INDUSTRIAL ENERGY EFFICIENCY PROJECT IN GHANA

Energy Management Systems (EnMS)

CASE STUDY

INDUSTRIAL DECARBONIZATION ACCELERATOR

Praise Export Services Limited
Pokuase, Accra, Ghana

Company size (personnel)
Large
(100 or more)

Sector
Food processing industry

Utility intervention
Electricity

Year joined project
June 2021

Date of implementation
2022

Duration
15 months

Company profile

Praise Export Services Limited (PESL) is a Ghanaian owned food-processing company incorporated in 1994 as a private limited liability company. The company started operating as a service provider in packaging, documentation and shipping with three staff members. In 1995, PESL started exporting a small range of locally processed and non-processed food stuff, such as gari and fresh yams, to the United Kingdom.

The company has gradually added a list of processed foods and now produces 36 products and exports to the United States, Canada, Netherlands, Australia, Germany and Norway. To date, PESL has 160 staff members and operates from its factory in Accra, producing and packaging palm cream concentrate, cereal mix, canned eggplant and peanut butter among other products. The company has acquired large tracts of lands in the Eastern and Volta regions with the intention of cultivating palm, cassava, maize and other crops.

Plant profile

The manufacturing plant is located at the Abenkwan Junction in Abese, along the Pokuase Katapor road in Accra. Over the last few years, the company has collectively invested over US$100 million in scaling up its operations, mainly in structural expansions and retooling/equipment upgrades, and it has created thousands of employment opportunities across the company's various value chains. To ensure resource efficiency, plant upgrades are being undertaken in an active drive to reduce energy consumption, offset on-site CO_2 emissions and boost production.

The bulk of energy used by the manufacturing plant is electricity from the grid. The electricity forms about 79% of fuel costs. A negligible amount of diesel is used for standby generators to safeguard against grid outages.

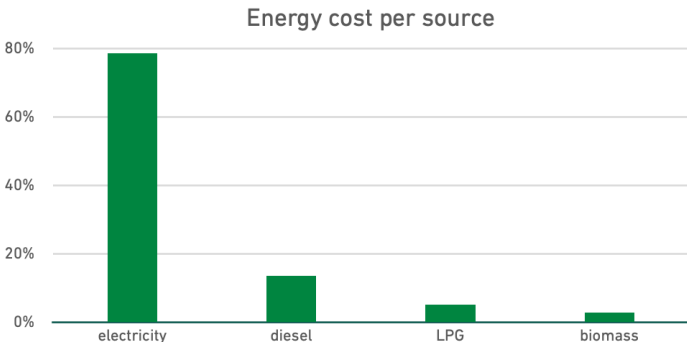

Figure 1: Energy cost per source.

The facility uses four energy sources:

- Electricity
- Biomass (firewood, kernel, fibre and bunch); unquantified (not weighed)
- Diesel for backup generators in the event of power outages
- Liquified petroleum gas (LPG)

The LPG is used for drying and boiling oil (Zomi). The biomass, a side product of the palm fruit, is used to produce steam. Steam is used for blanching, cooking the palm fruits, sterilization and boiling regular palm oil. The company also uses solar. Solar power is limited to backup for security cameras and night lighting to avoid using the generator.

Energy breakdown areas of significant energy consumption

Certain equipment has been identified as a significant energy user (SEU), based on installed capacity. The SEUs are shown below:

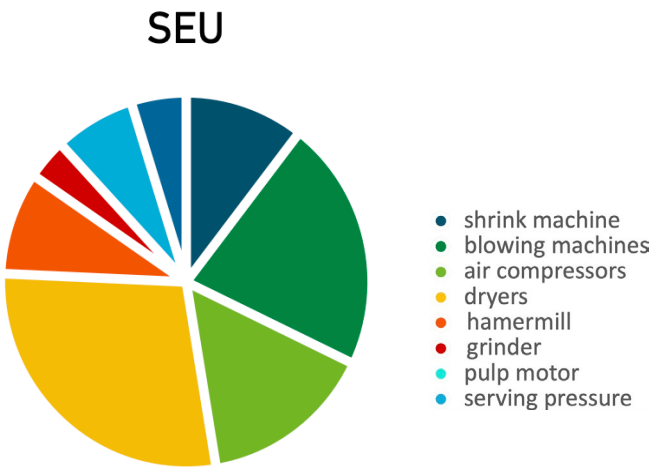

Figure 2: The significant energy users.

