufficient generation capacity has made it essential to have an alternative management of supply to meet the demand, while simultaneously protecting the electricity power system from a total blackout. To this end, the main electricity utility, Eskom, has introduced Load Shedding Protocols which allow load reduction:

- Voluntary load reduction occurs when large industrial customers voluntarily reduce load by up to 20% when instructed by Eskom National Control in order to avoid getting load shed
- Interruptible load supply occurs when smelters can be contractually interrupted without notice or reduced by remote control or on instruction from Eskom National Control. Individual contracts place limitations on usage (typically a maximum of 2 hours per week) - these customers get favourable tariffs in return for this arrangement with Eskom.
- Interruption of supply are all the contracted as well as mandatory demand reduction resources utilised by Eskom National Control. This includes interruption of supply due to transmission network faults.
- Manual load reduction, known as load shedding, is triggered when the above measures are insufficient to balance the system or when the time to complete the above measures is not enough to prevent a blackout.

Eskom expects load shedding to be a recurring challenge for the next 5 years as the electricity supply shortfall is expected to continue over this period [7], [8]. Residential and C&I consumers realized the need for alternative solutions to wholesale electricity and cleaner electricity, thus the market for self-consumption has grown whilst government works on amending and streamlining regulations to facilitate growth in the RE C&I market.

CHAPTER 1: THE SECTOR IN BRIEF

Although there is no universally agreed definition, the Commercial and Industrial (C&I) market segment usually refers to the electricity supply made to business or corporate consumers, as opposed to households.

With less than 10 years ahead to achieve the Sustainable Development Goals' (SDG) targets, a key role in the energy transition will be played by corporate actors, that accounts for about two-thirds of global electricity consumption [9], while about 23% of CO2 energy-related emissions [10] are due to industrial activities.

In recent years, the C&I consumers' commitment to clean power and sustainability has seen a rapid growth. An increasing number of companies are adopting different strategies to demonstrate their corporate responsibility in improving their environmental footprint, by setting specific targets and policies. This trend, coupled with a significant decrease of renewable energy technologies' costs, is driving a growing number of C&I consumers to actively procure RE, particularly solar PV, to supply their own operations.

Corporate sourcing of renewables is made possible through two different approaches: an active approach and/or a passive approach[11].

In a **passive approach**, consumption is based on the average renewable electricity content already **available in the grids** from which companies source their electricity.

In an **active approach**, companies actively procure or produce the renewable electricity they consume.

This study refers to "corporate sourcing of renewables" to a company actively consuming RE to sustain its operations. Several business models allow a corporate to adopt an active approach for sourcing of renewables. At global level, generation for self-consumption is the most common, followed by power purchase agreements (PPAs) and purchase of energy attribute certificates (EACs)[11].

According to a 2017 analysis by the International Renewable Energy Agency (IRENA), based on data from 2,410 companies, the global market for the corporate sourcing of renewables reached 465 Terawatt-hours (TWh), corresponding to only 3.5% of total C&I electricity demand (13,500 TWh) and about 18.5% of total C&I renewable electricity demand (2,600 TWh).

The materials sector - which includes mining, pulp and paper, and chemicals - is by far the largest electricity consumer, with a share of renewables of 13%. While the financial sector boasts the highest share of renewables at 24% [11]. As shown in **Figure 2**, the global C&I electricity demand is projected to reach over 24,750 TWh by 2050. IRENA estimates that about 21,300 TWh (86% of this projected demand) would need to come from renewables to be in line with global climate objectives. The difference between this figure and existing company targets, commitments, and ambitions (3,800 TWh) leaves about 17,500 TWh of global untapped opportunity for the renewable energy sector[9].

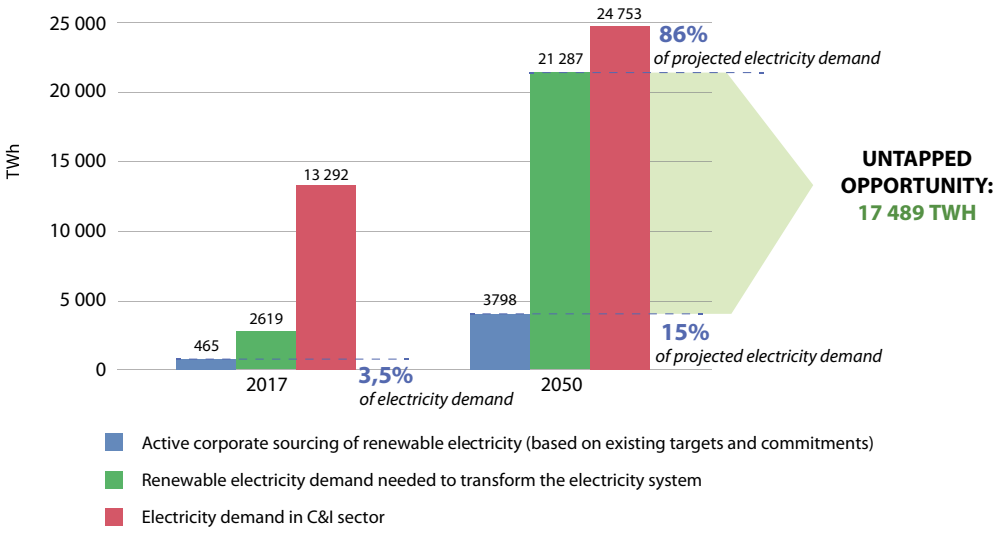


Figure 2: *Potential for corporate sourcing of renewable electricity in the global C&I sector. Source: IRENA[11]*

Despite companies actively sourcing renewables concentrated in Europe and North America, the market is also growing in emerging economies such as India and South Africa.

1.1 C&I market: a double opportunity

Investing in a corporate source of renewables means not only cost savings, long-term price stability, and security of energy supply but allows businesses to cut a significant portion of GHG emissions, reducing their environmental footprint. The growing C&I market segment represents a great opportunity to establish good practices, drive and foster investments in renewables so as to accelerate the energy transition at a global level, because of the importance of the industry in global consumption.

In the last decade costs of both solar and wind technologies have continually declined, gaining competitiveness compared to fossil fuels. The reduction of approximately 50% of wind turbine costs and 80% of solar PV costs, makes renewables the cheapest source of power in many parts of the world[11]. The declining of RE technologies' costs coupled with favourable policy landscapes and high-quality supply has strongly encouraged many companies in investing in renewables to power their own operations.

In many countries, particularly in emerging economies, C&I consumers suffer from low power quality and an unreliable grid. In a 2020 World Bank Enterprise Survey[12] on South African firms, 55% of firms interviewed chose electricity as their biggest obstacle, followed by access to finance (16%), political instability (13%) and corruption (6%) as shown by **Figure 3**.

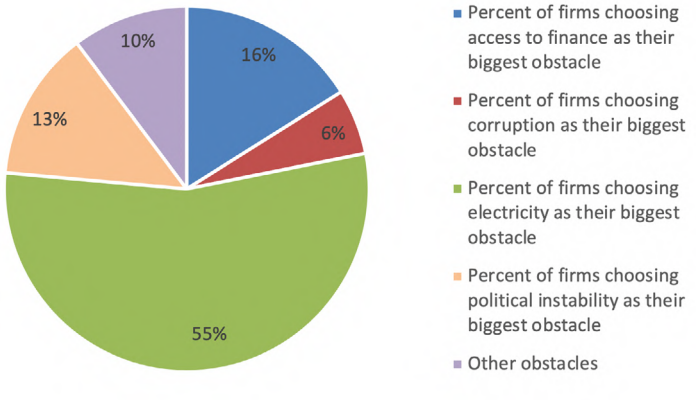


Figure 3*: Top business environment obstacles for firms in South Africa. Source: The World Bank[13]*

Frequent load shedding in South Africa causes relevant economic losses, making the use of diesel backup systems essential to their operations.

As shown in **Figure 4**, more than 90% of firms in South Africa experience electrical outages, with an average of about 8 (**Figure 5**) outages per month. Inadequate electricity supply increases costs, disrupt production and reduce profitability[12]. It forced about 63% of South African firms to own or share a generator while it is estimated that 5.5% of their annual sales is lost due to electrical outages[13].

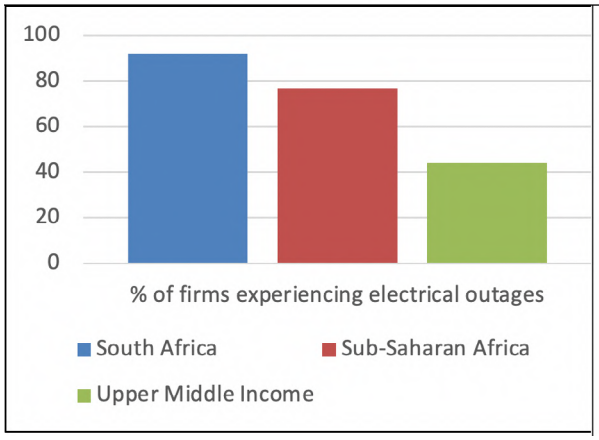


Figure 4: *% of firms experiencing electrical outages. Source: The World Bank [13]*

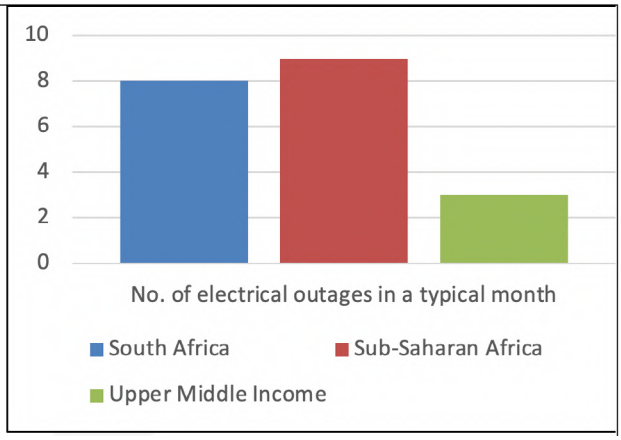


Figure 5: *Number of electrical outages in a typical month. Source: The World Bank[13]*

According to Eskom there is a shortage of between 4,000 and 6,000MW of electricity capacity. Bridging this gap is essential to support the economic growth of South Africa. In this context, ensuring affordable, fast, and renewable energy solutions to commercial and industrial customers represents a concrete opportunity to accelerate the energy transition, affecting regulatory policies, electricity prices, and best practices.

1.2 Market overview

The C&I market segment is acquiring growing importance in the energy market. In fact, while electricity consumption from C&I consumers has been slightly decreasing in South Africa since 2010 (Figure 6), globally it grew by more than 20% and it is expected to continue to grow in the coming years.

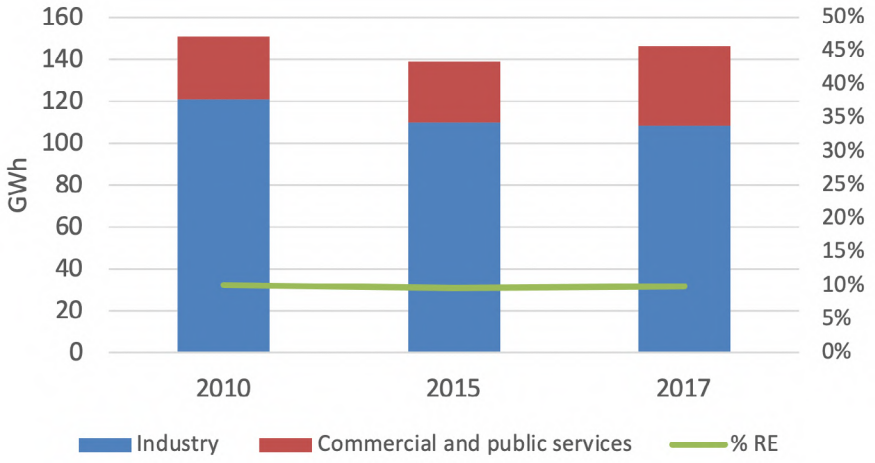


Figure 6: *South Africa electricity consumptions by sector, by year [GWh]. Source: IEA*

In South Africa, onsite solar PV is by far the main source for C&I consumers that actively procure or produce electricity from RE. The number of wind projects remains low, while cogeneration from biomass and biogas is more common. Given the Electricity Regulation Act (ERA) Schedule 2 limitations and associated regulations, the majority of C&I projects range between 100kWp and 1MWp, and are mostly self-consumption systems. At present, projects above 1MWp are limited as they require generation licences, which are not easy to obtain. However, this is set to change completely as the South African president, Cyril Ramaphosa, announced in June 2021 that regulations were being amended to increase the threshold from 1MWp to 100MWp. This will be game changing for the C&I market segment.

Official data on installed capacity for the C&I market in South Africa is not available as there is no comprehensive database of RE projects outside the utility scale projects. It is difficult to estimate the actual installed capacity from small scale embedded generation (SSEG) installations as NERSA only started registering systems in 2017 as mandated by the ERA amendments in November 2017.

Despite the lack of reliable data, **Figure 7** shows the estimate of SSEG, primarily rooftop solar PV, using numbers compiled by Power Quality Renewables Services (PQRS) in their database, added with the CSIR estimate[14]. For 2018 and 2019 GreenCape provides an estimate for the number of installations – 600 MW cumulative SSEG capacity by the end of 2018 and 850-1000 MW cumulative SSEG capacity by the end of 2019 [15], and 1150MW by the end of 2020 [16]. The Association for Renewable Energy Practitioners (AREP) similarly estimates that at the end of 2019 SSEG capacity to be between 944 – 1030 MW [17]. The AREP numbers are what Eskom used in their 2020 Medium Term System Adequacy Outlook (MTSAO) report.

According to GreenCape, the C&I market share of total installed SSEG capacity is 70% [16], resulting in a potential market of approximately 805 MW in 2020. According to an International Finance Corporation (IFC) study, the future estimates of SSEG in South Africa, which not only considers the C&I segment but other sectors as well - such as residential - is 6 GW by 2030[18]. A total resource capacity for South Africa of 100 GW with technical potential of 70 GW has also been estimated[18].

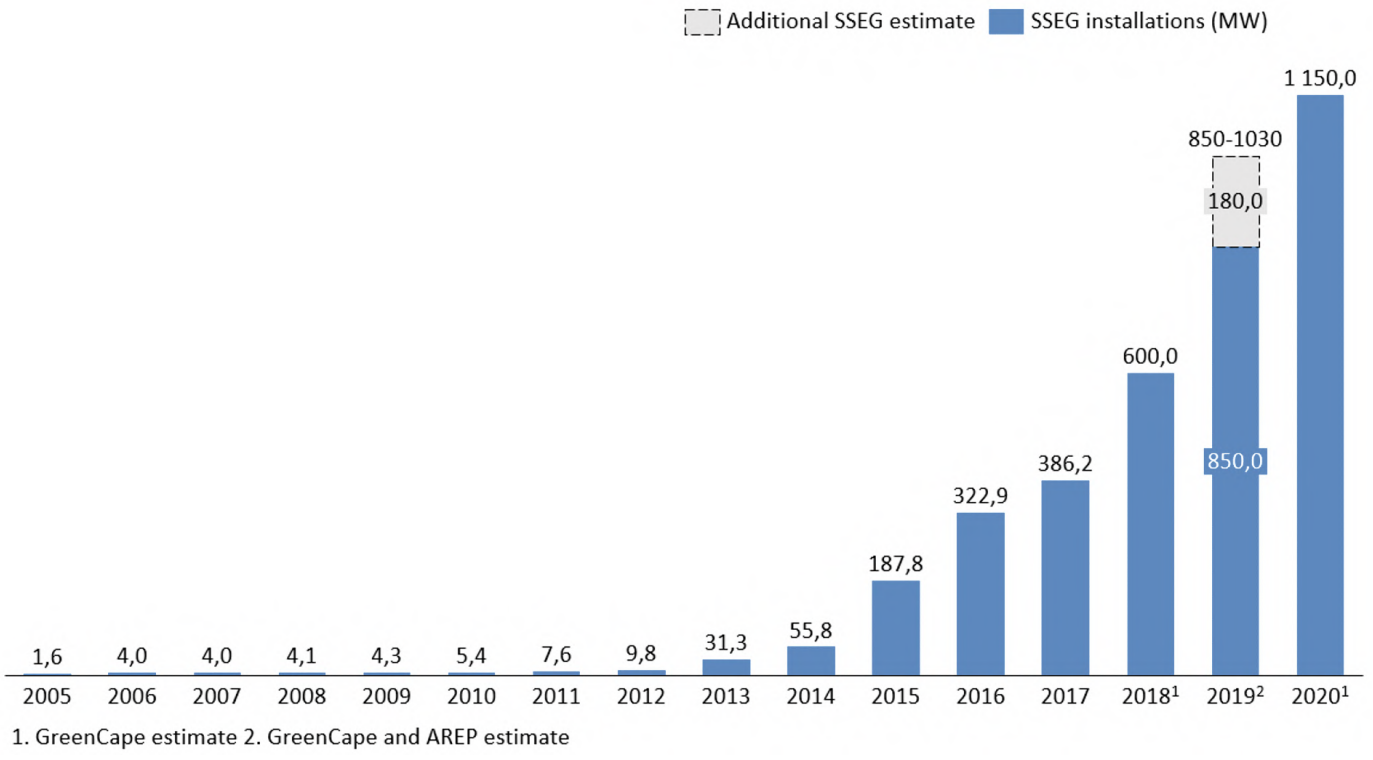


Figure 7: *SSEG cumulative capacity additions. Source: PQRS, GreenCape, CSIR, Eskom, AREP*

Corporate sourcing of electricity occurs in roughly a third of the world's countries, mainly located in Europe and North America. Beyond developed countries, South Africa and India were the only two emerging countries to enter the top ten countries for number of companies actively sourcing renewable energy. In fact, nearly half of the 37 South African companies analysed by IRENA[11][15] reported that they are actively sourcing from renewables, in line with the global average. If read together with the challenges and economic losses met by South African companies, this data confirms the appetite of C&I consumers for supplying their businesses with dedicated renewable energy solutions to ensure reliable, sustainable and affordable electricity.

[15] Data refers to the companies included in the survey carried out in the IRENA publication "Corporate Sourcing of Renewables: Market and Industry Trends".

CHAPTER 2: CORPORATE SOURCING MODELS AND TRENDS

Several sourcing models are available to companies that want to invest in renewable generation for their operations. Self-consumption is the prevailing model by consumption at the global level and it is dominated by energy-intensive industries in the materials sector (**Figure 8**). Excluding the materials sector, the most common models are the purchase of unbundled energy attribute certificates (EACs; see section 2.2) and power purchase agreements (PPAs), respectively at 28% and 25%. Utility green procurement programmes (UGPP), with just 7% of the market share, are available in the market as well.

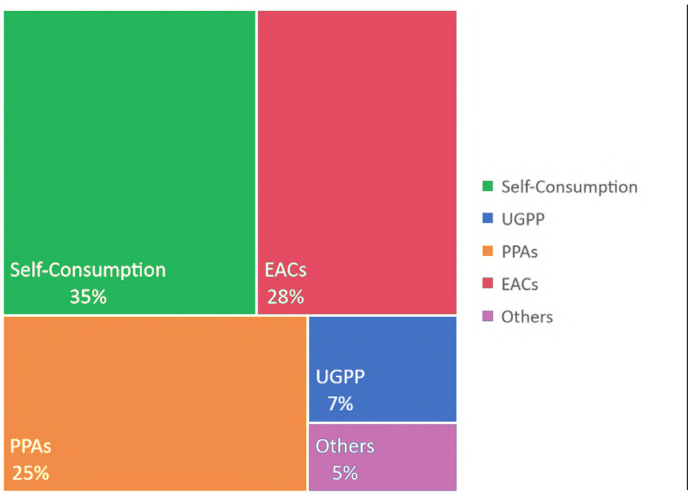


Figure 8: *Global corporate sourcing of renewable electricity by sourcing mode. Source: IRENA[11]*

2.1 Power Purchase Agreements (PPAs)

Power Purchase Agreement is a contract through which a buyer (or off-taker) can purchase electricity and the related EACs from an IPP. The buyer can be an energy utility, a licensed power trader or a business customer. A corporate PPA is a contract in which the buyer is a business customer, usually a commercial or industrial one[11].

The PPA contains all the legal and commercial terms and obligations for the sale and purchase of the power between the two parties. The PPA also sets out the required design and outputs for the power plant, operation and maintenance specifications - such as the commercial operation starting date, the schedule for delivery of electricity, penalties for under delivery, payment terms, termination, and end of termination of the asset if applicable. A PPA is also a key financial instrument since it defines the revenue and credit quality of the project. The typical duration of a PPA contract is between ten and twenty years, depending on the time that will allow the IPP to recover the investment.

Many forms of PPAs are available worldwide today, varying according to the electricity market structure, the needs of the buyer, seller, and financing counterparties. A first categorization can be done at macro level among physical, sleeved, and virtual PPAs.

2.1.1 Types of PPAs

Physical on-site PPA

The Physical PPA is a contract through which an IPP directly sells electricity and associated attributes (EACs) to a buyer, agreeing on a fixed or a discount-to-market price. Under this model, the IPP directly injects electricity on the consumption site. Since the project is located close to the consumption site, the model is also called on-site generation.

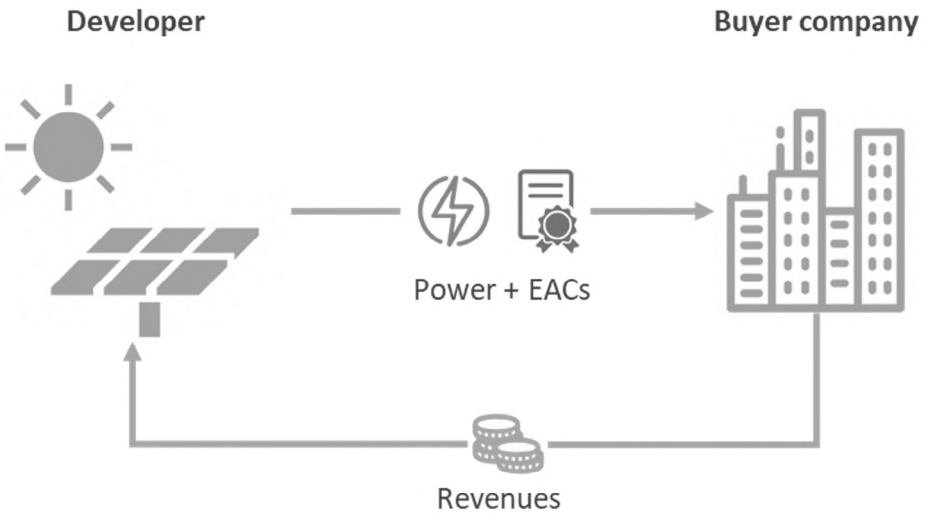


Figure 9: *Physical on-site PPA scheme*

Sleeved PPA

Sleeved PPA is a contract through which an IPP sells electricity and associated attributes to a buyer, agreeing on a fixed or a discount-to-market price, by means of an intermediary utility company. In the sleeved PPA model the intermediary utility company handles the money and energy transfer to and from the IPP on behalf of the buyer. The utility takes the energy directly from the RE project and "sleeves" it to the buyer at its point of intake, for a fee. Sleeved PPA contracts might foresee additional services such as supplying residual quantities of electricity or selling surplus quantities, trading EACs, or assuming various risks. Sleeved PPAs are typically used for off-site generation which involves use of the electricity grid.

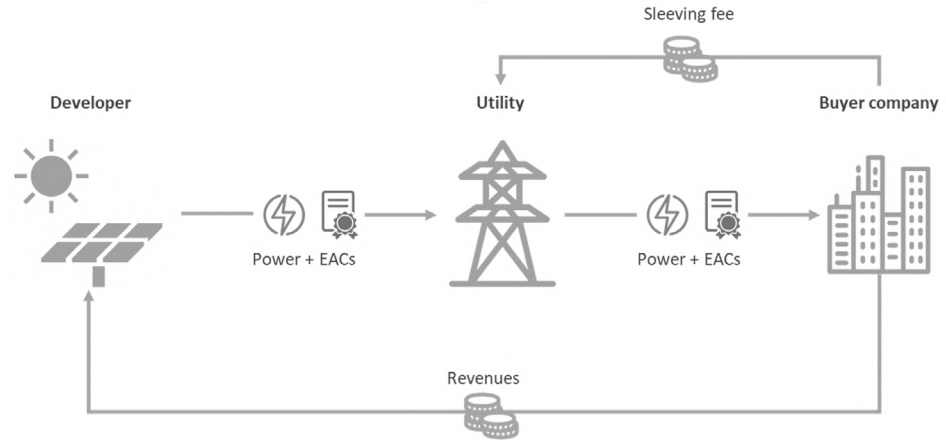


Figure 10: *Sleeved PPA scheme*

Virtual PPA

Under a virtual PPA contract the developer sells its electricity in the spot market, agreeing on a strike price with the off-taker. The developer and the off-taker settle the difference between the variable market price and the strike price, this difference determines the payment flow. The off-taker receives the EACs that are generated. It does not include a physical supply of electricity.

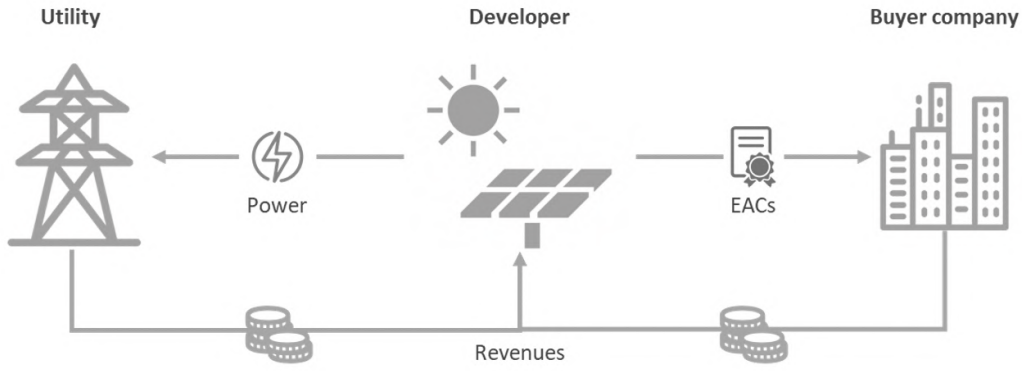


Figure 11: *Virtual PPA scheme*

In both sleeved PPA and virtual PPA the generation system is located out of the consumption site, hence they are also called off-site generation.

2.1.2 Trends and segmentation

Being the second most widespread sourcing model, corporate renewable energy PPAs can be found in 35 countries and are expanding globally, with North America boasting the most consolidated PPAs market (**Figure 12**).

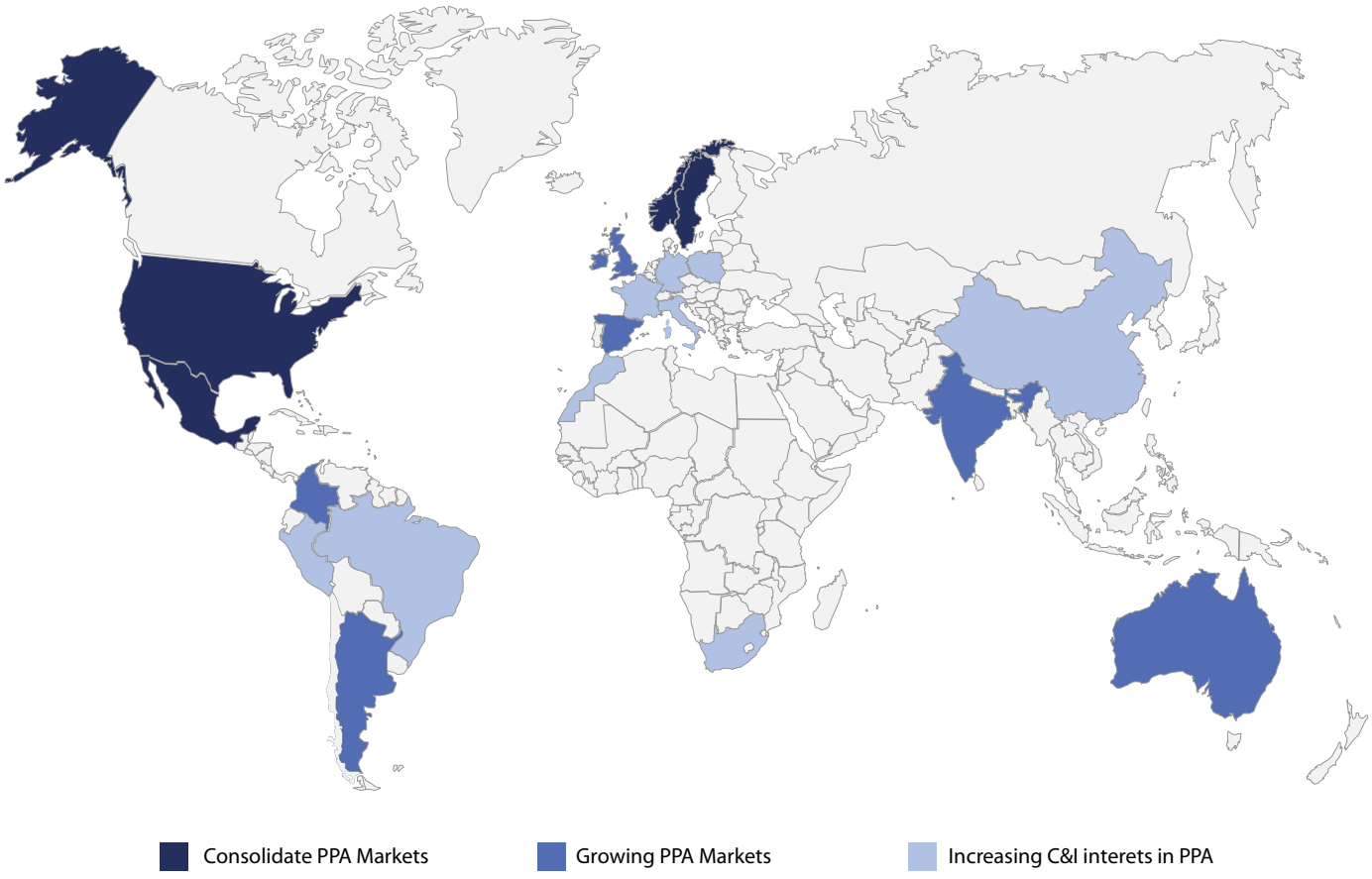


Figure 12: *PPA market by country. Source: BNEF*

In 2019 global corporate PPAs recorded an increase of 40% from the previous year, except for Asia Pacific where they declined compared to 2018, while United States registered the largest increase (**Figure 13**).

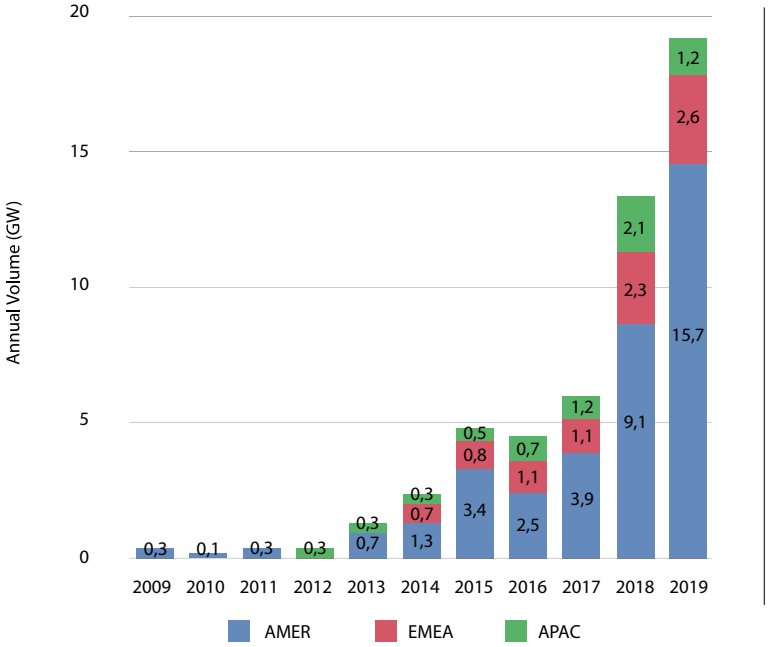


Figure 13: *Corporate PPAs growth by year. Source: BNEF*

2.1.3 PPAs in South Africa

In South Africa, NERSA requires the submission of PPAs between contracting parties as a supporting document to a generation license application or for registration if the generation facility has been exempted. There are no standard PPAs set by NERSA, except under the REI4P, and corporate PPAs are generally drafted by the parties involved. Only physical and sleeved PPAs are allowed, while there is not a virtual PPA market yet. Due to the lack of a tailored regulation for business clients, corporate PPAs are regulated by the same rules of PPAs.

