# Energy Services

## MARKET INTELLIGENCE REPORT

2024

SOUTH AFRICA UKPACT

GreenCape

Market Intelligence Report 2024

# ENERGY SERVICES

## GreenCape

GreenCape is a non-profit organisation that works at the interface of business, government, and academia to identify and remove barriers to economically viable green economy infrastructure solutions. Working in developing countries, GreenCape catalyses the replication and large-scale uptake of these solutions to enable each country and its citizens to prosper.

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# List of abbreviations and acronyms

| | |
|---|---|
| **AEF** | Agro Energy Fund |
| **BBS** | Bounce back load guarantee scheme |
| **BTM** | Behind the meter |
| **C&I** | Commercial and industrial |
| **CPI** | Consumer price index |
| **CSIR** | Council for Scientific and Industrial Research |
| **DALRRD** | Department of Agriculture, Land Reform, and Rural Development |
| **EE** | Energy efficiency |
| **EBB** | Energy Bounce Back Loan Guarantee Scheme |
| **EPC** | Engineering, procurement and construction |
| **ES** | Energy services |
| **GW** | Gigawatt |
| **GWh** | Gigawatt hours |
| **GIZ** | Deutsche Gesellschaft für Internationale Zusammenarbeit |
| **kWh** | Kilowatt hour |
| **kWp** | Kilowatts peak |
| **LCOS** | Levelised cost of storage |
| **LDS** | Low demand season |
| **Li-ion** | Lithium-ion |
| **MIR** | Market intelligence report |
| **MW** | Megawatt |
| **NECOM** | National Electricity Crisis Committee |
| **NERSA** | National Energy Regulator of South African |
| **NMD** | Notified maximum demand |
| **O&M** | Operations & maintenance |
| **PPA** | Power purchase agreement |
| **PV** | Photovoltaic |
| **Q** | Quarter |
| **RE** | Renewable energy |
| **SALGA** | South African Local Government Association |
| **SAPVIA** | South African Photovoltaic Industry Association |
| **SARB** | South African Reserve Bank |
| **SARS** | South African Revenue Service |
| **SSEG** | Small-scale embedded generation |
| **TOU** | Time-of-use |
| **UPS** | Uninterrupted power supply |
| **USD** | United States Dollar |
| **Wh** | Watt hours |
| **Wp** | Watt peak |

**Exchange rate used:** 1 USD = 18.40 ZAR

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# EXECUTIVE SUMMARY

**This market intelligence report (MIR) is compiled for foreign and local investors looking to invest in the South African green economy through project development, asset management, equity, debt, equipment manufacturing, or support services. It highlights investment opportunities in embedded generation and energy storage created by South Africa's diversifying energy services (ES) market.**

The term ES is used to describe three interrelated energy market segments in the South African energy space, namely rooftop solar photovoltaic (PV); energy storage; and energy efficiency (EE) (the last available as online content). These market segments are increasingly bolstered by offerings in the energy finance sector, which in themselves also present opportunities for financial investors.



## Key developments influencing the market in 2023/24

In 2023, the growth rate of South Africa's small-scale embedded generation (SSEG) sector continued to increase resulting in an all-time peak between the first and second quarter of 2023. This growth resulted in a large influx of imported equipment and system registration applications with distributors. Rooftop solar PV installations and behind the meter (BTM) energy storage are both opportunities that are expected to continue to be lucrative for investors in the short term (next five years). The long-term stability and growth of these opportunities will however be linked to factors such as the continuation of demand driven by unreliable grid supply and cost saving allowed by installing embedded generation, the availability of skills, strong due diligence processes, as well as appropriate regulatory and quality assurance mechanisms.

**Rooftop solar PV installations** have a strong business case that is driving increasing maturity, concentration, and competition within the market. There are three sub-segments within this market that are promising:

- Small to medium-sized commercial and industrial (C&I) projects (100 to 300 kilowatts peak (kWp)) where there is steady and consistent growth as the market spreads both within metros, such as the City of Cape Town and Johannesburg, as well as to other regions of the country.
- Large rooftop C&I installations (larger than 800 kWp) where a first-mover private independent power procurement market has taken shape. This is especially attractive for Eskom[1] clients where power purchase agreements (PPAs) can be offered at rates less than the Eskom's Megaflex tariff.
- Solar PV secondary markets such as operations and maintenance (O&M) where increased portfolio sizes are driving modernisation to improve efficiency.

**BTM energy storage** as a market is driven by the need for energy independence and resilience. Loadshedding[2] is driving sharp demand in back-up power and uninterrupted power supply (UPS) applications, particularly in the commercial, industrial, and agricultural sectors where the cost of energy insecurity is high. Back-up power for the residential segment accounts for the majority of the current market size by installed capacity. Alternatively, the C&I sector has long-term value through use cases such as peak shaving and tariff arbitrage which promotes viability beyond loadshedding. BTM storage is expected to grow significantly as lithium-ion (Li-ion) battery prices continue to decrease over the next five to 10 years.

The SSEG opportunities described above are enhanced by improved access to finance as commercial banks have developed dedicated SSEG finance portfolios. Corporate and capital-constrained customers are also opting to transfer the performance and investment risk onto to the service provider through lease structures and PPAs. In the case of the latter, there is the added benefit of ensuring a long-term fixed typically reduced tariff.

The following opportunities have not been explored in this report, since they are currently limited by slow growth and substantial barriers:

**Energy-as-a-service** – Current market size: R4 billion.

**Smart grid devices** – Current market size: R2.5 billion.

**Carbon offsets** – Current market size: R100 million.

For more information on these opportunities

ACCESS ONLINE CONTENT

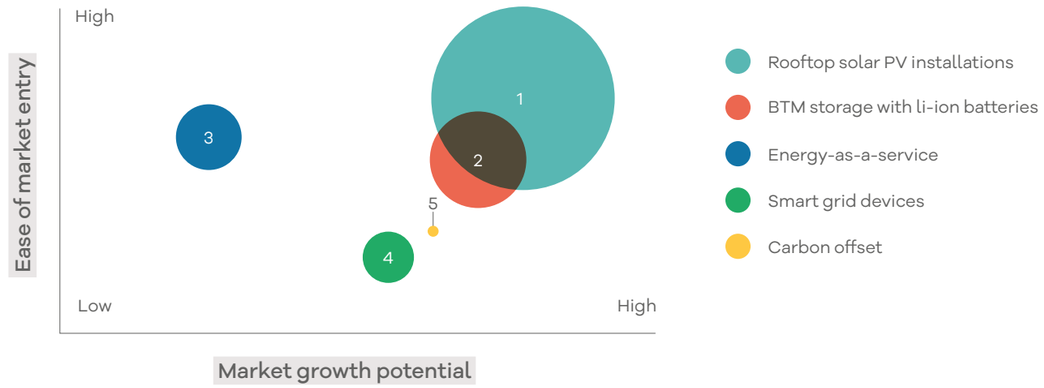



**Figure 1:** ES market growth potential matrix

1 Eskom is South Africa's state owned electricity provider.

2 Loadshedding is a controlled demand reduction mechanism implemented by Eskom to protect the national electricity power system from a total blackout.

**Table 1:** Summary of opportunities in the ES market

| OPPORTUNITY | | | | | |
|---|---|---|---|---|---|
| ROOFTOP PV INSTALLATIONS | | | | | |
| MARKET SIZE | KEY DRIVERS | BARRIERS | STAKEHOLDERS | TERM | MACRO CONTEXT |
| **R88.4 billion** by 2030 or **R14.7 billion** per year | • Rising cost of electricity<br>• Diverse financing mechanisms including commercial debt, PPAs and lease agreements<br>• Enabling regulatory environment such as municipal embedded generation frameworks, feed-in tariffs and the removal of the generation license requirement<br>• Financial incentives by government institutions through the 12BA tax deductions, the Energy Bounce Back Loan Gaurantee Scheme (EBB) and the Agro Energy Fund (AEF) | • Insufficient skilled engineering, procurement, and construction (EPC) companies' capacity to meet project demand<br>• Institutional capacity constraints resulting in diverse due diligence processes and an increased administrative burden | • Renewable energy (RE) developers<br>• EPC companies<br>• Commercial banks<br>• Investment and equity funs<br>• PV equipment manufacturers and distributors<br>• National Treasury<br>• Land Bank<br>• Department of Agriculture, Land Reform, and Rural Development (DALRRD)<br>• South African Revenue Services (SARS) | Current opportunity | • Over reliance on imports for key components facing delays from international shipping challenges; conflict in the Red Sea has led to rerouting of shipping from the Suez Canal to longer routes, as well as local port inefficiencies<br>• Expected loadshedding at stage 2-8 throughout the year with long-term energy shortage |

| OPPORTUNITY | | | | | |
|---|---|---|---|---|---|
| BTM LI-ION STORAGE | | | | | |
| MARKET SIZE | KEY DRIVERS | BARRIERS | STAKEHOLDERS | TERM | MACRO CONTEXT |
| **R12 billion** by 2030 or **R2 billion** per year | • Loadshedding driving demand for energy storage solutions<br>• Stronger long-term business case compared to other technologies<br>• Flexibility of battery technologies allows additional value-stacking such as peak shaving, load shifting, and tariff arbitrage | • Limited availability of skills<br>• High exposure to equipment import delays<br>• Nascent regulatory environment, especially related to safety and quality | • RE developer<br>• EPC companies<br>• Commercial banks<br>• Investment and equity funds<br>• Battery original equipment manufacturers, assemblers, and distributors | Current opportunity | • Over reliance on imports for key components facing delays from international shipping challenges; conflict in the Red Sea has led to rerouting of shipping from the Suez Canal to longer routes, as well as local port inefficiencies<br>• Expected loadshedding at stage 2-8 throughout the year with long-term energy shortage |



# WHAT'S NEW?

**This MIR provides updates on the opportunities, barriers, and regulations discussed in the 2023 Energy Services MIR with a specific focus on opportunities and barriers for rooftop solar PV and BTM battery storage.**

### What happened in 2023

**Year-round:**
*Bottom-up market sizing studies reveal rapid growth of embedded generation*
The momentum generated by the perceived growth of the SSEG sector due to loadshedding resulted in significant private sector investment; including into geographic information system remote sensing data on the current installed capacity as well as determining the total accessible market. The South African Photovoltaic Industry Association (SAPVIA) launched its data dashboard, which indicates that the PV sector has grown to 3 gigawatts (GW) (not including ground mount projects or public procurement) by the end of Quarter 1 (Q1) 2023. Eskom has estimated that the sector had grown to 5 GW by the end of Q4'23 according to its system status reports (Eskom 2023a).

