TO BESS OR NOT TO BESS

South African businesses look for energy alternatives.

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AT A GLANCE

The combination of yearly double-digit energy tariff increases and continued load shedding poses a real threat to South African businesses today. Consumers are looking into alternative energy solutions, which can address the increasing energy costs as well as improve their resilience during load shedding. To date, the combination of solar PV and backup diesel generators were the go-to options, but with diesel becoming extremely expensive and scarce at times, consumers have to consider battery energy storage systems (BESS).

Case Study: A typical commercial office building

LOAD PROFILE

The typical daily load profile of this commercial building is shown in the graph below. As expected, there is little to no load at night and a gradual increase during the day as temperatures rises and air-conditioners are switched on. The peak load was recorded at 43kW, a value used to determine the size of the hybrid inverter, and the daily consumption of 340kWh is used to size the solar PV system. Note that although there were two load shedding intervals, the load remained on.

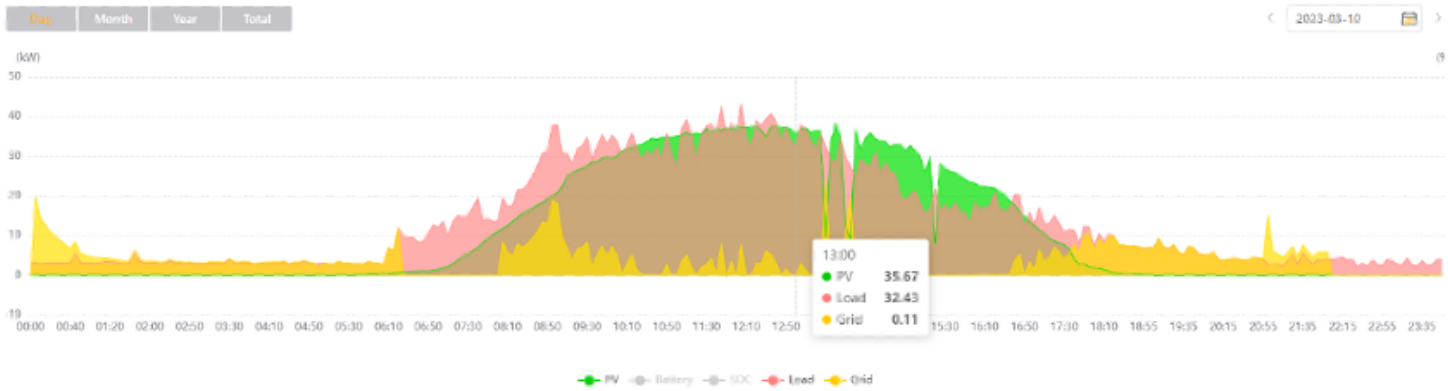
SOLUTION INSTALLED

A 50kW hybrid inverter, a 100kWh high-voltage lithium battery, and a 45kWp solar PV system. This system will decrease the consumer's dependence on the grid by 75%, for a consumer to be completely independent i.e., 'off-grid' this value needs to increase to 100%. In most cases 'off-grid' systems do not make financial sense, in our experience the consumer should target a value between 60-80%.

Solar PV: A 45kWp solar PV system was designed, and the output of the system is shown in the graph below. The maximum output value of 38kW was measured, i.e., a DC/AC performance ratio of 85% was achieved and the system produced a total of 270kWh for the day. The three output dips noticed in the graph are caused by cloud cover.

RESULT

Laying these diagrams over one another showcases the impact of the solar PV on the power consumed from the grid, which has reduced from 340kWh to 90kWh, i.e., a 75% saving was realised.



South Africa will be expected to experience over 250 days of load shedding during 2023, predominantly at stage 4.

ESTIMATED SAVINGS AND PAYBACK: SOLAR PV

The total blended tariff for energy is **R1.50/kWh from council.**
The solar PV system produced **270kWh for the day,** thus saving the customer R405 per day.
Extrapolate this over month and the saving amounts to over **R12 000, and over R145 000 for the year.**

One can assume that commercial buildings have little to no load during weekends and can therefore adjust the numbers above by applying the factor of **22 workdays / 30 calendar days**. However, it is important to note that without the battery, the solar system would have had to switch off during load shedding and possible savings would have been lost.