Despite the dominance of Eskom in the electricity sector, since 2012 NERSA's Regulatory Rules on Network Charges for Third Party Transportation of Energy regulation allows any load customer to go into bilateral arrangements with any third-party generator (NERSA, 2012, clause 6.7), enabling bilateral PPA with non-Municipal and non-Eskom generators.

Specific permits are required to generate, trade, import or export electricity. The requirements are mandatory for anyone, and depend on the size of the generation system. Specifically:

- Small-scale projects – under 1 MW – only requires registration with NERSA (via the distributor), but does not need any license to generate.
- Medium-large scale projects – >1MW – requires a generation license from NERSA.

In June 2021, President Cyril Ramaphosa announced that the threshold for not requiring a generation licence would increase from 1MW to 100MW, and therefore the above limitations are likely to change in the coming months once the amendments to Schedule 2 of the ERA have been approved and been made official.

Whereas the electricity buyer is a business (corporate PPA) that is able to guarantee a long-term agreement, and in the case of a sleeved PPA, the distributor (Eskom or municipalities) acts as a wheeler of the generated power. The IPP is required to obtain the relevant approvals from NERSA such as the generation license before a wheeling[16]/Use-of-System agreement can be concluded and to sign a connection agreement with the network operator. In case of physical PPA, no wheeling agreement is required.

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[16] *The term wheeling describes the transportation of power through the grid from the seller to the buyer. It deals with the use of electricity networks and related costs (including connection, maintenance, operation and administration costs).*

Barriers and opportunities

Currently, the corporate PPAs market in South Africa has reached about 16 MW, almost entirely covered by solar PV technologies.

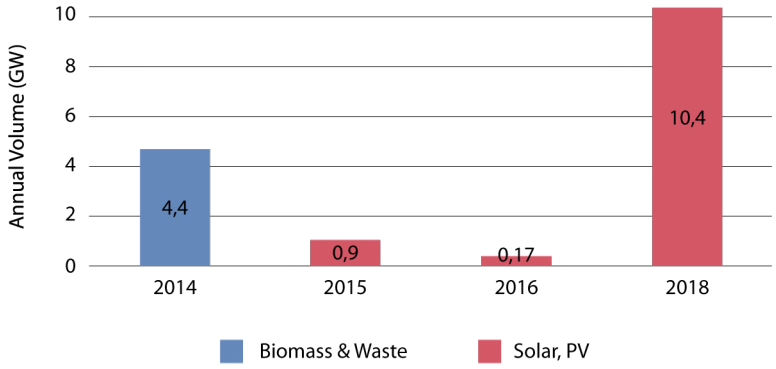


Figure 14: *Corporate PPAs capacity by signing year by sector (MW). Source: BNEF*

As shown by **Figure 14**, Corporate PPAs market in South Africa is still limited. This is mainly due to the lack of a specific regulation for business clients which makes the authorization process slow and complex, especially for medium and large-scale generation.

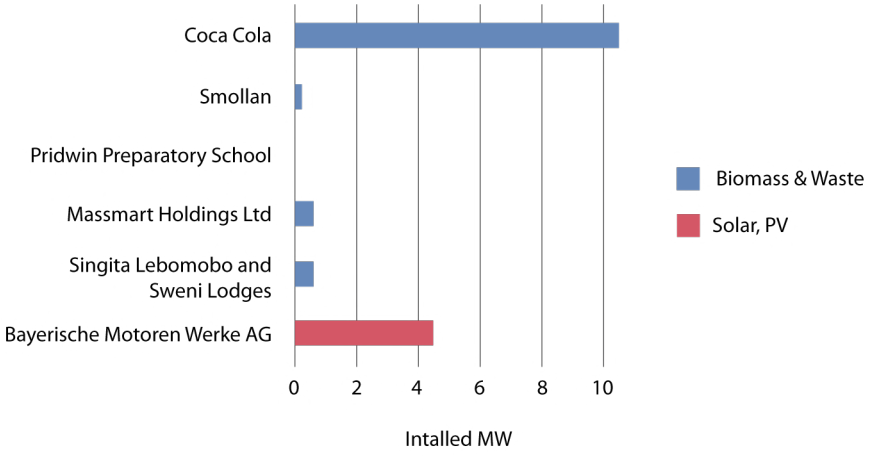


Figure 15: *Top off-takers in South Africa corporate PPAs market by capacity (MW). Source: BNEF*

PPAs are a sustainable and cost competitive way to source electricity and represent an opportunity for buyers, producers and the entire community. Bankable PPAs allow the producers to get projects funded by providing revenue certainty, while allowing the buyers to purchase electricity at a fixed price, reduce their carbon footprint, and have access to a reliable service.

Moreover, boosting PPA growth could improve grid stability and reduce the electricity demand from Eskom by making available power from additional and local renewable sources.

On the other hand, PPAs require a higher level of financial security compared to other sourcing models. Indeed, C&I clients who intend to sign a PPA need to assure the producer and its financier that it will be able to bear a long-term contract, since the project achieves its bankability only if the off-take agreement is considered financially secure by financial institutions.

BOX 1: INTERNATIONAL BEST PRACTICES

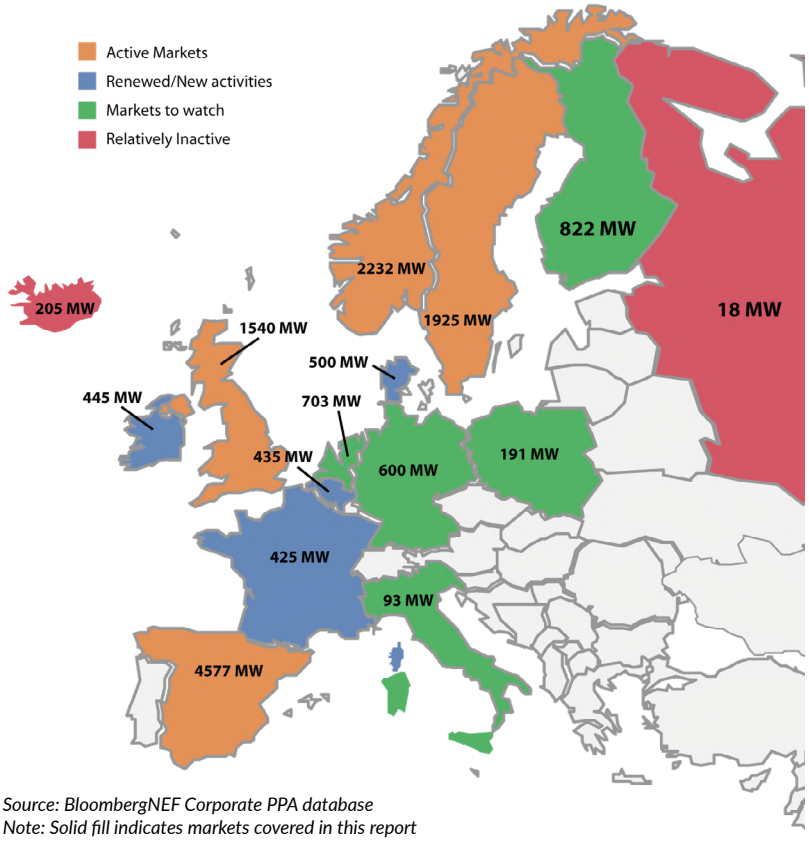


Figure 16: *EMEA corporate PPA markets. Source: BNEF*

Spain

Corporate PPAs have spread in 15 European countries since 2009, concentrated in Spain, Norway, Finland, and United Kingdom. These four countries account for the 70% of total European PPAs.

Spain alone accounts for 31% of all the PPAs signed in Europe. In that country, about 40% of electricity generation comes from renewable sources, dominated by wind. About 50% of the final consumption of electricity is due to the industrial sector while an additional 30% is due to the commercial and public services sector[20].

In the last few years, wind and solar PPAs have improved significantly in Spain, having a growth spurt in 2020 which totalled 4.2GW out of 4.6GW installed in the country, making Spain Europe's largest corporate PPA procurement market.

The relevance of the country in the market is due to multiple factors. Spain boosts one of the highest solar potential in Europe (about 4.4 kWh/kWp[21]) and high-capacity factors for onshore wind (2,800 equivalent hours per year[22]). The abundance of solar and wind resources has led to competitive pricing, setting a record in onshore wind. Moreover, the availability of flexible contract structures has boosted the PPAs markets.

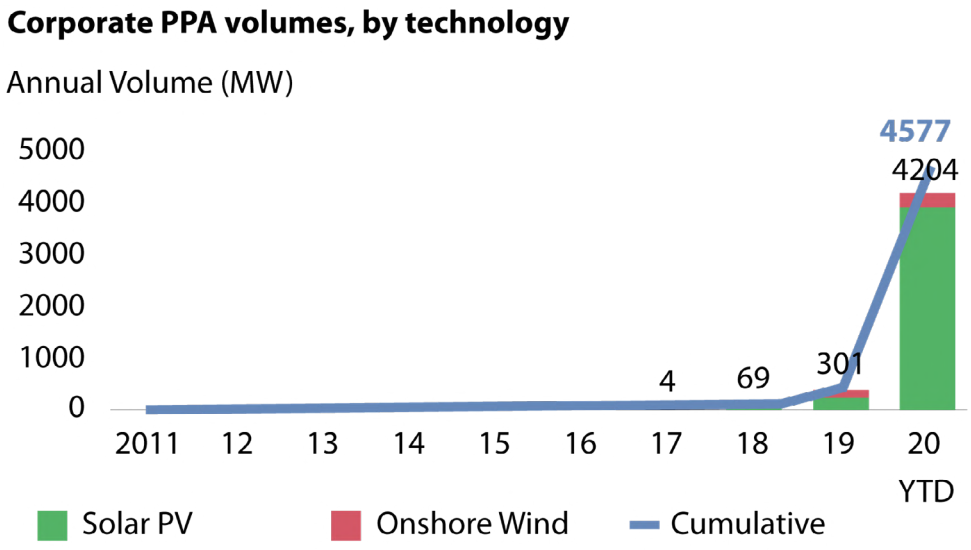


Figure 17: *Corporate PPAs growth – Spain. Source: BNEF[23]*

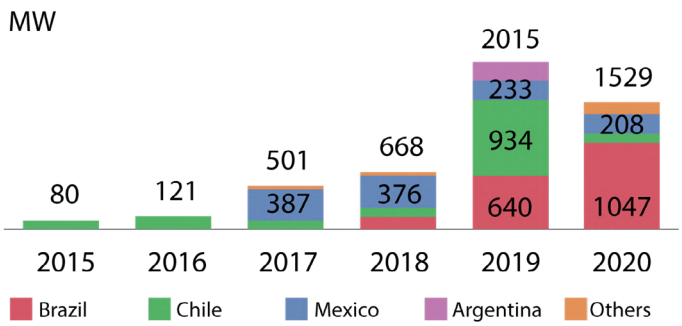
Concerning technologies, the C&I PPA market in Spain is strongly dominated by solar PV, which accounts for more than 85% of total PPAs signed. In the country, 23 different corporations in 10 different sectors adopted PPAs to source their businesses. Lastly, Spain can be considered a pioneer in the pan-European virtual PPA, thanks to the project developed by Nike and AB InBev, and representing the first and largest cross-border project in Europe.

Chile

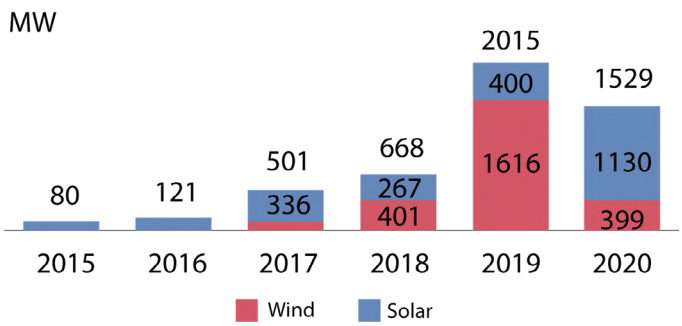
In recent years, Latin America has witnessed significant growth of corporate PPAs. In 2019, corporates bought a record 2GW of clean energy under PPAs – three times the amount they bought in 2018 – of which half (934 MW) was in Chile.

Chile is the first Latin American country to adopt PPA schemes. PPAs have been active in the country since the early 2000s and have seen a constant growth even before booming in 2019. Regulation has allowed for private PPAs for large consumers (more than 5MW installed capacity) for a long time and regulated PPAs for supply to regulated customers from 2006.

Latin America corporate PPA totals, by country



Latin America corporate PPA totals, by tech



Source: BloombergNEF
Note: Pre-market reform Mexico PPAs are not included. These figures are subject to change and may be update as more information is made available. Others include Colombia, Dominican Republic and Panama.

Figure 18: *Latin America annual corporate PPA. Source: BNEF[24]*

In Chile, about 45% of total electricity generation comes from renewable sources, strongly dominated by hydro. The solar and wind potential is being increasingly exploited: wind and solar began to spread in 2013 and currently represent about 17% of electricity generation.

More than 70% of electricity consumption is due to C&I sectors, making these sectors a huge opportunity for the spread of renewables. The corporate PPA market in Chile is dominated by the mining sector, representing one-third of total electricity demand. Concerning technologies, corporate PPAs are balanced between solar and wind.

2.2 Energy attribute certificates (EACs)

Energy attribute certificates are contractual instruments proving the origin of a pre-set amount of renewable electricity consumed. Each certificate attests that a specific amount of energy, typically 1 MWh, fed or taken from the grid has been generated by a specific renewable energy source.

EACs represent a currency trading in the renewable market and allow consumers to make credible claims of renewable energy use. Indeed, certificates, issued proportionally to the amount of electricity generated, can be kept, sold into the market or transferred to third parties (e.g., final consumers) by the energy producer company who own them. The purchasing and selling tariffs are based on the market prices.

In most of the market EACs can be acquired bundled or unbundled. In the bundled EAC case, certificates and electricity are delivered coupled. This happens, for instance, in the sleeved PPA models, where the IPP sells both the electricity generated and the related certificates. In the unbundled EAC case, the certificates are acquired separately and independently from physical electricity purchase, as shown in **Figure 18**.

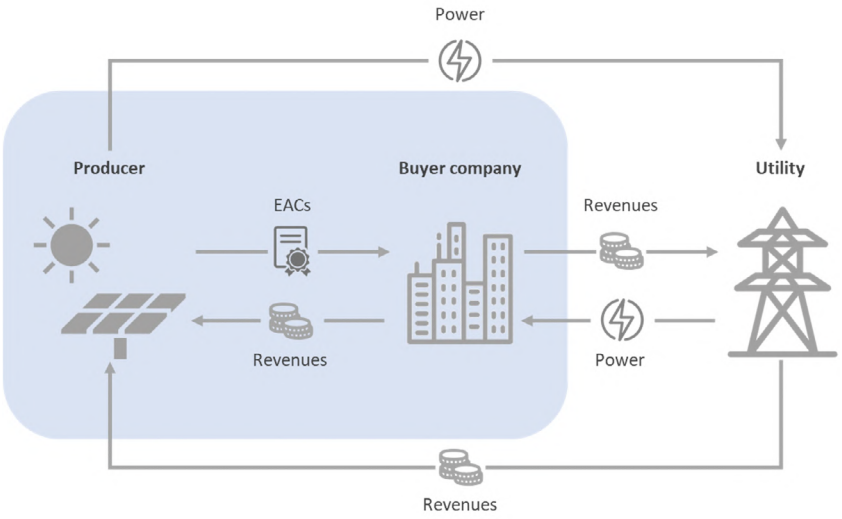


Figure 19: *Unbundled EAC scheme*

2.2.1 Types of EAC Mechanisms

Guarantees of origin

Guarantees of Origin (GO) is the certification scheme adopted by the European Union. Each GO certifies 1 MWh of renewable electricity energy. They are issued monthly and are valid for a calendar year. The register of GOs for each European Country is locally managed by the specific national bodies. GOs are exchanged through the Platform of Bilateral Contracts or on the GO Market.

International Renewable Energy Certificate standard

International Renewable Energy Certificate (I-REC) Standard is a non-profit organisation that maintains a framework for standardisation across EAC tracking systems. It provides a central tracking platform that local tracking registries can use for international trade. As **Figure 20** shows, I-REC market has been growing continually since 2017, exceeding 2,000,000 MWh.

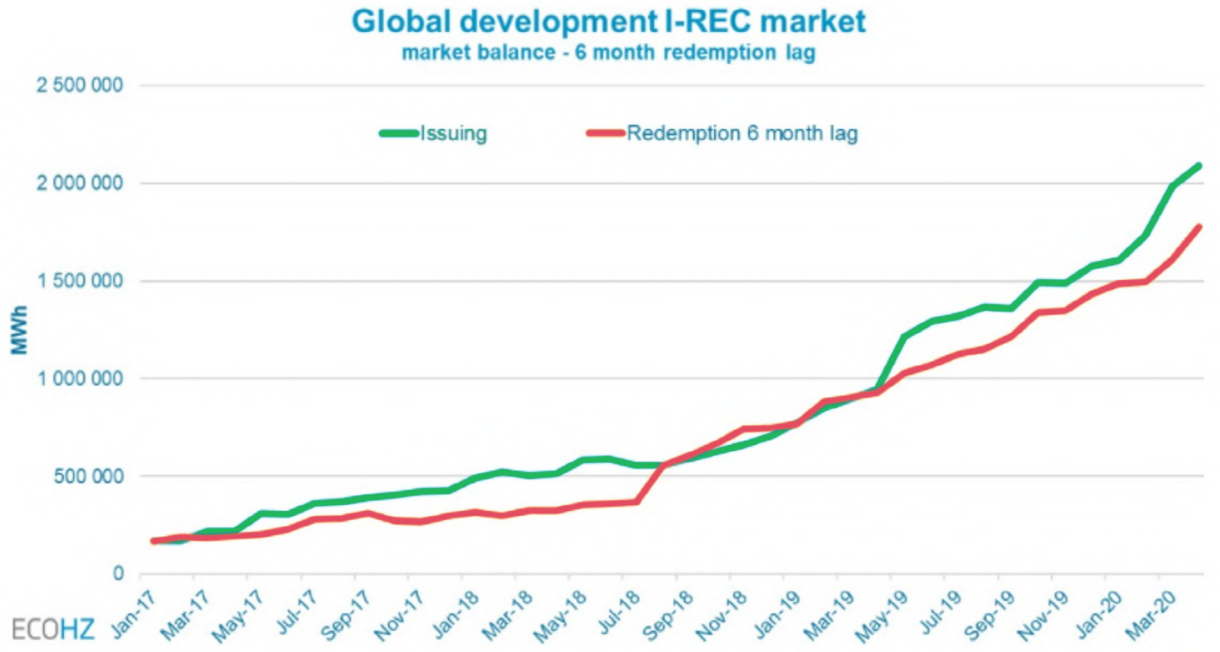


Figure 20: *Global I-REC market growth. Source: ECOHZ*

Tradable instruments for global renewables

Tradable instruments for global renewables (TIGRs) which are developed by APX[17], a provider of environmental registry services, are instruments which provide a tracking platform and standards for eligible generation types. They are predominantly used in Southeast Asia, in countries such as Singapore and the Philippines.

Country-specific systems: RECs

In addition to the previously mentioned mechanisms, many countries have developed their own EAC system in the form of Renewable Energy Certificates (RECs). Among them we find Australia, Japan, Mexico, and United States.

Among the country specific systems, the United States system is of particular interest, as its transactions of unbundled certificates (RECs) were estimated at 52 TWh, about 40% of the global unbundled EAC market[11]. The United States has two market channels for renewable energy certificates available: the compliance market and the voluntary market. The compliance market is present in 29 States. According to its rules, in these states the electric companies are required to supply an established percentage of their electricity from renewable sources and demonstrate compliance with this requirement by purchasing RECs. On the contrary, in the voluntary market, RECs are traded on a voluntary basis, usually at a lower price compared to the compliance market RECs.

2.2.2 Trends and segmentation

There are many instruments to issue and track EACs available around the globe, operating both at international and country specific levels. About 130 TWh of corporate renewable electricity was sourced through unbundled EACs in 2017[11].

[17] *APX, Inc. is a leading provider of infrastructure solutions to the environmental and energy markets.*

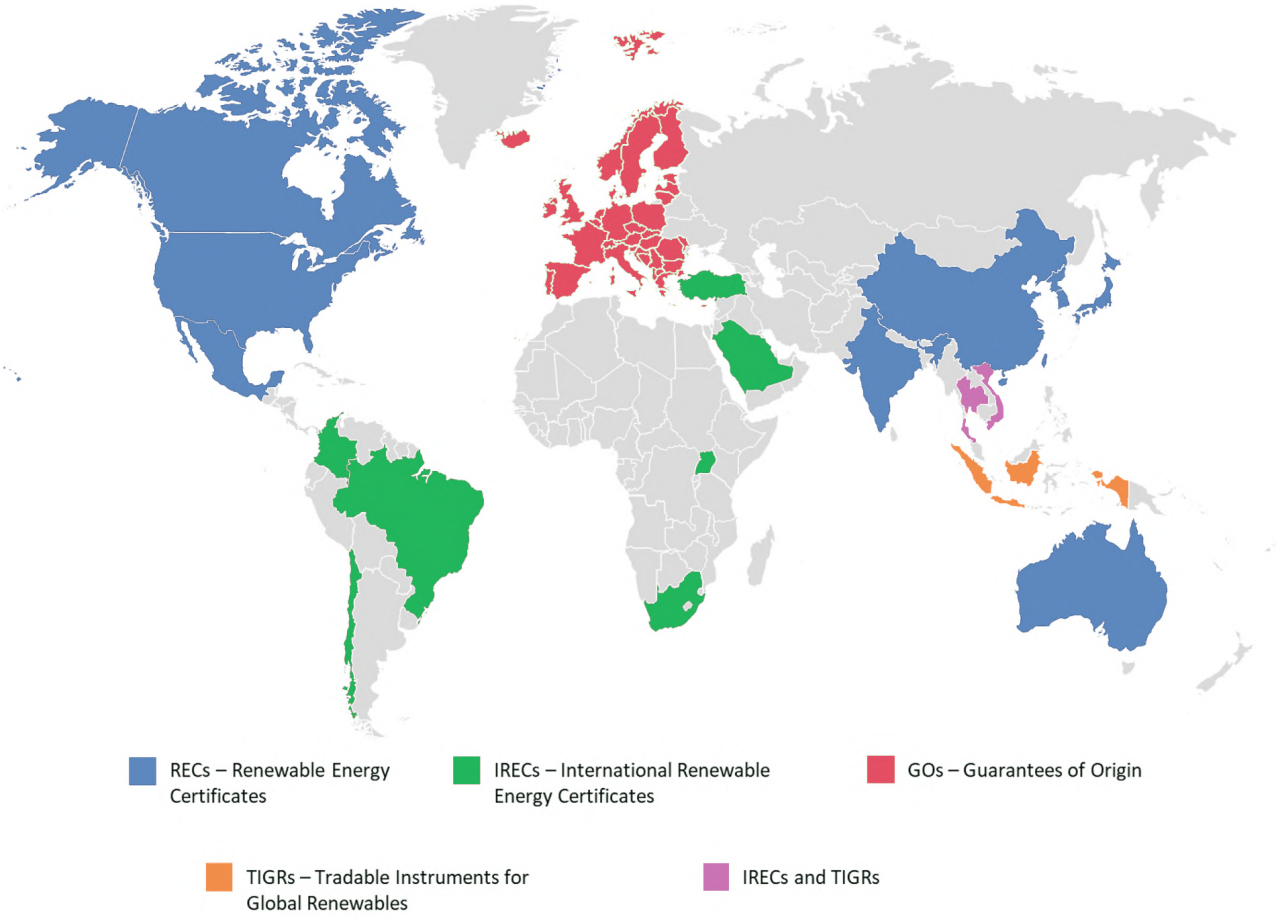


Figure 21: *EACs mechanisms by country. Source: IRENA*

2.2.3 EACs in South Africa

Energy Attribute Certificates can be traded through two different programmes in South Africa. The South African voluntary REC market, consistent with the rules of the European Union market specifications, is administered by zaRECs (Pty) Ltd. on behalf of the members of the Renewable Energy Certificate Association of South Africa (RECSA). RECSA has 29 registered generators, 11 traders, and more than 45 customers, among which are private companies (75%), local authorities, events, NGOs, development agencies and other associations. Market participants automatically become members of RECSA as they produce, trade or consume RECs in the country.



Figure 22: *zaRECs issuing producers distribution. Source: zaRECs*

In addition to zaRECs market, the I-REC programme is also available in South Africa, where the issuer body is Green Certificate Company (GCC).

2.3 Corporate direct investments for self-consumption

In addition to all the models mentioned above, companies have the possibility to directly invest in their own generation. This is made possible through two different mechanisms: ownership and leasing.

2.3.1 Types of corporate direct investments

Ownership

In most markets, companies are allowed to deploy their own renewable energy system for their energy supply. The company directly investing in self-generation becomes responsible for the entire project life and assumes related financing risks and responsibilities.

Most commonly, self-generation projects are located on-site, but in some cases, electricity is generated off-site and transferred (either physically or under a financial contract) to the end user. For off-site projects, transmission or wheeling charges may be applied.

With the existence of net–metering or feed-in-tariffs, the generation system can be connected to the national grid (on-grid system - Figure 21), allowing the company to inject the surplus electricity they produce and to purchase from the grid the electricity shortfall, if any.

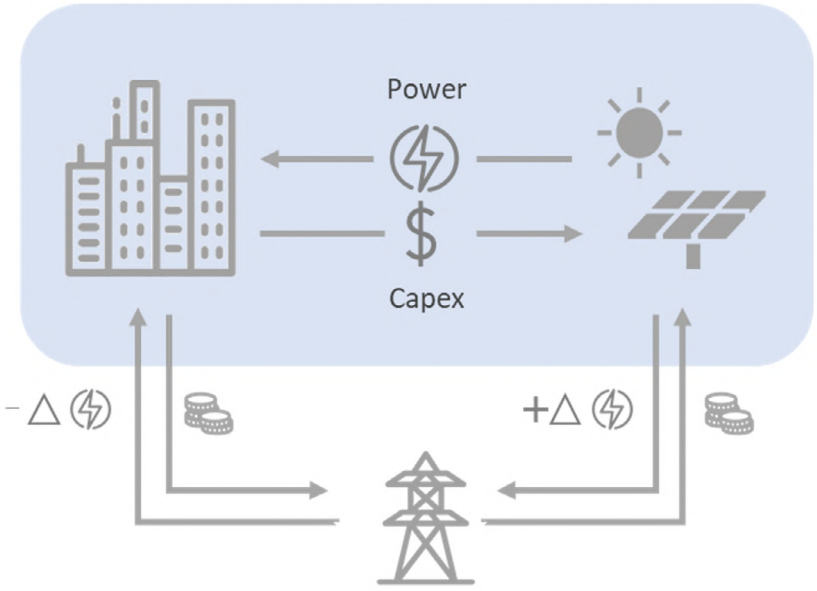


Figure 23: *Ownership: on-grid scheme*

Leasing

The lack of upfront capital to invest in building an asset, necessitates the need for leasing of assets. The leasing framework provides the owners of generation facilities with the opportunity to lease their facilities at a fixed monthly/annual leasing fee, which is usually unrelated to the volume of power generated by the leasee. The size of the plant can also be designed to achieve 100% of self-consumption in off-grid sites. On the other hand, where the national grid is available the excess power can be fed into the grid and sold to the wholesale market.

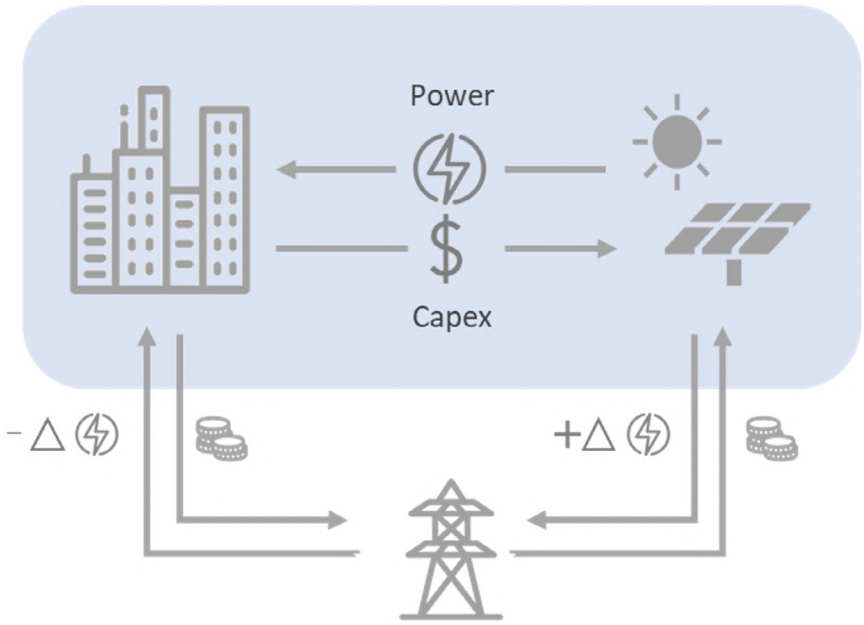


Figure 24: *Ownership: leasing scheme*

2.3.2 Trends and segmentation

Compared to other sourcing models, direct investment models have become widely used in developing countries, where national grids are often limited and unreliable. Moreover, with the decline of renewable energy systems costs and increased pressure to decrease their carbon footprint, globally companies are increasingly encouraged to invest in their own generation. So far, solar PV projects that are appropriately designed can provide a solid payback period of 4 to 6 years, or an internal rate of return (IRR) of 15%-25%. Globally self-consumption is the most common sourcing model, followed by the purchase of unbundled EACs and PPAs[11].

The materials sector represents about 90% of global corporate sourcing of renewable energy. More than 60% of its consumption come from self-consumption, with the remaining part dominated by PPAs. In sectors other than the materials sector, self-consumption accounts for just 10% of the renewable electricity consumed, on average. This not only includes companies that install small-scale, on site rooftop solar PV systems, but also industries outside the materials sector that produce electricity from by-products such as cogeneration.

2.3.3 Corporate direct investments in South Africa

The market volume of the self-consumption model is steadily growing, and is driven by the strong increase of national electricity prices, planned power shutdowns (“load shedding») and enhanced legal framework. The regulatory responsibility for power plants under 1 MW rests with municipalities and no generation license is required, however registration needs to be done with NERSA. Increasingly more municipalities are allowing the operation of grid-connected power plants through the relevant connection agreements for self-consumption purposes by providing net metering schemes.

BOX 2: INTERNATIONAL BEST PRACTICES

Vietnam

In Vietnam about 40% of total electricity generation comes from renewables, mostly from hydroelectric sources. Despite the abundance of renewable resources, wind and solar are still largely underdeveloped, and only recently Vietnam moved to create a proper regulatory structure needed to establish a strong clean energy market. Most of the final consumption is due to C&I sectors (> 60%). For solar power specifically, the legal and regulatory regime is rapidly evolving, and recent reforms include and regulate enabling additional options, such as direct PPAs and self-consumption.