*Local manufacturing goes from strength to strength*
Local manufacturing capabilities continued to expand to meet the needs of the fast-growing SSEG sector. Local manufacturers were able to take advantage of multiple high demand markets including the private independent power procurement market, telecommunications, residential and commercial PV, and foreign markets in Africa and Europe. Some notable examples included the launch of Ener-G-Africa's 15 megawatt (MW) solar panel assembly plant and breaking ground on the new location of SolarMD's battery giga-factory both in Cape Town (Burger 2023; Illidge 2023). A number of other manufacturers also increased their production in 2023 getting closer to their nameplate plant capacities.

**March:**
The Council for Scientific and Industrial Research (CSIR) established an indoor energy storage testbed which improves the local capacity to test the performance and reliability of Li-ion batteries and is accessible to small, medium and micro-sized enterprises, manufacturers and importers (CSIR 2023).

**April:**
National Treasury and SARS published draft amendments to two renewable energy tax incentives for public comment. First, an expansion of the 12B tax incentive to a 125% tax deduction for businesses in the first year with no threshold on generation capacity and available to projects brought into first use between March 2023 – February 2025. Second, a rooftop solar PV tax rebate for individuals to the value of 25% of the cost of any new or unused panels up to a maximum of R15 000, which was subsequently discontinued. This was as a response to the country's energy crisis and aimed to encourage private investment into expanding SSEG capacity at both the commercial and residential level.

**June:**
The import of SSEG equipment surged in the second quarter of 2023, with a 125% increase from 2021. In particular, this was driven by a 180% increase in the import of Li-ion cells and battery packs to the value of USD 820 million in the second quarter.

**August:**
National Treasury launched the Energy Bounce Back Loan Guarantee Scheme (EBB). This is a contingent liability on the government's account under which the South African Reserve Bank (SARB) will be liable for initial losses up to 20%. Commercial banks will facilitate the EBB on an opt-in and first come, first served basis until August 2024 or until the EBB reaches 1 000 MW. It applies to both solar PV and battery energy storage solutions.

The AEF was launched in collaboration with the Land Bank and the DALRRD. The fund is designed to provide financial support for the acquisition of alternative energy assets, strategically targeting energy-intensive agricultural activities such as irrigation, intensive agricultural production systems, and cold chain related activities.

**There's also one big change to our MIR structure**

This year we've also updated our 2024 MIRs to create new hybrid reports. In order to make our printed reports shorter, and to keep up with unpredictable and regular policy changes, we've moved the sector overview and policy sections, which were traditional chapters in our MIRs, online. These sections will now be updated in real time and can be accessed by clicking on the button below. Our PDF reports and printed booklets have been shortened to focus more directly on the emerging opportunities in the sector. We hope these changes improve your reading experience

ACCESS ONLINE CONTENT



1

# INTRODUCTION AND PURPOSE

This MIR is compiled for foreign and local investors looking to invest in the South African green economy through project development, asset management, equity, debt, equipment manufacture, or support services. It highlights investment opportunities in embedded generation and energy storage created by South Africa's diversifying ES market.

In 2023, the growth rate of South Africa's SSEG sector continued to increase, resulting in an all-time peak between the first and second quarter of the year. This boom resulted in a large influx of imported equipment and system registration applications with distributors. Similarly, BTM Li-ion battery backup systems experienced a growth aligned with increasing energy insecurity challenges such as loadshedding. The two market opportunities described in this document are expected to continue to be lucrative for investors in the short term (next five years). The long-term stability and growth of these opportunities will however be linked to factors such as the continuation of demand driven by unreliable electricity supply and cost saving allowed by installing SSEG, the availability of skills, as well as appropriate regulatory and quality assurance mechanisms.

The MIR is accompanied by an online sector overview which can be found here. This includes detailed and regularly updated information on the global context, local landscape, sector statistics, policy, and governance structures. No EE opportunities have been highlighted in the 2024 ES MIR as the EE markets in South Africa continue to show sluggish activity despite significant potential. The information on EE opportunities is broken down and discussed in-depth in the online content per EE technology. Furthermore, the term SSEG is used in a limited sense to refer to solar PV as the growth and opportunity in alternative technologies, such as small-scale wind and biogas, are limited.

The opportunities herein are thus those that will be the most attractive to investors based on the current market dynamics in the ES sector as well as based on insight into its future trajectory.

Note: GreenCape's Large-scale Renewable Energy MIR explores investment opportunities into renewable energy projects greater than 1 MW and excludes rooftop solar PV. The large-scale renewable energy market is thus not covered in this Energy Services MIR.

For questions, queries, or to access GreenCape's services, contact the ES team at energysectordesk@greencape.co.za.

**CONTACT THE ENERGY SERVICES SECTOR DESK**



2

# MARKET OPPORTUNITIES

The evolving South African energy landscape creates opportunities for investors, financiers, project developers, component manufacturers, and suppliers in the ES market.

This section covers two key opportunities:, rooftop solar PV installations and BTM battery storage. Each sub-section is structured as follows:

- **Investment opportunity:** describes the specific investment paths into South Africa's ES market and the potential size of the market.
- **Market drivers:** covers those factors that enhance the development and increase the growth of investment opportunities into ES market.
- **Market barriers:** covers those factors that reduce the attractiveness and increase the risk of the investment opportunities.

## 2.1 Rooftop solar PV installations

Rooftop solar PV installations have become a popular and economical means for both small and large energy users to improve their resilience in the face of rising electricity costs and loadshedding.[3] This has been supported by enabling policy and regulation and the availability of diverse financing mechanisms. Overall, a strong business case will continue to drive the growth of this investment opportunity.

### 2.1.1 INVESTMENT OPPORTUNITY

The market for rooftop solar PV installations has continued to grow rapidly as a business-level energy and price resilience intervention. It has been historically challenging to size the market due to discrepancies in information on installed systems and number of systems registered with the appropriate distributor, either Eskom or the local municipality. According to aerial surveys conducted in Cape Town and Johannesburg, the majority (over 70%) of systems by quantity are not registered with the respective distributor (PEETS 2020). The distributors are, however, able to account for most of the added capacity on the grid as it is mainly the smaller residential systems that are not registered. Table 2 shows a sub-segmentation of the rooftop solar PVs market by system size.

**Table 2:** Rooftop solar PV installations market size
(Source: SAPVIA 2023, Eskom 2023a, and GreenCape Analysis)

| ROOFTOP SEGMENT (Q1 2023) | RESIDENTIAL | C&I AND AGRI | LARGE ROOFTOP C&I |
|---|---|---|---|
| **System size** | 0 – 30 kW | 30 kW – 1 MW | 1 MW – 5 MW |
| **Capacity (MW)** | 700 | 1 500 | ~1 000 |
| **Total installed capacity (MW)** | | | ~3 200 |
| **Quarter on quarter growth** | 137% | 45% | 85% |

Table 2 shows that the residential and large rooftop C&I sectors were the fastest growing. The growth of the former can be attributed to very high market volatility in relation to customer experience of loadshedding. Prolonged periods of loadshedding greater than stage 4[4] is a strong driver for the investment decision of a residential client and can result in "boom & bust" cycles when loadshedding is suspended and demand decreases in response.

As a result, many established residential installers target the small C&I and agricultural segment (<300 kWp) where there has been consistent growth as this allows them to turn over procured equipment and mitigate excessive warehousing costs. From Table 3 and Figure 2 it can be seen that by the end of Q1 of 2023 residential PV systems dominated the market by quantity, but not necessarily by installed capacity.

3 Although the demand for rooftop solar PV is influenced by loadshedding, it does not provide offtakers with a solution to loadshedding without the inclusion of a battery energy storage system. Loadshedding as a driver is covered under section 2.2.2.1.

4 Loadshedding is categorised into 'stages' accompanied with a schedule of when power users will experience a black out. Each 'stage' is indicative of the shortfall of power available to the grid in GW, i.e. stage 4 loadshedding is indicative of a 4 GW shortfall.



**Table 3:** Residential vs C&I PV systems by quantity in major metros, end of Q1 2023
(Source: SAPVIA 2023)

| PROVINCE | NO. OF SYSTEMS | % RESIDENTIAL (BY QUANTITY) VS C&I |
|---|---|---|
| **City of Tshwane** | 22 956 | 94 |
| **City of Cape Town** | 21 342 | 91 |
| **City of Johannesburg** | 15 040 | 87 |
| **Ekurhuleni** | ~7 500 | >80 |
| **eThekwini** | ~1 800 | >80 |

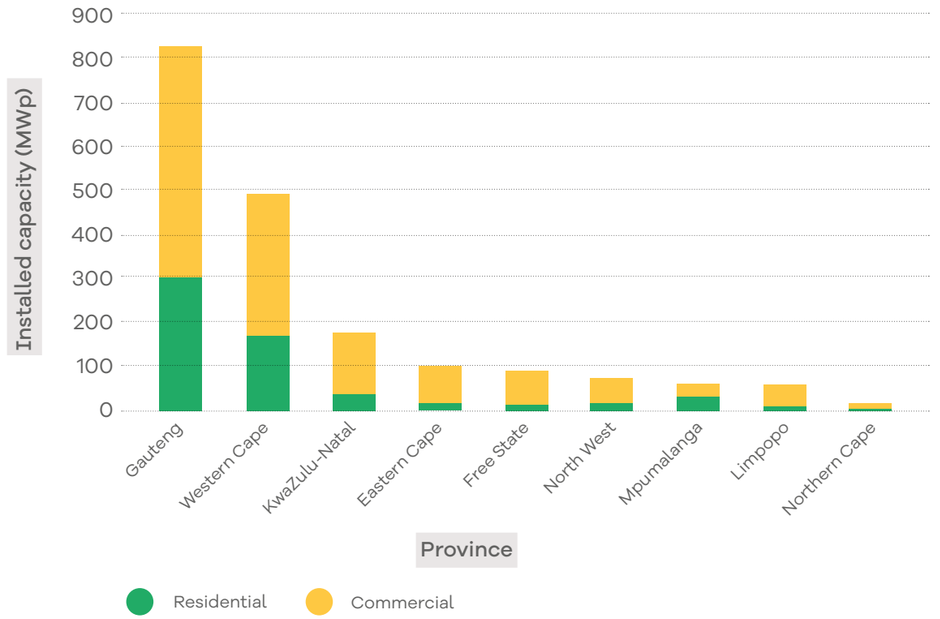
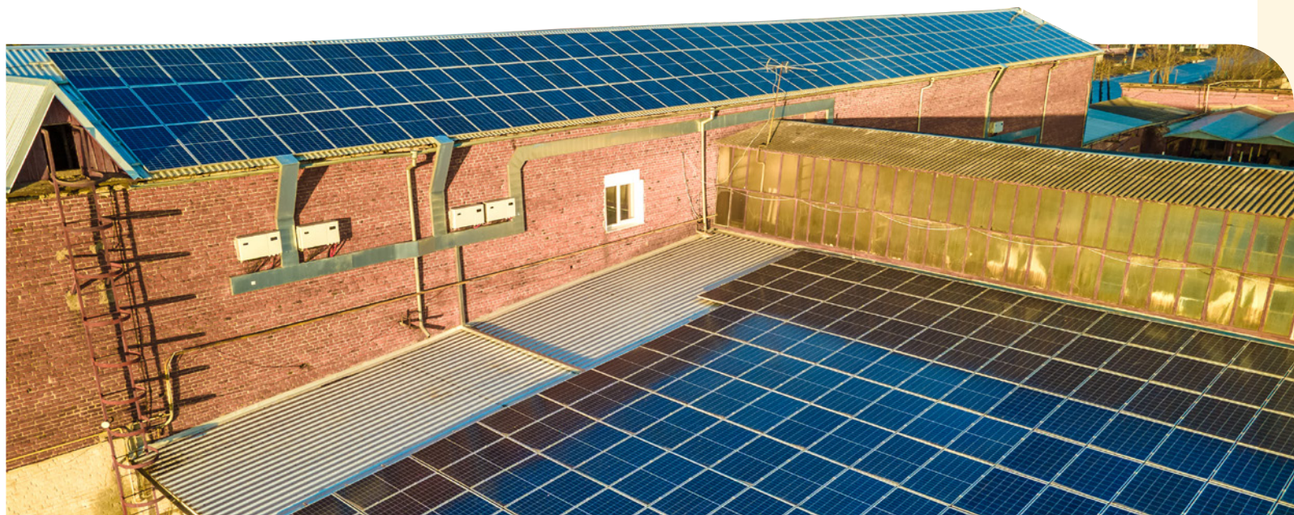



