Empowering sustainable shea butter processing: A decentralised energy access solution for Burkina Faso

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1. Introduction

- Shea butter is a flourishing industry attracting stakeholders from the cosmetic, pharmaceutical, and food sectors worldwide.
- Conventional shea butter processing technic –the most widespread method- involves huge environmental concerns: i.e. processing residues management, consumption of water, and energy specifically provided by firewood (between 8-10 kWh of heat/kg of crude shea butter produced).
- Extraction of shea butter using mechanical screw press offers opportunities of being more time, and resources efficient (Fig. 1).
- The current research intends to design a reliable decentralized powering system for a more sustainable shea butter production chain.

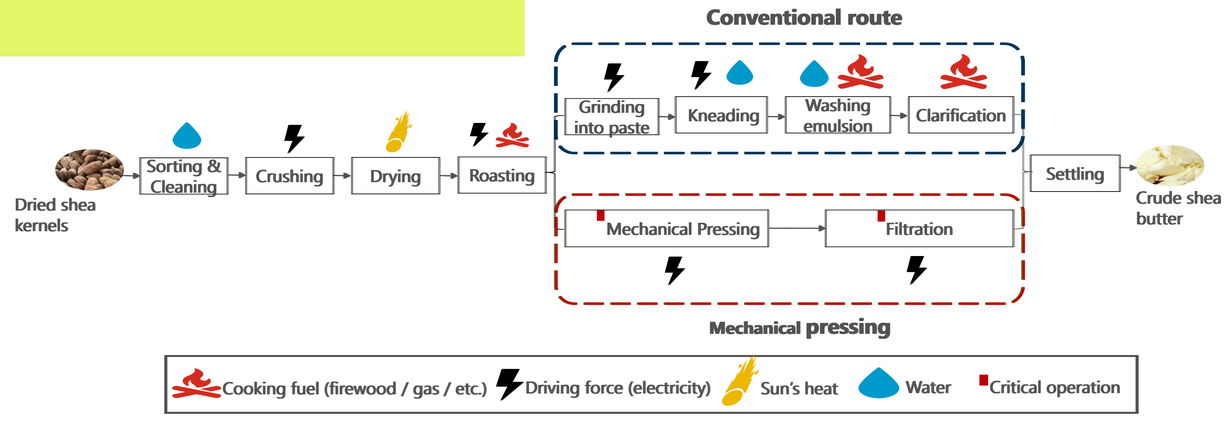


Fig. 1: Conventional processing *Vs* mechanical screw press based shea butter extraction.

2. Material and Methods

- Review of existing and adopted technically proven shea butter processing methods.
- Comprehensive electrical energy audit from existing processing plant in Toussiana, Burkina Faso using CA 8331 power analyser (Fig. 2).
- Definition of 2 scenarios as baselines for power sizing solutions.
- Design of the annual power profile, and reliable powering solution using Matlab R2023 software and HOMER Pro.