Looking at the corporate market, under the current regulation, self-consumption appears to be the most attractive option. Recently, solar rooftop projects have been rapidly growing, fostered by the feed-in-tariff schemes which offer convenient tariffs for electricity fed into the grid. Indeed, only solar PV systems of 1 MWp in capacity and smaller are eligible for self-consumption and exempted from the power generation license requirement; while any bigger customer must both apply for a grid connection and sell 100% of its generation to national grid via a PPA[25].

Thanks to this mechanism Vietnam has recorded a total of 11,855 rooftop PV projects installed by C&I customers, for a total of about 2GW[18] (November 2020).

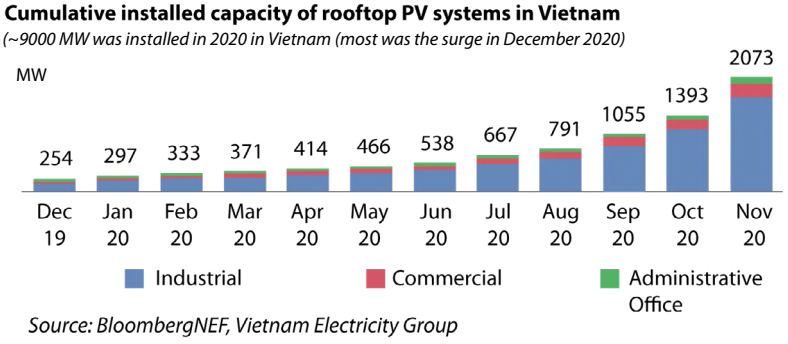


Figure 25: *Self-consumption trends in Vietnam. Source: BNEF* [19]

2.4 Utility green procurement programmes (UGPP)

Utility green procurement is a tool allowing the buyer to purchase renewable energy through specific products or through tailored renewable energy tariffs offered by certain utilities. Compared to other mechanisms, it usually does not require any long-term agreement, however, it allows the signing of tailored contracts according to the buyers and producers' needs. UGPPs are present in 39 countries and are particularly spread among big companies. In 2017, their global market reached about 34 TWh. However, South Africa does not yet have a similar UGPP programme available.

2.4.1 Types of Utility green procurement programmes

Green Premium Products

Following this model, the utility obtains renewable EACs by purchasing them from a third-party or by means of its own generation plants, and the final buyer purchases the certificate directly from the utility. The range

[18] *1H 2021 Corporate Energy Market Outlook*
[19] *BNEF - 1H 2021 Corporate Energy Market Outlook, p 44*

of products and tariffs available is notably wide in liberalized markets, where customers can choose their electricity supplier.

Contrary to the green tariff model, green premium products don't offer the prospect of price saving, but allow companies to easily buy green electricity without long-term agreements.

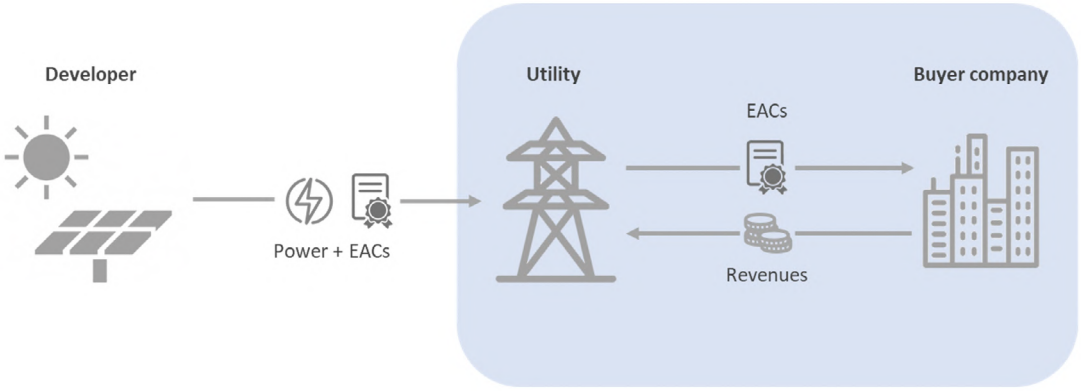


Figure 26: *Green procurement: premium product scheme*

Green tariff

Green tariff programmes allow buyers to purchase renewable electricity from a specific generation asset by means of a long-term contract with the utility at a profitable price, offering the opportunity to cut electricity bill. This mechanism differs from the sleeved PPAs. Indeed, while in the sleeved PPA model the contract agreement is signed between the producer and the final client (a business in case of corporate PPA), with the utility acting as an intermediary, in the green tariff model the contract is taken out directly between the utility and the buyer.

2.5 Highlights

This chapter provides an overview of the different sourcing models available to companies that want to invest in renewable generation for their operations. Self-consumption is the prevailing model by consumption at the global level, followed by unbundled energy attribute certificates and power purchase agreements. Globally, utility green procurement programmes have limited market share as they are available only in liberalized markets and, thus, not in South Africa.

The C&I market in South Africa presents untapped opportunities for energy players and customers, and it is expected to grow rapidly in the next decade. In South Africa, this market segment is dominated by self-consumption, that is steadily growing driven by the strong increase of national electricity prices, planned power shutdowns ("load shedding») and enhanced legal framework.

Corporate PPAs market is still limited. This is mainly due to the lack of a specific regulation for business clients which makes the authorization process slow and complex, especially for medium and large-scale generation.

International experiences from Spain and Chile provide concrete examples of the growth of the PPA market, which will be further analysed in chapter 3, while the Vietnam case is an interesting example of the potentiality of the self-consumption segment.

CHAPTER 3: POLICIES, REGULATIONS AND TARIFFS

3.1 Overview of key legislation and regulations

This section is a literature review which provides an overview of key legislation, regulation and codes that impact the development of the C&I RE market in SA whilst identifying the key requirements of each document. The documents that were assessed are:

- *Electricity Regulation Act*
- *National Energy Act*
- *Integrated Resource Plan*
- *White Paper on Renewable Energy*
- *Carbon Tax Act*
- *Carbon Offset Regulations*
- *Electricity Pricing Policy*
- *NERSA Regulatory Rules on Network Charges for Third-Party Transportation of Energy*
- *Transmission Grid Code*
- *Distribution Grid Code*
- *South African Renewable Energy Grid Code (SAREGC)*
- *NRS 097-2-1*

3.1.1 Electricity Regulation Act

The Republic of South Africa (RSA) gazetted the Electricity Regulation Act (ERA), No. 4 of 2006 on 5 July 2006. The ERA was later amended by the ERA Amendment Act, No. 28 of 2007 on 21 January 2008. The ERA was enacted to make provision for market competition by providing a framework that would allow for private sector participation in the generation segment [26], the amended ERA added additional definitions, textual corrections, a section to deal with electricity reticulation by municipalities and to extend the regulatory powers of the minister [27]. The ERA objectives are [28]:

- *To establish a national regulatory framework for the electricity supply industry,*
- *To make the National Energy Regulator the custodian and enforcer of the national electricity regulatory framework,*
- *To provide for licenses and registration in the manner in which generation, transmission, distribution, trading and the import and export of electricity are regulated*
- *The amended ERA has one additional objective [27]:*
- *To regulate the reticulation of electricity by municipalities; and to provide for matters connected therewith.*

Below is a discussion of the ERA as it pertains to generation licenses and exemptions thereof. This is followed by a discussion of the ERA as it pertains to wheeling in SA.

Provisions for generation licenses under the ERA

To generate electricity in SA a generation license for the generation capacity is subject to approval from NERSA, this then allows generators to develop and operate generation facilities [29]. Electricity generation licences are granted or treated as granted pursuant to section 7 of the ERA which authorises generators to generate electricity [30]. In the ERA, the "Regulator" refers to NERSA which is responsible for issuing licenses for generation, transmission, and distribution activities, import and export of electricity and trading upon application [28], except for instances provided for under exemptions in the Schedule 2 of the ERA which removes the obligation of specified parties to apply for and hold a generation license, wherein registration is sufficient [31].

The ERA provides detail on the application processes and requirements for getting electricity generation licenses. There have been several improvements of the ERA, however, there is no consolidated recent ERA in place and the licensing requirements need improvement to accommodate smaller embedded power plants which may not need as much detail as large-scale utility power plants. However, Schedule 2 amendments of the ERA facilitate registration with NERSA with exemption from licensing, and this is set to increase from 1MW to 100MW. An entity that must hold a license in terms of section 7 must apply to NERSA in accordance to Section 10 for the license in the form and in accordance with the prescribed procedure[28]. The application should include the following:

- *A description of the applicant, including vertical and horizontal relationships with other persons engaged in the operation of generation, transmission and distribution facilities, the import or export of electricity, trading or any other prescribed activity relating thereto,*
- *Documentary evidence of the administrative, financial, and technical abilities of the applicant as may be required by the Regulator,*
- *Description of the proposed generation, transmission, or distribution facility to be constructed or operated or the proposed service in relation to electricity to be provided, including maps and diagrams where appropriate,*
- *General description of the type of customer to be served and the tariff and the plans and the ability of the applicant to comply with applicable labour, health, safety and environmental legislation, subordinate legislation and such other requirements as may be applicable,*
- *Detailed specification of the services that will be rendered under the license,*
- *Evidence of compliance with any integrated resource plan applicable at that point in time or provide reasons for any deviation for the approval of the Minister[28].*

The maximum period, for which the generating license will be valid, depends on the expected life of the plant. The generating license fee is payable per kWh generated for licensed generators, and the fee is used to fund the regulatory cost in the ESI[32].

The IPPs or other power producing entities that will be selling electricity to third parties should have a Power Purchase Agreement (PPA) in place. Standard PPAs are 15-20 years – which allows developers to recoup their investment [33]. Traditionally, PPAs are intended to cover 100 percent of the financing of the generation facility which requires lengthy PPA terms, whereas regular power supply contracts are in shorter terms of one, two or three years. For this reason, C&I consumers are reluctant to enter into long term agreements. The main reason cited by a report by Accenture on the slow uptake of corporate PPAs by C&I consumers is the misalignment between what the developers want to sell and what the C&I consumers want to buy [34]. C&I consumers are said to want flexible pricing that is comparable to grid prices and they prefer shorter-term contracts of 3-5 years because they want to avoid having to forecast and commit to their consumption requirements too far into the future [34].

Exemptions for generation licenses

Schedule 2 of the ERA allows for the removal of the obligation of specified parties to apply for and hold a generation licence. Furthermore, it allows for generation of electricity for own use (self-consumption). The amendments of Schedule 2 exempt the following from requiring licenses or registration with NERSA:

- *The operation of a generation Facility for the sole purpose of providing standby or backup electricity in the event of, for a duration no longer than, an electricity supply interruption.*
- *The operation of any generation Facility provided that:*
  - *irrespective of capacity (MW), the Facility does not have a Point of Connection (POC);*
  - *if the Facility has a capacity of no more than 100 kilowatts and has an existing POC*[20]

[20] *However, in these cases Eskom is required to keep a register of the facilities – the generators are required to apply for a grid connection, pay the quoted fees and sign the required Eskom agreements [154].*

Systems that are isolated from the grid i.e., off-grid, do not need to register or be licensed with NERSA. This amendment was particularly welcomed by large industrial power users as they could generate own-use electricity without any dependence on the grid. The amendments go on to exempt the following from requiring licenses but still needing registration with NERSA:

The operation of a generation facility-

- *with a capacity of no more than 1MW and a POC on the distribution power system. It should be noted that this is set to increase to 100MW since the announcement by President Cyril Ramaphosa that the ERA would be amended to increase the threshold from 1MW to 100MW. This is to be approved and implemented in the months following the June 2021 announcement,*
- *for demonstration purposes only, whether or not the facility is connected to a transmission or distribution power system (for a period not exceeding 36 months),*
- *where the electricity is produced from waste or the residual product of an underlying industrial process, in circumstances in which the generation Facility is operated solely to supply electricity for consumption by a customer who is related to the generator or owner of the generation facility*

The amendment exempts grid-connected embedded generation of under 1 MW (soon to be 100MW) from requiring licenses [35]. It was received well by C&I stakeholders as it would fast-track the establishment of generation facilities and reduce the burden on NERSA to approve licenses – which can be a lengthy process, taking up to 120 days [33].

Provisions for wheeling under the ERA

Wheeling is the transport of electricity from one entity to another using the transport network of a third entity (in most cases an established utility) [37]. Wheeling can also occur when a private company generates electricity for own use at a generation facility that is remote from the load and thus needs to make use of the transmission or distribution network [37]. According to the ERA a transmission or distribution licensee must, to the extent provided for in the license, make provision for the non-discriminatory access to all users of the transmission and distribution network [19]. This makes allowance for wheeling of electricity by using Eskom's network or a distributor's network in SA [37].

In the amended version of Schedule 2 of the ERA, the Minister makes provision for generators to enter into connection agreements with distributors for the wheeling of energy provided they comply with the Grid Code technical requirements. The objectives of the ERA that enable wheeling are to[38]:

- *Facilitate investment in the electricity supply industry,*
- *Promote the use of diverse energy and energy efficiency,*
- *Promote competitiveness and customer/end-user choice,*
- *Facilitate a fair balance between the interests of customers and end users, licensees, investors in the electricity supply industry and the public*

To fast-track the development of the SA ESI, the ERA should be updated accordingly so that it considers the changing operating environment of the ESI. The amendments to the ERA have provided for some of these changes, but more is required to foster an optimal environment for the development of the C&I market such as an update to the NERSA Regulatory Rules on Network Charges for Third-Party Transportation of Energy.

3.1.2 National Energy Act

The National Energy Act (NEA) of 2008 was formulated to provide regulations that ensure uninterrupted energy supply in SA and to ensure that energy supplied is diverse, affordable and from local sources where possible [39]. The objectives of the NEA are as follows[39]:

- *To ensure that diverse energy resources are available, in sustainable quantities and at affordable prices, to the South African economy in support of economic growth and poverty alleviation, taking into account environmental management requirements and interactions amongst economic sectors,*
- *To provide for energy planning, increased generation and consumption of renewable energies, contingency energy supply, holding of strategic energy feedstock and carriers, adequate investment in, appropriate upkeep and access to energy infrastructure,*
- *To provide measures for the furnishing of certain data and information regarding energy demand, supply, and generation,*
- *To establish an institution to be responsible for promotion of efficient generation and consumption of energy and energy research and to provide for all matters connected therewith*

According to the NEA, the Minister of the DMRE must establish the mechanism to collect, collate and analyse energy data and information, manage energy data and information, and avail energy statistics and energy information to the public. The Minister must annually publish an analysis on reviewing energy demand and supply for previous years, forecasting energy supply and demand for no less than 20 years and of plausible energy scenarios of how the future energy demand and supply landscape could look like under different demand and supply assumptions[39]. To achieve this, the NEA makes provision for the Integrated Energy Plan (IEP), and by extension the IRP.

The NEA provides for the efficient and diverse use of energy resources in SA, including RE. Furthermore, it makes provision for the establishment of the South African National Energy Development Institute (SANEDI) which conducts research into energy related topics – including promotion of RE technologies and energy efficiency[39]. The NEA does not provide specifics on self-consumption and does not include how this could form part of the IEP. However, an official IEP is yet to be published and is one of the gaps in the energy industry in SA. The completion of the IEP could shed light on the role that self-consumption will have in the long term in South Africa's electricity generation landscape. However, the IRP has addressed some of the challenges in the meantime.

3.1.3 Integrated Resource Plan

The IRP is the official long-term plan for the SA electricity generation sector [29]. There have been several IRPs since the first one (IRP2010) was promulgated in March 2011. The subsequent versions were drafts - IRP2016 and IRP2018 - and the latest gazetted version is the IRP2019 which was published in October 2019. According to the IRP2019, the IRP 'is an electricity infrastructure development plan based on least-cost electricity supply and demand balance, taking into account security of supply and the environment' [40].

Implementation of the IRP is followed by ministerial determinations for capacity additions issued under section 34 of the ERA Regulations on New Generation Capacity. The IRP allocates generation technology, capacity, and timing for South Africa's power sector over a 30-year period. The latest IRP makes allowance for up to 4GW of other[21] capacity with a limit of 500MW per annum from 2023 – including distributed generation (DG) own-use, CoGen, Biomass, Landfill. For 2019 to 2022, the IRP states that capacity allocation for this category should be 'to the extent of the short-term capacity and energy gap'. Further, according to the IRP, 'Other/Distributed generation includes all generation facilities in circumstances in which the facility is operated solely to supply electricity to an end-use customer within the same property with the facility' [40].

3.1.4 White Paper on Renewable Energy

The White Paper on Renewable Energy (WPRE) was gazetted in November 2003. The WPRE sets out Government's vision, policy principles, strategic goals, and objectives for promoting and implementing RE in SA. The WPRE has four key strategic areas which it addresses [41]:

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[21] *Refers to other sources of electricity generation besides the main ones (coal, nuclear, gas, diesel, hydro, solar, wind and storage) namely distributed generation, co-gen, biomass and landfill.*

- ***Financial Instruments****: Promote the implementation of sustainable renewable energy through the establishment of appropriate financial and fiscal instruments,*
- ***Legal Instruments****: Develop, implement, maintain and continuously improve an effective legislative system to promote the implementation of renewable energy,*

Under the legal instrument, one of the deliverables is the delivery of appropriate regulations for grid connection and wheeling of electricity generated from RE [41].

- ***Technology Development****: Promote, enhance, and develop technologies for the implementation of sustainable renewable energy,*

Under the technology instrument one of the objectives is to promote the development and implementation of appropriate standards and guidelines and codes of practice for the appropriate use of technologies [41]. It also proposes that RE R&D be integrated into SANEDI.

- ***Awareness Raising, Capacity Building and Education****: The goal is to develop mechanisms to raise public awareness of the benefits and opportunities of renewable energy*

The WPRE provides the key focus areas for the promotion of RE development. The WPRE set a target of 10,000 GWh electricity production from RE sources, namely solar, wind, biomass, and small hydro by 2013 [41]. However, it did not set any longer-term targets. It further goes on to highlight the importance of RE in DG in positively impacting demand side management and reducing the need for additional power plant capacity [41]. Proper regulatory and legal framework is needed to support the entry of RE generators[42] which is one of the strategic focus areas under the WPRE.

3.1.5 Carbon Tax Act

The Carbon Tax Act 15 of 2019 was officially gazetted on 22 May 2019 [43] and came into effect on the 1 June 2019, making SA the first country in Africa to do so. The Carbon Tax is being levied to emitters involved in fuel combustion, industrial processes and fugitive emissions including the government and aims to mitigate climate change by reducing GHG emissions [44].

The Carbon Tax is being introduced through a phased approach, the first phase is from 2019 to 2022, wherein the rate is R120 per ton of CO2 in 2019, increasing to R127 per ton in 2020 [44]. The second phase will be from 2023 to 2030, and phase three thereafter. Emitters are granted tax allowances ranging between 60% and 95% which leads to an effective tax rate ranging between R6 to R48 per ton of CO2. This relatively low tax rate is to provide emitters' time to transition their operations to cleaner technologies. The tax rates and tax allowances are subject to adjustment after the end of the first phase, which will be on 31 December 2022. The tax rate will increase by the amount of the consumer price inflation (CPI) plus 2% for the preceding tax period until 31 December 2022 and by inflation thereafter [43], [44]. The following are the allowances provisioned under the Carbon Tax Act [43]:

- ***Trade exposure allowance****: The trade exposure allowance offers up to 10% that is applicable to businesses that are in a sector that is exposed to trade.*
- ***Performance allowance****: A performance allowance of up to 5 per cent for companies that reduce the emissions intensity of their production processes [45].*
- ***Carbon offset allowance****: The allowance which is up to either 5% or 10% is primarily for businesses that invest in emission reducing projects.*

The Carbon Tax Act was developed as one of the components that SA is employing in its strategy to reduce carbon emissions and meet climate commitments.

3.1.6 Carbon Offset Regulation

The South African Government gazetted the Carbon Offset Regulations under section 19 (c) of the Carbon Tax Act in November 2019 [46]. The regulations stipulate the eligibility criteria for carbon offset projects, steps to claim the offset allowance and establish an administrative authority to manage the processes. The main objective of the regulations is to provide a regulatory framework for the development and administration of the carbon offset scheme under the Carbon Tax Act [44].

The purpose of introducing the regulations was to provide a mechanism that would allow industries to invest in mitigation projects at a lower cost to what they would be able to achieve during their own operations and thereby lower their tax liability [44]. Renewable energy generation is eligible for carbon offsets under specific eligibility criteria in the regulations. In addition, it would incentivise the sectors and activities that are not covered by the carbon tax to mitigate as well since projects that are not directly subject to the carbon tax but still reduce emissions in SA may be able to register the emissions reductions as carbon offsets [46], [47]. This allows SA companies to purchase carbon credits from third parties to offset their carbon tax liability. The regulations were developed by the National Treasury (NT), DMRE and the Department of Environment, Forestry and Fisheries (DEFF) [48]. The carbon offset projects are developed through three different standards – namely the Clean Development Mechanism (CDM), Verra's Verified Carbon Standard (VCS), and Gold Standard (GS) [44]. In July 2020, the Carbon Offset Administration System (COAS) was launched by DMRE to function as the administrative system for the carbon offsets. **Figure 27** depicts the main processes in the COAS [49].



Figure 27: *Overview of carbon offset process [49] Source: DMRE*

The Carbon Offset Regulations have been fully implemented with the establishment of the COAS and entities are developing projects and trading in carbon credits.

3.1.7 Electricity Pricing Policy

The Electricity Pricing Policy (EPP) of 2008 is responsible for providing direction and implementing principles for electricity prices in SA. The EPP reflects the most recent policies and legislation in relation to electricity pricing. The EPP, empowers NERSA to diverge from the previously approved licensee tariffs' by allowing Negotiated Pricing Agreements (NPA), which is followed through a transparent application and approval via DMRE. The EPP must ensure that the costs for generating, transmitting, and distributing electricity is considered in the electricity price. NERSA must decide on the amount of funds to be allocated based on requests made by the licensee and based on a set methodology.

The EPP reinforces the ERA by stating that consumers have a right to access the network as owners are obliged to allow customers access to and use of their networks if the customers have paid the relevant NERSA approved charges [50]. The full cost to operate the networks should be reflected in the various connection and Use-of-System (UOS) charges i.e., no additional charges unless the wheeling results in incremental costs. NERSA is

responsible for the development of a methodology for transmission and distribution wheeling tariffs [50] and to approve cost of supply (COS) studies from distribution licensees.

3.1.8 NERSA Regulatory Rules on Network Charges for Third-Party Transportation of Energy

In 2012, NERSA published the Regulatory Rules on the Network Charges for Third-Party Transportation of Energy ("The Rules"). The provisions of the ERA authorise 'the Energy Regulator to prepare and pass rules designed to implement the national government's electricity policy framework, the IRP and the Act'. The legal basis for the Rules lies in the ERA where in Section 4 (a)(ii) of the ERA, it states that 'the Regulator must regulate prices and tariffs' [51]. The provisions of the ERA state that non-discriminatory access to the networks must be provided on conditions relating to [51]:

- *the circumstances under which access must be allowed;*
- *the circumstances under which access may be refused;*
- *the strengthening or upgrading of the transmission or distribution power system in order to provide for access, including contributions towards such upgrading by the potential users of such systems, if applicable,*
- *the rights and obligations of other existing or new users regarding the use of such power systems;*
- *compliance with any rule, code or practice made by the Regulator; or the fees that may be charged by a licensee for the use of such power system*

Basic principles of the third-party access framework [51]:

- *A generator has the same rights of access to the network as a load, subject to the Code (Distribution and Grid Code) and Distribution and Transmission rules*
- *A consumer has the right to purchase energy from a third-party generator*
- *The Wholesale Administrator will administer the third-party access mechanism, including the balancing component of the mechanism.*
- *The network owners will not be liable for the effects arising from the failure of their networks to deliver energy contracted under PPAs between consumers and generators. The standard liability for direct damages will apply*
- *Third-party access will be provided to South African generators, if they are licensed by NERSA to generate and trade (which may include bilateral contracting).*

The following assumptions were adopted for the purposes of the framework [52]:

- *The generator must have an approved licence to generate and trade from NERSA*
- *The generator must sign the connection and UOS agreement*
- *The third-party access will be implemented initially up to an overall limit of 300 MW*
- *Not applicable to generators connected at low voltage (<1 kV)*
- *The System Operator may contract with non-Eskom Generators to provide reserves and other ancillary services*
- *All third-party access allocations shall be made on a calendar month basis*
- *Banking[22] will be allowed under certain conditions*
- *When wheeling on Eskom networks, the account(s) will be adjusted in terms of Eskom's policy on the reconciliation of accounts*

Provisions for power purchase agreements

Under the Rules, it states that 'any load customer shall be free to go into bilateral arrangements with any third-party generator,' i.e., non-Municipal and non-Eskom generator. This rule indicates that bilateral PPAs in theory are allowed, although this has not been made explicit.

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[22] *Banking is a financial and accounting mechanism under which a service provider earns credit for excess RE supplied to the grid [155]*

Provisions for wheeling

The Rules approve the necessary guidelines for wheeling by stating that 'Wheeling of energy shall be allowed, subject to the generator receiving its approvals from NERSA to sell to a third party and the signing of the network service provider's (NSP) Connection and Use-of-System Agreement.' [51]. Currently, Eskom is the only formal NSP that can conduct wheeling – with exceptions from some municipalities who have wheeling frameworks and charges despite prevailing regulations.

The UOS charge is a collective term for all network-related charges, raised for the use of the network. These charges are the unbundled regulated tariffs, charged by the NSP for making transmission or distribution capacity available to the generators and other distributors [51]. Wheeling tariffs must enable a licensee to recover the full cost of its licensed activities and reflect a fair distribution of the costs between end-users and the licensee, including a reasonable margin. The application of UOS tariffs allows for the recovery of fixed and operation and maintenance (O&M) costs, transmission losses and costs for ancillary services procured by the System Operator [51]. These UOS charges do not recover connection charges, which should be charged separately [51].

Types of wheeling arrangements [51]:

A generator may enter the following arrangements for the sale of energy to a third party:

a. *Sell to remote consumer or consumers through Eskom NSP,*
b. *Sell to a directly connected consumer, but not export onto Eskom networks,*
c. *Sell to a municipal customer from a generator connected to Eskom's distribution network,*
d. *Sell to an Eskom customer/Eskom from a generator that is connected to a municipal distribution network.*

Figure 28 illustrates wheeling arrangement examples.

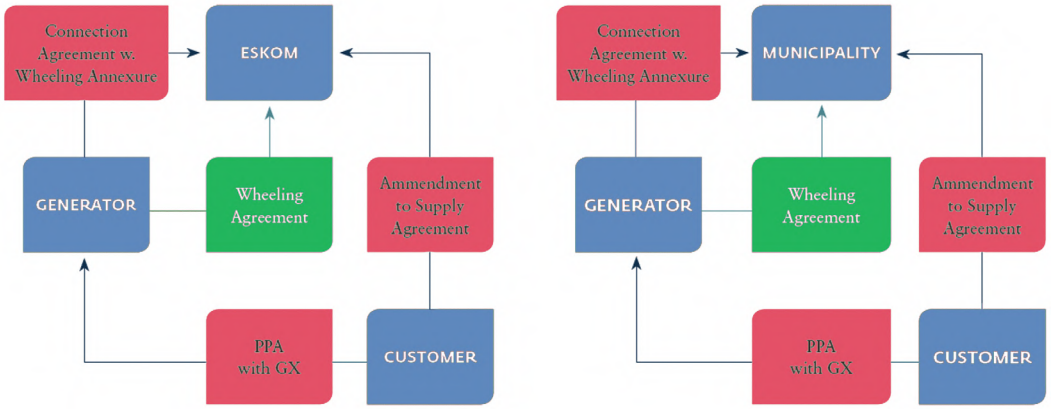


Figure 28: *Wheeling arrangements, Eskom and municipality networks [33]. Source: IFC*

Transmission and Distribution Technical Requirements

The ERA states that all parties should have non-discriminatory access to the transmission and distribution network, provided they are not in arrears and have followed the rules of the grid codes. The next set of documents that are discussed are the grid codes applicable to transmission and distribution and the codes that are specific to RE and embedded generation.

3.1.9 Transmission Grid Code

A Grid Code is defined as a technical specification which defines the parameters a facility connected to a public electric grid must meet to ensure safe, secure, and economic proper functioning of the electric system. In SA, NERSA together with the Grid Code Advisory Committee (GCAC) is responsible for developing and updating this code which contains connection conditions for generators, distributors, and end-use customers, including the standards used to plan and develop the Transmission System (TS). The Transmission Grid Code shall ensure the following [53]:

- *Accountabilities of all parties are defined for the provision of open access to the TS*
- *Minimum technical requirements are defined for customers connecting to the TS*
- *Minimum technical requirements are defined for service providers*
- *The System Operator's obligations are defined to ensure the integrity of the IPS*
- *Obligations of participants are defined for the safe and efficient operation of the TS*
- *The relevant information is made available to and by the industry participants*
- *The major technical cost drivers and pricing principles of the service providers are transparent*

The responsibility of the service providers under the Transmission Grid Code shall be:

- *To show no interest in whose product is being transported*
- *To ensure that investments are made within the requirements of the Grid Code*
- *To provide open access, on agreed standard terms, to all parties wishing to connect to or use the TS. The Grid Code defines what is understood by non-discrimination through the definition of consistent and transparent principles, criteria and procedures.*

The Transmission Grid Code is carried out through the licensing requirements of the transmission service providers and registration of other participants [53] and is applicable to all RE technologies[54].

3.1.10 Distribution Grid Code

The Distribution Grid Code is an industry code that defines conditions for access to and use of the Distribution System (DS) including basic rules, procedures and requirements that govern the O&M of the DS. The Code forms part of the licensing conditions of the distribution NSPs and is also intended to define the technical aspects of the DS, which the distributors and DS users should comply with [55]. The objectives of the Distribution Grid Code are to ensure [55]:

- *Non-discriminatory access to the DS*
- *Adherence to minimum technical requirements for connection to the DS*
- *DS integrity & adequate service delivery*
- *Clarifies accountabilities of all parties*
- *Information availability*

The Codes under the Distribution Code are [55]:

- *Glossary of definitions - Preamble*
- *Distribution Network Code*
- *Distribution System Operating Code*
- *Distribution Metering Code*
- *Distribution Tariff Code*
- *Distribution Info Exchange Code*
- *Code Governance*

Considering the distribution codes, the focus is on the Distribution Network Code (DNC). This code describes the procedure for new connections and sets out the responsibilities of all parties regarding the use and development of the distribution networks including some embedded generation connection requirements [55]. Distributors are obliged to connect embedded generators under the conditions stipulated under "Application for Connection" referred to in 3.2 of the DNC. For users to connect to the DS, all are required to comply with the DNC.

The objectives of the DNC are stated as follows [56]:

- *To set the basic rules of connecting to the DS,*
- *To ensure that all users of the DS are treated in a non-discriminatory manner,*
- *To specify the technical requirements to ensure the safety and reliability of the DS*

The compliance with the code ensures that there is improved efficiency, transparency, and harmonization amongst the industry role players, namely the embedded generators, co-generators, end-customers, retailers, resellers, distributors, and the system Operator[55].

3.1.11 South African Renewable Energy Grid Code

The SAREGC provides the minimum technical and grid design requirements for RE plants connected or wanting to connect to the TS and the DS [57]. It is compulsory for all RE plants connected to the TS and the DS to comply with the requirements of this code. These requirements are determined and specified based on the plant sizes and connection voltage level. The code applies to but is not limited to the following RE technologies: solar PV and concentrated solar power (CSP), wind, small hydro, landfill gas, biomass, and biogas. Although most of the RE technologies meet the SAREGC requirements there are plants that are excluded because they do not meet the emissions and reactive power capability limits. Plants with slow responses have experienced problems with meeting the Grid Code requirements [54]. This Grid Code supersedes all other grid codes for RE plants if a conflict arises. The RE generators are required to report information about their operations to NERSA monthly. This code is key to all C&I generators planning to connect to the national TS and DS.