**Figure 2:** Total installed capacity of commercial and residential PV systems (<1 MWp) in different provinces at the end of Q1 2023
(Source: SAPVIA 2023)



It is expected that the total accessible market for the residential segment will be limited by affordability. Typical systems (5 kWp PV with 5 kilowatt hour (kWh) Li-ion battery) are in the price range of R100 000 to R240 000. Lower-cost systems can be indicative of poor quality equipment and non-compliance with regulatory requirements. Access to better quality equipment and installations is being enabled by leasing structures which are offered by vetted installers that have partnered with banks or investment funds with funding platforms.

The growth of the large rooftop C&I segment is due to it only recently being enabled by positive regulatory developments. These include amendments to the Electricity Regulation Act 4 of 2006 in 2021, which changed the generation capacity limit for projects that do not require an electricity generation licence from 1 MW to 100 MW, and the ongoing development of tariff incentives, the energy trading landscape and wheeling frameworks/tariffs, which opens up the opportunity to building owners that do not have significant on-site loads.

An increase in the number and size of rooftop solar PV installations will also result in a greater role for ancillary markets such as O&M. The market for O&M contract rebuys is not very lucrative as it is a low-margin and high-risk market. There is, however, growing traction for advanced metering and monitoring applications which enable O&M companies to maximise the number of portfolio sites handled per asset manager whilst also reducing the cost of reactive maintenance which requires a physical visit to the site.

The installed capacity for rooftop solar PV installations grew from 2.1 GW to 3.2 GW from the beginning of 2022 until the first quarter of 2023, as illustrated in **Figure 3**. This represents a 52% increase and a current market value of R41.6 billion.[5] It is expected that the installed capacity will increase to 10 GW with a market value of R130 billion. This **6.8 GW** growth provides a total opportunity investment value of **R88.4 billion** by 2030 or **R14.7 billion per year.**

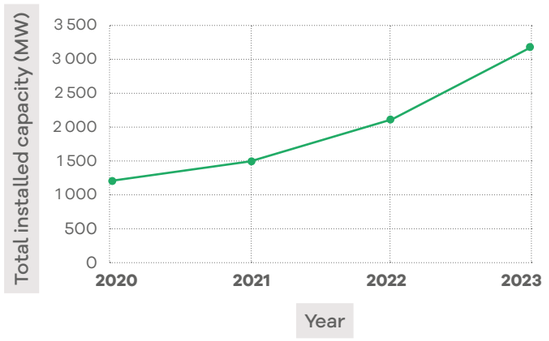



**Figure 3:** Rooftop PV installed capacity growth Q1 2020 – Q1 2023
(Source: SAPVIA 2023 and GreenCape Analysis)

## 2.1.2 DRIVERS

The core drivers of rooftop solar PV installations are cost resilience against rising electricity tariffs, loadshedding, enabling policy and regulations, the availability of diverse finance mechanisms and funding incentives available from government institutions. These are discussed in more detail in the sections that follow.

### 2.1.2.1 Rising electricity costs

Rapidly rising electricity prices have created a sizeable demand for viable alternative energy sources in South Africa. Comparing Eskom's price increases to South Africa's inflation rate as reflected by the Consumer Price Index (CPI), reveals that average inflation per annum between 2018 and 2024 was 4.56% and the inflation adjusted average standard Eskom tariffs have increased by 28.1% over this period.

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As a result of the challenges and the operational costs at Eskom, the utility applies to the National Energy Regulator of South Africa (NERSA) for tariff increases year-on-year to recover lost revenues. This has resulted in a 653% increase in the electricity tariff from 2006 to 2022 (PowerOptimal 2023). There has been an average increase of 12.5% per annum from 2019 as shown for Eskom's Megaflex low demand season (LDS) tariffs in **Figure 4**. An 18.65% increase has already been approved for 2024/25 and will come into effect from April 2024.

Additionally, Eskom is attempting to minimise the impact of loadshedding during peak periods through the extensive use of diesel-based open-cycle gas turbines. The greater the supply shortfall, the more reliant Eskom becomes on these turbines and subsequent diesel spend to mitigate against higher stages of loadshedding. Excessive diesel expenditure drives up the overall cost of electricity over time.

5 This assumes the total installed cost of solar PV is R13/Wp.



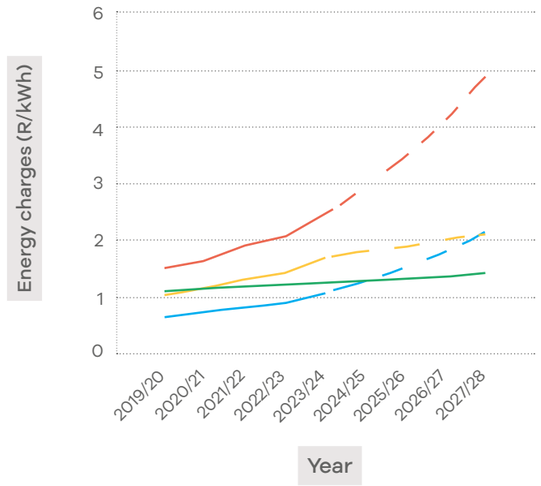


**Figure 4:** Historical and projected electricity tariffs: Eskom Megaflex + 30% municipal markup
(Source: Eskom 2023b)

It is predicted that low solar PV prices will drive down the rate of tariff increases for daytime tariffs in the long term as the public procurement of solar PV increases. This impact will be the most significant in the low demand season (September to May) for energy users on time-of-use (TOU) tariffs. Non-energy charges and TOU tariffs outside of daylight hours will likely increase by above inflationary values to counter potential losses from low solar PV prices. Municipalities are moving towards a tariff structure with greater emphasis on fixed access charges, as opposed to energy charges. This is to protect against revenue losses as PV penetration increases and to ensure that the grid can be maintained.

### 2.1.2.2 Diverse and innovative finance mechanisms

The majority of rooftop solar PV systems smaller than 1 MWp are financed through asset or property secured commercial debt. The risk perception of solar PV has come down significantly from where it was in 2015/16 and as result most banks can offer lending rates below prime. Factors that have contributed to the favourable rates include the maturity of the solar PV market in South Africa and the fact that many developers, EPC companies, and installers have established a successful track record, and are constantly improving internal due diligence and vetting processes.

This finance mechanism accounts for 60% to 70% of all projects smaller than 1 MWp. It is still favoured as the system owner retains the maximum benefit compared to service-based offerings where the developer keeps a larger portion of the return and takes responsibility for the ownership, performance, and maintenance of the PV system. Asset or property secured commercial debt, when combined with tax incentives (covered in **section 2.1.2.4**), effectively results in a reduction in the cost of the system by ~30%. As a result, the payback period on an upfront loan is typically in the range of four to six years.

Two main service-based offerings make up the remaining 30-40% of projects:

- **PPAs** (30% to 35% of projects): This is the main finance mechanism when the energy user wants to take a hands-off approach to procurement and ownership. This is advantageous when there is not an ability to raise the necessary capital for an outright purchase. It is also favoured by corporates and property groups who may not always have dedicated facilities managers and want to procure solar PV across multiple sites in their portfolios.
- **Lease agreements** (2% to 3% of projects): This is not very common in the C&I market. Compared to the other two options discussed, it is expensive and does not have any significant advantages over a PPA structure for the energy user. It is favourable for the service provider as payments are not based on the performance or energy output of the system, but there would normally be a minimum performance baseline and warranties in the contract. For this reason, this mechanism is quickly becoming the main finance mechanism for C&I BTM Li-ion storage back-up as it saves the service provider from the difficulties of structuring an appropriate PPA tariff without being able to accurately predict asset usage and the impact of loadshedding.

Both of the above options offer flexible contract terms ranging from five to 20 years. Shorter terms would mean a higher repayment premium or PPA tariff. Provision can be made for a buy-out clause to the remaining repayment value expected over the entire contract term. Some PPA providers may also provide the option to base the tariff on allowing the energy user to keep the asset beyond the end of the contract term. Some PPA providers may also provide the option to base the tariff on allowing the energy user to keep the asset beyond the end of the contract term. **Table 4** and **Figure 5** provide a summary and overview of the decision process for the different PV finance mechanisms discussed.