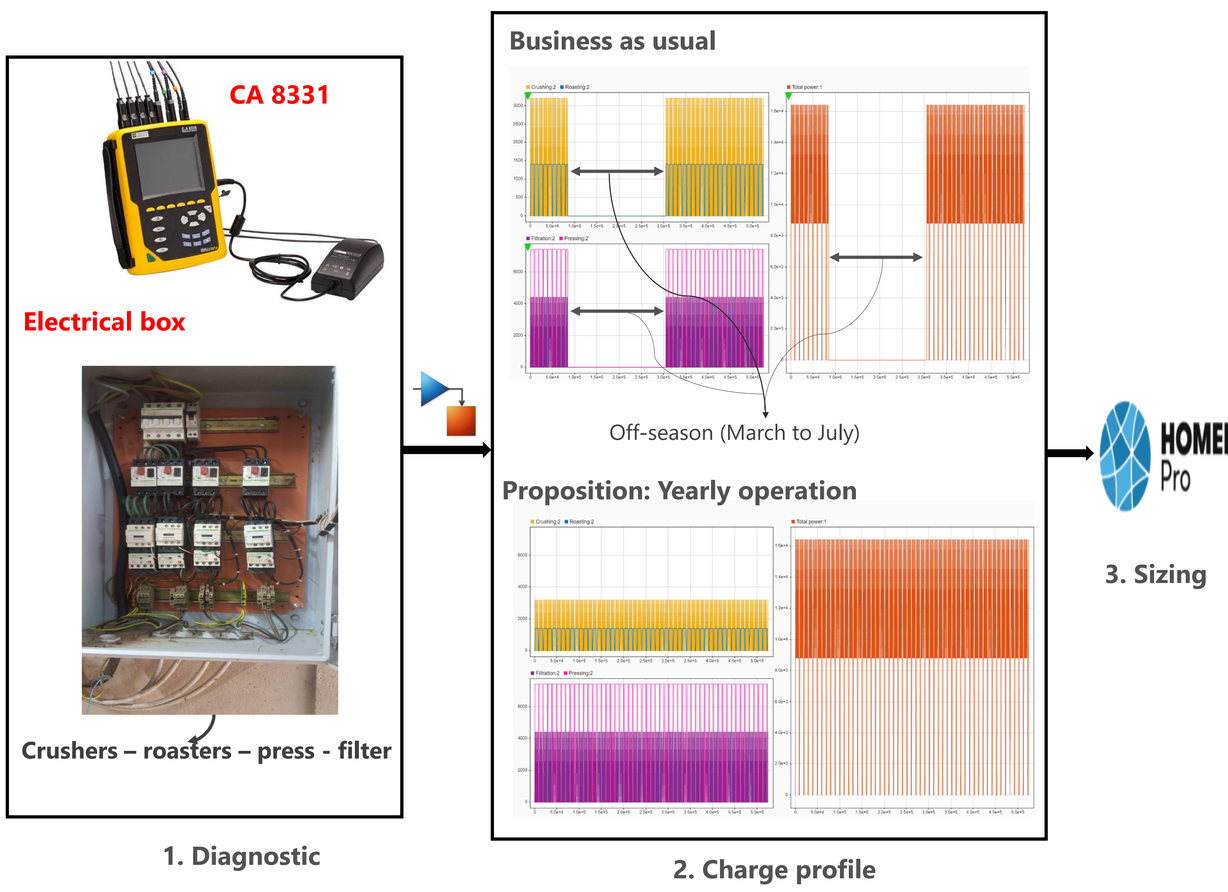


Fig. 2: Methodology – Sizing principle

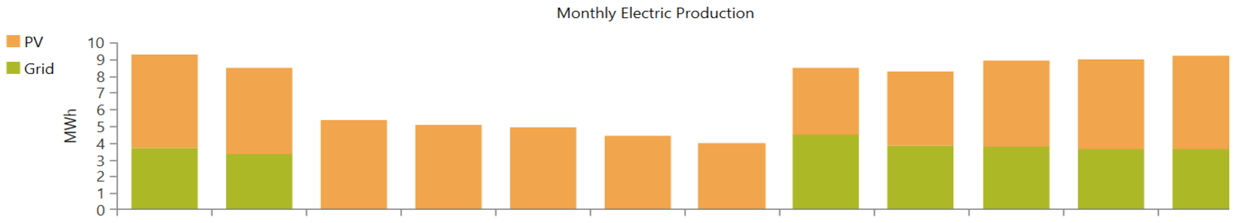
3. Results

Field investigation, Energy audit and sizing:

- Conventional (water based extraction) and mechanical screw press are the typical shea butter production methods in Burkina Faso.
- Shea butter extraction via a screw press implies the use of a press filter alongside with the screw press, therefore, these 2 operations has been targeted as critical.
- Processing operations are carried on only from August to February due to weather related challenges.
- Designed algorithm on Matlab based on the industry operating plan describes reliably the electrical consumption trends throughout the year.
- Current operation plan induces high excess unused electricity from the PV during non-operating period (up to 41% of the year´s generation).
- Year round operation reduces energy waste by 33%, and slightly improves cost of electricity either while all the processing appliances are considered or only critical loads (Fig. 3).

BUSINESS AS USUAL

Parameters	Total loads	Critical loads
Levelized COE (€/kWh)	0.15	0.16
Renewable penetration (%)	46.3	43.5
Excess electricity (%)	41.3	40.7



FULL-YEAR OPERATION

Parameters	Total loads	Critical loads
Levelized COE (€/kWh)	0.12	0.13
Renewable penetration (%)	51.6	48.5
Excess electricity (%)	27.5	27.6

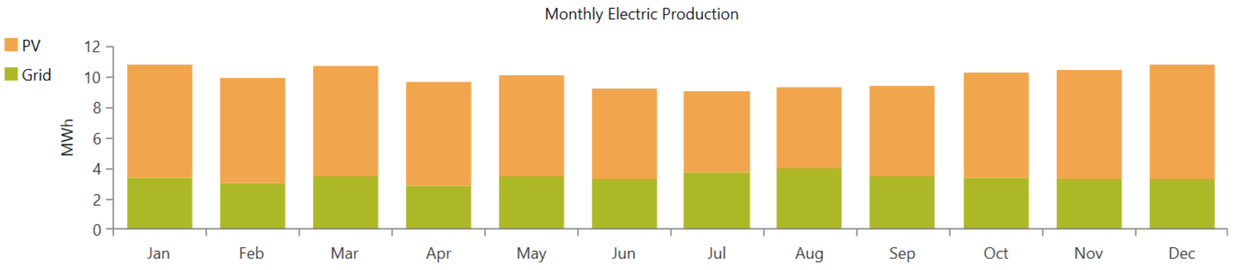


Fig. 3: Electrical production per source.

4. Conclusion and outlook

- Conducting processing activities throughout the year allow effective utilization of generated renewable energy from solar PV plant.
- Weather related challenges must be addressed: too hot from March to May to allow shea butter storage, and rainy to allow kernels drying from June to July.

Reference: Nounagnon, B.S., N'Tsoukpoe, K.E., Kpegba, K. *et al.* Sustainability challenges in conventional shea butter production in Africa: a review of energy consumption and resource efficiency. *Environ Syst Decis* (2023). https://doi.org/10.1007/s10669-023-09925-y

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