3.1.12 NRS 097-2-1 – Grid Interconnection of Embedded Generators

The NRS 097-2-1 defines the standards for the utility interface for the interconnection of SSEG systems to a utility network [58]. It applies to SSEG systems that have a nominal capacity that is less than 1000 kVA, which is connected to a single-phase, dual-phase or three-phase low voltage network [58]. The C&I industry and the municipalities use the NRS 097-2-1 to connect customers as it is a suitable, simpler substitute to the impact assessments required for each application to integrate to the grid. Municipalities and C&I generators look to the NRS 097-2-1 guidelines and the SAREGC for guidance on regulatory rules for integration.

This section provided a discussion on some of the key legislation and regulations that pertain to the development of RE by C&I consumers. All the documents discussed have key considerations for C&I RE market development. There are elements of the regulations covered that provide the necessary ingredients to grow the market e.g., exemptions provided for electricity generation under the ERA and the DG allocation under the IRP. However, there are still gaps that are stunting the growth of the market e.g., the application processes for generation licenses. The next section discusses the implications of the documents discussed on the growth of the C&I RE market in SA.

3.2 Implications of regulations on C&I market development

This section provides a summary of the implications of the key legislation, regulations, and codes on the generation of electricity by C&I consumers, grid access which includes wheeling of electricity and interconnection, and lastly energy sale agreements which are key to the growth of the C&I RE market. Thus, the key aspects that will be investigated are:

- *Generation*
- *Grid access*
- *Energy sale agreements*

3.2.1 Generation

The electricity supply challenges currently facing SA C&I consumers have resulted in growing interest in developing SSEG facilities. This would result in increased reliability of supply. The below table is an assessment of the current legislative and regulatory framework as it pertains to generation of electricity for C&I consumers.

Table 1: Assessment of impact of regulations on C&I Generation
Assessment efficacy rating key: – 1-4 (Weak); – 5-7 (Moderate); – (8-10)Strong

Generation	Rating		Enabler	Barrier	Potential next step
RE generation capacity expansion targets		Integrated Resource Plan	• Utility-scale variable renewable energy (VRE) • A target of 500 MW per annum of DG and other technologies from 2023 • In short term allocation to DG is as needed to fill energy gap	• The IRP has annual threshold limits on new VRE which may affect how much of the 500MW can be built annually • The 500 MW per annum includes other technologies like biomass, CoGen and landfill	• Revise threshold in IRP or exclude DG from VRE limit • The targets for DG could be made explicit rather than bundled
		White Paper on Renewable Energy	• Provides the key focus areas for the promotion of RE development in SA • Highlights the importance of RE in distributed generation (DG) in positively impacting demand side management and reducing the need for additional power plant capacity	• The target for RE was 10,000GWh by 2013, no further longer-term targets were set in the paper, thus rendering it outdated compared to fast pace of developments in the RE space in SA	• Revise White Paper with updated policy and increase the RE targets for SA • Cabinet can continue to use the guidance in the White Paper to further the development of RE in the DG space
		National Energy Act	• Promotion and balance of all energy resources in the country, including the role of renewable energy	• No official IEP yet, thus no clear role for self-consumption in the overall energy security of SA	• The IEP should be developed to provide the necessary guidance of the role of RE and self-consumption

Clarity of licensing processes		Electricity Regulation Act - Licensing	• Clear licensing application procedure provided by NERSA	• There are many requirements in the application for NERSA a generation license and putting together the requirements can be time-consuming • NERSA possesses limited capacity to assess each application timeously resulting in longer lead times for approval for generation licenses. Licensing process can take up to 120 days [13].	• DMRE and cabinet need to review amendments to make allowance for larger systems to not require extensive licensing – while balancing technical requirements. • NERSA can simplify the licensing requirements and automate some aspects of the licensing process
Ease of licensing processes		Electricity Regulation Act - Registration	• Systems <1MW officially do not require licensing from NERSA, just registration • Systems with POC for own use <100kW do not require licensing or registration • Off-grid systems for own use do not require licensing or registration, regardless of size	• Larger C&I consumers deem this insufficient – would like this increased • Larger consumers may also prefer larger systems so they can wheel extra production to their other sites	• DMRE and cabinet need to review amendments to make allowance for larger systems – while balancing grid requirements. Most recently, industry has been asking for the limit to be 50MW (Eskom [21], BUSA [22], EIUG [14]). In June 2021 government made a landmark announcement that the threshold would be increased to 100MW in the subsequent months

The following case illustrates the challenges with getting a generation license approved for C&I embedded generators of larger systems.

BOX 3: Case study - Gold Fields 40 MW solar licensing

In 2017 Gold Fields, a gold mining company with operations in SA and other countries globally, began the process to get the license to establish their proposed 40MW solar PV embedded generation facility to provide power to their operations at their South Deep mine in SA. Due to lengthy licensing processes Gold Fields was only granted the approved license from NERSA in February 2021[59]. In May 2021, their board of directors were finally able to give the go ahead for construction, post the approval from NERSA.

These approval delays happened, despite ongoing bouts of load shedding in SA and ever-increasing electricity costs as a share of operating costs for the company at 13 percent in 2017 [60]. These licensing difficulties are not unique to Gold Fields and make the case for the proposed lift of licensing exemptions threshold to 100 MW to help facilitate electricity generation investment by large electricity consumers that is being considered by government.

The regulations for the promotion of RE self-consumption and embedded generation have been insufficient to stimulate significant growth for the C&I market. Despite the recent amendments to the ERA, larger C&I consumers such as members of the EIUG have stated that the 1MW threshold is insufficient and have called for

it to be increased. Further, the IRP2019 makes an allowance of 500 MW p.a. from 2023 for DG capacity additions – and allowing for capacity additions of DG to 2022 based on whatever is needed to meet the energy supply gap [40].

To progress the C&I market development, the licensing threshold should be increased as requested by industry to take advantage of the immediate opportunity presented to add much needed capacity. Furthermore, C&I consumers will benefit more from larger installations as their energy needs are more than residential consumers. In addition, NERSA is encouraged to improve their licensing processes through simplification and possibly automation of some of the steps for licensing. South African government should develop the IEP and clarify the role of self-consumption in addressing the electricity supply gap.

3.2.2 Grid access

To connect to the transmission and distribution networks in SA, generators are required to engage with NSPs and are required to get interconnection agreements. For this to happen there are grid codes and technical requirements that should be met as discussed in section 1.1. Once these conditions are met, developers can then gain access to the network. Wheeling on the other hand is concerned with the use of the network and the associated costs of delivering the electricity. Eskom is the only transmission licensee and distribution is shared between Eskom, the municipalities, and other licensed distributors. Therefore, the wheeling of power refers to the use of the Eskom transmission/distribution grid and/or municipal distribution grid to wheel power from a generator to a consumer. Table 2 is an assessment of the current regulatory framework as it pertains to grid access and wheeling of electricity for C&I consumers.

Table 2: Assessment of impact of regulations on Grid access

Assessment efficacy rating key: – 1-4 (Weak); – 5-7 (Moderate); – (8-10)Strong

Generation	Rating		Enabler	Barrier	Potential next step
Open access regime		Electricity Regulation Act	• A transmission or distribution licensee must make provision for the non-discriminatory access to their network • The ERA allows for wheeling provided a connection agreement is in place and Grid Code requirements are met	• SA has a vertically integrated ESI - which creates challenges to «open access» despite regulations • Wheeling is not consistent across distributors	• Current process of unbundling Eskom may make for a more «open access» system, however this is a gradual process

Grid connection		Transmission Grid Code	• Provides for all the technical requirements for use of the transmission system	• RE generators are expected to continuously conduct assessments to show compliance. The process of conducting these can be time consuming and costly for the C&I consumers	• Longer term planning for network requirements, which will reduce the frequency at which tests have to be conducted
		NRS 097-2-1	• Defines the standards for the utility interface for the interconnection of SSEG systems to a utility network • Simpler to implement than impact assessments in the DNC, • Preferred by munics and C&I generators	• The NRS-097 is a specification that was developed and is supplementary to the other Codes and is not recognized as South African National Standard	• Integrate NRS-097 standards and procedures into official Grid codes to simplify process for C&I consumers
		Distribution Network Code	• Provides for all the technical requirements for use of the distribution system	• Standard connection charges associated with connection to the distribution system could be an obstacle for C&I consumers • Consumers applying for HV and MV are taken through lengthier connection processes compared to LV consumers • Impact assessments on the DS can be time consuming, and the process can delay customers getting connected	• Use of NRS-027 for embedded generators to simplify process of connection
Wheeling tariff		Electricity Pricing Policy	• Ensures that the costs for generating, transmitting, and distributing electricity is considered in the electricity price • Asserts that end-users have a right to access the network provided they pay the requisite approved charges	• Wheeling is not consistent across distributors • Licensees must conduct COS studies and provide these to NERSA for approval which not all licensees have the technical capabilities to do • NERSA approval of COS can take time, and studies can also be rejected, and the licensee will have to make the necessary additional analysis – this leads to delays in establishing wheeling tariffs • COS studies are costly to conduct. However, without them, tariffs charged are generally lower than the cost to supply the energy, which may discourage developers	• The EPP must provide for or prescribe incentives for continued improvement of the technical and economic efficiency with which services are to be provided

As previously mentioned, for the connection to distribution networks, C&I consumers are required to comply with the relevant grid codes which can be complex depending on the size of the system. The codes and technical requirements discussed in section 1.1 and unpacked in Table 3 are to be adhered to. Many C&I consumers do not possess the technical knowledge to meet the requirements and thus make use of Engineering, Procurement and Construction (EPC) firms or technical consultants. On the NSP side, Eskom and municipalities are required to assess each project that requires connection, and in some instances for the municipalities there is a lack in technical capabilities to perform these assessments. The advent of the NRS series has assisted in this regard, as well as training provided by organisations.

The establishment of the wheeling agreement frameworks for municipalities and wheeling tariffs has not progressed sufficiently, with only a few municipalities managing to stipulate tariffs and complete COS studies for NERSA to review. Eskom is the only official NSP that can wheel electricity, although the bolder municipalities have taken steps to ensure that wheeling can occur on their networks.

The challenge faced by the C&I market is conducting COS studies and getting them approved, therefore the EPP in remedying that could provide support for improvement of technical and economic efficiency of the electricity services.

3.2.3 Energy sale agreements

Sale agreements in the form of PPAs, where applicable, are required for the sale of electricity between generators and end-users or NSPs. The below table is an assessment of the current regulatory framework as it pertains to energy sale agreements for C&I consumers.

Table 3: Assessment of impact of regulations on energy sale agreements
Assessment efficacy rating key: – 1-4 (Weak); – 5-7 (Moderate); – (8-10)Strong

Generation	Rating		Enabler	Barrier	Potential next step
PPA		Electricity Regulation Act	• Municipalities can procure or buy new generation capacity in accordance with the IRP determinations in accordance to the Amended Electricity Regulations on New Generation Capacity	• Munics must comply with the Municipal Systems Act (MSA) and Municipal Finance Management Act (MFMA) before entering PPAs • C&I developers might be hesitant to enter PPAs with munics due to historical financial challenges • PPAs can be lengthy, which may not be ideal for munics but is a requirement for developers to recover their investments • Adherence to IRP determinations and generation licenses are required to procure new capacity, which is deemed a limitation by munics	• Reduce length of PPAs where feasible and allow developers to ensure their investments • Improve financial stability of munics as at present mainly the large, well-funded metropolitan munics are able to pursue PPAs for additional supply to their networks

PPA		Regulatory Rules on Network Charges for Third-Party Transportation of Energy	• NERSA regulations state that any load customer shall be free to go into bilateral arrangements with any third-party generator	• Bilateral PPAs are allowed, however getting approval from NERSA remains a challenge • PPAs can be lengthy, which may not be ideal for C&I consumers but is a requirement for developers to recover their investments	• Clarify rules for PPAs and simplify requirements from NERSA • Reduce length of PPAs where feasible so to meet customers needs and allow developers to ensure their investments
Captive generation		Electricity Regulation Act	• C&I consumers are able to generate their own energy without energy sale contracts or generation licenses	• The C&I consumers generally do not possess the technical know-how to establish the captive power plants • Can be really expensive to go completely off the grid	• Use of EPC firms to fast-track process

For energy sales, NERSA's Regulatory Rules on Network Charges for Third-Party Transportation of Energy allows for bilateral PPAs in theory, although this has not been made explicit. SSEG customers generally do not enter in PPA agreements as their systems are usually <1MW and are often for own use. For larger C&I consumers looking to establish captive power plants, it may be costly as they generally do not possess the technical capabilities in-house to establish their own generation facilities and thus make use of EPC firms, and costs would further increase in the case of off-grid solutions. In this case, corporate PPAs are an opportunity for having access to reliable, affordable and sustainable electricity while avoiding high up-front investments needed for owned self-consumption systems and mitigating challenges and risks of EPC and O&M phases. However, the uptake of PPAs requires innovative structures that can accommodate the needs of both the generator and the buyer – as the buyers are C&I consumers, their energy consumption needs are not as predictable as utilities or municipalities and due to this they prefer shorter term contracts [34].

It is worth noting that the ERA amendments on New Generation Capacity made in 2020 allow for municipalities (please note that municipalities are not considered C&I customers) to enter PPA agreements and procure their own electricity supply.

3.2.4 Implications of regulations and policies on project development process

Figure 29 is a summary of the impact of the regulations and policies on the project development process which includes project planning, license and grid connection application, financing, procurement, and construction, testing and commissioning and O&M. It considers all the key documents discussed in section 1.1 and briefly details where the main challenges lie.

This section focused on discussing how the legislative polices, regulations and codes discussed in section 1.1 foster or hinder the development of the RE C&I market. Although there are several supportive elements, there are still several challenges that need to be addressed such as establishing and approving municipal wheeling frameworks, increasing embedded generation licensing exemption thresholds, improving generation licensing procedures and increasing NERSA's capacity to process applications, amongst others. Annexure 1 details the risks associated with PPAs and self-consumption market projects which project developers have to also consider.

	Project planning	License and grid connection application	Financing	Procurement & construction	Testing & commissioning	Operations & Maintenance
Brief description	• Bankable feasibility study completed • Developers put together project requirements – land/building assessments, EIA conducted	• Application process for grid connection and licensing / registration with NERSA is initiated	• Developers secure funding for projects, and sign PPA agreements • Sign wheeling agreements	• Process to obtain the relevant materials and skills to construct the plant • Build the generation facility	• Testing of facility • Generation facility starts	• Ensuring facility operations and meeting technical requirements for operations
Relevant regulation/ policy	• ERA	• ERA • Grid codes • NRS-097-2-1	• ERA • EPP	• NEC3 • FIDIC • SANS 10142 Series • Building and wiring codes	• Grid codes • NRS-097-2-1	• Grid codes • NRS-097-2-1
Challenges	• Facilities >10MW need ministerial determination • Unclear role – and incentive – for self-generation	• The ERA only exempts <1MW facilities from licensing • Grid connection fee and generation license fee required can be expensive for smaller SSEG generators • Admin delays in application process from NERSA side	• PPA regulations lack clarity • Wheeling frameworks need to be developed for municipalities to provide clarity for developers	• Comply DTI's minimum local content requirements • Selection of reliable PV components for long term assured performance	• Grid impact assessments and testing required before connection • The need for NRS-097-2-1 to provide simpler connection requirements for MV connected RE plants	• Continuous monthly reporting to NERSA on operations

Figure 29: *Project development phases and relevant regulation. Source: CSIR Analysis*

3.3 International context

The literature review conducted for the SA market identified a range of barriers that need to be addressed by policy decision makers in the future. This section conducts an international literature review for three nations to fill identified barriers with international policy and regulatory best practice. The extent of this review is limited to key policy and regulatory documents that could fill the barriers identified from the local context. The nations are:

- *Chile*
- *Vietnam*
- *Spain*

The section begins by providing a high-level comparison of SA to the selected countries. It is then followed by a brief discussion of the key policies and regulations from each international country and the key lessons that SA can take from each.

3.3.1 Comparison summary of international experiences to SA

This section summarises the key legislative policies and regulations identified by the local literature review and compares them to key policies and regulations from the international literature review. **Table 4** is the comparison summary of the key regulations and policies for the three countries and SA with a brief literature review of each country thereafter.

Table 4: Comparison of C&I regulatory challenges and best practices

Assessment efficacy key: – Weak; – Moderate; – Strong

	South Africa	Chile	Vietnam	Spain
Generation	**Electricity Regulation Act:** • A generation license is required to generate electricity in SA, subject to approval from the Minister. • The application process for licensing is lengthy due to the many requirements. • Systems <1MW officially do not require licensing from NERSA, just registration	• **General Law of Electrical Services:** The generation of energy is a free activity (no generation license required). However, grid-connected facilities, are subject to the instructions of the Independent Co-ordinator of the National Electricity System (ICNES). • **Decree – Law 57/2019:** Systems <200MW are only subjected to meet technical standards. The technical standards must establish a methodology that can calculate a limit to the installed capacity.	• **Circular No. 16/2017/TT-BCT:** PV systems >1 MW must obtain a license to generate electricity, which can be obtained from the EVN or ERAV. Systems <1 MWp are considered eligible for self-consumption	• **Decree 960/2020: The** generation facilities are obliged to register in the electronic registry of the economic regime of renewable energies monitored by Director General of Energy Policy and Mines. • **Renewable Energy Plan 2011-2020:** Each RE technology is faced with different process of obtaining licence. • **Law 24/2013:** Self –consumption facilities are allowed to sell their surplus energy to the system. • **Royal Decree 244/2019:** System<100KW are not obliged to register
Wheeling agreements	**Electricity Pricing Policy:** • Wheeling charges are mandatory for the use of transmission and distribution networks • COS studies are to be submitted to NERSA by licensees to establish wheeling tariffs • Wheeling charges allow licensees to maintain the network	**General Law of Electrical Services:** Owners of facilities with surpluses of<9MW production are exempt from wheeling tariffs; and those of >9MW to <20MW must pay a toll for the power exceeding 9MW.	**Offsite PPA:** Offsite physical delivery of power often requires payment of a wheeling fee to the transmission and/or distribution system operator for associated costs[62]	**According to Office of Utilities Regulation (2019):** The wheeling pricing supported in the intra-day and bilateral contract markets contains the connection charge and use of the system charge[63]
Interconnection	• Standard connection charges could be an obstacle for C&I consumers • SAREGC requires compliance, testing and regular reporting to NERSA • NRS-027 provides best practice standards for connection for embedded generators	• According to M. Pollitt (2004) Chile has opened the negotiation platform for the transmission and distribution charges. • General Law of Electrical Services: Grants open access for generators to connect to the grid.	• Transmission and distribution charges are regulated by the Vietnamese Government	**Royal Decree-Law 23/2020:** RE generators are granted permits to access the electricity networks. **Law 24/2013:** Third parties are allowed access to networks, which is associated with network charges.
Energy sale agreements	• Eskom signs PPAs as the single-buyer in the market • NERSA allows bilateral PPAs – however only one has been approved officially by NERSA • Munics are allowed to buy energy from IPPs according to latest ERA amendments	**General Law of Electrical Services:** • PPAs in Chile are signed by distribution companies when supplying regulated customers. For unregulated customers PPAs are signed directly by generators.	• EVN is the only legal buyer of electricity • PPAs are obtained through negotiation and signing by relevant EVN branch[64]	• **According to Petretti. L (2021):** Corporate PPAs are allowed under the bilateral contract. • **According to Bloomberg NEF (2021):** Cross-border virtual PPAs are exercised in which corporate consumers purchase from different electricity markets to where their load is located.

The following section provides brief details of the key regulations and policies for the three countries of comparison.

3.3.2 Chile

Generation

General Law of Electrical Services

The General Law of Electrical Services regulates the electricity sector in Chile [65]. Generation is generally liberalized, however, if a generator chooses to connect to the national grid, they are subject to legislation where they can and must inject energy and on the spot market, which has regulated prices [66][67]. Owners or operators of grid-connected generation facilities are subject to the instructions of the Independent Coordinator of the National Electricity System (ICNES).

Law 19.940

Law 19.940 enables any generating company to sell energy into the electricity market. The opening of the market to smaller power generators facilitated the viability of small RE plants [68]. It serves to regulate electricity transportation, establishes a new rate regime for medium electrical systems and stipulates the adequacy indicated in the General Law of Electrical Services [69]. The main objective of the law is to ensure that generators that are not integrated into the system can inject their energy as the system allows for third-party non-discriminatory access.

Power Purchase Agreements

PPAs can be obtained through bilateral negotiations or through participation in auctions — carried out by the National Energy Commission (NEC). Independent consumers are expected to purchase their own electricity supply independently and to select their preferred procurement mechanism[67]. PPAs are signed with distribution companies for regulated customers, and signed with generators in case of unregulated customers (customers who demand over 5 MW of capacity, or those who demand over 500 kW and less than 5 MW that have chosen to be unregulated), and positions are adjusted on the spot market at the marginal cost determined hourly by the NEC for each node [70].

Technical requirements and network charges

Generators with installed capacity of more than 20MW are expected to incur regulated distribution and transmission charges. The latter makes provision for transmission network access charges to be open to negotiation by generators wanting access and is coupled with wide planning and determination of access terms. The government through the NEC set up the electricity prices of the main interconnection systems, which provides a guide in terms of capacity projections [71].

Law No. 21.118

Law No. 21.118 states the conditions so regulated end consumers can inject energy to the grid through a netbilling methodology.[72]. Regulation establishes the limit of 300 kW and aims for self- consumption, but whenever the consumer has surpluses this are deducted in future electric bills. The methodology considers conducting studies that assess the impact on safety of the network that the generation equipment may cause. The technical standard establishes cases in which the methodology should be used and the frequency for the update may not exceed 4 years.

Lessons learnt from Chile for the South African C&I market:

- *Chile has progressed well in opening the negotiation platform for distribution and transmission charges for potential generators wanting to connect to the system in order to promote open access.*
- *When connecting to distribution grids, the developer must conduct studies of impact that will be approved by the distribution company and charges will be defined by a regulated study carried on every four years. In SA, distributors must conduct an impact assessment study each time a generator wants to connect to the grid which may cause delays*
- *In Chile, PPAs are signed between distributing companies and unregulated customers and the PPA regulation allows consumers with installed capacity >2MW to choose their tariff category, as they can negotiate energy contracts with the distributors. In SA, Eskom was the only entity allowed to sign PPAs. However, the latest amendments to the ERA now allow municipalities to procure and buy energy from IPPs and bilateral PPAs are allowed by NERSA.*

3.3.3 Vietnam

Generation

Decision No. 32/2006/QD-BCN

Decision No. 32/2006/QD-BCN states the conditions and procedures for issuing and managing operating licenses. Electricity activity permits are granted with different time limits for the electricity value chain, based on the scope of operation, types of electricity, registration duration, competence, and professional qualifications of the electricity operating unit[73]. Depending on the size, an electricity generation license must be obtained from the Ministry of Industry and Trade (MOIT), the Electricity Regulatory Authority of Vietnam (ERAV), or the relevant provincial People's Committee [74].

Circular No. 16/2017/TT-BCT

Article 13 states that a grid-connected PV or rooftop PV power project having a capacity of 1 MW or more must obtain a license to generate electricity and comply with Circular No. 12/2017/TT-BCT [75].

Self-Consumption Model

The self-consumption model allows owners of rooftop solar PV systems to directly consume the electricity generated from their system instead of injecting it into the grid[76].

Business Case for C&I RE Development in Vietnam

Key policy implications for C&I procurement of starting residential rooftop solar PV (RTS) in July 2019. These implications create significant procurement option constraints for companies buying RTS systems for self-consumption [63]:

- ***System size limited to 1 MWp**: Only PV systems of 1 MWp in capacity and smaller are considered RTSs and eligible for self-consumption, net billing, and receiving payment from EVN for excess generation exported to the grid. Any PV system larger than 1 MWp is considered "ground mounted". In these cases, the customer is prohibited from self-consumption and must apply for a grid connection through MOIT and sell 100% of its generation to EVN's grid via a standardized solar PPA.*
- ***Payment rates for net billed, excess solar generation are geography-based**: Solar projects under 1 MWp can connect to the grid and sell excess energy. In exchange for this energy, EVN, pays the customer for each kWh, at the stated net billing rate, plus a value added tax (VAT). Net billing payment rates are calculated at the regional level or "zone" level.*

Power Purchase Agreements

There are two types of PPAs in Vietnam, contracts for projects with a capacity of more than 30MW and contracts for RE and small hydro projects with a capacity of less than 30MW. Consequently, small hydro and RE projects less than 30 MW do not need to negotiate electricity prices with the EVN, and the EVN cannot interfere with prices. The electricity prices set out in the PPAs are calculated based on the annual avoidable cost tariff schedule of the MOIT[77].

Decision No. 13/2020/QD-TTg and Circular 18/2020/TT-BCT

According to Decision No. 13/2020/QD-TTg (April 2020), establishing the Feed-in-Tariff for solar plants, EVN as power purchaser, is responsible for purchasing the entire power output generated by grid-connected solar power projects, as well as prioritizing load dispatch to exploit the entire capacity of the generated power output[78]. However, in Circular 18/2020/TT-BCT (July 2020), revising model PPAs for grid connected and rooftop solar plants, the obligations of EVN to purchase the entire power output of the plant and to give rooftop solar priority to dispatch have been removed.

Despite this has led to inconsistency with the previous Decision No. 13 and to contractual uncertainties for the seller, new installations of rooftop solar plants have boomed in 2020.

Technical requirements and network charges

There is no specific requirement to notify the MOIT prior to the operation of the electricity transmission network. However, before the network can be connected to the national grid, the electricity regulators will check whether the network satisfies the technical and personnel requirements. The charges for the transmission and distribution of electricity are regulated by the Vietnamese Government. The annual average transmission price is determined based on the NPTC's total transmission revenue and the total electricity NPTC allocates to units at the delivery points[74].

Circular No. 32/2010/TT-BCT

The Circular states the regulation on distribution power system. The scope of the circular includes operational standards of distribution power system and, conditions and procedures for connection to the distribution power grid. Article 34 of section 2 states that in normal operating mode, power users of the distribution grid must ensure that their devices do not cause a negative phase voltage sequence component at the POC of more than 3% of the nominal voltage at the 110 kV voltage level or more than 5% of the nominal voltage at the 110 kV voltage level[79].

Lessons learnt from Vietnam for the South African C&I market

- *In Vietnam there is a self-consumption model which allows for the deployment of a rooftop solar which may facilitate the growth of the C&I market, as it has several advantages such as low payment risks and sole ownership of all rooftop system[76].*
- *In Vietnam, the single buyer EVN signs PPAs, however, compared to SA, the PPAs clearly distinguish between contracts for RE projects with a capacity of more or less than 30MW.*

3.3.4 Spain

Generation

Royal Decree 960/2020, of November 3.

The decree regulates the regime of economic use of renewable energies for production facilities of electric power. The decree strives to promote investments in RE to reduce the GHG emissions to achieve the goal of neutrality climate no later than 2050, based on a 100% renewable electricity system. The facilities in which the generation of RE will be taking place are obliged to register in the electronic registry of the economic regime of renewable energies, the registry that is the responsibility of the Director General of Energy Policy and Mines [80].

Renewable energy plan 2011-2020

Under this plan, the obtaining of license is different to each RE technology, with development of geothermal energy for electricity generation faced with unclear and length process of obtaining a licence; with the administrative procedures that could run for a period of 3 to 5 years for medium and high geothermal energy temperature [81].

Self-consumption

Law 24/2013, of December 26, on the Electricity Sector

The Law asserts that consumers with any form of self-consumption will have to register in the Administrative Registry of Self-Consumption of Electrical Energy. The procedure of registration and communication of data is also made available at the Administrative Registry of Self-Consumption of Electrical Energy. The Government has put in place a mechanism on which the facilities with self-consumption facilities sell their surplus energy to the system [82].

Royal Decree 244/2019.

The Royal Decree 244/2019, of April 5, which regulates the conditions of the administrative, technical and economic self-consumption of electrical energy, was promulgated as a modification of Article 9 of Law 24/2013, of December 26, on the electricity sector. Under this decree, the generation facilities intended for self–consumption with the power capacity of less than 100kW are not obliged to register. These facilities can also inject their energy surpluses into the grid [83].

Power Purchase Agreements

There is no specific regulation that covers corporate PPAs for RE, but they are covered under conventional bilateral contract [84]. Renewable PPAs accounted for 3.5GW [85], with Solar PPAs accounting for larger portion of a total of 3GW in 2020, which made Spain the leading corporate PPA in Europe [86]. Spanish PPAs are diversified to include cross-border virtual PPAs and under this approach, a corporate consumer purchases RE from different electricity market to where their load is located. The cross-border virtual PPAs structure offers the geographical flexibility to corporate consumers, regardless of the location of their loads. These virtual PPAs are beneficial to corporations in the market whereby the corporate PPAs are not available due to regulatory framework. In Europe, Spain is the only country that consistently offers the lowest price for solar PPAs and that has partly given developers competitive advantage and the ability to attract more consumers [86].

Technical requirements and network charges

Law 24/2013, of December 26, on the Electricity Sector

The approval of the Law 24/2013 was meant to expand on the existing process of progressive liberalisation of the electricity sector, by opening the networks to third parties and establishing an organised energy trading market. Although networks allow third-party access, it is associated with costs that are meant to maintain the networks. The activity of commercialisation of electricity that takes place on the networks is liberated in that the regulatory framework allows freedom of contract and choice of consumers and electricity suppliers [82].

Royal Decree-Law 23/2020, of June 23.

The Decree puts measures in the field of energy and other areas for economic reactivation. The Decree is intended to improve and simplify the processing of authorization procedures for the construction, expansion, modification, and exploitation of electrical installations across the value chain. The Decree allows RE generators to access the networks through granting permits. The permits are allocated for a maximum validity of five years. The Decree allows the authorization of facilities with an installed capacity that is greater than the power and connection granted, provided that the evacuation limits are respected in the operation of plant. This eliminates an unjustified regulatory restriction that prevents efficient design of the facilities for optimal use of the renewable resource [87].

Lessons learnt from Spain for the South African C&I market:

- *In Spain, there is both an unregulated and regulated tariff structure, with the regulated tariff initially set to control the price of electricity generated and the unregulated tariff being the market electricity price determined by the demand and supply of electricity [88], whereas in SA only regulated tariff structure exists which is regulated by NERSA.*
- *Although there are no specific regulations governing the PPAs, PPAs in Spain are entered into in a form of a bilateral contract and there is access to all potential buyers, contrasted to SA where only Eskom and municipalities with strong financial position are allowed. However, according to NERSA third-party access rules, although not explicitly stated, bilateral PPAs are allowed. The PPAs structure is highly liberated in Spain, as both RE developers and off-takers have options to choose whomever they want to contract with.*
- *Spain encourages energy surpluses from self-generation to be pumped into the grid and this is facilitated by a signed surplus compensation contract. Additionally, the generation facilities for RE sources are encouraged to be developed through auction bidding for remuneration framework containing subsidy payments meant to reduce the generation costs of electricity and ensure developers gain investment returns.*

This section aimed to provide lessons from other countries that would address the barriers for RE C&I market development in SA. Some of the key lessons include opening negotiation for transmission and distribution network charges, reducing the frequency of technical impact assessments for distribution network connection, allowing flexible and clearer negotiation of PPA contracts, and encouraging self-consumption by clear regulations on compensation for injecting power into the grid.

3.4 Economics and Tariffs

The cost of electricity is a driving factor in future market growth. Electricity tariffs paid by C&I consumers in the mining, manufacturing and wholesale and retail trade sectors are investigated by providing a detailed overview of current tariff structures. The section also provides brief definitions for the different components of the tariff. These components are listed below:

- *Connection charges*
- *Energy charges*
- *Time of use*
- *Ancillary services*
- *Losses*

Tariff structures for two municipalities and Eskom are investigated as many C&I consumers would obtain their electricity directly from Eskom and not through the municipality. The municipalities selected were based on the availability of data and level of existing relationships as can be leveraged to obtain the necessary insights.