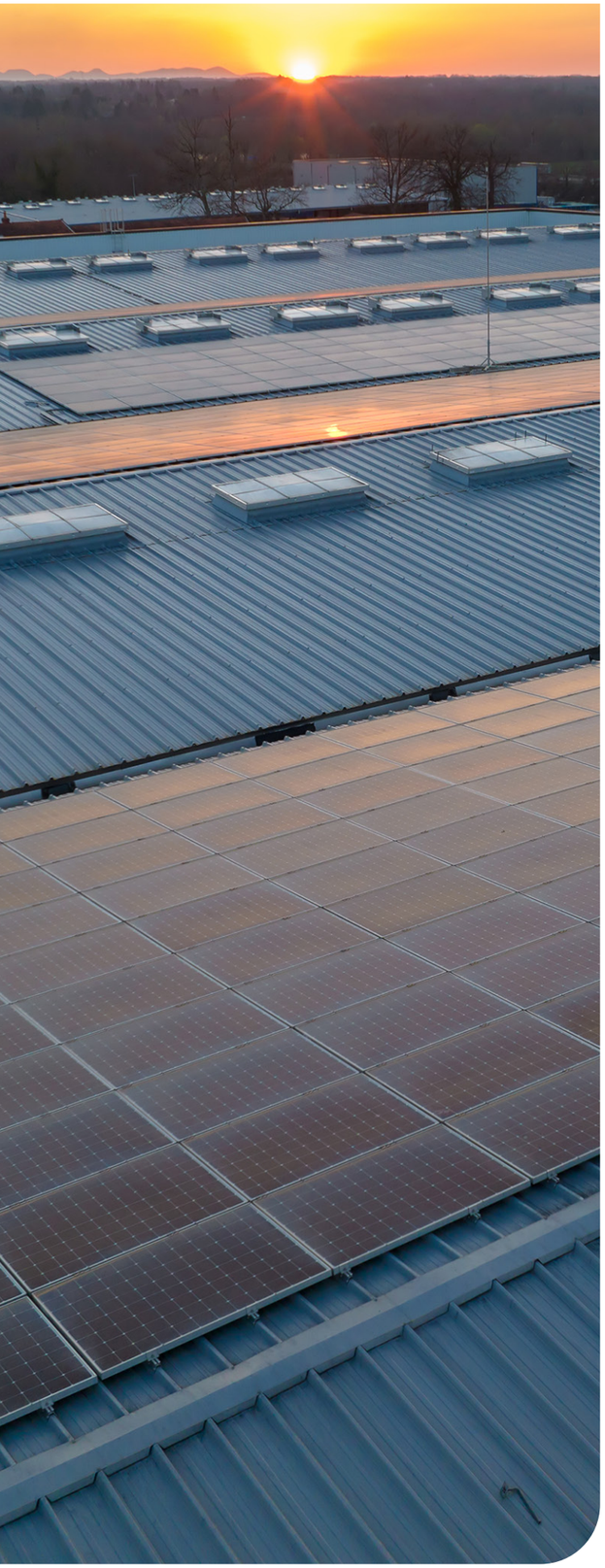

**Table 4:** PV finance decision drivers

| OPTION | WHY AND WHEN |
|---|---|
| **Outright purchase** | Want to maximise the benefit from the system. Capital outlay can be self-funded. |
| **Debt finance** | Want to maximise benefit from the system. Capital needs to be raised. |
| **Lease agreement (rent-to-won)** | Cannot afford the previous two options but want to own the system in the long term. Want to minimise system performance risk over the lease term. |
| **PPA** | Do not need or want to own the asset. Access utility bill savings from day 1 of operation with developer ensuring adequate system performance. |

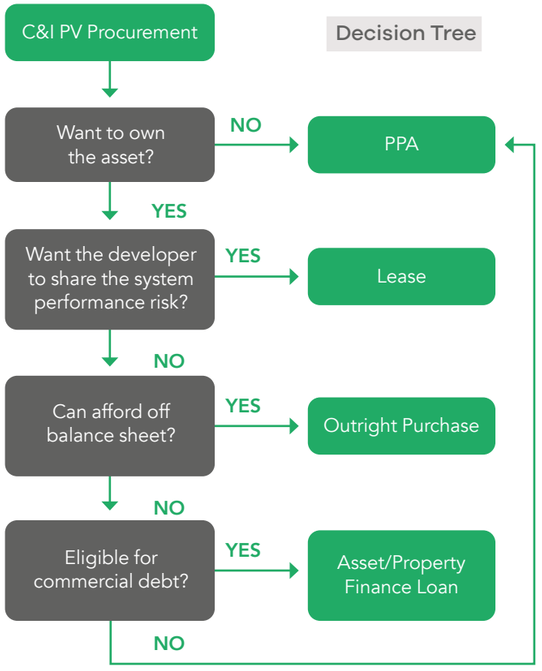


**Figure 5:** Solar PV finance decision tree



Table 5 provides a summary of a market benchmarking survey conducted for the rooftop solar PV market for the period 2023/24. Notably, there is an economies of scale effect where the larger the system the better the price per Wp or PPA tariff. Based on the current market competitive PPA rates, a cost saving of 30% to 50% is typical relative to a municipal tariff of R2.30 per kWh.

**Table 5:** PV market price benchmarks 2023/24

| PROCUREMENT OPTIONS / SYSTEM SIZE | <100 KWP | <500 KWP | >500 KWP | >1 MWP |
|---|---|---|---|---|
| **Outright purchase** (per kWp) | R12.00 – R16.50 | R12.00 – R15.00 | R11.50 – R14.00 | R11.00 – R13.50 |
| **Debt finance** (five - 10 years) | Above amortized plus risk dependent interest %, typically below prime. For more info visit (Link to section in online content) | | | |
| **Lease-to-own** (10 years) per month excl. escalation pa) | R7 000 – R30 000 | R25 000 - R120 000 | R100 000 - R200 000 | >R210 000 |

### 2.1.2.3
### Enabling policy and regulatory environment for SSEG

The country-wide rollout of national embedded generation rules, regulations, and tariffs to promote the safe and legal uptake of embedded generation for own use[6] has been a major local driver. Figure 6 and Figure 7 present data obtained on the positive uptake of SSEG processes in municipalities.

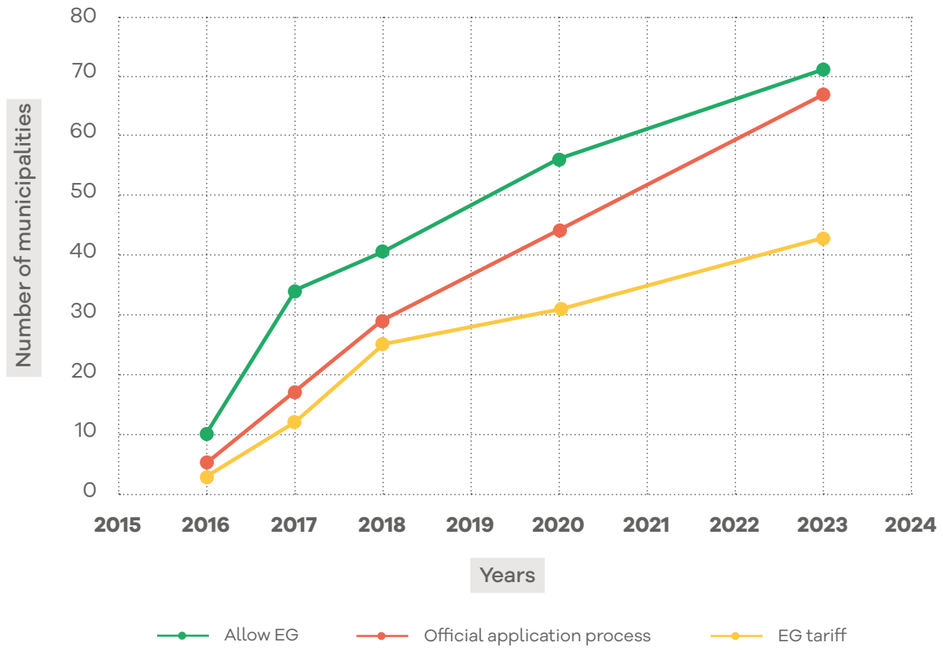


**Figure 6:** Uptake of SSEG processes in municipalities
(Source: SALGA 2023)

6 The generation of electricity on the load site where it will also be consumed.

According to the South African Local Government Association (SALGA) survey, only 43% of a total of 165 municipal distributors allow SSEG onto their network, 41% have official application processes, and 26% have approved SSEG tariffs (SALGA 2023). **Figure 7** shows that all major metros allow EG, and that processes in the Western Cape and Gauteng are quite well-developed. In 2023, a number of municipalities in the Northern Cape, Free State and Mpumalanga made provisions to allow for embedded generation whilst not yet having official application processes yet. **The Municipal Embedded Generation Support Programme** is helping to accelerate the implementation of official application processes by onboarding municipalities onto a centralised application platform. The most progress still to be made is in Eastern Cape, KwaZulu-Natal, and Limpopo.

The Municipal Embedded Generation Support Programme offers technical assistance to integrate embedded generators into municipal distribution networks. Municipalities are offered a range of training sessions and support activities, with the objective of capacitating municipalities with technical knowledge of embedded generation integration and setting tariffs. The programme is led by SALGA, funded by the GIZ and implemented by Sustainable Energy Africa in partnership with the Solar Training Centre (SALGA 2023).