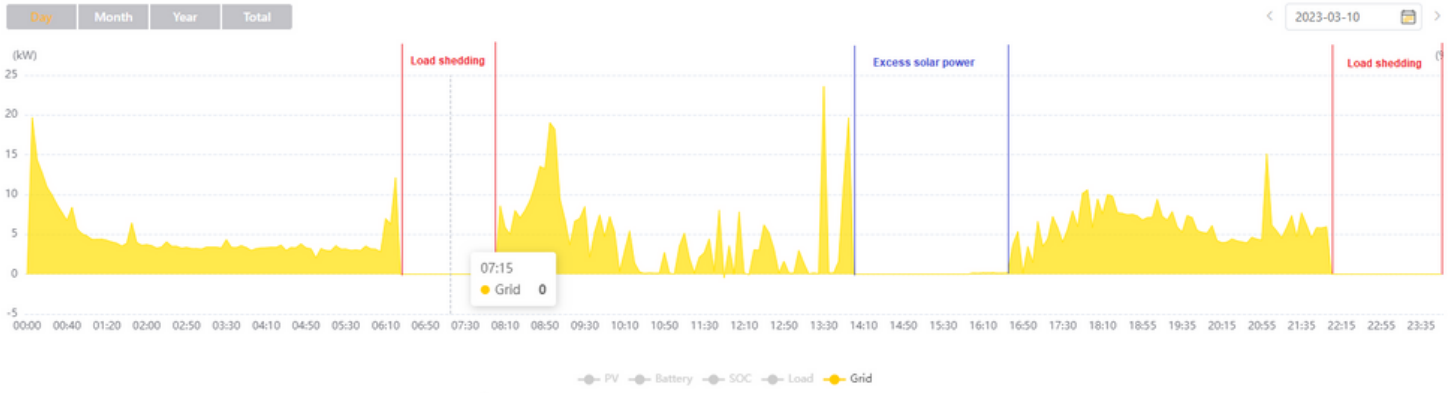
The installed cost of this solar PV system: **R500 000**
Cost of solar would be recouped in: **3 years, 5 months**

The benefit is that the solar system carries a **25-year warranty.**
If the savings amount of **R145 000** per year is used, the potential estimated saving of the solar PV system would amount to
over R4 200 000, considering a 10% annual tariff increase.

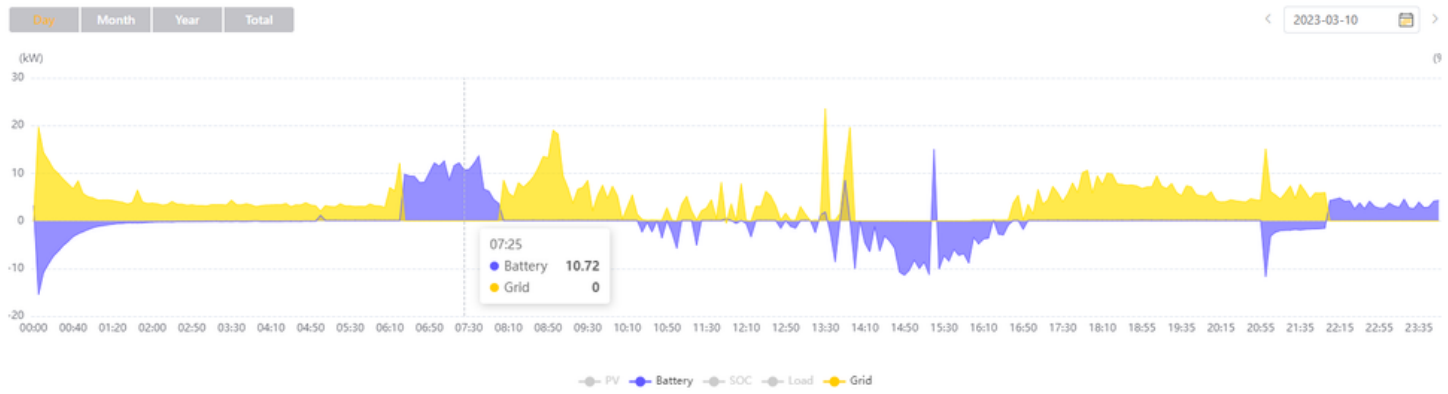
This investment will yield a ROI of 760%