The subsequent section provides a high-level overview of how the wholesale tariff trajectory could evolve based on the anticipated future generation mix within the power sector. This future view will allow a glimpse into further RE development for C&I consumers. To conclude this section, an analysis on the wheeling charges framework in SA for Eskom and municipalities was investigated to better understand the current status quo of such charges and their effects on further C&I market development.

3.4.1 Wholesale electricity tariff

The average wholesale electricity tariff[23] in SA has been increasing steeply for the last decade as shown in Figure 30. The average wholesale tariff is expected to increase further by roughly 30% from today to 2023 based on the latest Eskom Multi-Year Price Determination (MYPD4) application [89], to become cost reflective.

In the late 1970s to mid-1980s Eskom embarked on a capacity expansion programme which included the construction of multiple large coal-fired power stations. Eskom increased real electricity prices sharply to raise capital required to fund the new build. In the two decades that followed, the real wholesale electricity price steadily declined and by 2004/5 electricity prices in SA, and particularly those paid by industrial consumers were among the lowest in the world [90]. From 2008 onwards electricity prices again rose sharply as the power supply became increasingly constrained and Eskom began to implement loadshedding. At the same time, Eskom embarked on another large build programme to increase power supply capacity despite a lack of cash reserves. NERSA approved several steep increases in annual tariffs between 2008 and 2020, resulting in electricity prices increasing over 400% during this time.

[23] *Average wholesale electricity tariff = Eskom total electricity sales (ZAR) / total electricity sold (kWh)*

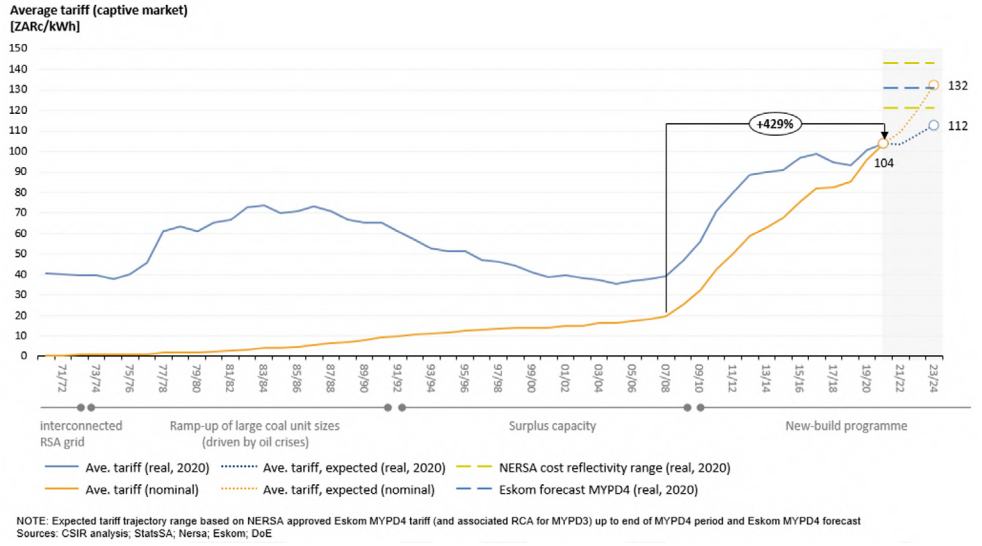


Figure 30: *Average wholesale tariff trajectory (Real and nominal) 1970 to 2020. Source: CSIR Analysis*

3.4.2 Electricity tariff structures in South Africa

In South Africa, energy consumers either purchase electricity directly from Eskom or from their local authority/ municipality. Municipalities purchase most of their electricity directly from Eskom and then redistribute the electricity to end-users and in turn, add their own distribution (network costs), retail costs and an allowable profit margin. There are currently 266 local municipalities in SA as shown in

Table 5 and **Figure 31**, although not all local municipalities have distribution licenses.

Table 5. Types and numbers of municipalities in each province in South Africa

Province	Municipalities			
	Metropolitan municipalities	Districts municipalities	Local municipalities	Total
Western Cape	1	5	24	30
Eastern Cape	2	6	37	45
Northern Cape	0	5	27	32
Free State	1	4	19	24
KwaZulu-Natal	1	10	50	61
North West	0	4	19	23
Gauteng	3	2	7	12
Mpumalanga	0	3	18	21
Limpopo	0	5	25	30
Total	**8**	**44**	**226**	**278**

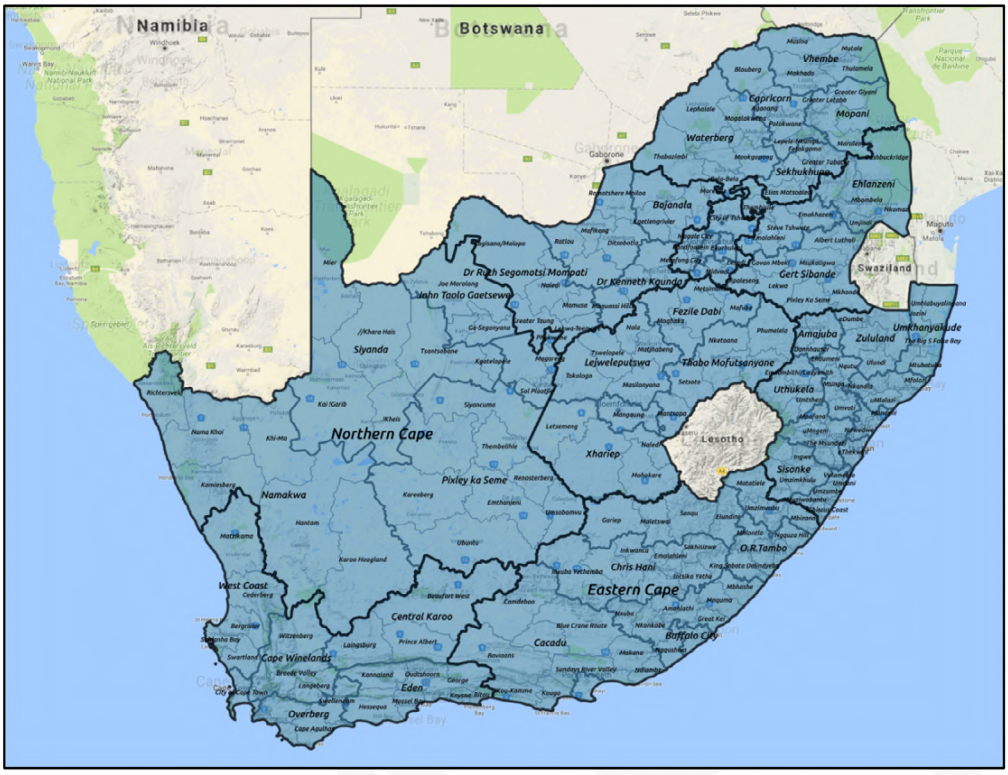


Figure 31: *Map showing the 226 local municipalities in SA. Source: SAGEN-3, CSIR*

Eskom and the local authorities currently have several electricity tariff structures for different customer categories. Eskom last revised its tariff structures in 2012 and have recently applied to NERSA for approval to implement changes to these tariff structures in response to an updated cost of supply study, [91] however there has been no publicly available information indicating when this would be approved. The cost of supply study showed that the existing electricity tariff structures no longer accurately reflect the cost differentials between energy and networks costs for a large portion of electricity end-users.

The relatively energy-intensive mining and manufacturing industries are the dominant consumers of electricity in SA as shown in **Figure 32**, accounting for roughly 60% of total electricity sales (portion of sales embedded in local-authority sales).

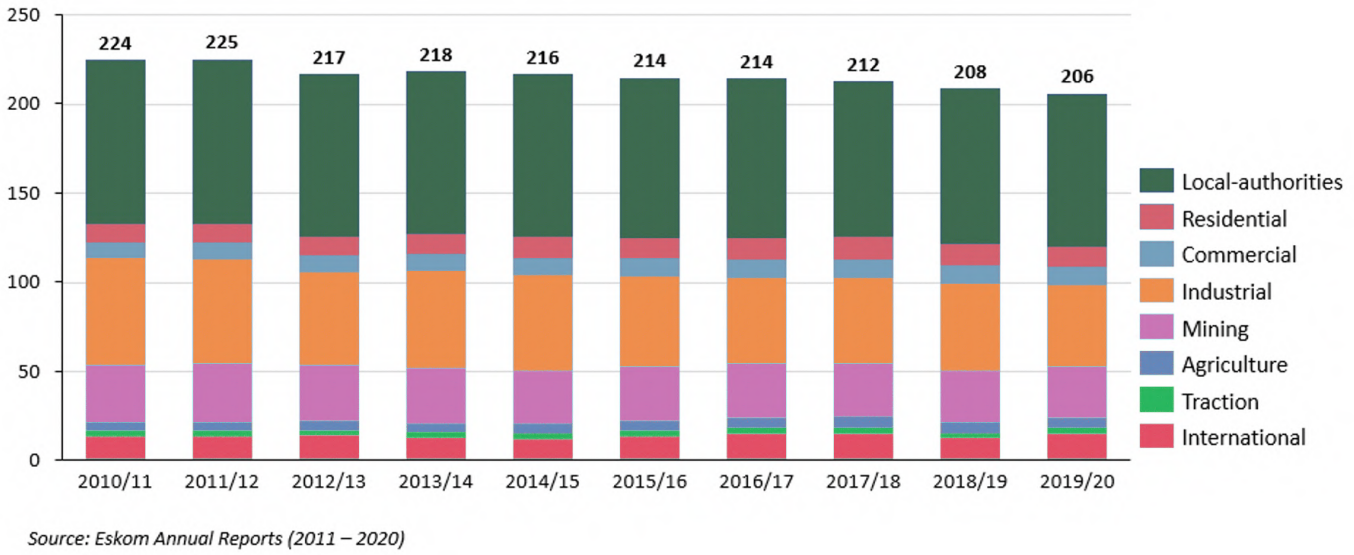


Figure 32: *Eskom total annual electricity sales volumes in GWh from 2010 -2020. Source: Eskom*

C&I customers with a notified maximum demand (NMD) greater than 1 MVA who are supplied directly by Eskom are typically on a Time of Use (TOU) tariff structure, namely the Megaflex tariff[24], while the relevant municipal licensees apply their own tariffs. All other customer segments who install SSEG, whether supplied by Eskom or municipalities, are required to move to a TOU tariff structure. C&I customers who have installed grid-tied generation are moved to the Megaflex-Gen tariff (>22 kVA connections). On the Megaflex-Gen tariff, any excess energy fed into the grid, which is not wheeled to another Eskom customer, is credited at the Gen-offset tariff [92]. If there is exported energy into the grid and this energy is wheeled to another Eskom customer (the off-taker), then the off-taker is credited at the Gen-wheeling tariff.

The Megaflex tariff varies depending on the transmission zone, network connection size, maximum instantaneous demand, and time of use of electricity (hour and season). Eskom have classified six pricing zones for generators, namely, the Cape, Karoo, KwaZulu-Natal, Vaal, Mpumalanga, and Waterberg.

There are several fundamental components of the Eskom Megaflex [93] electricity tariff namely:

- **Fixed Charges (R/month)** to recover overhead costs and costs that vary with size of customer base. These charges are based on the sum of the monthly utilized capacity(s) of each point of delivery (POD) linked to an account as well as administration charges,
- **Transmission, Network and Distribution Demand Charges (R/kW/month)** to recover long-run marginal investments required to meet peak demand. These charges are based on the voltage of the supply, the Transmission zone and the annual utilised capacity measured at the POD applicable during all time periods. Excess network capacity charges are also payable in the event of an NMD exceedance,
- **Energy Charges (R/kWh)** to recover variable costs to meet the customer load. These are TOU differentiated active energy charges including losses, based on the voltage of supply and the transmission zone of the customer. There are three TOU periods namely peak, standard, and off-peak. An example of the Megaflex tariff for a non-local municipal customer located in Transmission Zone ≤ 300km with Voltage ≥66kV & ≤132kV is shown in Figure 33, illustrating the different TOU tariffs,
- **Ancillary service charges (c/kWh)** based on the voltage of the supply applicable during all time periods,
- **Reactive energy charges (c/kVArh)** supplied in excess of 30% (0.96 power factor or less) of the kWh recorded during the peak and standard periods. The excess reactive energy is determined per 30-minute integrating period and accumulated for the month and will only be applicable during the high-demand season

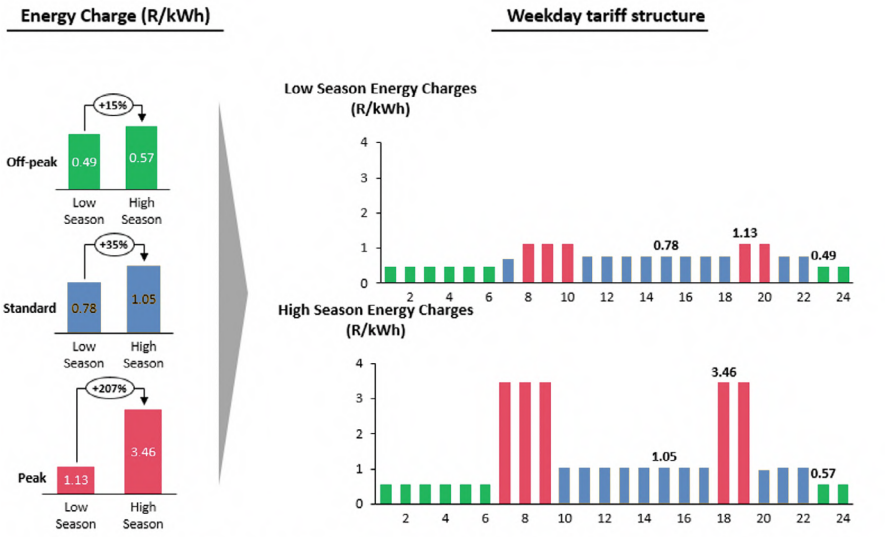


Figure 33: *Illustration of energy charges and time of use periods for the Eskom Megaflex tariff (2019/20). Source: Eskom*

[24] *An electricity tariff for Urban customers connected at medium voltage, high voltage and transmission voltages that consume energy (importers of energy from the Transmission and Distribution System) and generate energy (exporters of energy to the Transmission and Distribution System) at the same point of supply (or metering point).*

Eskom's Megaflex tariff also incorporates three transparent cross-subsidies, namely:

i. **The Affordability Subsidy (AS)** - funded by Eskom's direct industrial and business customers and is calculated based on an end-users' total active energy demand,
ii. **The Electrification and Rural Subsidy (ERS)** - funded by Eskom's direct industrial and business customers and municipalities and is calculated based on an end-users' total active energy demand,
iii. **The Urban Low Voltage Subsidy (ULV)** - funded by all Eskom's customers on urban tariffs that take supply at 66 kV or a higher voltage. This charge is based on the voltage of the supply and charged on the annual utilized capacity measured at the POD applicable during all time periods.

Presently, Eskom tariffs for large C&I customers are recovering fixed costs mostly through variable usage charges. In other words, the current tariffs largely bundle distribution network costs, electricity costs, and other ancillary services costs together in a uniform per-kWh rate. This high portion of cost recovery from variable charges presents a challenge when there is a reduction in energy sales as fixed costs are no longer fully recovered. This may ultimately lead to a subsidy for customers with embedded generators, which may then be recovered from other customers across the network. The actual cost split between variable and fixed costs incurred by Eskom were determined in a cost of supply study and are shown in **Figure 34**. The average cost structure across various size municipalities, as determined from a survey performed by NERSA [94], showed that variable costs form roughly 74% of municipal electricity costs.

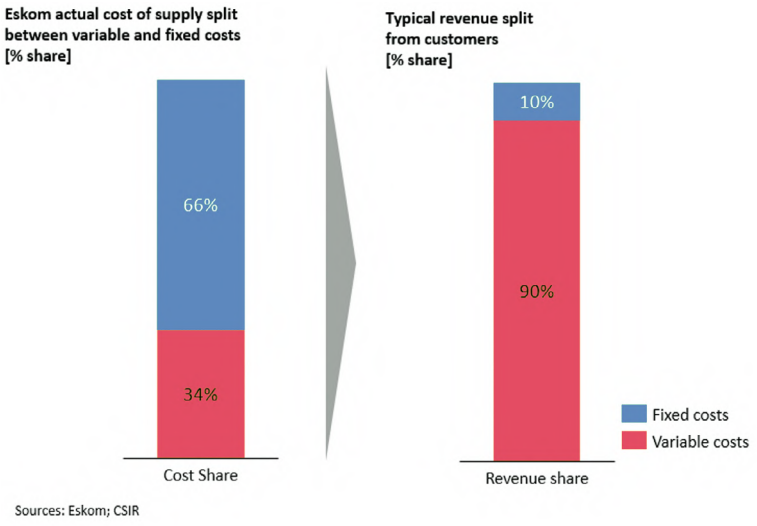


Figure 34: *Current Eskom cost and revenue share between variable and fixed costs/revenue demonstrating Eskom's financial risk to declining energy volume sales. Source: Eskom & CSIR*

An example of the annual electricity cost for a large commercial office park (annual electricity demand ~30 GWh/annum) and large industrial customer (annual electricity demand ~1.3 TWh/annum) located in Gauteng, purchasing electricity directly from Eskom on the Megaflex tariff, is illustrated in **Figure 35**.

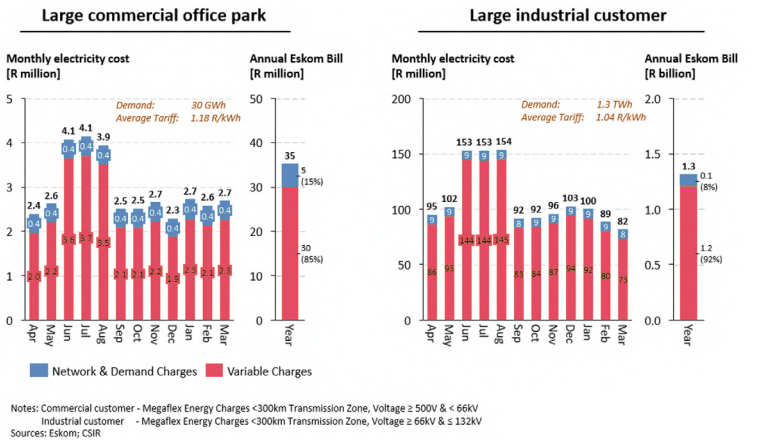


Figure 35: *Electricity costs for a C&I customer in Gauteng on the Eskom Megaflex tariff. Source: Eskom & CSIR*

The typical weekly demand profiles assumed in this illustration are shown in **Figure 36**. Over 85% of the total annual electricity charges are typically from variable usage charges and larger industrial customers typically have lower tariffs than commercial customers.

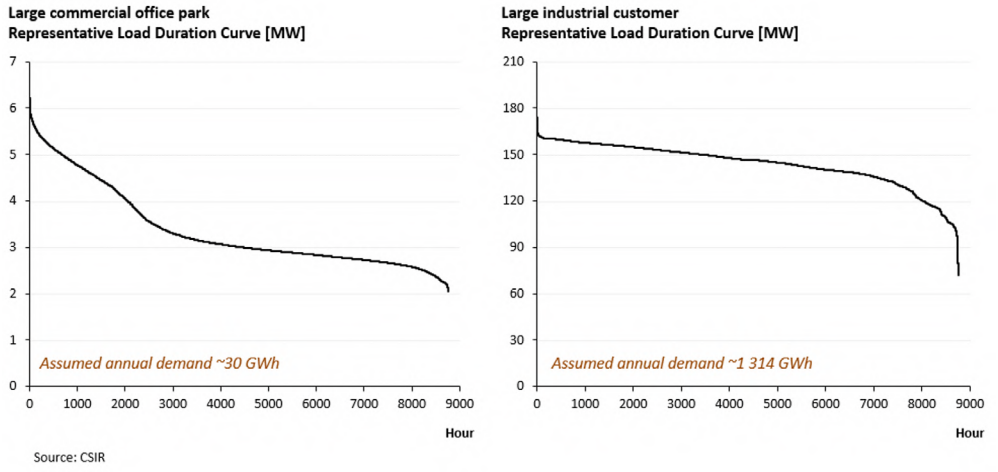


Figure 36: *Assumed annual demand profiles for a C&I energy user for illustration purposes. Source: CSIR Analysis*

Reductions in electricity sales for Eskom or municipalities could be due to several reasons such as customers responding to increasing electricity prices or the uptake of embedded supply sources such as rooftop solar PV. The cost of solar PV in SA is already today lower than the current Eskom variable energy charges, making it an attractive investment to off-set electricity costs. The prevalence of loadshedding over the last decade has also contributed to the uptake of SSEG. This poses a threat to revenue recovery if these customers reduce their energy consumption. When customers install SSEG, municipal/Eskom revenue is reduced due to reduced sales volumes sold to these customers as well as potentially compensating them customers for excess electricity fed into the grid. This ultimately led to Eskom publishing their strategic direction and objectives for their electricity tariff structures [95] in 2017, which summarised their objectives over the next 5 years. After this, in 2020, Eskom submitted an application to NERSA for structural tariff changes based on an updated cost of supply study [91].

Some key strategic objectives for tariffs highlighted by Eskom are summarized below:

- Tariffs to be more cost-reflective in structure i.e., fixed versus variable charges and in level,
- Tariffs that incentivise customers to stay connected to the grid,
- Tariffs that enable better management of demand and supply

In addition to an expected shift towards tariffs with a higher fixed charge component, Eskom have further stated that the TOU price ratios between charges (i.e., all other c/kWh values compared to the summer off-peak price) have been in place since 2005 and no longer reflect the current system requirements and costs in the time-of-use periods. Their 2020 tariff application to NERSA reflects the anticipated changes to the TOU periods but they did not seek significant structural changes to the share between fixed and variable electricity tariffs.

Similarly, municipalities are considering similar structural changes to their electricity tariffs. Several municipalities have already introduced SSEG tariffs, or are in the process of doing so, based on cost of supply studies to protect their revenue. If over the coming years Eskom do apply for significant structural changes to the electricity tariffs such that most of the revenue is recovered through unavoidable fixed costs, and energy charges drop below the levelised cost of electricity (LCOE) of solar PV (~60c/kWh), the business case for installing solar PV for self-generation may become unfavourable. However, at the same time the cost of solar PV continues to decline, making the tipping point at which there is no longer a business case lower each year.

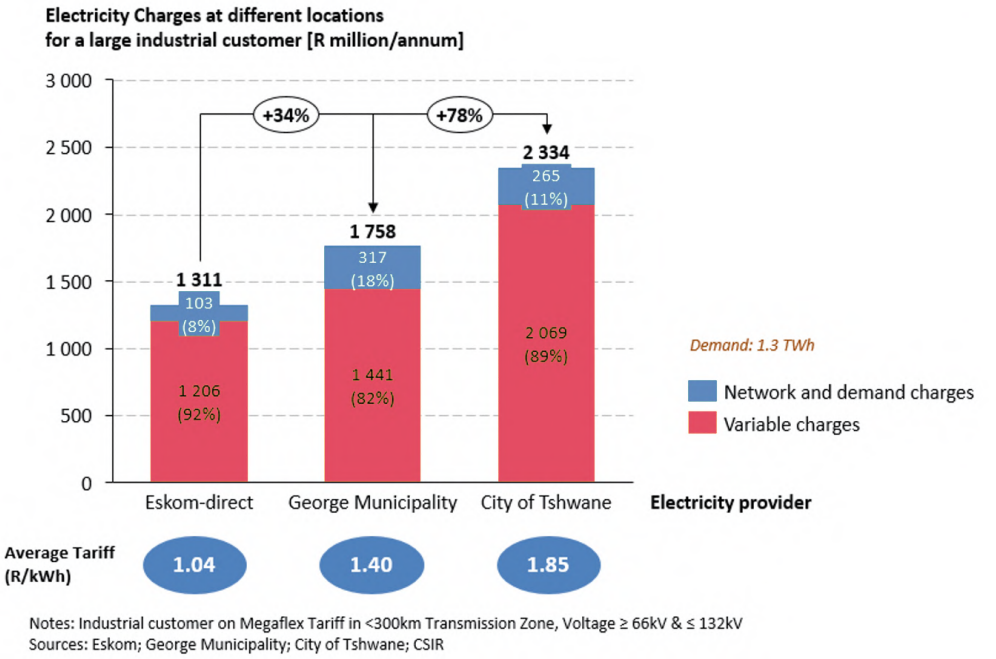


Figure 37: *Comparison of annual electricity charges for an industrial customer per electricity supplier*

As mentioned previously, some customers are being supplied by municipalities. Municipalities purchase electricity from Eskom and resell this electricity to customers, typically with their own tariff mark-up. A comparison of the electricity costs for the same industrial customer profile used previously in **Figure 35** connected to two different municipalities, namely George and City of Tshwane, is shown in **Figure 37**. The TOU tariffs for large industrial customers were used for both municipalities. Electricity costs and the tariff composition vary widely depending on the location of the customer.

3.4.3 Future evolution of the wholesale electricity tariff in South Africa

The long-term electricity mix and resulting price path in SA is defined by the DMRE in the IRP 2019 [40], which runs to 2030. This plan is based on a least-cost capacity expansion simulation of the SAn power system, subject to several constraints. The IRP 2019 installed capacity and energy mix is shown in **Figure 38**. The first new build capacity (beyond short-term emergency options) occurs in 2022 and consists of 1.6 GW of wind, 1.0 GW of solar PV and 0.5 GW of stationary storage. New coal capacity (0.75 GW) is planned for 2023 (and another 0.75 GW by 2027) as per DMRE policy adjustment process, followed by 1.0 GW of new gas capacity in 2024 (and further gas capacity from 2027 onwards). Imported hydro-based electricity of 2.5 GW from Inga is also included in 2030.

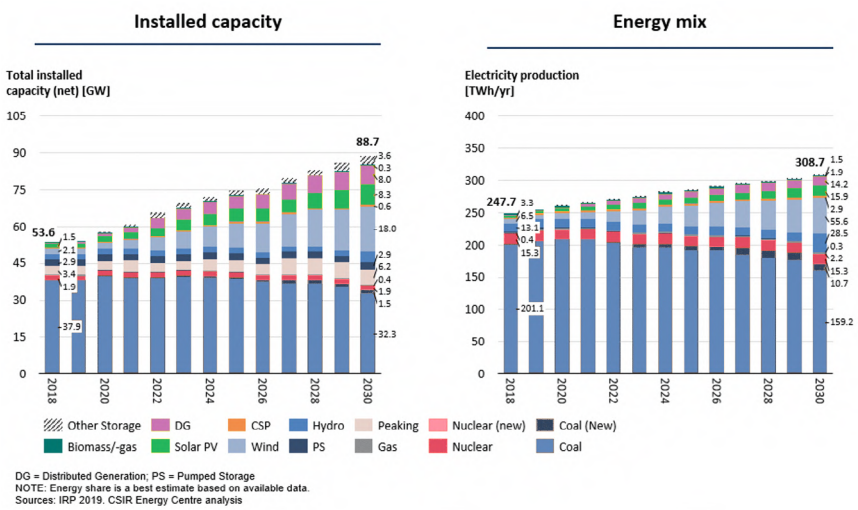


Figure 38: *Promulgated IRP 2019 annual Installed capacity and energy mix. Source: DMRE & CSIR Analysis*

The projected electricity price path resulting from this plan is shown in **Figure 39**. The steep increase from 2017 to 2018 in this plan is an adjustment from the actual tariff in 2017 to the actual cost (cost reflective tariff) in 2018. The price path from 2018 onwards thus represents a price equal to the cost of power generation. As can be seen, electricity tariffs are expected to continue increasing over the next decade (in real terms).

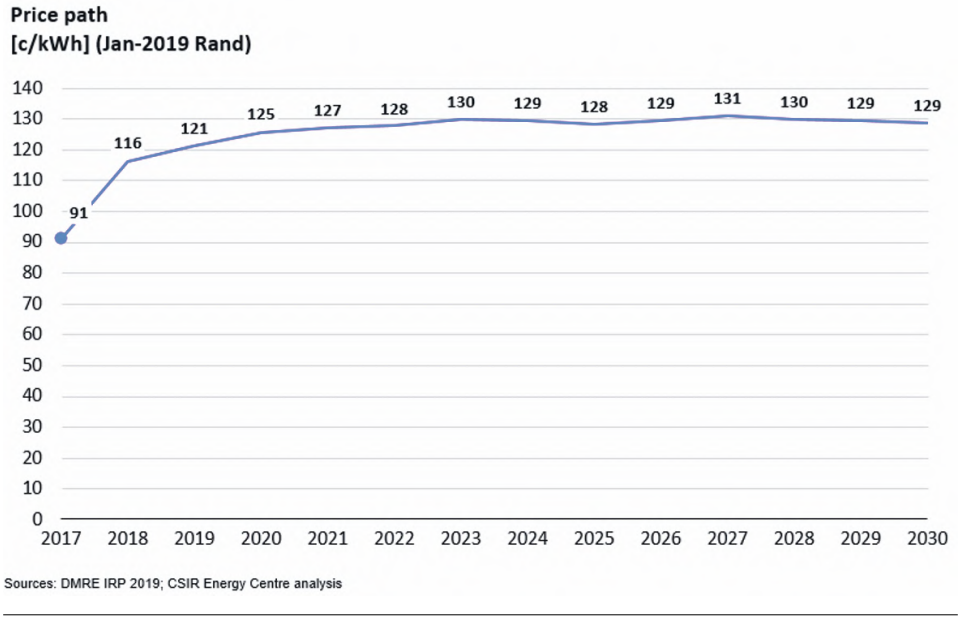


Figure 39: *IRP 2019 projected electricity price path 2017 - 2030 (Real terms) [40]*
Source: DMRE & CSIR Analysis

The LCOE for utility-scale and rooftop solar PV installations (0.5-1.0 R/kWh) in South Africa is already today, considerably lower than the average price path and is expected to continue declining. However, the business case for installing solar PV is dependent on the actual unbundled tariff the customer pays to Eskom or municipalities as summarized earlier. For example, C&I customers who are connected to the Eskom distribution network who are on the Megaflex tariff (Figure 33) pay TOU energy charges which vary between 0.78 - 1.05 R/kWh during standard periods (which overlap most with the timing of solar PV generation). Although the LCOE of rooftop and utility-scale solar PV available to C & I customers is estimated to be between 0.5-1.0 R/kWh in South Africa today, these customers are also charged fixed demand charges, which are not off-set by solar PV generation. Some municipalities already offer a feed-in tariff for excess solar PV generation but this is likely to be of benefit to residential customers who tend to have a lower electricity demand during the middle of the day.

As summarized in Section 3.5.2, Eskom and a number of municipalities have already indicated that they intend to move towards higher fixed charges in the coming years, increasing the risk of an economic business case for SSEG. However, at the same time the cost of solar PV continues to decline, making the tipping point at which there is no longer an economic business case for SSEG lower each year. Careful consideration of all of the tariff components and how they are expected to evolve over time is thus necessary to determine the economic business case of SSEG for C&I customers.

3.4.4 Wheeling charges in the South African context

This section provides a brief discussion of wheeling charges and how Eskom and municipalities approach wheeling charges. Wheeling charges are the costs of using the network and are also known as network use charges [96].