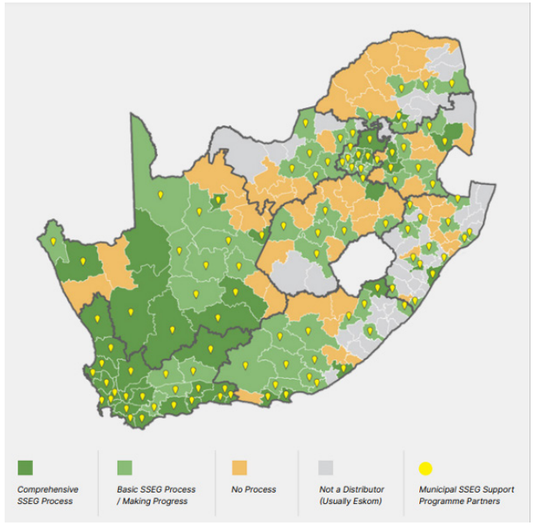


**Figure 7:** Municipal embedded generation processes map
(Source: SALGA 2023)

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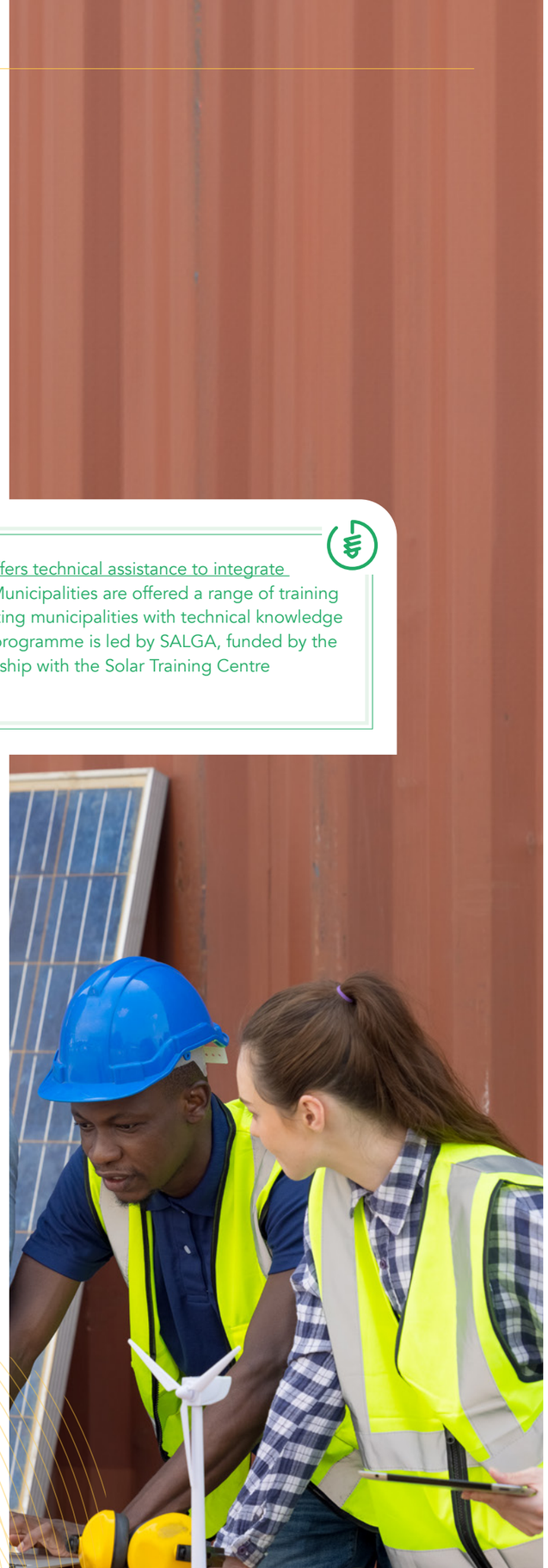




There are a large range of feed-in tariffs across the municipalities depicted in **Figure 8**. Some municipalities, including Buffalo City, the City of Cape Town, and the City of Tshwane, utilise a fixed feed-in tariff, whereas others, such as the City of Ekurhuleni, eThekwini, and Nelson Mandela Bay, implement a TOU tariff with varied feed-in tariffs depending on the time of day or season. Feed-in tariffs allow embedded generation system owners to get remunerated per kWh unit they export back onto the municipal grid. It is also important to note that many municipalities apply a fixed monthly charge to customers that choose to use embedded generation, resulting in an upfront usage fee independent of the feed-in tariff.

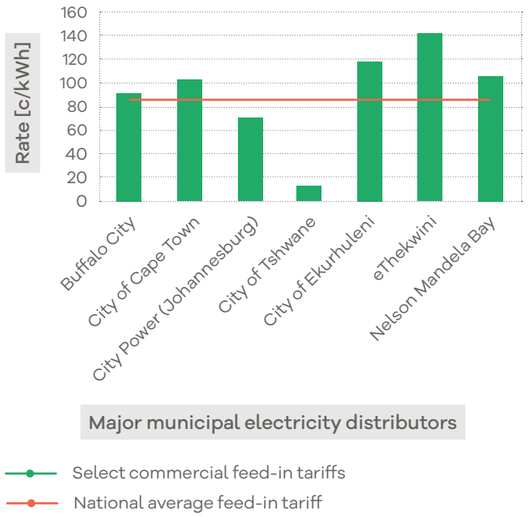



**Figure 8:** Commercial feed-in tariffs for major municipalities in South Africa[7]
(Source: SALGA 2023 and GreenCape analysis)

Whilst the national average of available feed-in tariffs remains relatively low at 86.9c (**Figure 8**), it is still a good added benefit, when built on an already strong business case for own generation. There is currently no guarantee on the structure and rate of municipality (and Eskom) determined feed-in tariffs from year to year. Municipalities are fine-tuning tariffs to be more cost-reflective, with the bulk of their costs derived from energy TOU purchases from Eskom. These changes at the municipal level complement legislative changes at a national level. Together these changes herald a freer, more 'liberalised' electricity market, in which stakeholders can be more empowered in their energy choices.

Wheeling is becoming increasingly relevant to the large rooftop C&I market as it creates off-take opportunities for SSEGs that do not have significant on-site loads and/or may have other facilities that may require the power. The National Energy Crisis Committee (NECOM)[8] is supporting collaborative engagements to ensure the short-term bankability of wheeling via the:

- Development of a national wheeling framework to be adopted by NERSA,
- Standardisation of municipal wheeling guidelines, and
- Standardisation of the use of systems contracts for all municipalities.

From a tariff perspective, if energy on a PPA at a lower rate than Eskom Megaflex can be offered, all parties participating in the transactions will benefit from a wheeling arrangement. Currently, the average daytime charge from Eskom is ~ R1.60.

Licensed energy traders can be a key intermediary for wheeling as they take away the off-take risk for the generator. They have the ability to purchase power from multiple electricity generators across the country and supply it to various end customers nationally, through the use of Eskom and municipal networks.

### 2.1.2.4 Financial incentives by government institutions

The South African government launched three financing incentives and a proposed tax incentive aiming to improve the financial viability of installing solar PV systems and thus increase the rate of growth in the sector; the BBS; the AEF; and the addition of section 12 BA to the Income Tax Act of 1962 to temporarily expand section 12B.

In August 2023, the National Treasury launched the EBBS. This initiative aims to incentivise the installation of rooftop solar PV over 12 months and is aimed at both small businesses and households that are experiencing difficulties resulting from unreliable power supply. The scheme functions through the National Treasury providing the SARB with a guarantee, recorded as a contingent liability on the government's account. The SARB will be liable for initial losses up to 20%. Commercial banks will facilitate the EBB on an opt-in and first come, first served basis until August 2024 or until the EBB reaches 1 000 MW (National Treasury 2023a). At the launch of the EBB, the National Treasury adjusted the scheme to include power storage assets without generating capacity, like batteries and inverters (National Treasury 2023b).

7 The graph indicates the fixed TOU tariffs or a select standard rate high demand season tariffs where TOU is relevant.

8 There has been a concerted effort to end loadshedding and achieve energy security through the implementation of South Africa's Energy Action Plan (EAP). The NECOM was established in 2022 to ensure that the EAP objectives are fully implemented.

The AEF provides funding support through blended financing of alternative energy assets to alleviate the impact of loadshedding on operations in the agricultural sector. The programme has been established through a partnership between the Land Bank and DALRRD and focuses on purchasing equipment and infrastructure for alternative energy sources directly linked to farming operations, in particular, poultry, cattle and horticulture (Land Bank 2023).

Treasury, together with the SARS proposed the addition of Section 12BA to the Income Tax Act to temporarily replace section 12B to provide a higher tax incentive to businesses implementing RE projects. Section 12BA provides incentive for renewable energy systems that will allow businesses to claim an upfront deduction from their taxable income of 125% of the cost incurred for RE assets. The incentive only covers RE systems brought into use between 1 March 2023 and 1 March 2025. The temporary nature of the incentive aims to encourage businesses to respond in accordance with the current energy challenges. This tax incentive is complemented by EBB to allow business to access funding for RE (National Treasury 2023c).

A similar incentive for individuals was announced during the 2023 Budget Speech, consisting of a 25% rebate on the cost of solar PV modules, up to a maximum value of R15 000. This incentive was only valid for the 2023/2024 tax year and was not extended to the 2024/2025 tax year (National Treasury 2023d).

These initiatives by government institutions could drive growth in the uptake of rooftop solar PV systems.

### 2.1.3 BARRIERS

The barriers to unlocking the ES market in South Africa are insufficient EPC company capacity to keep up with the demand for projects and limited quality assurance mechanisms to ensure systems that are installed are appropriate in terms of quality, safety, and compliance. This poses risks to the industry's reputation and long-term sustainable growth.

#### 2.1.3.1 Insufficient skilled EPC company capacity to match project demand

Most construction work for rooftop solar PV systems larger than 100 kWp is sub-contracted, although some companies are vertically integrated to provide a full turnkey solution from design to construction and O&M. The challenge is that many new entrants to market, especially those targeting larger rooftop solar PV systems (larger than 800 kWp), focus only on project development. As a result, greater demand is placed on existing and established EPC companies which already have construction pipelines planned up to a year in advance. This has two main negative effects.

First, it slows down the growth of the market and can also lead to logistical and cost challenges in managing the timing of distribution and storage of equipment for sites. As illustrated in **Figure 9**, a typical construction should take no longer than three to six months and the expectations from energy users is that solar PV is fast response technology. But, with capacity delays, an average procurement cycle of 18 months could be extended out to 30 months resulting in months of lost savings.

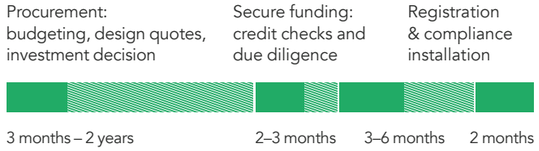



**Figure 9:** Procurement cycle for rooftop solar PV – C&I (Source: GreenCape Analysis)

Second, it incentivises EPC operations that do not prioritise installation quality and compliance over speed and efficiency. As the sector grows, more and more work is subcontracted to teams that lack expertise and training. This also speaks to an increasing need for demand-led training for EPC companies including roles such as those highlighted in **Table 6**, covering expertise areas such as skilled and semi-skilled trades, project management, as well as electrical, structural, and civil engineering and design.



**Table 6:** Skills in high demand in rooftop solar PV installations

| SKILL LEVEL | WHITE COLLAR | HIGHLY SKILLED | BLUE COLLAR (SKILLED) | BLUE COLLAR (SEMI-SKILLED) |
|---|---|---|---|---|
| **Solar PV rooftop installations / installations / EPC companies** | Project development manager | Electrical engineer | Solar PV installer (electrician) | Solar PV mounter |
| | Business development manager | Solar PV designer | Grid connection engineer | |

### 2.1.3.2 Institutional capacity constraints

The surge in interest in installing SSEG, with or without battery energy storage, has added an unexpected load to the wider ecosystem of stakeholders, including:

- the finance industry: commercial banks, funds, funding platforms;
- the insurance industry: underwriters, insurers, brokers; and
- distributors: municipalities, Eskom.