There are three main production departments: canning, oils and powders. The process for each is as follows:

Canning:

The fruits for the process are cleaned, graded, then washed. This is followed by the cooking of the fruits with water and steam. Cooked fruits are drained and pressed to extract cream. The cream is strained and cooked to expel moisture. Immediately after, while still hot, the cream is manually filled into the cans. The filled cans are sealed by the seamer machine. Soon after, the cans are sterilized with steam and cooled immediately with water. The cooled cans are cleaned, labelled and packed in boxes..

Oils:

Praise Exports buys the oil from its suppliers for bottling. PESL uses LPG to boil the oils. The oil is cooled overnight, bottled and packed in boxes.

Powders:

This department is responsible for the production of powdery or gritty products from cereals and grains. The grains are fermented or roasted, depending on the product, and milled. The resulting product is then dried in electric ovens, sieved and bagged.

The challenges

The increasing costs of energy and water were becoming a growing concern to PESL. This spurred the company to collaborate with the Ghana National Cleaner Production Centre under the UNIDO Ghana Industrial Energy Efficiency Readiness Project in late 2021. Resource efficiency, a cleaner production assessment (RECP) and an energy audit were undertaken by the UNIDO team at the site.

The assessment identified existing opportunities for energy reduction. The audit also revealed that energy use is not well accounted for as there is no record of how much biomass is used to fire the boiler. The boiler and steam line have limited instrumentation which does not allow for the quantity of steam generated and used to be measured.

PESL's management has noted these challenges and taken steps to implement some of the energy system optimization recommendations that stemmed from the audits, beginning with those that have low or no cost implications.

Prior to the energy audit, PESL was required by the Environmental Protection Agency of Ghana to carry out the following energy improvements. The report of the EPA is dated 7 April 2021. The energy requirements are summarized in the table below.

Improvement required	Compliance date	Status
Reduce energy consumption from 81 kWh/ton to 50 kWh/ton	30 June 2023	Ongoing
Replacement of all E1 motors with E3	31 December 2021	Ongoing
Reduce from 0.97 litres/ ton to 0.68 litres/ton	30 June 2023	Ongoing
Install solar power for lighting	31 December 2021	Completed
Monitor energy consumption	30 June 2021	Non-compliant

The team observed that PESL is implementing some general initiatives which include some energy management options. These efforts need to be better coordinated and evaluated, and the measurable outcomes and benefits clearly documented prior to project initiation. This will allow management to clearly demonstrate the benefits to all stakeholders.

Capacity building

Internally, more capacity building is required to enable the full implementation of an energy management system at PESL.

Two staff were appointed and enrolled on the UNIDO Energy Management System (EnMS) training. The creation of general awareness among staff of the need to improve energy savings has commenced with a poster campaign. But a more detailed and sustained campaign is required to ensure savings are made, especially on those issues that are influenced by human behaviour..

Key findings

Implementation period	January 2022 – January 2023
Total number of projects	**7**
Monetary savings in cedis	14 940
Energy savings in GJ	84.96
Total investment made cedis	24 300
Overall % of total consumption saved	14.4%
Total savings from no cost interventions	1.9% of the total

Note 1: CO_2 conversion factor is set at 1 GJ = 0.2896 tCO_2e.

The trend of electricity consumption and the total production is shown below:

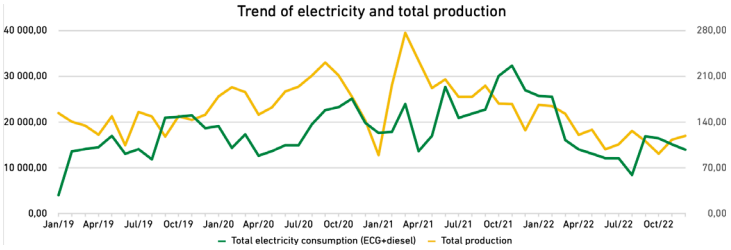

Figure 3: The trend of electricity consumption.

The figure shows there is no relation between the total production and the electricity. There is also no correlation between the different product categories and the energy consumption of the various products.

During the project, we focused on low-cost opportunities and awareness. The principles were:

- Electricity consumption was measured using the main metre. Production data was extracted from a manual list.
- Aligning the dates of the electricity metre readings and production dates was crucial to obtain acceptable regression models.
- The biggest opportunities lay in improving operational control, energy awareness created during operational training and exploring solar photovoltaics (for lighting).
- Operation control and awareness training was carried out for all process operators, highlighting their impact on energy performance.