The types of charges applicable for wheeling under NERSA guidelines are [52]:

- *General UOS charges (payable whether wheeling occurs or not)*
- *Network charges*
- *Reliability service charges (for the provision of ancillary services)*
- *Service and administration charges*
- *Losses charges*
- *Less the affordability subsidy not raised on the wheeled energy*

i. Eskom wheeling charges

Eskom wheeling charges are referred to as UOS charges. These charges recover the transmission and distribution licensees' regulated costs associated with retail, capital, operations, maintenance, and return on assets [97]. In addition to the UOS charges, there are charges related to the load and generators sides. The Eskom Tariff booklet describes the generation wheeling tariff as 'A reconciliation electricity tariff for local and non-local electricity customers connected at >1kV on Urban or Rural networks on the Megaflex, Megaflex Gen, Miniflex, Ruraflex or Ruraflex Gen Time of Use (TOU) electricity tariffs that have entered a wheeling transaction with a generator' [93]. The charges levied for wheeling follow the NERSA guidelines. It should be noted that Eskom does not enter into long-term wheeling agreements at a fixed rate. Therefore, C&I customers should be aware that they may be subject to changes in tariffs and tariffs structures.

ii. Municipal wheeling charges

A few municipalities have entered into wheeling agreements and have wheeling tariffs in place such as the City of Cape Town, City of Tshwane, and Nelson Mandela Bay Municipal Metro [98]. For wheeling tariffs to be approved by NERSA the municipalities/distributor licensees are required to conduct a COS study which has the objective of 'apportioning all costs required to service customers among each customer class in a fair and equitable manner' [99]. This will allow for the resulting tariff to be fair for all parties. However, at present very few municipalities have conducted these studies and their UOS charges are not unbundled i.e., the tariffs are bundled and include the grid system and energy costs [96]. According to an analysis conducted by the South African Wind Energy Association (SAWEA), wheeling charges differ significantly between municipalities. Wheeling charges for City of Cape Town, Nelson Mandela Bay and City of Johannesburg fell in a range between 30-40 c/kWh while wheeling in City of Ekurhuleni and City of Tshwane were between 15-20 c/kWh. The lower rates were due to the municipalities lower overall energy charges to their customers [98].

BOX 4: Case study: Nelson Mandela Bay Municipal Metro

This municipality has a framework wheeling agreement in place which is a generic agreement that states the maximum private power that is allowed for wheeling and the conditions under which it will wheel power [26]. **Figure 40** below depicts an example of the wheeling agreement that is used by the municipality. The municipality has set a target of 10% to be from wheeled RE [26]. The agreement stipulates that only traders that are registered with NERSA can apply to wheel power. Traders are then charged a standard grid charge, and post a COS study, the grid charge is set at around 20% of the value of the power wheeled [96].

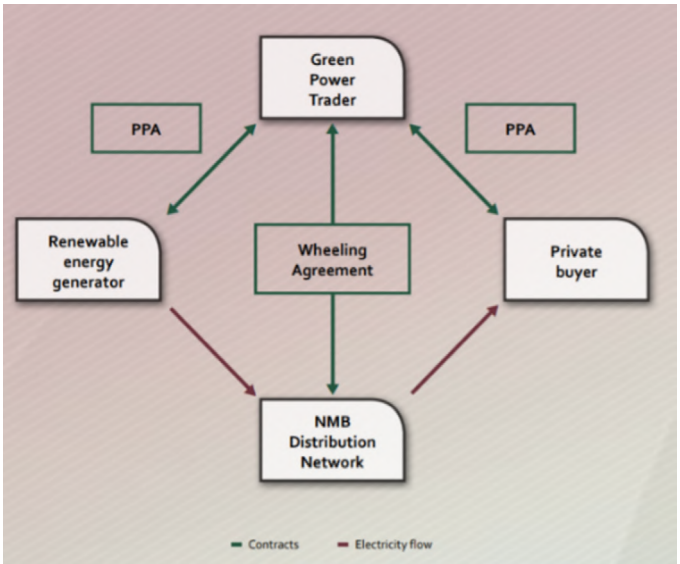


Figure 40: *Schematic of the wheeling framework [96] Source: CityEnergy*

3.5 Highlights

This chapter provided a discussion of the key legislation, policies, regulations, and codes that pertain to the development of RE by C&I consumers. The regulations for the promotion of RE self-consumption and embedded generation have been insufficient to stimulate significant growth for the C&I market. Despite the recent amendments to the ERA which exempt energy generators with a capacity <1MW from licensing requirements from NERSA [28], larger C&I consumers have stated that this is insufficient and have called for this threshold to be increased. The IRP2019 provides the plan for power sector capacity additions through ministerial determinations and makes an allowance for DG capacity additions [40].

The main challenges presented are with the application for generation licenses by project developers, limitations within NERSA to process applications and COS studies, limitations within the regulations to allow for wheeling and bilateral PPA agreements. C&I consumers are required to comply with the relevant grid codes for connection to distributor networks which can be complex depending on the size of the system. Several potential solutions were highlighted to overcome these challenges and stimulate growth of the market, such as:

- *Simplifying the licensing requirements and automating some aspects of the licensing process*
- *Increasing threshold for exemption from generation licensing while still ensuring integrity of technical requirements*
- *Longer term planning for municipal network requirements, which will reduce the frequency at which tests have to be conducted*

The international literature review provided key lessons that SA can learn and apply to the development of the C&I market such as opening negotiation for transmission and distribution network charges, reducing the frequency of technical impact assessments for distribution network connection, allowing flexible and clearer negotiation of PPA contracts, and encouraging self-consumption by clear regulations on compensation for injecting power into the grid.

The economics and tariffs section provided an investigation of the current tariff structures and how these pertain to C&I consumers and concluded with a brief discussion on wheeling charges in SA. Electricity tariffs in South Africa are expected to continue increasing over the next decade (in real terms) as informed by the national IRP2019. Eskom and a number of municipalities have already indicated that they intend to make changes to the structure of electricity tariffs to customers, which include moving towards higher fixed charges in the coming years, increasing the risk of an economic business case for SSEG. However, at the same time the cost of solar PV continues to decline, making the tipping point at which there is no longer an economic business case for SSEG lower each year. Careful consideration of all of the tariff components and how they are expected to evolve over time is thus necessary to determine the economic business case of SSEG for C&I customers. The establishment of the wheeling agreement frameworks for municipalities and wheeling tariffs has not progressed sufficiently, with only a few municipalities managing to stipulate tariffs and complete COS studies for NERSA to review.

CHAPTER 4: BENEFITS AND CHALLENGES

4.1 Potential benefits and challenges for South African C&I consumers

4.1.1 Client business case analysis

The C&I market comprises of companies with varying electricity consumption requirements, from small rooftop solar PV installations that serve commercial buildings and processes to large scale applications in the industrial sector. The falling costs of RE, rising electricity tariffs, increasing pressure to decarbonise operations, and losses to business performance arising from load shedding have resulted in increased interest in RE self-consumption options by C&I consumers.

The Government has passed supporting policies and amended the income tax law to favour RE embedded generation installations by businesses. The current IRP2019 ministerial determinations make provision for up to 500 MW per annum of DG (which covers embedded generation between 1 and 10 MW) from 2023 to 2030 [40]. The President of South Africa, Cyril Ramaphosa, during his 2021 State of the Nation (SONA) address held in February, announced that the government would work on amending ERA regulations further to increase the threshold for embedded generation that would not require licensing from the current 1 MW [100]. The carbon tax and carbon offset regulations create accountability for carbon emissions and reward the entities making efforts to reduce their carbon footprint. Some municipalities have feed-in-tariffs (FIT) that provide incentives for feeding excess production back into the grid. In addition, the big banks are providing more financing options for embedded generation. All these factors make a compelling business case for C&I consumers to explore RE embedded generation installations to supply their businesses with reliable electricity.

Furthermore, currently the electricity tariffs charged by municipalities are skewed towards variable costs which represent the energy component. Therefore, embedded generators can save a substantial amount since they would deal with the fixed cost component of the tariff, and not the energy cost. However, this may change if the structure of the tariff is changed to be more cost reflective and represent a balance between variable and fixed components of the tariff. This may reduce the business case for embedded generation as potential savings would be adversely impacted.

Implications for C&I business

Benefits

- ***Increase in reliability of power supply****: C&I businesses can use embedded generation to increase the availability of electricity supply to sustain their businesses and reduce some of the impact of load shedding [101].*
- ***Reasonable payback period in the current tariff environment:*** *There is a potential to reduce the payback period for solar PV systems to 6 years with a fair valuation by the municipality on the SSEG tariff, depending on the tariff structure and if there is a fixed charge component [102]. This is attractive as consumers can recover their investments quickly, and contend with the O&M costs, as the typical lifetime of PV installations is 20-25 years [103]. Bigger industrial customers with larger scale PV could have even shorter payback periods.*
- ***Reduced electricity bills:*** *This results in savings on variable costs for the business over the lifetime of the system. Savings are further boosted during standard and peak periods wherein Eskom charges higher rates for electricity. Solar PV production tends to overlap mostly with standard tariffs and some peak hours in the mornings. C&I customers typically have demand profiles that are well correlated with solar PV production. GreenCape estimates savings on electricity costs to be up to 16 percent for embedded generators, which can be redirected into the business to pay off the investment for the system [103]. These savings will likely increase as solar PV prices decline further and tariffs increase year on year.*

- ***Feed-in-tariffs and net-metering offered by several municipalities:*** *C&I consumers who produce surplus electricity can get paid by municipalities at a set feed-in-tariff e.g., the City of Cape Town will pay 72 ZAR cents per kWh fed back into their network. Additionally, some municipalities are allowing net-metering on their networks.*
- ***Savings on diesel back-up generator costs****: Many businesses have resorted to diesel back-up generators to mitigate for the loss of electricity during load shedding periods. However, this is a costly solution especially with fuel prices on the rise. Thus, the installation of RE self-consumption facilities will result in savings on diesel costs for back-up generators.*
- ***Income Tax savings****: Section 12B of the Income Tax Act (Act 58 of 1962) was amended on 1 January 2016, and provides for full depreciation of the costs in the year of commissioning of a grid-connected solar PV system of less than 1 MW [104]. This results in an effective reduction of 28% in the company's income tax. Systems larger than 1 MW have a capital depreciation allowance over three years with 50% of the capital cost in the first year of commissioning, 30% in the subsequent year, and 20% in the third year [104].*
- ***Value Added Tax savings****: C&I companies that are registered for VAT with the South African Revenue Service (SARS), can deduct the VAT portion of their solar PV system [103]*
- ***Reduction in carbon tax****: The SA Carbon Tax Act applies tax to GHG emissions from entities operating in SA. Installing RE systems will reduce the total tax liability. Furthermore, the carbon offset regulations allow entities to offset their emissions through eligible projects.*
- ***Reduction in carbon footprint****: SA has committed to Nationally Determined Contributions (NDCs) under the 2015 Paris Agreement which requires sectors to reduce their total emissions. Therefore, C&I companies are working towards playing their part in their respective sectors through commitments to reduce their carbon footprint. Investing in RE systems has been a good solution for them to achieve this, over and above investments in energy efficiency.*

The following cases illustrate benefits that have been realised or will be realised by C&I customers that have invested or are planning on investing in renewable energy embedded generation projects for their operations.

BOX 5: Case study - Old Mutual Mutualpark



Old Mutual is an investment, savings, insurance, and banking group that has operations across the African continent. The company installed a 1MW solar PV system in Pinelands, Cape Town. The system was installed by SOLA Future Energy and comprises 3,600 solar panels with a surface area of about 7,000 square meters [103], with coverage of 565 carports [105]. There is 1.9 GWh of electricity generated annually which results in a 5% reduction in electricity costs. The system is to operate for the next 25 years providing energy savings of approximately R3.7 million per annum, resulting in a payback period of approximately 5.5 years [106]. In addition, the facility saves 2125 tonnes p.a. in carbon dioxide (CO2) emissions saved [103]

BOX 6: Case Study - Ford announces a 13.4 MW rooftop solar for SA factory



In November 2020, the Ford Motor Company of Southern Africa announced that it will be installing a 13.4 MW system at its' manufacturing plant in Silverton, Pretoria. The solar installation is a partnership with SolarAfrica called 'Project Blue Oval' and it will cost R135 million (equivalent capex of 10,074 R/Kw). The project will involve specially developed and locally manufactured solar PV carports throughout the facility. The solar PV carport manufacturing will create 100 jobs. The project will be one of the largest solar PV systems mounted at a manufacturing facility in the world, with its 31,000 solar PV panels covering 4,200 parking bays. The solar system will deliver 30 percent of the Silverton manufacturing facility's annual electricity needs. Ford's vision is to have the Silverton facility 100 percent green and self-sufficient by 2024 [107].

Challenges

- ***Application and approval processes are challenging to navigate****: The processes required to be followed to get connected to municipal networks has been identified as a key challenge for potential C&I consumers. This is exacerbated by having different entities being responsible for various parts of the process instead of a single co-ordinating body [108].*
- ***Insufficient regulations to stimulate fast growth****: Although the IRP and ERA are both making progress with creating an environment that encourages embedded generation – the processes have been slow. Net-metering regulations have not been made official, wheeling frameworks for municipalities are still mainly under development or awaiting approval from NERSA, and systems larger than 1MW must contend with lengthy generation license applications.*
- ***Lack of maturity in local solar PV component manufacturing****: The solar PV manufacturing supply chain requires further localisation as efforts were hampered by policy uncertainty over the last decade. The missed opportunity that was presented by the REIPPPP to establish well-functioning local manufacturing supply chains means that procurement costs associated can be prohibitive.*
- ***Labour shortage****: Sourcing local high-skilled labour has been cited as a challenge by utility scale IPP developers [109]. In addition, sourcing accredited local installers has also been a challenge for smaller installations and thus many installations have been subpar and are not up to industry standards [110].*

This section outlined the benefits and challenges provided for the client business case for the development of RE projects for C&I consumers. The challenges that need to be addressed are around processes, insufficient regulations, lack of localisation and labour shortages. To improve the business case, these challenges need to be addressed. This could be done through simplifying processes, increasing NERSA's human resources, clarifying, and improving regulations, putting in place plans and/or formal regulated targets to increase localisation and taking advantage of the new REIPPPP bidding rounds and renewed fervour in establishing local RE supply chains. Furthermore, the local labour force can be upskilled through relevant training and providing accreditation for installers. This can be done through initiatives such as PV GreenCard which provides training and verified certification that installers can present to consumers. However, buy-in from the market is required to increase uptake of the PV GreenCard certification. The next section elaborates on the benefits and challenges around employment and skills development.

4.1.2 Employment and skills development

There are several drivers for decarbonisation in the SA power sector namely, an abundance of RE resources, dropping RE technology costs, climate change commitments, a coal fleet approaching retirement and the need for new power generation capacity [109]. A just energy transition (JET) will open new opportunities for coal sector employees and other job seekers. Domestic skilled labour is required to support this transition. The bulk of job creation in RE generation occurs within the high-skilled labour group, classified as employees with an education level above Grade-12 [109]. Of the new jobs created in this group, about 70% are highly qualified jobs [109]. Therefore, the potential employment gains depend on the availability of a skilled workforce. IPPs have indicated that the required skilled labour is not present, and this is a challenge for IPPs who want to maximize their local content [109]. Thus, there has been an influx of foreign labour to build projects. This was an interim step to fix the skills shortage, however, it has been highly criticised as it is not encouraging localisation [109]. Skills development is a priority to ensure that local skills meet the needs of the industry.

In the utility-scale REIPPPP, projects have had a large and increasing proportion of local content which has had a positive impact on job creation in SA. In 2020, a total of 52,603 direct job years (59 693 FTEs) were created for SA citizens, of which 42,355 were in construction and 10,248 in operations[111]. Although, REIPPPP projects have mandated minimum levels of local content, the requirements do not specify how the implementation of local content will lead to an increase of local manufacturing. Therefore, it has been challenging to sustain and build supporting industries for the RE sector because of the uncertainty around the requirements and policy uncertainty [112].

Implications for C&I business

Benefits:

- ***Increased youth employment:*** *Contribution to reducing youth unemployment which is currently at an estimated 55.75% [113]. Training and development in the solar PV industry can contribute to reducing the high unemployment levels. Employment that can link sustainable development and the youth is vital [114]. The REIPPP programme has created more than 38,000 jobs for young people and women in communities surrounding the plants[115].*
- ***JET skills capability building:*** *There is an opportunity to build skills that can be used in the JET, as there is significant job creation potential from RE which can offset some of the job losses from the coal value chain as SA transitions to lower carbon electricity. Since 2014, the International Labour Organisation (ILO) has provided SA with a set of training and capacity building opportunities to meet the job development potential of a greener economy[116].*
- ***Increased female participation in the energy sector:*** *Although, the energy sector is primarily male-dominated, women are making their way into the sector. Institutions such as Women in Oil and Energy South Africa (WOESA) prioritize the facilitation of women's participation in business opportunities in the energy sector. However, more needs to be done and a stronger implementation of existing policies and empowerment of women is still needed[117]. C&I companies can take advantage of the opportunity presented by growth in this market to stimulate employment for women.*
- ***Increased opportunities for small business development:*** *The growth in RE embedded generation provides opportunities for small to medium sized businesses to be established along the RE manufacturing value chains, system installation and services.*

Challenges:

- ***Skills and labour shortages:*** *There is a lack of high-skilled labour in the sector which has resulted in high levels of foreign labour and not enough knowledge and technology transfer from the imported labour.*
- ***Unauthorised and substandard installers:***
  - *Unqualified personnel can install equipment, which results in inferior quality. Poor design and clients may be misinformed on certain aspects of their installation.*
  - *The law requires that a SSEG installation be issued, as an addition or extension of an existing electrical installation, with a Certificate of Compliance (CoC) prior to the connection to the distribution network. It appears that several SSEG installations are being undertaken by people who are not registered with the Department of Labour (DoL) and are not authorised to issue a CoC[110].*

Job creation impact from renewable energy distributed generation

Illustrating job creation potential – I-JEDI

To assess the gross employment impacts of increased RE deployment, the CSIR has adapted the International Jobs and Economic Development Impacts (I-JEDI) tool for South Africa. The I-JEDI tool has been used in several CSIR projects namely, the GIZ Just Transition; CoBenefits and IRP comments, to name a few. The I-JEDI model estimates the economic impact of construction and operation of power plants, by characterizing these two phases in terms of domestic and international expenditure. Model data is then used in the country-specific input-output (I-O) model to estimate employment, earnings, gross domestic product (GDP) and gross output impacts [109].

I-JEDI provides jobs in terms of direct, indirect, and induced as defined below:

- **Direct jobs** *are those which are directly related to the power plant. For example, workers employed during construction, or during the operations of the power plant.*
- ***Indirect jobs*** *are associated with activities related to the power plant. Examples include the manufacturing of power plant components, or with construction related activities such as cement manufacturing or transport of components to construction sites.*
- ***Induced jobs*** *are a category of jobs which arise from economic activity in an area, but which are not directly related to the RE industry. For example, Renewable energy technicians may spend part of their wages on buying property, thus inducing jobs in the property industry. When the construction workers on the solar PV farm are injured, then the doctors and nurses providing medical services would be considered induced jobs.*

To illustrate the job creation potential arising from solar distributed PV (DPV) generation plants, three I-JEDI scenarios were run for different sized plants – 1 MW, 5 MW and 10 MW. **Figure 41** shows the results from the analysis and illustrates the jobs that can be created from installation of solar PV systems for C&I consumers.

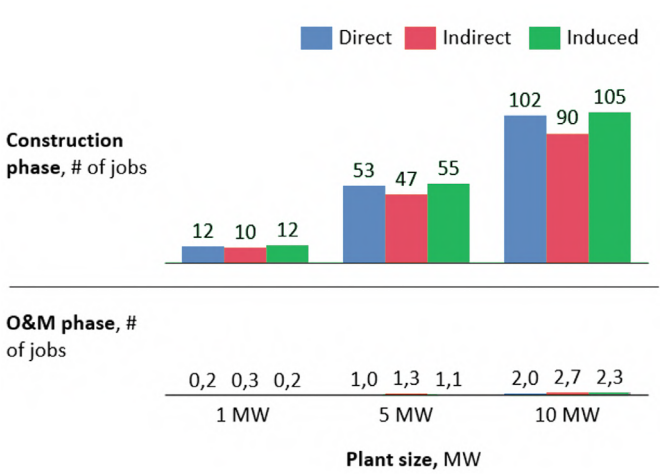


Figure 41: *I-JEDI results for comparison of different sized solar PV C&I plants. Source: CSIR Analysis*

CSIR estimates that potential employment from SSEG to 2030 assuming annual total capacity additions of 200MW to grow from 2,600/year in 2019 to 3500/year in 2030 for construction jobs and grow from 100/year to 1500/year for O&M jobs [110]

Skills development

The challenges identified in this section were the lack of skilled labour and accredited installers for RE. One of the potential solutions to solve for accreditation and training is the South African PV GreenCard which is a safety certification, quality assurance standard, and training programme for solar PV installers. It focuses on education, skills development, and training to build installer capacity, as well as improving standards development and compliance in line with international best practice. Quality and safety are assured before being certified and registered on their database through the advanced education and training provided to solar PV installers. This certification means that these installers are competent and comply with all relevant national and municipal electrical regulations [118].

For skills development, several universities are offering courses and degrees with a green curriculum such as the South African Renewable Energy and Technology Centre (SARETEC) at the Cape Peninsula University of Technology. SARETEC provides specialised training to the RE sector in SA through formal training and short courses. [119]. Similarly, the University of Stellenbosch offers various degrees and short courses at their Centre for Renewable and Sustainable Energy Studies (CRSES).

Furthermore, the Skills for Green Jobs Programme, the Department of Higher Education and Training and the Department of Science and Technology jointly developed and implemented a new National Certificate Vocational optional subject called Renewable Energy Technologies, which falls under the 3-year Electrical Infrastructure Construction Programme. This involved lecturer training on the RE curriculum, the development of student textbooks and lecturer guides. The subject was well received and five Technical and Vocational Education and Training (TVET) colleges have offered it [120]. In the case mentioned above, the local Further Education and Training (FET) College reintroduced welding into the curriculum, while solar PV installation training took place in Atlantis in February 2016.

4.1.3 Summary of benefits and challenges for C&I consumers

Below is a summary of all the potential benefits and challenges for C&I market development discussed in this section.

Table 6: Benefits and challenges for C&I consumers

	Client business case analysis	*Employment and skills development*
Benefits	• Increase in reliability of power supply • Reasonable payback period in the current tariff environment • Reduced electricity bills: • Feed-in-tariffs and net-metering offered by several municipalities • Savings on diesel back-up generator costs • Income and Value Added Tax savings • Reduction in carbon tax • Reduction in carbon footprint	• Increased youth employment • Just Energy Transition skills capability building • Increased female participation in RE sector • Increased opportunities for small business development
Challenges	• Application and approval processes are challenging to navigate • Insufficient regulations to stimulate fast growth • Lack of maturity in local solar PV component manufacturing • Labour shortage • Negative impact from future electricity tariff structural changes	• Skills and labour shortages • Unauthorised and substandard installers

4.2 Potential benefits and challenges in municipalities and utilities in SA

4.2.1 Effects on municipal and national utility balance sheets

Electricity production by Eskom peaked in 2007 and has since been steadily declining, see Figure 41 [5]. This decline is due in part to challenges with availability of supply, but also due to migration of businesses to other countries or closing operations permanently because of increased frequency of load shedding over the past 13 years. The challenge with unreliable electricity has led to an increase in embedded generation in residential and C&I customers which has decreased sales further.

The reduction in sales translates to reduced revenue and lower profit margins, therefore, to keep up their capital and operations expenditure, Eskom applies to NERSA for tariff increases that will allow them to manage their operations. These tariff increases lead to more consumers defecting from the grid, resulting in reduced revenue and a requirement for additional tariff increases. This has led Eskom into what is known as the utility death spiral [121]. **Figure 42** shows the decline of Eskom's electricity sales after the first instance of load shedding in 2007 and the annual amount of load shedding and Eskom IPP purchases [101],[5].

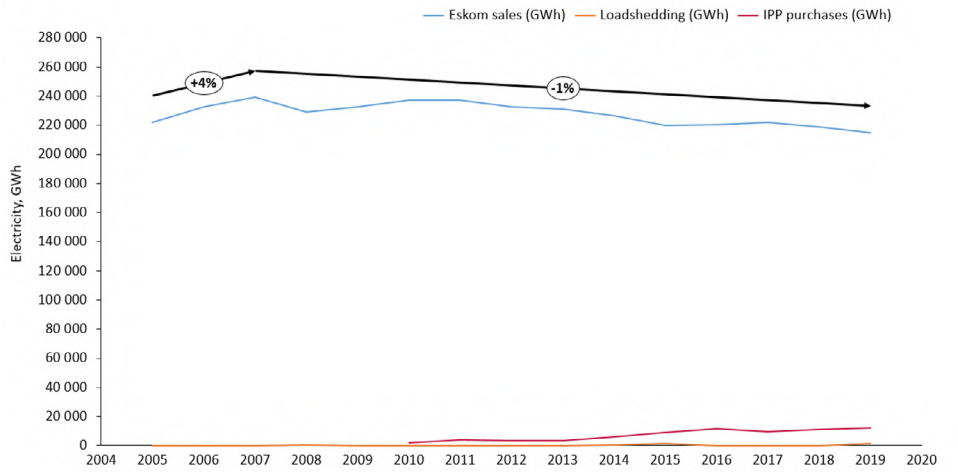


Figure 42: *Comparison of Eskom Sales to IPP purchases and load shedding. Source: Eskom & CSIR Analysis*

Municipalities have had a decline in their resales of electricity to end-consumers as embedded generation capacity increases in their networks. As discussed in Chapter 1, the SSEG market has grown in the past couple of years, reaching over 1 GW in 2020. Municipalities purchase electricity from Eskom on a TOU tariff, and then go on to sell to their end-users at a rate which has their own distribution (network costs), retail costs and an allowable profit margin included. This results in higher tariffs charged by municipalities during standard and peak periods.

Due to the nature of solar PV, embedded generators take advantage of the daytime use of solar PV to save on costs of electricity that would be incurred during standard and peak periods. This results in higher losses to municipalities as they lose out on the revenue they would have received during these periods, which a study has shown is when they make up to 60% of their gross profit [122]. This study assessed how municipal profit margins were affected by solar PV embedded generation by modelling the PV load profile and comparing it to residential power use and TOU tariffs. The study shows that solar generation only really affects the profit that is earned during daytime wherein 97 percent of solar generation occurred between 9am and 6pm. See **Figure 43** for daily active energy charge profit for municipalities based on Eskom TOU periods [123].

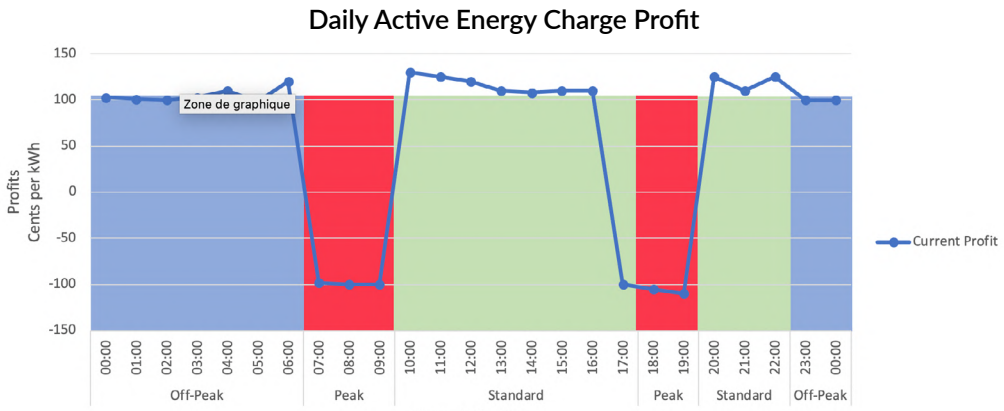


Figure 43: *Daily active energy charge profit by TOU [123]. Source: AMEU*

On the other hand, most municipalities do not have wheeling frameworks in place and are not yet charging the right tariffs for use of their networks. Increased revenues from wheeling of energy could offset some of the losses presented by decreased consumption by embedded generators. They could also take advantage of net-metering on their networks wherein they purchase electricity from consumers in their networks at a reduced cost compared to Eskom – especially during standard and peak periods. Even though NERSA released a consultation paper on net metering in SA, there has been no progress and it remains unregulated. However, some municipalities have already gone ahead and allow it on their networks.

Municipalities are exploring ways to encourage private RE development through development of application guidelines and procedures relating to SSEG. Municipalities benefit from fixed charges to customers connected to their network and reduced costs associated with decreased bulk purchases from Eskom as well as decreased technical distribution losses from these purchases [124]. There has been a marked increase in municipalities with processes to accommodate SSEG. **Figure 44** shows the increase of municipalities who are implementing processes to enable SSEG uptake in their networks. There are 56 municipal distributors that allow SSEG installations, 44 that have an official SSEG applications system and 31 with SSEG tariffs [125]. According to the South African Local Government Association SALGA), the main reasons behind this increased uptake by municipalities is capability building efforts that support municipalities to accommodate increased SSEG, legislative frameworks that have facilitated SSEG roll-out and an increased willingness by the municipalities to embrace the energy transition [125].

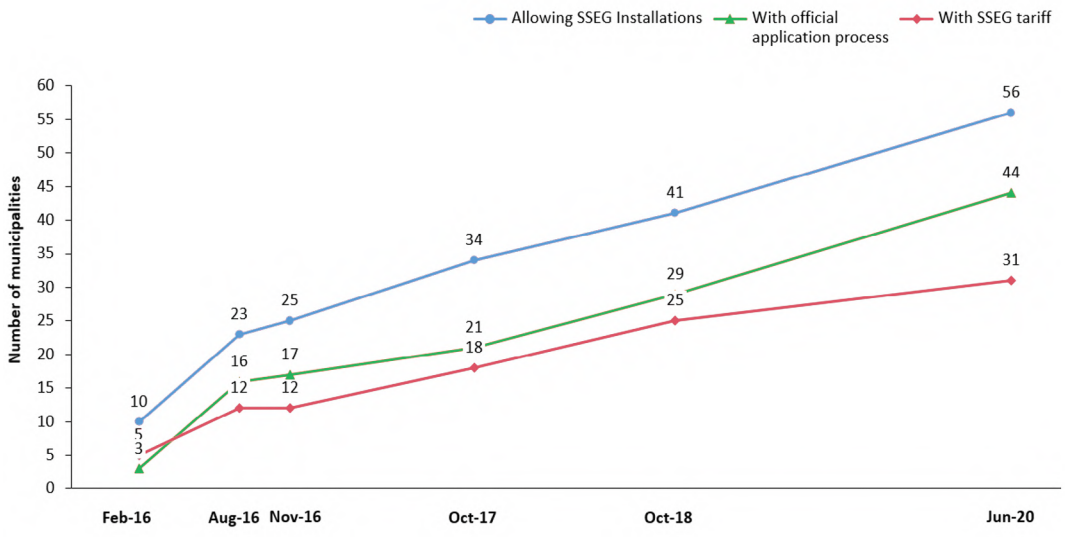


Figure 44: *Overview of national uptake of SSEG by municipalities. Source: SALGA*

Implications for municipalities/Eskom

Benefits

- ***Municipalities can change their tariff structures to gain revenue****: Municipalities can take the opportunity to adapt their tariffs from the current flat structure to a structure that reflects their operating environment. This can be done using proper COS studies to structure tariffs in a cost reflective manner. This could mean a reduction in the portion attributed to variable costs in the tariff and an increase in the fixed costs, as well as a feed-in-tariff to compensate consumers for their exported energy.*
- ***Municipalities can establish wheeling frameworks to gain income from embedded generation****: More municipalities can get their COS studies conducted and submitted to NERSA so that they can take advantage of the opportunity to charge wheeling tariffs for use of their networks and get additional income.*
- ***Decreased investment requirements in generation for utility****: The increase of embedded generation, especially larger scale systems (>1MW) will defer some of the investment that Eskom would have had to make in the generation segment.*
- ***SSEG does not require government guarantees****: The construction of RE power plants for use by C&I consumers will not be funded by government related funds but rather the C&I entities themselves which reduces the burden of debt on Eskom, municipalities and national government.*

Challenges

- ***Insufficient NERSA capacity to process COS studies****: The ability for municipalities to adjust their tariffs and establish proper wheeling tariffs is dependent on NERSA capacity to process their COS studies and the municipalities technical capabilities or availability of finance to hire consultants to conduct their COS studies*
- ***Increased SSEG installations reducing municipal revenue****: The marked increase in SSEG installations, reduced demand and an increase in energy efficiency projects has resulted in a decrease in the total sales of electricity for municipalities. This results in decreased revenues for the municipalities which depend on electricity revenues for a substantial portion of their income.*
- ***Increased Eskom tariffs increases municipal tariffs****: Since most municipalities are resellers of Eskom electricity, when Eskom increases their tariff, they are obliged to do the same. Municipal tariffs are higher than Eskom as they add network costs, retail costs and an allowable profit margin. With the drop in solar PV prices the LCOE for solar is significantly less than municipal tariffs and therefore more consumers are investing in solar PV systems.*
- ***Potential subsidisation for embedded generators****: Since the current tariff structures are weighted towards the variable costs for both Eskom and municipalities – the reduction in energy sales results in fixed costs not being able to be fully recovered. This could result in increased electricity tariffs across all customer categories to make up for decreases in revenue which would result in a subsidy for embedded generators.*

The decreased revenues may result in reduced regular maintenance of the distribution network and a lack of investment in the distribution grid which may result in dilapidated municipal grid infrastructure. In addition, the decreasing municipal revenues could lead to the municipalities seeking financial assistance from government beyond what they currently receive or being unable to finance their distribution operations and having an increased risk of being unable to continue distributing electricity. Municipalities need to find innovative ways to finance their other operations – and not be solely dependent on electricity revenues. They could restructure the tariffs so that the fixed cost component has a justifiable heavier weighting versus variable energy costs. They could ensure that their wheeling frameworks are developed and approved by NERSA so they can generate revenue from the use of their network.