These stakeholders conduct their own due diligence processes. In cases where they are unable to scale their capacity in response to a surge in demand, there may be delays in obtaining necessary approvals or financing, consequently leading to delays in the installation of solar PV systems. Another challenge faced by project developers is the diverse requirements of these stakeholders, contributing to an increased administrative burden during project execution.

Many of the stakeholders have found mechanisms to address these capacity constraints. For example, some banks provide access to a vetted list of installers and a vetted equipment list. Municipalities may also have specific requirements; for example, the City of Cape Town maintains a list[9] of type-tested inverters/equipment in accordance with NRS 097-2-1[10]. Municipalities may also put in place mechanisms to accelerate the processing of applications for authorisation of SSEG systems on their networks. With this in mind, the City of Cape Town, for example, has simplified its application and approval process by requiring all systems to be grid-tied (as of October 2023) and is developing an online application form.

## 2.2 BTM Li-ion energy storage

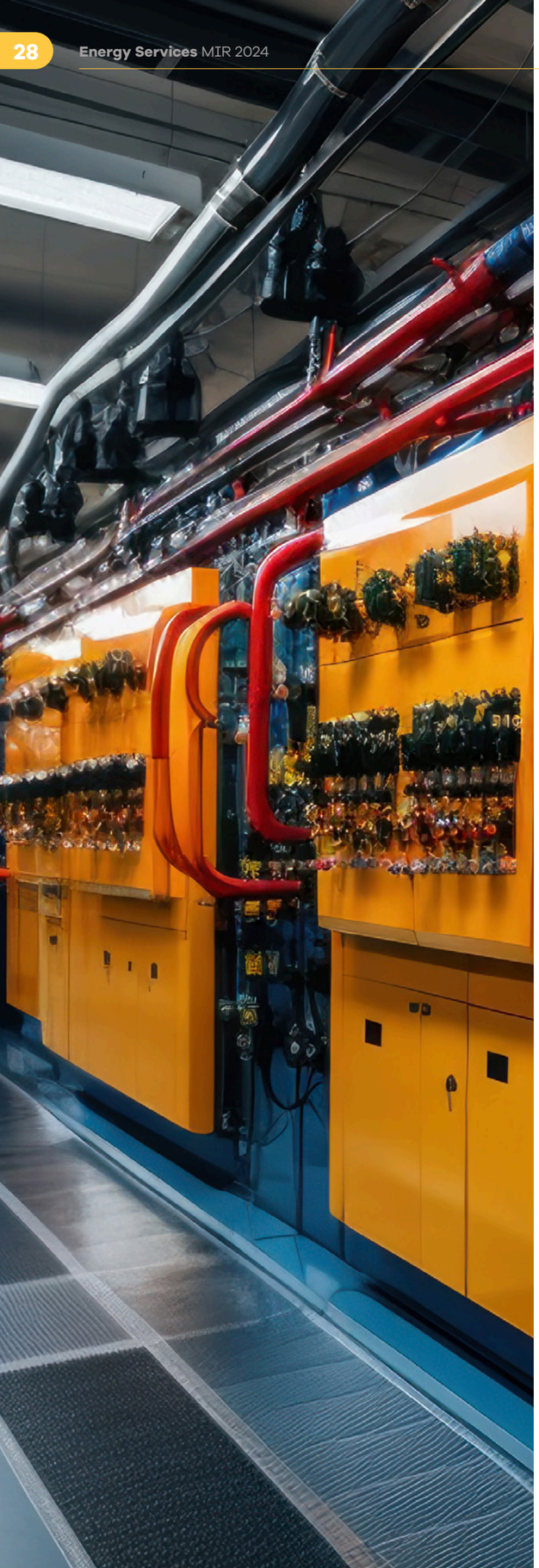
Li-ion battery backup provides a long term cost competitive asset which shields energy consumers against energy insecurity challenges such as loadshedding. Whereas in the past C&I SSEG investment decisions were driven by resilience against rising energy costs, from 2022/23 this shifted to an energy resilience priority. Overall, this is a dynamic and fast-growing market that has potential for local industrialisation.

### 2.2.1 INVESTMENT OPPORTUNITY

Li-ion battery technology has become the most tried and tested alternative back-up technology to the conventional diesel generator in South Africa over the past five years. It remains the leader in this market, due to its short duration performance, relatively fast charging times, and proven operational stability. There has been a 90% decrease in the cost of Li-ion batteries since 2010 (Statista 2023) and there are further indications for lower price potential due to developments in technology and manufacturing. However, it is expected that increasing resource scarcity relative to demand and global supply chain dynamics will play a role in slowing these reductions as soon as 2025 onwards (IEA 2022).

9 See: City of Cape Town Energy Directorate 2024.

10 NRS 097-2-1: Grid Interconnection of Embedded Generation – Part 2 Small-scale embedded generation – Section 1: Utility interface



Overall, growth in this space is driven primarily by a need for backup and UPS systems during loadshedding. The most promising short duration application (<4hrs) is Li-ion batteries for the commercial, industrial, and agricultural sectors up to stage 4 loadshedding. These sectors in particular cannot afford unreliability in power supply, as this has knock-on negative effects on machinery, manufacturing processes, and production. For example, for certain processes it may take several hours to start up a plant; and inconsistent irrigation may result in irreversible spoilage or impact on the quality of food produce. Notably, early growth in the market has been driven by the demand for residential hybrid PV installations discussed in the preceding section. Whilst growth in that segment of the market is expected to continue, a similar trend it is expected in battery storage that it will outnumber C&I in quantity but not in installed capacity. A greater investment in larger Li-ion storage systems will be supported by progressively increased financier confidence in battery lease structures tied to a five to 10-year warranty based on the battery's expected lifespan / usage.

In 2023, the installed capacity grew from 500 MWh to 1.2 GWh representing 140% growth and a current market value of R9 billion. Assuming the battery to PV system ratio in 2023 (0.36 Gigawatt hours (GWh)/GW PV) and the cost of battery systems remains at R5/Wh, it is expected that by 2030 the installed capacity will reach 3.6 GWh with a market value of R18 billion. This 2.4 GWh growth provides a total opportunity investment value of **R12 billion by 2030** or **R2 billion per year** for BTM Li-ion energy storage and will be smaller than the total energy storage market that includes grid sized systems, electric mobility, and other uses.

## 2.2.2 DRIVERS

The core drivers of BTM Li-ion storage market are loadshedding, a strong business case relative to other backup technologies, and use case flexibility which allows for value-adding cases beyond energy security.

### 2.2.2.1 Loadshedding driving demand for backup power

Since 2008, loadshedding has been an almost constant part of the South African electricity landscape. This trend has continued in 2023, as depicted in **Figure 10** and reached an all-time high for a third year in a row. According to Eskom's Medium-Term System Adequacy Outlook 2024 – 2028 (Eskom 2023c), without significant recovery in Eskom's energy availability factor, South Africa will continue to experience high levels of unserved energy, and thus loadshedding, until at least 2028.



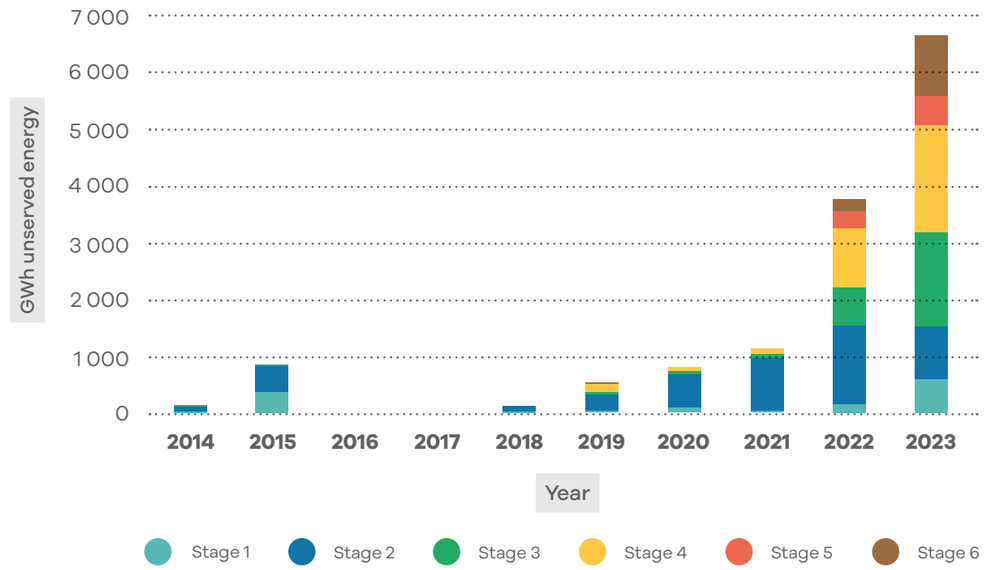



**Figure 10:** Loadshedding statistics in terms of total GWh unserved energy per loadshedding stage (Source: ESP 2023)

Loadshedding has an immediate financial and ultimately economic impact of losses experienced by businesses due to extended periods without power. Stage 6 loadshedding, first experienced in 2019 but significantly featured in 2023, results in eight to 10 hours of electricity blackouts a day. This drives the response by residents and business that seek to mitigate this impact through the installation of BTM Li-ion storage back-up and UPS systems.

### 2.2.2.2 Strong business case relative to other backup technologies

In 2023, the comparative cost dynamic between storage and commonly used backup technologies continued to favour Li-ion batteries. As can be seen from **Figure 11**, the price of diesel has been decreasing in 2023 from the steady rise in price since the Russian invasion of Ukraine in February 2022. The fuel price reached peak levels toward the end of 2023 which highlights its volatility and the influence of multiple factors including high global crude oil prices, the weakening South African rand, global supply chain disruptions and government levies. The long term uncertainty of the diesel price, and the likelihood that it will continue to increase make it less attractive compared to other backup technologies.

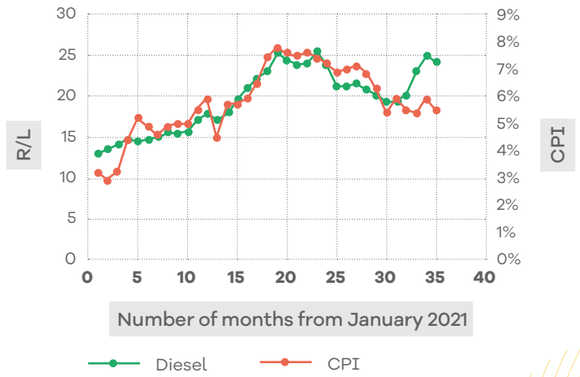



**Figure 11:** Cost of diesel compared to CPI 2021-2023 (Source: DMRE 2023 and StatsSA 2023)

Levelised cost of storage (LCOS): The cost of kWh electricity discharged (or generated) from a device when accounting for all cost incurred and energy produced throughout the lifetime of the device. For batteries, this would most notably include the cost of replacements; and for generators this would include fuel and maintenance cost.

