

Performance analysis of a solar-storage hybrid system in a remote oil extraction SME in Senegal

AUTHORS

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I. INTRODUCTION

The current project was implemented in the frame of the project BIOSTAR that investigated renewable-energy solutions to improve the energy security of agro-processing small and medium enterprises (SME) in west Africa.

At Yaye Aïssatou oil mill in Passy, Senegal, a 19.8 kW_p solar photovoltaic (PV) system with 17 kWh lithium-ion battery storage was installed to supply electricity for peanut processing equipment.



Figure 1: Aerial view of the solar installation at Yaye Aïssatou oil mill.

The system was designed to cover 85% of the SME's electricity demand, reducing dependence on the grid and mitigating the impacts of power outages.

This study evaluated the performance of the solar PV system supplying a peanut processing SME under real operating conditions.

II. MATERIAL AND METHODS

1. The solar PV system

The main characteristics of the installed solar PV system are presented in Table 1.

Table 1: Characteristics of the installed solar PV system

Parameter	Value
Installed PV capacity	19.8 kW _p
Number of modules	36
Batteries capacity	17 kWh
Operating configuration	Solar PV + battery + grid
Monitoring	Victron VE.Cerbo GX

The system supplies a peanut sheller, oil press, plate filter, fan and lighting.

2. Parameters analysed

- PV power and energy,
- The energy economies

Data represent the operating period of one campaign from August 2025 to March 2026.

III. RESULTS AND DISCUSSION

1 System performance

The daily PV power output during the study period is presented in Fig. 2.

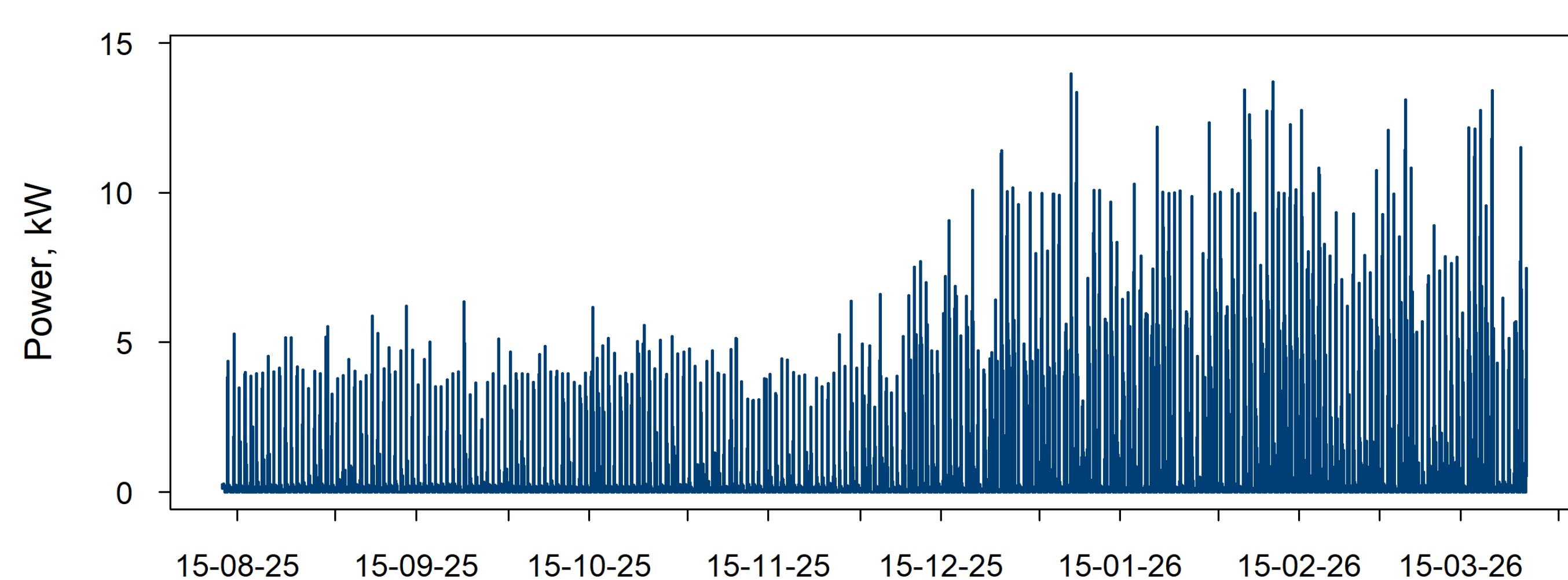


Figure 2: Power output of the PV system

The energy yield is presented in Fig. 3.