4.2.2 Analysis on government guarantees

The energy sector has significant investment requirements which can be costly to finance. To help with financing challenges, governments sometimes opt to provide guarantees to the utilities to help them become profitable or sustainable as these are primarily state-owned, especially in developing markets [126]. In SA, the REIPPP programme allowed for the increase of IPPs in RE electricity generation. Eskom was mandated by Cabinet to be the single-buyer of electricity in SA and entered PPAs with the IPPs in the programme. The government made provision for sovereign guarantees to IPPs as they entered PPAs of up to 20 years with Eskom. Under these payment guarantees, if Eskom is unable to comply with its obligations under the PPAs, National Treasury is obliged to purchase power from the IPPs. Furthermore, the government may be required to pay project sponsors if a project is terminated early [126]. These payment guarantees have been recognized as one of the key drivers for the success of the REIPPPP.

As previously mentioned, the ERA was amended in October 2020 to allow municipalities to develop their own power generation projects if they are in good financial standing. Therefore, municipalities will not need to rely on Eskom when they want to purchase sustainable and reliable electricity from IPPs or to generate their own electricity through projects using municipal waste [127]. However, given the current state of most municipal finances and their cash flow problems, the development of these power generation projects may be delayed. On the 30th of June 2018, 10 municipalities reported negative cash balances compared to 19 municipalities as of 30 June 2017. Although there is an improvement in cash balances, in the 2018/2019 financial year, all municipalities - except for metros - experienced an increase in creditors. This was due to defaults in payments for services by customers, indicating an increase in financial pressure[128]. These persistent financial challenges could affect their ability to enter PPAs, which puts them at a disadvantage compared to Eskom as they have no guarantees to back up their contracts [129].

Implications for municipalities/Eskom

Benefits

- ***Guarantees provide Eskom with security in case of default****: The provision of sovereign guarantees by the government gives Eskom the security it needs to enter in long-term PPAs with IPPs as they can count on government to pay if they are not able.*
- ***Increased investment in the RE sector****: Guarantees provide investors with confidence, especially in countries where there are a lot of project risk from regulations and the political environment. The guarantees act as a catalyst that ensures projects are carried through, which results in increased RE development.*

Challenges

- ***High debt burden of Eskom****: Due to the high debt burden at Eskom, there is an increased risk of default by the utility wherein it might not be able to or be willing to pay for the electricity from IPPs. However, to date Eskom has not defaulted on any of the payments to the IPPs [126].*
- ***Poor financial health of many municipalities****: Due to the challenging financial circumstances which many municipalities are in there is an increased potential risk of default on PPA contracts by municipalities. Municipalities may need to guarantee payment to IPPs from the government as they are at a higher risk of defaulting on payments to IPPs. Given the regulatory risks and the elevated level of government exposure to sovereign guarantees, municipalities would have to make a compelling case for approval [130].*
- ***Government debt reduces likelihood of guarantees****: Given the increase in the current government debt, there is a chance that government may decide not to provide guarantees in upcoming REIPPPP bidding rounds and there is minimal chance of providing guarantees to municipalities. An increase in guarantees widens the budget deficit, this leads to an increase in government debt and borrowing costs, which at present SA cannot afford [131].*

Government guarantees were indeed an effective mechanism for the establishment of the REIPPPP and its' success. However, considering the financial position of the government, which was already precarious before COVID-19 and has now deteriorated further because of the pandemic, it may not be possible to provide guarantees indefinitely on projects and another alternative mechanism for securing projects should be explored.

4.2.3 Network upgrade deferral and grid constraints

The increase in RE distributed generation presents new challenges for distribution system operators (DSO) and as their penetration increases, the operators must integrate and accommodate them on their respective networks. Traditionally, the design of flow of electricity in the electricity value chain was unidirectional – going from the generator to the end-consumer. However, the introduction and increase of own generation in the residential and C&I market has changed the status quo and now the flow can be bi-directional. This results in end-consumers having the ability to send their excess electricity back into the grid, which can have negative grid impacts especially if there are many embedded generators on the same network [132]. This can create challenges for the distributor such as voltage fluctuations, thermal constraints, and poor quality of supply [132]. Under the Grid Codes discussed in chapter 4, it is a requirement for potential embedded generators to have grid impact assessments conducted by the respective DSO of the network they would like to connect to. This is to ascertain the impact their system may have on the overall operation of the network and to ensure that the generator meets all the minimum technical requirements to connect to the grid.

On other hand, the increase in distributed generation could result in a network investment deferral for future demand. This provides DSOs the opportunity to defer investment for some time. Furthermore, as the embedded generation market grows, the DSOs can incentivise connection at certain points in their networks to reduce investment requirements on their part. Furthermore, as DSOs plan to reinforce or replace aging distribution assets, they can redesign the network to be able to easily integrate embedded generators into their network [133].

Implications for municipalities/Eskom

Benefits:

- ***Reduction in technical losses on the network****: Losses on the network are reduced as electricity does not have to travel long distances to reach the load centres as the additional electricity is coming from the embedded generators that are already within the network.*
- ***Decongestion of network assets due to demand growth****: The increase in embedded generation will allow DSOs to defer some of the required investment into the network that is as a direct result of increasing demand. Municipalities and more especially Eskom benefit from this because it relieves some of the pressure on them to reinforce and increase their network capacity.*
- ***Increased security of supply****: The addition of embedded generators to distribution networks adds increased availability of supply and removes pressure on centralised generation – which at present is a major benefit for SA DSOs. It is for this reason that many municipal DSOs have increased connections of SSEG and are looking to procure and buy their own electricity from IPPs.*

Challenges

- ***Complex technical assessment requirements****: DSOs need to conduct grid impact studies to ensure compliance of embedded generators to connect to their respective networks. This must be done each time a new generator needs connecting. However, in SA this can be done well using the NRS-097 series – which is a guideline for the connection of LV embedded generators.*
- ***Networks unable to accommodate embedded generation due to design constraints****: Most municipal networks are not properly maintained or are still in the phase of development where they are trying to expand their networks. Their networks were not designed for large generation uptake of embedded generators – in*

general networks were designed to connect large generators at the transmission network level, not distribution. The aggregation of SSEG on one network can become large and hard to manage when the system is not designed to handle large generation.

- ***Increase in network technical difficulties in weak networks**: Embedded generation can cause negative impacts on the network if the network is weak. They can create issues such as voltage fluctuations which could result in damaged equipment. In addition, uncontrolled and unmonitored injection of electricity can lead to inferior power quality. Additionally, thermal overloads can be experienced in power transformers resulting in reduced performance and reliability.*
- ***Capacity balancing on the network may be compromised**: The DSOs must ensure that the network can handle the amount of electricity being transmitted. This requires careful power balancing from the DSOs to ensure that the capacity of the network is not exceeded by the surplus electricity being fed into the network.*
- ***Lack of technical capacity and/or capabilities**: Municipal DSOs do not always have the in-house capabilities or the capacity to conduct the grid impact assessments. According to the SALGA 'Status of SSEG in South African Municipalities' November 2020 report, 76 percent of municipal responses surveyed cited technical capacity and approval processes as the main challenges for integrating SSEGs onto their networks, see Figure 45 below [125]. In these cases, they can make use of the services of consultants who specialise in grid impact studies and are familiar with guidelines such as the NRS-097 series*

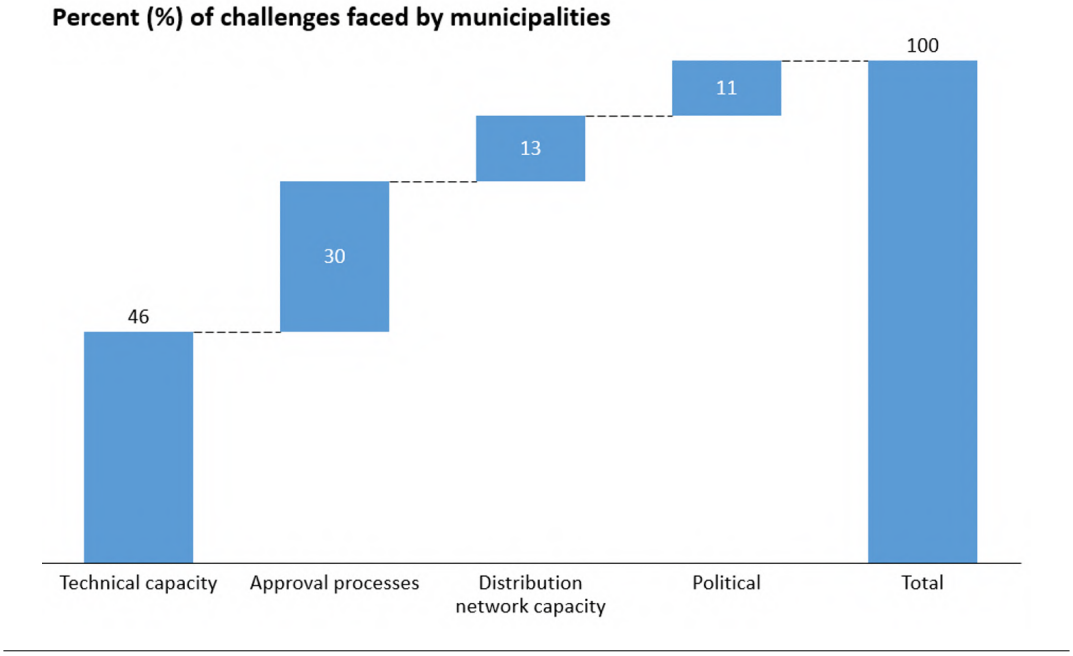


***Figure 45:** Main Challenges in accepting SSEG onto municipal distribution networks. Source: SALGA*

The challenges presented in this section illustrate that majority of the municipalities require upskilling of their personnel through training and development and to hire the relevant skills to fill the technical skills gap. The use of consultants is a feasible workaround for the lack of skills, but this can become expensive – and with the decreasing revenues presented by the uptake in rooftop solar PV and other self-consumption options, the consulting fees start to add up.

The municipalities also need to strengthen their networks to ensure that they can handle the variable power being connected to their networks – this will require additional funding over and above their general O&M. Long-term forecasting should be considered based on trends and the current demographics of the network to mitigate and plan for increased capacity on the network to avoid overloading the network.

4.2.4 Summary of benefits and challenges for municipalities and Eskom

Below is a summary of all the potential benefits and challenges for municipalities and Eskom that were discussed in this section.

Table 7: Benefits and challenges for municipalities and Eskom

	Effects on municipal and national utility balance sheets	*Analysis on government guarantees*	*Network upgrade deferral and grid constraints*
Benefits	• Municipalities can change their tariff structures to gain revenue • Municipalities can establish wheeling frameworks to gain income from embedded generation • Decreased investment requirements in generation for utility • SSEG does not require government guarantees	• Guarantees provide Eskom with security in case of default • Increased investment in the RE sector	• Reduction in technical losses on the network • Decongestion of network assets due to demand growth • Increased security of supply
Challenges	• Insufficient NERSA capacity to process COS studies • Increased SSEG installations reducing municipal revenue • Increased Eskom tariffs increases municipal tariffs • Potential subsidisation for embedded generators • Decreased revenues may result in poor maintenance and lack of investment in network infrastructure • Decreased revenues may result in increased government contribution to municipalities	• High debt burden of Eskom • Poor financial health of many municipalities • Government debt reduces likelihood of guarantees	• Complex technical assessment requirements • Networks unable to accommodate embedded generation due to design constraints • Lack of technical capacity and/or capabilities • Increase in network technical difficulties in weak networks • Capacity balancing on the network may be compromised

4.3 Cross-cutting potential benefits and challenges of increased renewable energy embedded generation

4.3.1 Carbon tax

South Africa is a large GHG emitter, particularly CO2, representing 1.4% of total global emissions and 36.8% of the emissions in Africa in 2019 [134]. This is due to the high dependence on coal by the energy industry [2]. SA has committed to reducing its emissions by submitting NDCs under the Paris Agreement which requires that emissions peak between 2020 and 2025, plateau for 10 years thereafter and decline from 2036 [135]. Apart from abundant RE resources, continued load shedding and rising electricity prices as a motivation for RE development in SA, the Carbon Tax also constitutes as a good motivator, especially for C&I entities with high energy requirements.

Municipalities and Eskom are also required to adhere to regulations under the Carbon Tax Act. Energy intensive C&I companies including smelters, mines and steelworks rely on electricity as a dominant source of their energy. Electricity purchased by municipalities from Eskom for the companies operating in the boundaries of the municipal network is mainly generated from coal [136] thus, increasing the municipal Carbon Tax liability.

Municipalities have energy intensive service delivery requirements, such as refuse removal, sewage collection and disposal, street lighting, electricity, and water supply. The Carbon Tax will increase the price of energy that is required for these services. Furthermore, municipal landfill sites also contribute to GHG emissions and increase the tax liability of municipalities. The revenue stream of municipalities is also affected as customers transition to self-generation from lower carbon technologies and increase their energy efficiency. Furthermore, municipalities compensate customers for the electricity that they feed back to the grid [124].

To reduce the impact of the carbon intensive electricity, municipalities are looking to sign PPAs with RE IPPs, which has been approved by government. Additionally, other municipalities have made use of their waste for gas to electricity projects and solar PV rooftop development for their own building operations [136]. Moreover, they have considered landfill gas (LFG) extraction for electricity projects, which provides them with an opportunity to reduce emissions while producing electricity to reduce costs and improving the safety and quality of life of residents who live near the landfill sites. Landfill gas conversion to electricity yields a substantial GHG emissions reduction, where GHG emissions are reduced through conversion of methane to water and CO2, which is then captured [137].

Eskom has a considerable CO2 footprint and thus a large Carbon Tax liability. According to their 2020 annual report, it incurred a high Carbon Tax liability emanating from recorded 2019 total GHG emissions amounting to 212,6 MtCO2e and wants to secure funding to transition to RE to reduce carbon emissions [5][138]. Practical examples include establishing their Sere Wind Farm which contributed 283GWh to the national grid as well as eight rooftop and ground-mounted PV sites at Eskom facilities [138]. In addition, Eskom has established a RE unit, which focuses primarily on purchasing of RE from IPPs and plans to invest in utility scale RE power generation technologies to reduce the GHG emissions [138][139][140]. However, keeping the emissions within the limit has not been an easy task for Eskom, as there are periods where power stations exceed emission limits. To address this, the Generation Environmental Compliance Steering Committee was established to address continuous exceedances of atmospheric emissions and poor specific water usage in the coal fleet [138].

Implications of the Carbon Tax Act

Benefits

- ***Increased incentive to invest in RE****: Investment in RE projects will result in reduced carbon tax liability, furthermore, the amounts that would have been used for the carbon tax levy can instead be used to contribute towards investment in RE projects.*
- ***Phased rollout of carbon tax liability encourages investment in decarbonisation projects****: The phased nature of the carbon tax will allow entities to invest in projects that will help them reduce their carbon tax liabilities. However, the window of opportunity is limited.*
- ***Carbon offsets and carbon trading provide additional incentive****: The Carbon Tax through the carbon-offset regulations allows businesses to trade in carbon credits to make more money as businesses are given a maximum allowance of permissible CO2 emissions. Businesses that do not use up their full allowance can trade that for credits [141]. Furthermore, businesses can make the use of carbon offsets to compensate for their GHG emissions by reducing emissions elsewhere in their business e.g., through RE projects.*
- ***Tax-free allowance relieves burden of tax liability****: Businesses qualify for a tax-free allowance that ranges between 60% to 95% of the total GHG emissions which will lower the burden of the carbon tax levy on their operations [142].*
- ***Exemptions for smaller businesses****: Businesses that are in electricity, heat production and food processing with a maximum capacity of 10 MW are exempted from paying carbon tax, which provides small-scale producers enough time to transition to low carbon technologies [45].*
- ***Improved health for affected parties****: The RE installations at the C&I company sites can result in improved employee health as they are now less exposed to CO2. Furthermore, the surrounding communities around the C&I businesses sites will benefit from reduced emissions and have less adverse impacts on their health.*

Challenges

- ***Burden of tax on Eskom****: Eskom is the single largest GHG emitter in SA, therefore, the burden of the carbon tax on the utility is notable.*
- ***Negative effect on municipal revenues****: More C&I consumers with high GHG emissions are transitioning their production activities to cleaner technologies through SSEG. This has negative implications for municipal revenues as these customers reduce their consumption of electricity [124]. However, the consumers migrating to RE technologies incur fixed charges for the use of the network which might offset some of the lost revenue for municipalities [124].*
- ***Negative effect on municipal landfill sites****: The carbon tax levy on municipal landfill site emissions will adversely affect their environmental performance, as they are plagued with capacity issues and often appear last on the list on municipal budgetary allocations.*
- ***Potential pass-through of costs to end-users****: Eskom and municipalities could pass through a portion of costs attributed to their carbon tax liability to customers, resulting in higher tariffs.*

The Carbon Tax was introduced to assist South Africa reduce emissions and has been one the drivers for increasing RE development. Eskom has had to critically think about how they reduce their emissions as the burden of the tax liability has put a strain on their already ailing finances. Municipalities are also required to think of innovative ways to reduce their emissions and generate revenues and there has been reduction in revenues as users move to cleaner energy and the added burden of the tax liability.

4.3.2 Carbon offset regulations

As mentioned in chapter 4, the South African Government gazetted the Carbon Offset Regulations in November 2019 [46] and the main objective of the regulations is to provide a regulatory framework for the development and administration of the carbon offset scheme under the Carbon Tax Act [44].

In relation to C&I market development, according to the regulations companies can offset 5-10 percent of their GHG emissions to reduce their carbon tax liability [48]. Small scale RE projects of up to 15 MW installed capacity are eligible for offsets under the regulations. For projects larger than 15 MW, only technologies with a cost less than R1.09/ kWh, will be eligible as carbon offsets [46].

For municipalities, investing in projects such as the LFG to electricity plant in eThekwini municipality is a practical way for them to use the resources at their disposal to offset their carbon tax liability. Furthermore, they can encourage end-users in their networks to invest in RE development so that they can purchase credits if needed. The regulations also encourage municipalities to invest in cleaner technologies for their operations and increase their energy efficiency efforts.

Eskom is provided with an opportunity to reduce the impact of the carbon tax on their finances through investing in clean energy projects. To date the utility has built the 100 MW Sere wind power plant, and they have a department that is responsible for RE development. These projects will assist Eskom in reducing their carbon tax liability by offsetting some of their coal power station production. However, as the largest source of GHG emissions in SA, emphasis is on Eskom upgrading their operational power plants to meet the minimum environmental standards such as the Air Quality Act – rather than just looking to offset their carbon emissions or purchasing carbon credits.

Implications of Carbon Offset Regulations

Benefits

- ***Increased incentive to invest in RE****: The regulations incentivise companies to invest in RE development because they can benefit from the carbon offsets through:*
  - *Allowing large emitters to offset a portion of their GHG emissions and thereby reduce their carbon tax liability by investing in RE embedded generation and other eligible projects. This incentive will increase once the carbon tax allowances fall away.*
  - *Increased revenues for companies that can accumulate credits and sell to higher emitting entities.*
- ***Reduced carbon emissions:*** *The inclusiveness of the regulations incentivises all businesses to invest in cleaner energy solutions. This is good for the country, especially as more companies formally commit to reducing their carbon footprint. Furthermore, on a global level the scrutiny on how 'green' processes are for producing products and services is increasing.*

Challenges

- ***Purchase of carbon credits could reduce investment in long term mitigation projects****: Larger emitters could decide to purchase carbon credits to offset their emissions and defer investment in cleaner technology. Carbon credits should not be used as an avoidance mechanism for large GHG emitters. However, once carbon tax allowances fall away, the incentive to invest in carbon offset projects will increase.*
- ***Adverse impacts on surrounding communities****: Large emitters who rely on the purchase of carbon credits instead of implementing mitigation projects of their own will continue impacting surrounding communities' health.*

BOX 7: Case study - Sasol carbon offset purchase from Bethlehem Hydro IPP

In November 2020, Sasol, an integrated chemicals and energy company in SA secured more than 100,000 carbon credits from an IPP called Bethlehem Hydro. This is one of the first transactions on the COAS. Sasol is second largest GHG emitter in SA, after Eskom, and it has set a target to reduce its current GHG emissions from 63.9 million tonnes of CO2 equivalent (MtCO2e) per annum to 57 MtCO2e per annum by 2030 [143]. Sasol stated that buying carbon credits is one of the strategies they will employ to address their GHG emissions. Bethlehem Hydro operates a 7MW small hydropower plant that was commissioned in 2009 and has generated 383 GWh of clean electricity, providing an equivalent reduction of 350,000 tonnes of CO2 [143].

The Carbon Offset regulations have provided further incentive for companies to reduce their carbon emissions through carbon offset projects which reward them for investing in lower carbon energy. It is complementary to the Carbon Tax by reinforcing the requirement to transition to cleaner energy. However, companies can misuse the Carbon Offset facility by just purchasing credits instead of investing in projects that would reduce their carbon footprint.

4.3.3 Summary of cross-cutting benefits and challenge

Below is a brief summary of all the potential benefits and challenges presented by the regulations to encourage carbon emission reduction discussed in this section.

Table 8: Cross-cutting benefits and challenge

	Carbon tax and carbon offset regulations
Benefits	• Increased incentive to invest in RE • Phased rollout of carbon tax liability encourages investment in decarbonisation projects • Tax-free allowance relieves burden of tax liability • Carbon offsets and carbon trading provide additional incentive • Exemptions for smaller businesses • Improved health for affected parties • Reduced carbon emissions
Challenges	• Burden of tax on Eskom • Negative effect on municipal revenues • Negative effect on municipal landfill sites • Potential pass-through of costs to end-users • Purchase of carbon credits could reduce investment in long term mitigation projects • Adverse impacts on surrounding communities if only credits are traded, but no mitigation done

4.4 C&I RE real world project experience

4.4.1 CSIR Experience with establishing a solar PV embedded system

This section delves into CSIR's experience as a C&I consumer and setting up its solar PV system on its campus in Pretoria. The CSIR established the Energy Autonomous Campus (EAC) Programme, now known as their Smart Utilities Programme (SUP) within their Energy Centre in 2015 with the aim of creating a real-world research platform on its' campus by supplying energy from three primary energy sources: solar, wind, and biogas. The initial focus of the project was aimed at electricity supply for the campus, but with the longer-term goal of demonstrating sector coupling of electricity with transport, hydrogen, and heating/cooling, as well as batteries and thermal storage. The CSIR was an early adopter of commercial scale solar PV in South Africa, supporting local manufacturers and system integrators such as ARTsolar, Pia Solar, Summit Energy and Lamo Solar.



	Single Axis Tracker	Dual Axis Tracker	Building 17 Rooftop System	PV Phase 1
Installed Capacity [kWp]	558	203	250	911
CAPEX	10.75 Million	6.9 Million	4.7 Million	13.3 Million
LCOE [R/kWh]	0.83	1.00	0.87	0.77
Commissioning date	2015 Aug	2016 Dec	2017 Apr	2019 Apr
Decommissioning date	2040 Aug	2041 Dec	2042 Apr	2044 Apr

Figure 46: *Installed solar PV on CSIR campus (2015-2019). Source: CSIR*

The total capital expenditure on the solar PV projects to date is R35.1m, and has resulted in a substantial cost savings, reducing the electricity purchase costs from their municipality -Tshwane municipality, with a savings to date of R9.2m (26% of the capex has been recovered), and substantial further savings over the 25-year lifetime of the plant (net present value of R27.5m). It should be noted that half of the installed PV capacity was completed in 2019, so the projects are at an early stage of completion, with the cost savings only now being realised.

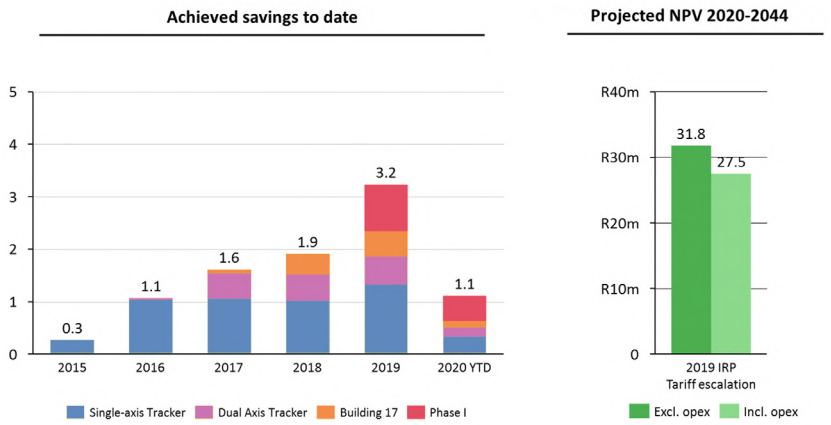
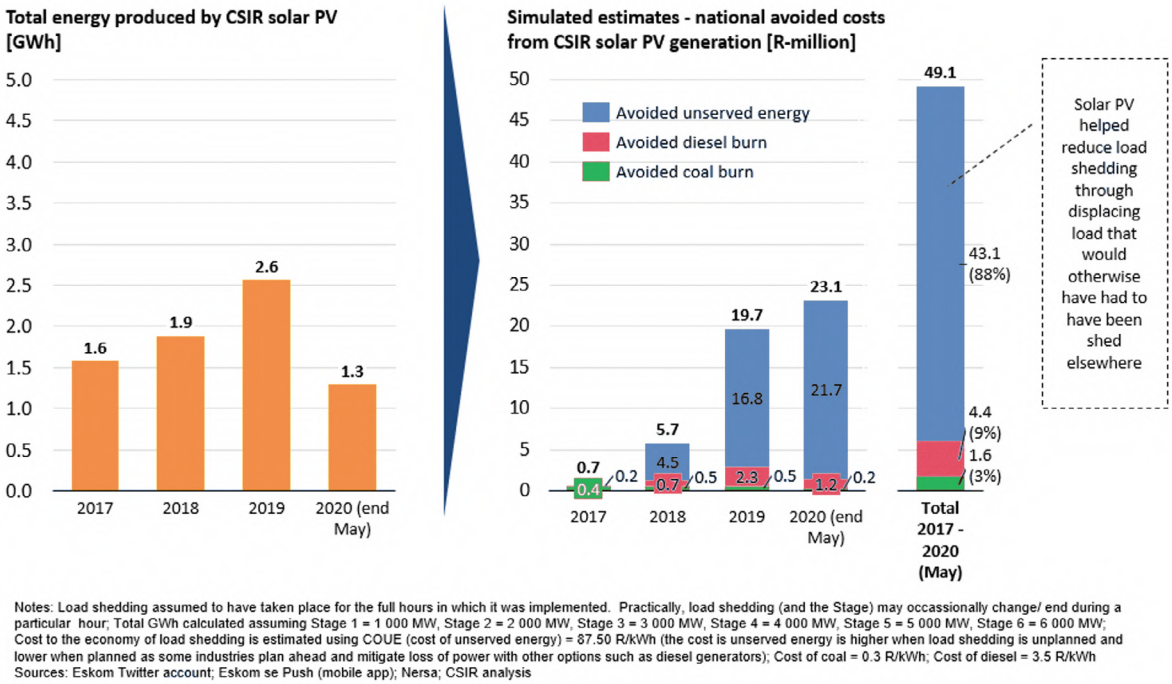


Figure 47: *Solar PV cost savings to the CSIR (2015 – June 2020 and future). Source: CSIR*

In addition to the direct electricity cost savings achieved by the CSIR, the PV plants have made a notable contribution to the national power system, offsetting coal and diesel fuel costs of R1.6m and R4.4m respectively. Furthermore, the PV energy contribution during periods of load-shedding resulted in a net economic gain of R43.1m by displacing load that would otherwise have been shed. This reflects a substantial contribution by the CSIR, and while the Scientia campus was exempted from load shedding, the CSIR PV plants contributed to the national energy supply.



Notes: Load shedding assumed to have taken place for the full hours in which it was implemented. Practically, load shedding (and the Stage) may occassionally change/ end during a particular hour; Total GWh calculated assuming Stage 1 = 1 000 MW, Stage 2 = 2 000 MW, Stage 3 = 3 000 MW, Stage 4 = 4 000 MW, Stage 5 = 5 000 MW, Stage 6 = 6 000 MW; Cost to the economy of load shedding is estimated using COUE (cost of unserved energy) = 87.50 R/kWh (the cost is unserved energy is higher when load shedding is unplanned and lower when planned as some industries plan ahead and mitigate loss of power with other options such as diesel generators); Cost of coal = 0.3 R/kWh; Cost of diesel = 3.5 R/kWh
Sources: Eskom Twitter account; Eskom se Push (mobile app); Nersa; CSIR analysis

Figure 48: *Existing CSIR solar has reduced the strain on the national power system and avoided coal and diesel fuel burn from Eskom (2015 – end May 2020). Source: CSIR*

Key challenges faced by CSIR:

- ***Registration and licensing process**: When CSIR started the registration process with NERSA in early 2017, there were limited guidelines or protocols. The relatively unknown process at the time meant that the registration process and associated communications with NERSA took a substantial amount of time. This however yielded a letter from NERSA that allowed the CSIR to proceed with the installation of solar PV plants that were less than 1 MWp. The registration and licensing process has now become far more established in SA and has reduced lead times to register small scale systems.*
- ***Connection to municipal network**: At the time there were no guidelines to follow by the municipality for connection to the network. However, the CSIR grid network falls outside Tshwane management as the campus is fed at a high voltage (HV) of 132 kV and it has its own medium voltage (MV) 11 kV and low voltage (LV) 400 V distribution network. Any issues on the LV side are dealt within the campus and does not risk the Tshwane municipality distribution network. Therefore, the CSIR went ahead with the solar PV installations and informed the municipality about the new solar PV connections at its campus.*
- ***Procurement**:*
  - ***System installation**: Design of the systems was conducted by internal CSIR team, but the procurement of qualified installers was put to market to construct the systems. CSIR must adhere to specific procurement guidelines and processes, wherein cost of services plays an integral role. The issue of balancing keeping costs optimal while keeping the integrity of the quality of the installation was challenging. The CSIR team worked to ensure quality of output by putting in place strict requirements.*
  - ***Equipment**: To uplift economic growth, The Department of Trade, Industry and Competition (DTIC) has set up minimum local content requirements. For solar PV installation domain, the following requirements were set Laminated PV Module (15%), Module frame (65%), DC Combiner box (65%), Mounting structure (90%) and the inverter (40%). The CSIR makes sure that the companies which respond to the tender RFP meet the local content threshold. For some components if it is difficult to meet the threshold, the bidders are required to apply and receive written exemption from DTIC.*

This section provides a real-world example of the experience of a C&I consumer that established solar PV facilities in South Africa to provide it with electricity for own use. Although, the project faced several challenges along the way such as the licensing, local content procurement and installation – which highlight the issues identified for the progression of the C&I market in SA – the project was eventually implemented, and the solar PV facilities are providing the CSIR campus with electricity.