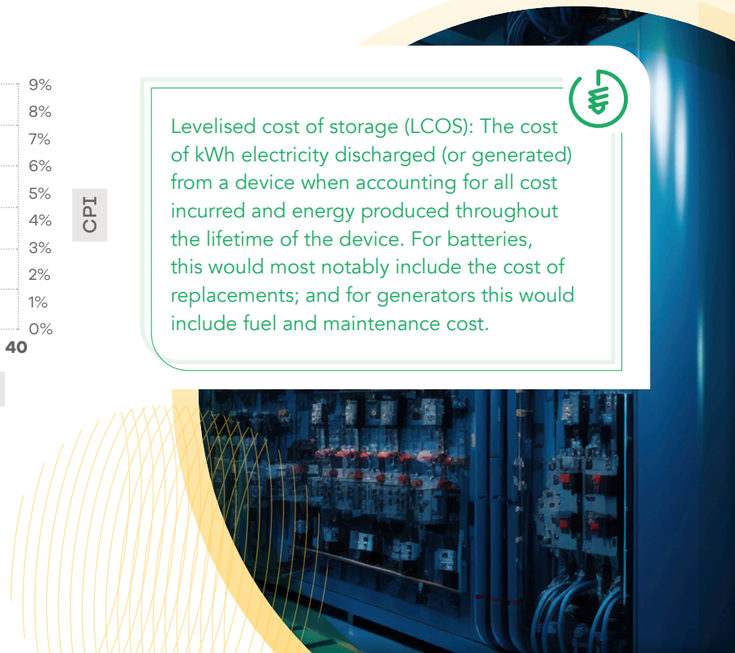


**Table 7** and **Figure 12** provide a comparison of feasible energy storage and backup technologies in South Africa for the C&I and agricultural segments on the basis of LCOS. It can be seen that battery storage technologies are cost competitive when considering lifetime costs for an equivalent backup requirement. This is further improved by the pairing of the battery with solar PV generation which is typically 40 to 60% cheaper than that from the distributor grid. Li-ion batteries are the most competitive at a LCOS of R3.50 – R6.50 per kWh. This shows that despite having relatively high capital costs, this technology is an economical long-term investment (10 years) for C&I and agricultural energy users seeking backup and UPS for their operations.

**Table 7:** Comparison of backup technologies

| TECHNOLOGY | ADVANTAGES | DISADVANTAGES | INVESTMENT COST R/KWH CAPACITY | LCOS R/KWH UNITS |
|---|---|---|---|---|
| **Advanced lead acid batteries** | Superior cycle life and depth of discharge compared to conventional lead acid<br><br>Function well at partial state of charge<br><br>Low cost compared to Li-ion | Impact and cost of disposal<br><br>Can be hard to find reliable quality<br><br>Short lifespan (2-3 years) | 2 000 – 3 000 | 5.00 – 6.50 |
| **Li-ion batteries** | High efficiency<br><br>High energy density<br><br>Improving technology in terms of performance and cost<br><br>8-12 year lifespan | Recharge time<br><br>Global lithium supply chain is constrained<br><br>Safety – thermal runaway | 6 000 – 10 000 | 3.50 – 6.50 |
| **Vanadium Redox Flow[11] batteries (VRFB)** | Effective long duration storage for >4 hour periods<br><br>Much longer life span than other batteries, 10 – 20 years | Only cost competitive for applications starting at >400kWh | 8 000 – 14 000 | 6.00 - 8.00 |
| **Diesel generator** | Dispatchable<br><br>Portable options available | Rising diesel prices<br><br>Chance of breakdown<br><br>May have carbon tax implications | 2 000 – 3 500 | 6.50 – 11.00 |

11 VRFBs could become a strong medium to long duration application (>4hrs) corresponding to greater than stage 4 loadshedding, however, the technology is still in early stage development in South Africa.

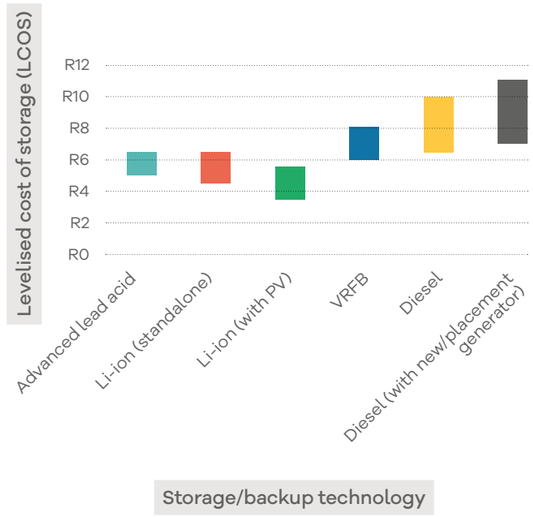



**Figure 12:** LCOS comparison of backup technologies (Q4 2023)

### 2.2.2.3 Value-stacking battery use cases

It is predicted that battery market penetration will further accelerate in the long term (five to 10 years) when Li-ion prices have dropped past a tipping point against TOU tariffs. Numerous value stacking options such as peak reduction and arbitrage will then become economically viable. Value stacking refers to the ability to leverage the same equipment, system, or process to deliver multiple benefits that maximise the financial benefit. There are promising use cases for BTM Li-ion storage, namely:

- Peak reduction/shaving: Batteries are charged during low demand periods and discharged during high demand periods, thereby reducing the peak energy demand from the distribution network. Peak shaving is most impactful on Eskom tariffs[12] that utilise Notified Maximum Demand (NMD). NMD is the demand capacity measured in kilo-volt-amperes that Eskom customers request. If customers exceed the NMD they are penalised with elevated network and transmission network charges (Eskom 2020). Peak shaving can reduce the risk of exceeding NMD and potentially allow facilities to reduce the NMD to benefit from lower tariffs.

- Tariff arbitrage: The battery storage unit is charged during off-peak periods and discharged during peak periods to take advantage of the difference in tariffs. For example, on an Eskom Megaflex TOU tariff with a long distance transmission zone (>900 km) and low voltage (<500 V), the off-peak rate during high demand season is R0.92 per kWh whereas the corresponding peak rate is R5.58 per kWh (Eskom 2023d). As a result, a C&I or agricultural energy user on a TOU tariff is a prime candidate to take advantage of this use case.

- Load shifting: Battery technology allows the reduction of electricity demand over one period and increasing the demand over another period to improve energy management. A use case of load shifting is realised by residential solar PV systems, where solar PV electricity production is at a peak during midday when energy demand is at a minimum, and the electricity demand is at a maximum in the early evening when solar PV production is at a minimum. Where municipalities have low feed-in tariffs or do not allow the electricity to feed into the grid, shifting the load using batteries could become a viable use case.

The multiple benefits of value-stacking go beyond just providing backup during loadshedding and thus provide a long term investment case in Li-ion storage installations notwithstanding the uncertainties of when loadshedding will no longer be needed.

12 Eskom implements NMD on most of their tariff structures.

### 2.2.3 BARRIERS

Although Li-Ion batteries are in high demand, further growth in the market is hampered by limited availability of skills for the design and installation of new battery systems. The lack of skills combined with nascent regulatory environment also pose an immediate safety and fire risk to installed systems. There is also an increased challenge with importing of products due to shipping delays and poor performing ports. South Africa has limited manufacturing capacity for Li-Ion batteries and is mostly reliant on imports from China. The nascent regulatory environment for battery installation and safety in South Africa also has the potential to hinder market growth if the risk of fires due to improper installation or use is not properly addressed.

### 2.2.3.1
### Limited availability of skills

The rate at which the rapidly growing demand for Li-ion battery storage can be produced and installed is expected to be limited by the availability of skills. Table 8 provides an overview of skills in high demand and at risk of shortages in the Li-ion storage sector.

**Table 8:** Skills in high demand in the Li-ion storage value chain

| VALUE CHAIN STAGE | HIGHLY SKILLED | BLUE COLLAR (SKILLED) | BLUE COLLAR (SEMI-SKILLED) |
|---|---|---|---|
| **Energy storage skills** | Electrical / mechanical / mechatronics engineers | Quality assurance and management | Battery technician Battery assembler |

The energy storage industry is a developing ecosystem which is falling behind its own rate of market offtake which is primarily driven by loadshedding. As energy storage markets continue to grow there will be an increase in the demand for skills in the assembly and retail/design/installation segments of the value chain. It is important that curriculums at education institutions are updated to include modules that are relevant to the energy storage industry and that adapt to the market dynamics to remain relevant to the nature and scale of the job opportunities. Among others, quality assurance, testing, and safety are important areas to address to enable the current growth in the battery storage market to be sustainable.

In addition to limiting the rate of deployment of BTM Li-ion storage, there is also a risk that the gap will be filled by those with poor or inadequate skills, which may ultimately undermine the credibility of the technology. Although, in the case of solar PV, there have been several initiatives to enable greater numbers of quality assured installers and mounters to be qualified (e.g. new training facilities at Tertiary Vocational Education and Training colleges), the introduction of a battery module component into the training certifications is required. It is also likely that current and new entrants to the market will need to invest in training and/or provide opportunities for practical experience (e.g. trainee and apprenticeships) to fulfil their skills demands.

### 2.2.3.2
### High exposure to equipment import delays

China currently dominates Li-ion cell production, although there are also some production facilities in the United States of America and Europe. Cell production has therefore already been captured by a few key players, including Panasonic, Contemporary Amperex Technology Co., Limited (CATL), and LG Chem. There is a promising local base of companies already participating in or considering local Li-ion battery production or assembly. Table 9 gives an overview of current Li-ion assembly in South Africa, totalling 8 000 MWh in 2023, with 61% of the manufacturing occurring in Cape Town. The majority of production serves the telecommunications industry for base stations and cell towers across Sub-Saharan Africa. BTM backup storage and electric mobility are both growing segments, which currently make up 15% and 10% of local production, respectively.