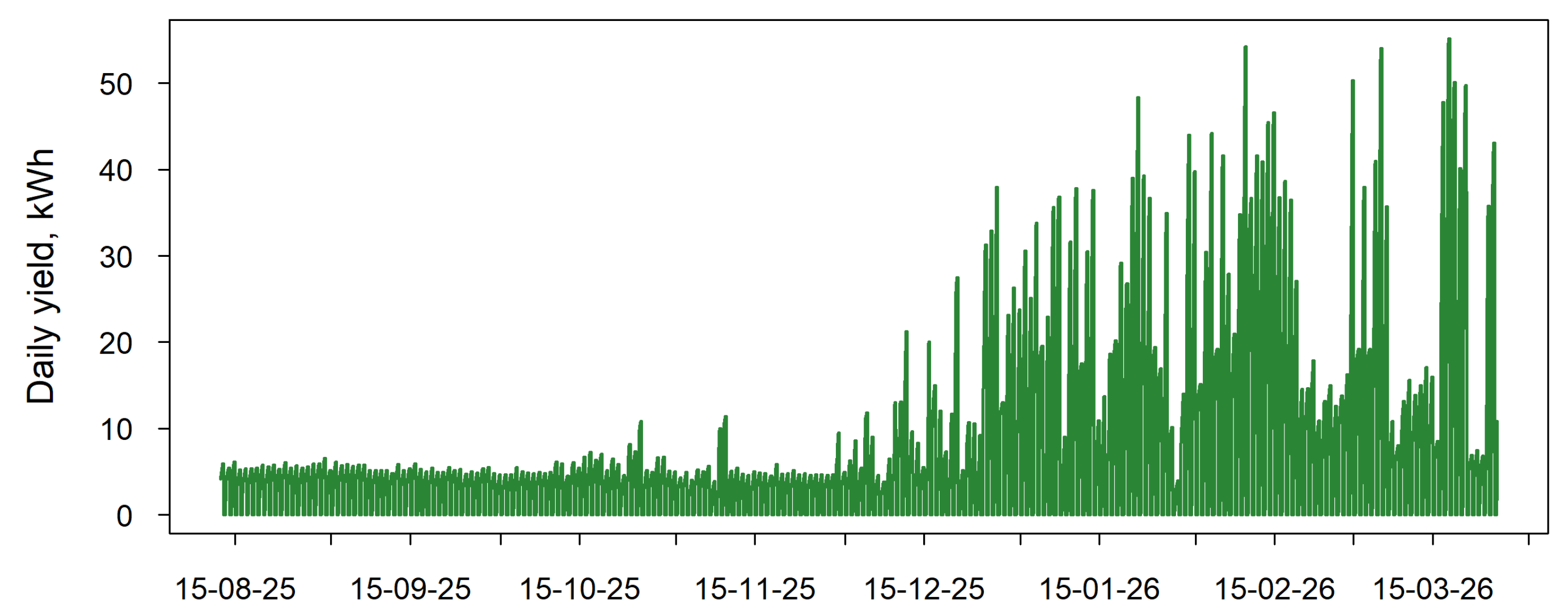


Figure 3: Total daily solar PV energy yield

During the processing season, the system recorded daily production peaks of 55 kWh.

Fig. 4 presents the batteries state of charge as a continuous time series over the entire monitoring period.

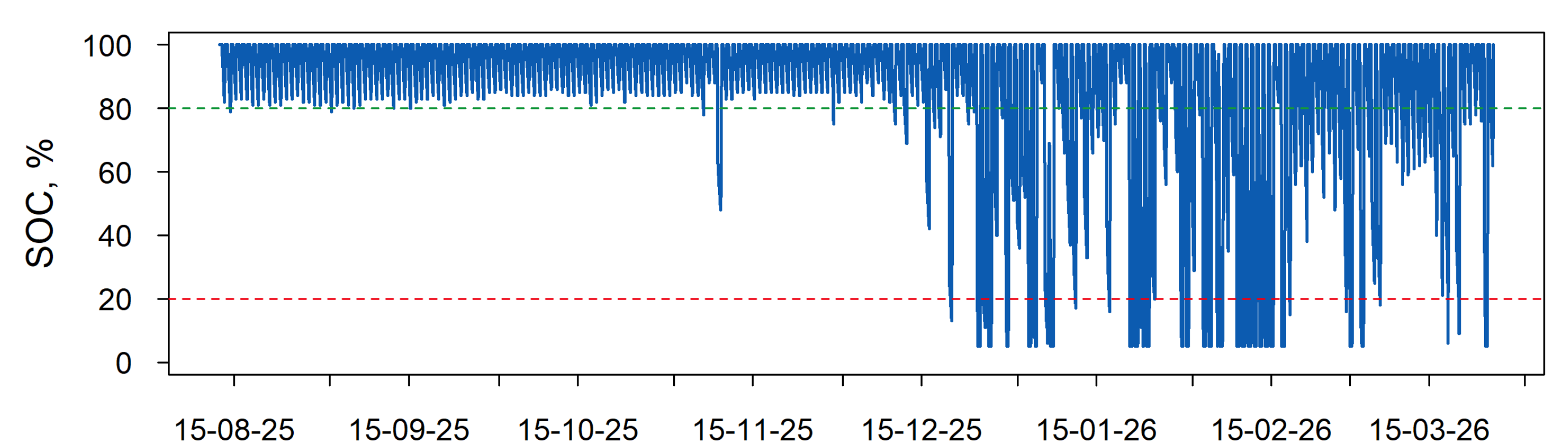


Figure 4: State of charge of the batteries

In general, the state of charge dropped overnight and then recovered the following day.

Economic benefits

Table 1 summarizes the savings made by the SME each month from the solar system in West African CFA franc (XOF).

Table 2: Summary table of economic savings from the SME

Month	Production (kWh)	Savings (XOF)
Aug – 2025	112.8	21 757
Sept – 2025	158.5	30 567
Oct – 2025	181.2	34 926
Nov – 2025	160.5	30 950
Dec – 2025	444.0	85 595
Jan – 2026	834.2	160 834
Feb – 2026	817.4	157 595
Mar – 2026	678.8	130 878
Total	3 387.5	653 102

It was during the transformation period that the SME made most of the electricity cost savings.

VI. CONCLUSION

The photovoltaic system installed offers a suitable solution for generating renewable energy to power the SME's agro-food processing activities.

This installation reduces the unit's reliance on the electricity grid and helped the SME to make up to XOF 653 102 in savings in one campaign (August 2025 – March 2026).

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