LOAD SHEDDING

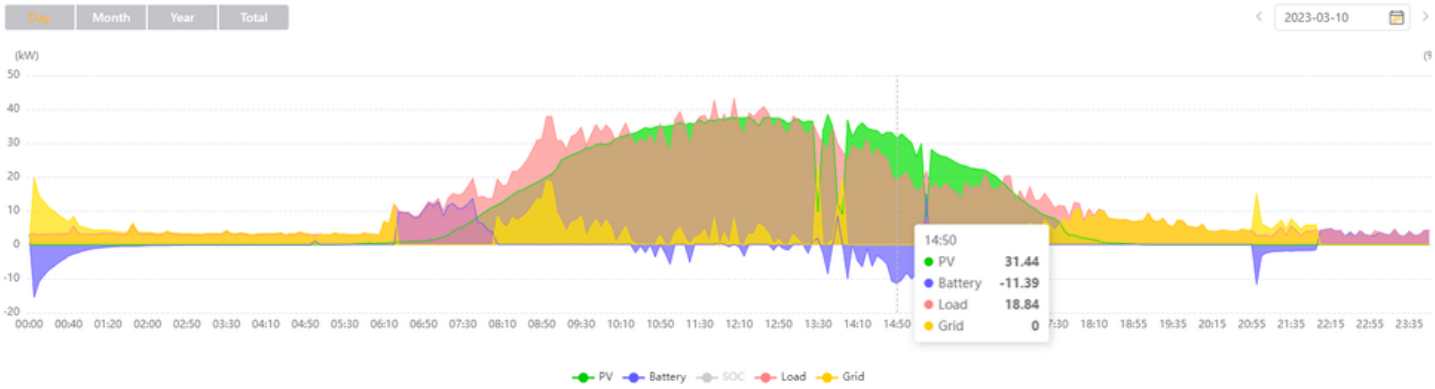
On this day load shedding was scheduled from 06h00 – 08h00 and again from 22h00-00h00, the graph shows clear flatlines during these periods. The flatline from 14h10 – 16h40 graph is a result of the solar PV exceeding the load, which will be used to charge the batteries.



The graph below shows that the batteries discharged (+ blue line) during the load shedding periods and was charged (- blue line) during the day whenever the solar PV exceeded the load of the building.



The graph below shows that at 14h50 the solar PV (31kW) exceeded the load (19kW), the surplus power (12kW) was used to charge the batteries.



ESTIMATED SAVINGS AND PAYBACK: BATTERY BACK UP

The cost of running a **backup generator** is estimated to be around **R7.00/kWh.** The total load consumed during the two load shedding periods amount to **30kWh**, i.e. the cost would have amounted to **R210**. If the load shedding periods were for example from 11h00 – 13h00, and 22h00 – 00h00, then the total load consumed would have increased to **80kWh**, i.e. the cost would have amounted to **R560**. Extrapolating this over a month, running the generator would have cost **over R 16 000**, and over a year this cost would have amounted to **over R190 000.**

The installed cost of this battery system: **R700 000**

Cost of battery would be recouped in: **3 years, 8 months**

If one had to purchase a **generator** to support this building during load shedding it would have cost around **R200 000.** If you subtract this from the battery cost, the nett cost of **R500 000** would have been recouped in **less than 3 years.** The **added benefit** is that the battery carries a **10-year warranty**, so if the **R190 000** per year is used; the **potential estimated saving of the battery system would amount to over R1 900 000, yielding a ROI of 270% for the initial investment.**

CONCLUSION

In the past battery energy storage systems (BESS) had a typical 8 to 10-year return as they could only be off-set against the peak time loads, and in some cases against the maximum demand costs. For this reason, investments were few and far between, but with South Africa's continued load shedding and the ever-increasing costs of diesel, these systems have become a feasible investment.

Other benefits of BESS systems include uninterrupted power supply to loads, cleaner energy to sensitive equipment compared to generators and when paired with solar PV systems it increases the user's reliability on the grid, i.e. the system can run the user for extended outage periods where backup generators will most likely fail.

BENEFITS OF BESS:

1. *Uninterrupted power supply to loads*
2. *Cleaner energy to sensitive equipment*
3. *Increases reliability*

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