**Table 9:** Local Li-ion production/assembly in 2023

| SECTOR | PERCENTAGE OF LOCAL PRODUCTION/ASSEMBLY |
|---|---|
| **Telecoms** | 70% |
| **BTM** | 15% |
| **Electric mobility** | 10% |
| **Other** | 5% |

Despite the above local production, the storage market is still highly dependent on battery imports. As can be seen from Figure 13, Li-ion cells and battery imports have increased sharply since the third quarter of 2022. Imports peaked in the second quarter of 2023 in line with the SSEG demand boom due to loadshedding, discussed in section 2.2.2.1. This dependency creates a big supply chain risk which is exacerbated by the poor performance of South Africa's ports.

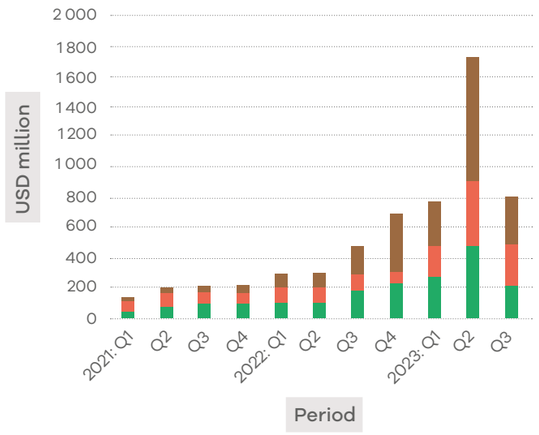



**Figure 13:** SSEG equipment imports 2021-2023 (Source: Trade Map 2023)



South Africa has four container ports, which scored the following rankings amongst 348 ports worldwide on the Container Port Index (World Bank 2023):

- Cape Town: 344 th
- Durban: 339 th
- Ngqura: 338 th
- Gqeberha: 291 st

It is clear that these ports have reported very poor performance compared to global standards. Poorly performing ports are characterised by limitations in spatial and operating efficiency, limitations in maritime and landside access, inadequate oversight, and poor coordination between the public agencies involved, resulting in a lack of predictability and reliability (World Bank 2023).

This has had a significant impact on the embedded generation value chain as it causes long lead times in procuring imported equipment sometimes up to nine months. The National Logistics Crisis Committee was established to enable a coordinated response to address the challenges in the South African freight and port logistics network. It intends to further support South Africa's state owned ports, rail and pipeline company, Transnet, through various measures, including stakeholder alignment and the mobilisation of resources, as well as assisting it to navigate existing challenges and ensure accountability.

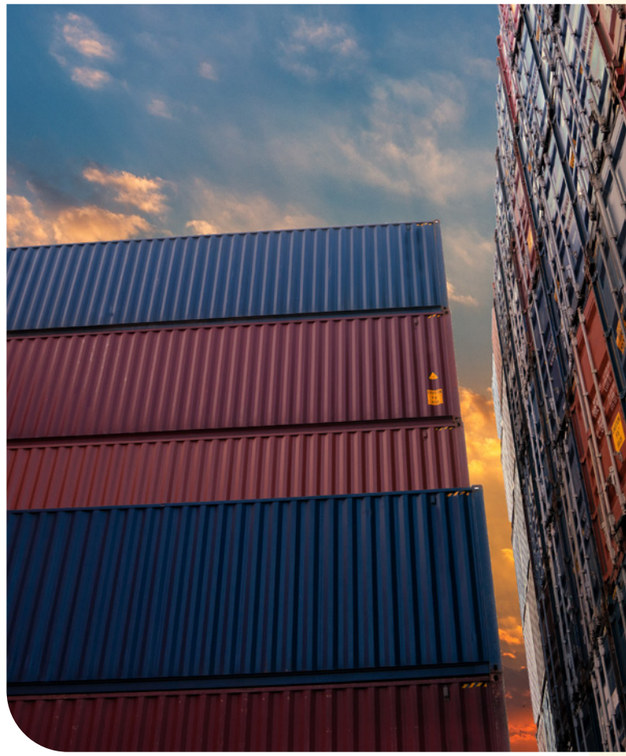
In the interim, there is potential for equipment aggregators to take on the role of fulfilling massive bulk orders for storage and distribution. This could alleviate the market stress, time, and expense placed on individual companies to secure equipment for their project pipelines.

### 2.2.3.3
### Nascent regulatory environment

Fire safety is of concern in the industry, both in the assembly plant and on-site at installation. Li-ion storage is highly susceptible to runaway behaviours and explosions when improperly installed and operated and requires specific mitigation and suppression strategies which are different to conventional fires. Safety is only covered to a limited extent in existing industry training course material, which puts workers at risk and puts an additional training load on battery assemblers to bridge the knowledge gap. Customers, especially residential customers, also have limited knowledge on the appropriate housing, placement, and maintenance of their storage systems. It is vital that risks associated with fire safety are mitigated as fire events not only pose significant immediate danger, but also have the potential to become highly publicised and cause a negative ripple effect through the industry from the risk appetite of finance and insurers to the perceptions held by the general public.

This issue is not unique to South Africa though. Globally, standards for battery safety are still being developed and debated in the form of updates to international standards (e.g. IEC 60364-7-712[13]) which are mirrored by updates in local standards (SANS 10142-1[14]).

Additionally, because of the increasing demand for BTM Li-ion storage capacity in the residential market, power distributors, in particular major metros like the City of Johannesburg and the City of Cape Town, are considering the current and long-term impact on the local distribution grid and are expected to adapt local regulation accordingly. One of the major issues is 'cold load pick-up' where all the batteries that were discharged during loadshedding start recharging at the same time immediately when the power comes back on. This causes spikes in demand that are hard to predict and create an initial peak power draw that either matches or surpasses the averted loadshedding draw when residential SSEG penetration reaches levels greater than 15%, essentially making loadshedding worse at a systems level (Ritchie et al. 2023). This exacerbated by many residential installers not limiting the charging rate of the battery to 25% of the circuit breaker size of the energy user's service connection as derived from the grid code NRS-097-2-3.[15] New planning and regulatory changes may be implemented to protect networks from the changing energy landscape.



13 IEC 60364-7-712: Low voltage electrical installations - Part 7-712: Requirements for special installations or locations - Solar PV power supply systems. This standard is normatively referenced in the local standards for wiring of premises SANS 10142-1.

14 SANS 10142-1: The wiring of premises Part 1: Low-voltage installations.

15 NRS 097-2-3: Grid Interconnection of Embedded Generation – Part 2 – Section 3: Simplified utility connection criteria for low-voltage connected generators

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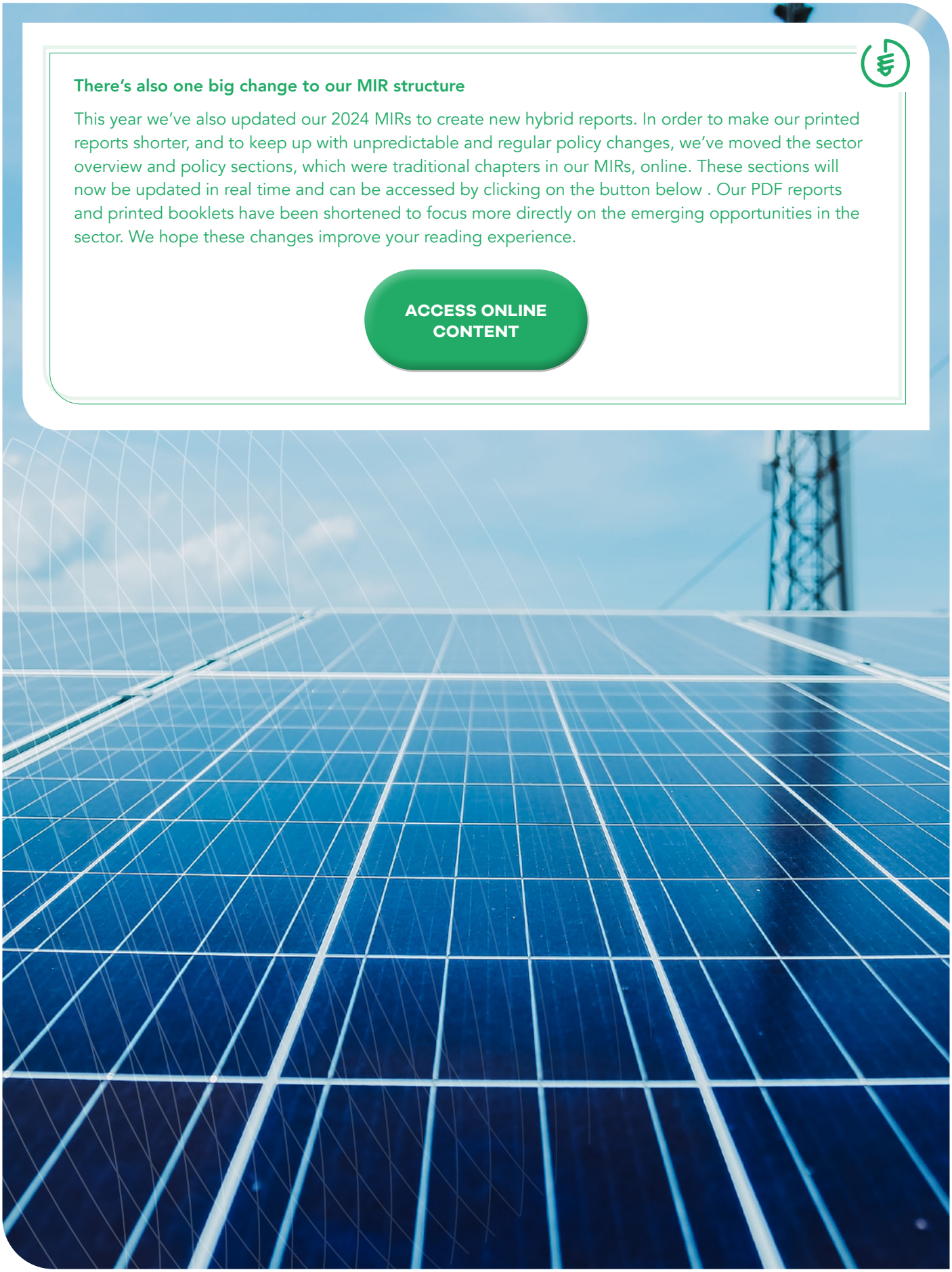
### There's also one big change to our MIR structure

This year we've also updated our 2024 MIRs to create new hybrid reports. In order to make our printed reports shorter, and to keep up with unpredictable and regular policy changes, we've moved the sector overview and policy sections, which were traditional chapters in our MIRs, online. These sections will now be updated in real time and can be accessed by clicking on the button below . Our PDF reports and printed booklets have been shortened to focus more directly on the emerging opportunities in the sector. We hope these changes improve your reading experience.

**ACCESS ONLINE CONTENT**



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