4.4.2 International Experience

This section provides two examples from separate countries – namely Vietnam and Spain – to further illustrate the experience of C&I consumers in establishing RE facilities and how South Africa can learn from these experiences to improve their C&I market development.

Vietnam

On the 4th of March 2021 Norsk Solar, a leading and fast-growing global C&I solar PV developer which operates across emerging markets, entered into a long-term agreement with Central Retail's Vietnam, the leading multi-format retailer in Vietnam, for an over 11 MW solar PV project. Norsk Solar, which operates across the Indochina region with its long-term local partner Indochina Energy Partners Pte. Ltd. (IEP) will provide the complete turnkey solution and guarantee the performance of the solar PV system throughout the lifetime of the agreement through their local special purpose vehicle (SPV), Norsk Solar (Vietnam) Co. Ltd[144].

This project will help Central Retail in Vietnam and its retail system operations with their sustainability agenda by generating over 300,000 MWh of clean electricity over the lifetime of the project; equivalent to offsetting more than 120,000 tonnes of CO2 emissions over the system lifetime. With the switch to solar power, Central Retail in Vietnam will enjoy the benefits of a cleaner and cheaper source of electricity to power its retail channels

at zero upfront capital investment. This contributes to Vietnam's ambitious target to increase its share of RE in the national energy mix and will provide local employment during the construction and O&M phases of the solar plants[144].

This is an example of onsite generation, where a C&I consumer, Central Retail in Vietnam, use its rooftops to install solar power plants that are built, owned, and operated by a developer, Norsk Solar. When the pilot program for direct power purchase agreement (DPPA) will start, also offsite generation will be possible, with C&I customers being able to sign bilateral contracts (specifically, Contract for Difference) directly with renewable generators for the procurement of clean energy [145].

Spain

The following case study outlines the successful Núñez de Balboa 500MW RE project, which was commissioned in Spain in 2020. The operational solar PV plant was developed by Iberdrola – a Spanish multinational electric utility company based in Bilbao, Spain [146].

The Núñez de Balboa solar PV plant involved an investment approaching €300m, and is located between the towns of Usagre, Hinojosa Del Valle and Bienvenida in Badajoz. The plant was built in just one year and completed in December 2019 [147], and the spill-over effects are as follows:

- Job creation: Construction took one year, employed 1,200 workers at peak times - 70% of them from Extremadura (a western Spanish region comprising the provinces of Cáceres and Badajoz).
- Localisation: The project added to the value chain with purchases worth 227 million euros from some thirty suppliers, many of which were local
- Millions of components: the installation of 1,430,000 solar panels, 115 inverters and two substations requiring the delivery of a total of 3,200 containers.
- Decarbonisation: The plant will generate clean energy to supply 250,000 people per year and will prevent the emission of 215,000 tonnes of CO2 every year.
- Green finance project: Iberdrola received green financing from the European Investment Bank (EIB) and Spain's state financial agency for the project.
- Promoting sustainable consumption: in a pioneering move for Spain, the project will supply clean energy to major clients committed to sustainable consumption in the banking, telecommunications, and distribution sectors through long-term PPAs.

The Spanish PPA market, in which the renewable energy developers and consumers have the discretion of choosing whom to contract for energy exchange purposes, has made it possible for Iberdrola to sign a long term PPA to supply 100% RE to three major Spanish companies. These companies are Kutxabank (which will use this electricity exclusively at all of its banking premises and branches across Spain), Euskaltel (telecommunications operator) and Uvesco (distribution group).

The enabling polices of the Spanish government, which among others include the simplified process of obtaining access and connection permits and administrative permits for construction and commissioning of energy plants have led to the commissioning and operation of the largest Solar PV plant in Spain, and by extension, in Europe.

4.5 Environmental, social, and political benefits and challenges

This section briefly assesses the macro challenges and benefits for RE development along the dimensions of environmental, social, and political.

Environmental

Benefits

- ***Decreased GHG emissions****: Increased installation of RE system will result in reduced GHG emissions which will have a positive impact on the environment and contribute towards mitigating the impacts of global warming and resulting climate change*

Challenges

- ***Environmental impact of associated local RE value chains****: The benefits of RE as clean, sustainable, reliable, and affordable energy are well established. However, although there is less impact from RE from an emissions perspective – there are environmental impacts related to their manufacturing and transportation. An example is during the production of solar PV cells, there can be toxic substances generated that may contaminate the water sources [148] The environmental impact will only really become a problem at higher levels of localisation. If SA chooses for example to localize the mining of raw material for batteries and solar PV materials, then this will have an adverse environmental impact. At current levels, the environmental impact is an externality and a cost to other nations.*

Social

Benefits

- ***Improved health****: Renewable energy has less externalities and impacts on surrounding communities. The health and wellbeing of communities and workers that were previously affected by the air and water pollution from coal-fired power plants will be less impacted.*
- ***Job creation and skills transfer****: As South Africa undergoes its' JET; jobs will be created in the renewable energy value chains. These jobs will be further increase if manufacturing supply chains are established locally. Furthermore, there will be RE development skills and knowledge development.*

Challenges

- ***Job losses****: On the other hand, as SA undergoes the JET, there will be jobs lost in the communities that depend on the coal value chain – from coal mining to the coal power stations. Furthermore, there will be job losses from the adjacent industries that service the coal value chain. Training the current coal-related workforce in RE technology will be required to reduce the impact of job losses.*
- ***Solar and wind resource location****: The solar and wind resources in SA are not necessarily located near the towns that are dependent on coal for their livelihoods. Therefore, some people may have to relocate.*
- ***High proportion of construction jobs****: The bulk of jobs comes from the construction phase, therefore the workers who do not get O&M jobs will have to relocate each time construction is complete or be without a job.*

Political

Benefits

- ***Contribution to meeting climate change commitment****: Encouraging and fostering an environment that increases in renewable energy will help South Africa achieve its commitments under the Paris Agreement and work towards the Sustainable Development Goals.*
- ***Pioneer for developing countries****: South Africa can position itself as a pioneer in promoting and growing RE penetration for fellow developing nations. Furthermore, there can be collaboration with other developing nations wherein manufacturing supply chains for RE components are harmonised.*

Challenges

- ***Uncertainty and delays in passing enabling regulations****: Although SA has put in place regulation and incentives to establish RE, several of the regulations are still lagging and have slowed down the development in RE. Amendments to the ERA are required to allow larger systems to be established without licensing and localisation regulations need to be clarified so that they foster the development of local manufacturing supply chains.*

4.6 Highlights

This chapter set out to highlight the benefits and challenges for renewable energy development by C&I consumers for self-generation and for C&I consumers in the case of PPAs. It also looked at the benefits and challenges from the standpoint of the national utility and the municipalities.

For the C&I consumers the main benefits and challenges that were assessed were those pertaining to the client business case for self-generation and the potential employment and skills opportunities presented by RE development. The analysis showed that the main benefits would be reduction in electricity bills, reduction in carbon tax liability, tax benefits as well as more reliable electricity supply. The main challenges highlighted were cumbersome application processes, lack of skilled labour to carry through projects, and lack of accredited installers.

For Eskom and the municipalities, the main benefits and challenges that were assessed were those pertaining to their balance sheets, government guarantees and network upgrade deferral and grid constraints. Some of the benefits highlighted were tariff adjustment to suit the new operating environment to reduce the impact of increased embedded generation, government guarantees provided to national utility contributing to growth of RE development, reduction in technical losses on the network and increased security of supply due to increased embedded generation. Some of the challenges highlighted were insufficient NERSA capacity to process COS studies from municipalities, reduced municipal revenues, complex technical requirements for network connection, lack of in-house technical capabilities to connect C&I embedded generators and challenges in balancing on the network.

The real-world examples from the CSIR and the international cases illustrate that there are gaps remaining within the regulatory and operational environment within South Africa. The CSIR experience highlighted challenges with regulatory processes and procurement. The international cases highlighted the need for clear and supportive PPA regulations. The benefits and challenges presented by the brief analysis of the environmental, social and political lenses illustrate that the development of renewable energy by C&I consumers has more beneficial outcomes despite the challenges presented.

CHAPTER 5: CONCLUSIONS AND RECOMMENDATIONS

The commercial and industrial sector demand for RE energy deployment in South Africa is expected to increase due to ever increasing electricity prices, unreliable power supply from Eskom, an increasing shift towards decarbonisation, an introduction to the carbon economy and the reduction in costs of RE. Understanding the framework in which RE is regulated in the embedded markets is critically important to developers and sector companies alike, while understanding how tariffs are structured provides further insights into the benefits of RE deployment. This chapter provides the key lessons learnt for RE development in the C&I market in South Africa, as well as several recommendations that could be considered to foster growth of the market.

Through the assessment of the regulations, policies and codes, the following can be concluded:

- *Although in roads are being made in regulations that will allow for the development of the market, such as increasing the ERA threshold for generation without licensing and including embedded generation in the ministerial determinations within the IRP, the consensus is that the regulations are insufficient to allow for growth. Further, the processes to get generation licenses are cumbersome which results in a slow rate of approvals.*
- *In addition, regulations around wheeling and bilateral PPA agreements remain unclear, and net-metering regulations have not gained traction, although some municipalities do allow it.*
- *Lastly, C&I consumers are required to ensure that they meet the relevant grid code requirements in order to be able to connect their generation facilities to the distribution network. These codes ensure the optimal technical performance of the network and compliance is mandatory. These codes can be rather complex for the inexperienced C&I consumer as well as for municipal distributors. However, the NRS-097 series provides some simplification for the processes, although all mandated codes have to be adhered to.*
- *The comparison to three other countries resulted in lessons learned for South Africa to stimulate C&I RE market growth. Main highlighted lessons include having open negotiation o of network charges, reduced frequency of technical grid assessments as per the grid codes, clear and flexible negotiation of PPAs, and clear regulations around net metering.*

Through the assessment of the economics and tariffs, the following can be concluded:

- *The South African power system is currently severely constrained due to a shortage of available generation capacity, predominantly caused by Eskom's unreliable aging coal fleet. Eskom has indicated that the power system is expected to remain constrained for at least the next 2 years.*
- *According to the IRP2019, the procurement of new generation capacity will result in electricity tariffs increasing over the next decade (in real terms),*
- *At the same time, the cost of rooftop and utility-scale solar PV has decreased substantially over the last few years, to the extent that there is a strong business case for deploying embedded generation in the C&I market at today's Eskom/Municipal tariffs.*
- *Current C&I tariffs are structured with a high portion of variable energy charges which can be avoided by reducing energy usage either through energy efficiency initiatives or embedded generation.*
- *With the anticipated increase in embedded generation, and the resulting decrease in revenues for distribution network service providers, Eskom and several municipal distributors have indicated their intention to restructure their electricity tariffs to be more cost reflective. This includes transitioning to higher fixed charges which cannot be offset by reducing energy purchases. This will affect the motivation for C&I consumers to explore embedded generation for their operations as this has a direct impact on the economic business case of embedded generation. C&I customers will have to carefully consider potential structural changes to future tariffs when calculating anticipated payback periods for embedded generation.*
- *Furthermore, challenges with cost of supply studies were highlighted as a challenge for municipalities to get wheeling frameworks and tariffs in place.*

Through the high-level assessment of the benefits and challenges for C&I consumers, municipalities and Eskom, the following can be concluded:

- *For C&I consumers:*
  - *The main benefits highlighted for developing RE were reduced electricity bills, reduction in carbon tax liability, tax benefits and more reliable electricity supply.*
  - *The main challenges highlighted were cumbersome application processes, lack of skilled labour and accredited installers to develop and install projects.*
- *For Eskom and the municipalities:*
  - *The main benefits highlighted were the potential tariff adjustment to reduce the impact of increased embedded generation, government guarantees to Eskom to allow for growth of RE, reduced technical losses on distribution networks and increased security of supply for customers with the connection of more embedded generation and their excess generation being injected into the grid.*
  - *The main challenges highlighted were reduced municipal revenues, complex technical requirements for network connection, lack of in-house technical capabilities to connect C&I embedded generators and challenges in balancing on the network.*

Recommendations

The below provides the recommendations based on the analysis conducted in this report:

- *Simplify the generation licensing requirements and automate some aspects of the licensing processes to unlock full potential of the embedded market for RE*
- *Increase the threshold for exemption from generation licensing while still ensuring integrity of technical requirements and ensuring continuous tracking of installation to assist with grid planning and security*
- *Increasing NERSA's institutional capacity in order to efficiently and timeously process generation license applications and COS studies*
- *Increase the technical capabilities for municipalities for them to efficiently assess embedded generation applications and implications for the operation of their network*
- *Careful consideration of all of the tariff components and how they are expected to evolve over time is necessary to determine the economic business case of SSEG for C&I customers. This is an area of potential future study which could look at what the impact of restructuring tariffs by increasing fixed charges would be on the C&I consumer business case for RE embedded generation.*
- *Innovative funding models could be developed and implemented to allow for the growth of the PPA market*
- *Clarify regulations for wheeling to allow for more uptake by C&I customers who want to diversify their electricity supply options without building their own facilities.*
- *Clearer regulations around bilateral PPAs and net-metering will also foster development of the C&I RE market. PPAs should be tailored for the C&I business case and allow for shorter term PPAs, provided the developer recoups their investment.*
- *Lastly, attention should be given to regulation around technical compliance and safety and assurance mechanisms to ensure the quality of systems.*

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ANNEXURES

Annexure 1: Key risks for PPA and self-consumption markets

This section will comment briefly on the key risks for power purchase agreements and self-consumption markets for developing and operating renewable energy generation facilities.
Power Purchase Agreements

Table 9 below gives a brief overview of the main risks related to PPAs based on industry experience. These risks were identified by the eThekwini Municipality for building, owning and operating a solar PV plant[61].

Table 9: Risks for PPA projects

Risk	Description of the risk	Level	Mitigation
Land Use Planning	• *Failure to obtain Municipal Permits* • *Failure to obtain Land Use authorisations*	Medium	• *Wherever Municipal Permits are required, the bylaws must be reviewed, and applications made in terms thereof.* • *Appropriate land development applications for the site must be submitted to the relevant authority.*
Site Risk	• *Sites for rooftop solar PV might not be correctly maintained or secured to allow the uninterrupted operations of the project*	Medium	• *C&I developers to ensure that sites selected can be effectively maintained and secured for the lifespan of the project and that costs of any additional site maintenance to be included in operational budgets*
Environmental risk	• *Possibility for liability of environmental damage from construction or operations.*	Medium	• *Conducting life cycle assessments (LCA) to estimate the overall energy usage and environmental impact from the energy produced by a technology. Constructing generation facilities in designated Renewable Energy Development Zones (REDZ) is a useful way to mitigate for environment risk.* • *Contract specifications to include environmental requirements to be met by C&I developers*
Financial risk: Changing tariff structure	• *Potential changes in the tariff structure may misalign costs and returns*	Medium	• *Put in place fixed rental escalation, which shields businesses from the variability of utility tariff increases and allows accurate predictions and budgeting for energy costs.*
Maintenance risk	• *Risks of deficiencies in operations and maintenance.*	Medium	• *C&I developers to ensure adequate maintenance budgets and staffing.*
Power grid risk: Grid access	• *Risks that the grid connection costs are higher than anticipated or grid connection costs are delayed.*	High	• *Owners of the grid to conduct grid studies and confirmation of suitability of all sites for connection as well as grid ability to evacuate power.*
Regulatory risk	• *Possibility that required approvals (such as licences) from other organs of government cannot be obtained or are obtained at higher cost than provided for.*	High	• *C&I developers to undertake due diligence on any regulatory requirements under its control (such as licensing requirements)*
Renting and leasing agreements vs PPA	• *In renting/leasing agreements, the developer runs the risk of O&M costs rising but being unable to raise price due to fixed rate.* • *Rising costs per energy unit as O&M costs increase.*	Medium	• *Agreement on amount fixed rate for lease agreements can be increased by at agreed intervals based on CPI, inflation, or another similar metric.* • *Agreement on fair increase to meet rising O&M costs*

Self-consumption

Table 10 gives a brief overview of the main risks related to self-consumption projects. They are mainly based on the CSIR Energy Centre's own experience while developing various ground and rooftop based solar PV plants at the Pretoria campus. CSIR Energy centre has commissioned 2 MWp of solar PV plant for self-consumption purposes as part of its Living Energy Lab Platform (LELP) program. Few risks were identified during the Integrated Resource Planning study for the Development Bank of Southern Africa (DBSA) Green Building project are also included.

Table 10: Risks for self-consumption projects

Risk	Description of the risk	Level	Mitigation
Financial risk	*Lack of funds to cover the capital expenditure*	High	*Necessary approvals secured from Executive Committee / Board members*
Regulatory risk	*Changes in policy and fees associated with generation and interconnection*	Medium	*Prior consent from the relevant municipality* *Registration and/or licensing from NERSA*
Environmental risk	*Site selection and preparation*	Medium	*Distributed PV systems on existing C&I infrastructure or on disturbed land present minimal environmental impacts. However, according to the National Environmental Management Act No. 107 of 1998 ("NEMA"), major alterations to the natural environment should be subject to environmental assessment before the activity can commence. While no significant environmental impacts are expected from rooftop and small ground mounted PV projects, it is important that these projects undergo an environmental screening assessment to determine if they should be subjected to an environmental impact assessment (EIA) per the NEMA Regulations. An experienced Environmental Assessment Practitioner (EAP) shall complete this process before the procurement phase. The NEMA Regulations provide a list of potential activities that can possibly trigger a Basic Assessment (BA)*
Engineering risk	*Hourly energy consumption data not reasonably obtainable*	Low	*Use historic billing information available with seasonal variance.*
	Hourly energy consumption available but not for entire year	Low	*Use recent hourly data available and adjust rationally for seasonal variance*
	Age, as-built drawings availability and structural integrity	Medium	*PV modules generally last for 20 to 30 years. Preference given to new roofs or recently refurbished roofs. A competent person (Structural Engineer) to assess whether the roof is suitable for solar PV installation (static or dead load calculations) and if required prepare the as-built drawings. Prior completion of the required structural modifications, surface paintings or waterproofing*
	Age, as-built drawings availability and adequacy of distribution board at Point of Connection (PoC)	Medium	*The PV system design shall comply with the relevant grid code requirements while connecting to the existing electrical infrastructure. The details regarding the point of connection are critical as the C&I customer's existing infrastructure is largely unknown to the developer. An electrical engineer shall assess the options available for the point of connection at the local distribution boards within the host facility. The assessment shall determine if the distribution boards and related electrical infrastructure need any refurbishments or upgrades to handle the new connection*
Procurement risk	*EPC contractor experience, financials, etc.*	Low	*Verify bank/s rating and follow standard two envelope bidding procedure*
	Project timelines might hamper to achieve minimum local content threshold stipulated by DTIC for the public sector	Low	*The preferred bidder obtains local content compliance letter or necessary exemption for the applicable components from DTIC*
Market risk	*Component prices could increase*	Low	*Short turn-around time between procurement processes and contract award to preferred bidder manage significant changes in prices*
Construction risk	*Theft of major components*	Low	*Increase security awareness during installation and plant operations*

Annexure 2: Energy policies applicable to Chile

The General Law of Electrical Services, which is also known as the Decree with Force of Law (DFL) No.4/20018 of 1982, is the base law that regulates the electricity sector in Chile [65] which has been updated through multiple legal modifications. It allows free access into generation, transmission, and distribution, at minimum cost while maintaining reliable services [149]. Energy generation is generally liberalized. However, if a generator chooses to connect to the national grid, they are subject to legislation where they must inject energy to the the spot market, which has regulated prices [66][67]. Owners or operators of grid-connected generation facilities are subject to the instructions of the Independent Coordinator of the National Electricity System (CEN). CEN organizes energy injections into the grid according to an economic merit criterion based on declared variable costs of every unit, which ensures that CEN orders the most efficient power plants (such as RE) inject energy into the grid at a given demand, followed if possible, by the least efficient power plants (such as coal, liquefied natural gas, and oil).

The tariff charged by distribution companies to their regulated customers is determined by the NEC conducted by the distribution company and the value added by the distribution network (VAD). The VAD includes allowed energy losses and a return on investment and is re-calculated every four years for a model company supplying similar types and locations of customers. Furthermore, owners with surpluses of less than 9MW-supplied power to the system are exempt; and those of >9MW and <20MW must pay a toll for the power exceeding 9MW. When the total capacity exempted exceeds 5 percent of the total installed capacity, the owners shall pay a proportion of the amount in excess.

Law 19.940

This reform was introduced in 2004 through the enactment of Law 19.940, which enabled any generating company —regardless of size—to sell energy into the electricity market. The opening of the market to smaller power generators facilitated the viability of small RE plants [68]. It serves to regulate electric energy transportation systems, establishes a new rate regime for medium electrical systems and stipulates the adequacy indicated in the General Law of Electrical Services [69].

Although the power sector is predominated by private participants, the lines and substations of the transmission system are concessioned by the government with technical advice from the National Energy Commission (NEC) and CNE. The transmission system is interconnected with the distribution grid and arranges for the supply to regulated end-consumers, which have concessions with distribution companies. The major objective of the law is to ensure that generators that are not integrated into the transmission system can inject their energy into the grid as the system allows for third-party non-discriminatory access provided the technical and economic conditions are met. Any electricity company that injects power into the grid with its own or contracted generation plants (i.e., wheeling) will be subjected to transmission costs in case the transmission is qualified as dedicated which means it is not aimed for public service. The transportation of energy through these systems is governed by private contracts between parties. In case of small and medium generators, the law introduced a partial or full exemption for RE plants supplying the system with a surplus power of less than 20 MW from paying tariffs for connecting electricity through the main distribution networks.

Every four years, a broader study directed and coordinated by the NEC is commissioned on the transmission system which covers the different scenarios of expansion possibilities of the generation and interconnection with other electrical technologies [69] in order to determine the transmission tariffs. However, in SA, the impact assessment studies are continuously conducted to accompany the applications made purposefully to connect to the system [56].

Decree – Law 57/2019

Law No. 21.118 states the conditions so regulated end consumers can inject energy to the grid through a netbilling methodology.[72]. Regulation establishes the limit of 300 kW and aims for self consumption, but whenever the consumer has surpluses this are deducted in future electric bills. The methodology considers conducting studies that assess the impact on safety of the network that the generation equipment may cause. The technical standard establishes cases in which the methodology should be used and the frequency for the update may not exceed 4 years.

Power Purchase Agreements

PPAs can be obtained through bilateral negotiations or through participation in auctions — carried out by the NEC. The auctions to supply regulated consumers establish long-term contracts at a fixed price for up to 15-20 years, and the government sets a price cap for the auctions. The price of capacity is also fixed by the NEC [70]. Independent consumers are expected to purchase their own electricity supply independently and to select their preferred procurement mechanism, which includes energy auctions. Distributors must contract their needs through auctions in order to supply regulated consumers. Since 2005, Law 20.018, also known as "Short Law II," requires electricity distribution companies to contract their energy requirements by means of competitive non-discriminatory auctions. A bid with the lowest price is awarded a long-term contract (typically, a PPA) for the project [150]. PPAs are signed with distribution companies in order to supply regulated consumers, and in the case of unregulated customers (customers who demand over 5 MW of capacity) contracts are signed directly with the generation company, and positions are adjusted on the spot market at the marginal cost determined hourly by the NEC for each node [70]. However, regulation allows consumers to choose the tariff category for regulated consumers, as those with the installed power of more than 5MW -considered unregulated customers- face a free market in which they must negotiate energy contracts with generation companies.

The auction process establishes that distribution companies must support the projected demand of their regulated customers with long-term PPAs [70]. The basic mechanism for auctions determines that the generator offers a price and a volume of energy and that the auction is cleared at an optimum point. Contract prices are passed directly to consumers through a pass-through mechanism [70].

Transmission and distribution technical requirements and network charges

The Chilean electricity grid has the main system, namely, the National Electric System, which consists of the transmission network and the generation plants. The system has an independent operator-CEN- whose operation is based on the regulatory framework and electricity service quality standards to ensure correct operation of the system regarding dispatching, frequency, and voltage of generating units [151]. Like SA, generators aspiring to connect to the network are required to comply with the technical, environmental standards and construction regulations.

The Chilean transmission system is regulated. Transmission network access charges are regulated and assumed by generators wanting access and is coupled with wide planning and determination of access terms. This is partially because the system of negotiated third–party access has worked well for new generators as no major lines of the transmission system have failed to be built. Latest regulation has addressed all transmission charges to the demand, in order to promote the power capacity development all along Chile [149].

Private participants are at the forefront of generation planning and are also responsible for developing and determining the projects related to generation capacity of the country. The government through The National Energy Commission (NEC) set up the electricity prices of the main interconnection systems, which provides a guide in terms of generation and transmission capacity projections [71].

Annexure 3: Energy policies applicable to Vietnam

Self-Consumption model

The most common rooftop solar installation model, in which the rooftop owner purchases the rooftop solar system and uses the benefit of the generation for internal consumption, simultaneously receiving power directly from the grid of EVN/the Power Purchaser. Depending on local regulations, excess energy generated by rooftop solar systems may or may not be fed back into the grid. This model has several advantages, including a short payback period, risk-adjusted returns over a longer period of time, low payment risks, and sole ownership of all rooftop systems. However, the main challenges are the requirement of upfront capital and technical capacity limits, which result in lower rooftop capacity than potential[76].

Decision No. 32/2006/QD-BCN

Article 5 that describes the scope of use of electricity activity permit states[152]:

- *The permit for electricity activities in the field of electricity generation is granted to units generating electricity that have electricity generating project invested in line with the approved electricity planning.*
- *The permit for electricity activities in the field of electricity transmission is granted to electricity units operating the electricity transmission with scope of management and operation of specific transmitted electricity network.*
- *The permit for electricity activities in the field of electrical distribution, import and export of electricity is granted to the electricity units that operate electricity distribution, import and export of electricity with specific geographic area of the electricity.*

However, according to article 7 organizations or individuals applying for an electricity license must comply with the following general conditions:

- *As organizations or individuals with business registration, established and operating under the provisions of the laws, including:*
  - *As an enterprise of all economic sectors is established and operating under the provisions of the laws;*
  - *As a cooperative is established and operating under the Cooperative Law;*
  - *As a business household or individual with business registration as prescribed by law;*
  - *Other institutions which are established under the provisions of the laws.*
- *Having a valid dossier for the granting of, amendment or supplementation to the electricity activity permit.*
- *Having the financial capacity to carry out the electricity activity sectors that was proposed the permit.*
- *In addition, organizations registering for electricity generation must comply with the following conditions[152]:*
- *Having technological equipment, means, workshops, architectural works in line with the approved technical design, built, installed and tested in line with current technical regulations and standards.*
- *People who directly manage the technique and operation must have a relevant bachelor degree in electricity or technique and have worked in the field of electricity production at least five years. Workers who directly operate must be trained and tested for operating procedures and safety procedures.*
- *The equipments of the electricity plant that require strict labor safety must be tested and granted a certificate of labor safety by competent agencies.*
- *The report on environmental impact assessment of electricity generation projects that have been approved by a competent state agency.*
- *System of fire prevention and fighting of electricity plant must be tested and accepted by a competent agency as provided by law.*

Circular No. 32/2010/TT-BCT

Connection to the distribution power grid

Article 32 states that[79]:

- *Plan for connection of new electrical devices, power grid and power plant to the distribution power grid must comply with the power development planning already approved by competent state authority.*
- *The power distribution unit shall notify the electricity users of the distribution power grid in case where the connection plan as suggested by customers is not consistent with the power development planning approved.*
- *In case where the plan on connection to the 110kV voltage level or connection to the new power plant is not consistent with the approved power development planning, the investor having plan on connection shall prepare documents to report to the provincial People's Committee for submission to the Electricity Regulatory Authority for appraisal and submission to the Minister of Industry and Trade to approve and adjust the provincial power development planning.*
- *In case where plan on connection to the medium voltage level is not consistent with the approved power development planning, the investor having plan on connection shall prepare documents to request the adjustment or supplementation and submit them to the Service of Industry and Trade for appraisal and submission to the provincial People's Committees for approving the adjustment of the district-level power development planning.*

Annexure 4: Energy policies applicable to Spain

Law 3/2013 of 4 June 2013.

The law has defined self-consumption "as energy consumption electricity from generation facilities connected within a network from a consumer or through a direct line of electrical energy associated with a consumer".

Under this law self –consumption is categorized as follows:

- *Consumer with a generation facility planned for its own consumption that is connected into the network of its supply point, and is not registered in the registration as a production facility. The consumer in this regard is regarded as consumer.*
- *Consumer with a production facility that is duly registered in the administration register of electrical energy production facilities and connected to the network. The consumer of this self –consumption will be regarded as consumer and producer.*

The law further asserts that all consumers subjected to self –consumption are obliged to contribute to the costs and maintenance services of the networks for self-consumed energy, when the generation installation is totally or partially connected into the grid. The costs to be incurred take this form, network access tolls, costs for the provision of backup services of the system and charges associated with system costs and in addition, there are technical conditions to be met before connecting to the networks. Regarding the access to connect to the grid, all consumers have the right to access and connect into the networks of transmission and distribution of electrical energy, provided the said technical conditions are met.

The law asserts that the independent regulator, National Commission for Markets and Competition (CNMC), plays a significant role in the development of renewable energy projects. To this end, the CNMC has, inter alia, the following authority:

- *To publish the end prices of the electricity market based on information from the market operator and system operator.*
- *To supervise the conditions and charges for connection applicable to new producers of electricity.*
- *To supervise the management and allocation of connecting capacity, the time spent by transmission and distribution companies in carrying out connections and repairs, and the mechanisms designed to ease congestion in network capacity [82].*

Royal Decree 244/2019.

The decree regulates the conditions administrative, technical and economic self-consumption of electrical energy as well as the activities of transport, distribution, marketing, supply and procedures of authorization of electric power installations.

The purpose of this royal decree is to establish:

- *The administrative, technical and economic conditions for the modalities of self-consumption of electrical energy defined in article 9 of Law 24/2013, of 26, December, of the Electricity Sector.*
- *The definition of the concept of nearby facilities for self-consumption purposes.*
- *The development of individual and collective self-consumption.*
- *The simplified compensation mechanism between deficits of self-consumers and surpluses from its associated production facilities.*
- *The organization, as well as the registration and communication procedure of data to the administrative register of electricity self-consumption.*

The decree exempted the generation facilities with the self −consumption power not exceeding 100KW from registering the facilities and are permitted to inject surplus energy into the transmission and distribution networks. The self-consumption under this decree is divided into self-consumption without surpluses and with surpluses. The supply mode with self- consumption without surpluses are imposed with anti-diversion mechanism that is installed to prevent the injection of surplus energy to the networks. The self − consumption with surpluses are entitled to receive compensation provided the primary energy source is renewable and the total power associated with the generation facilities does not exceed 100KW. Additionally, the self-consumption generators should sign the compensation contract with off-taker (consumer). The generation facilities are obliged to meet the technical, operational, quality and industrial safety to be authorised to operate. Regarding access and connection to the networks, self −consumption with surpluses generators must have permissions to access and connect into transmission and distribution networks, whereas the self −consumption without surpluses generators will be exempted from obtaining access and connection permits [83]

Royal Decree-Law 23/2020 of 23 June (RDL 23/2020).

The government recently passed this decree to approve measures in the energy sector. This new legislation introduces certain measures on access and connection to the grid to provide a rationale that will underpin appropriate development of RE sources. The decree requires RE facilities that have not been commissioned to meet certain milestones to avoid losing the right to access the grid. Non-fulfilment of these milestones will render forfeit the rights to access and connect to the grid [153].

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