The proposed interventions:

#	Saving opportunity description	Identification date	Significant Energy Use	Barriers/risk/notes	How are potential savings estimated?	Non-energy benefits
1	**New expansion project: Review equipment specification, workflow and processes to ensure optimal use of energy.**	June 21	Autoclave	Lack of detailed design specifications and layout plan	Yet to be determined	Improved workflow and reduced risk of accidents
2	**Use of biogas instead of electricity for drying foods.**	July 21	Dryer	Quality and quantity of biogas need to be determined, and equipment procured or adjusted to burn the biogas	Equipment ratings	Safer and efficient disposal of effluent and biomass
3	**Turn off shrink wrapping equipment during breaktime.**	February 22	Shrink wrap	Education and monitoring	Equipment ratings	Longer working life
4	**Improve lagging on steam pipes.**	February 22	Steam pipes	Education and monitoring	Temperature loss due to exposed system	Reduced corrosion
5	**Leakages of compressed air.**	February 22	Compressed air system	Education and monitoring	Energy lost due to leakage	Reduced nuisance noise
6	**Turning the boiler on and off daily.**	May 22	Boiler	Change to work schedule	Energy is required to heat water and metal parts of the boiler from room temperature to working temperature each day	More productivity and use of time
7	**Increase awareness**	2022	N/A	N/A	N/A	N/A

Implementation of an Energy Management System

The EnMS implementation project has five distinct phases and will be facilitated over a period of 12 months. Management has committed to implementing an ISO 50001 compliant EnMS. Evidence on progress for each phase is as follows:

Phase 1: Management responsibility and policy:

- There is a signed energy policy.
- There is a clearly defined scope.
- Access to detailed bulk electricity consumption is now available to help monitor consumption patterns (daily, weekly, etc.).

Phase 2: EnMS energy planning:

- Energy data was obtained for analysis and development of the project's baseline.
- SEUs have been identified with their energy consumption values.
- Objectives, targets and action plans are in progress for all energy sources.

The following are in the planning and development phase:

Phase 2: EnMS energy planning:

- Baseline and energy performance indicators are in progress for all energy sources.
- Maintenance and operational controls.

Phase 3: EnMS implementation and operations:

- Reinforce the energy awareness campaign and follow up with personnel.
- Identify and implement operational controls on equipment.
- Develop and use energy efficiency design technology.
- Communicate and implement suggestion schemes for energy efficient ideas.

Phase 4: EnMS Checking:

- The activities are planned.

Phase 5: Review

Implementation challenges

- Lack of adequate human resources.
- No budget for EnMS projects.
- Lack of data on specific energy consumption by SEU equipment.
- Organizational priorities and financial commitments have been made for 2021 and 2022.
- Determination of an energy baseline remains a challenge due to lack of adequate energy data.
- An accurate relation between energy consumption and production is yet to be established.

Highlights of operational/ESO interventions

Summary of implemented interventions

Based on the proposed opportunities, PESL has implemented the next energy saving measures:

#	Saving opportunity description	Implemented date	Energy saving	Cost saving (GH₵)
1	**Turn off shrink wrapping equipment during break**	January 23	5 600 kWh	7 100
2	**Improve lagging on steam pipes**	January 22	1 800 kg biomass	1 440
3	**Leakages of compressed air (only the minor)**	January 23	6 200 kWh	7 900
4	**Increase awareness:** • **Trained staff: creating awareness for energy saving** • **An energy committee has been set up. It comprises of operators, the head of compliance, engineers, and the head of operations** • **Information signages have been placed around the production area and compound**	May 22	N/A	N/A

Due to the implementation of the measures, the total cost will be reduced by 14%.

Highlights and other energy systems optimization interventions

General:

Raising the level of awareness across all departments off the need to improve energy performance and the impact of switching off equipment (e.g., switching off machines that are unnecessarily idling or lights that are unnecessarily switched on as well as swiftly reporting and repairing all compressed air leaks). This is done through training, narrowcasting and an energy committee.

Steam system (biomass):

- Many steam valves are not insulated, and this is a safety issue.
- Investigate the potential recovery of heat of the exhaust air (temperature is 180°).
- Steam is generated at eight bars. The need for eight bars is to ensure a maximum pressure at an equipment of five bars. But after fixing leaks at a different section, the pressure can be reduced to approximately six bars.
- Complete a steam trap survey and replace the failed steam traps (many steam leakages and condensate were observed). Optimize the condensate return system now that all the condensate is discharged.
- A high investment opportunity is to utilize the extra heat of the boiler as a feed of the absorption machine to create chilled water.

Air compressor system:

- During distribution air leakages were observed.
- Reduce leakage and consider installing a bigger compressed air receiver.
- Compressors are located all over the production area and the heat, which is generated by the compressor, comes out in the same room.
- By removing the heat with a duct, the compressor becomes more efficient.
- Establish a central air compressor system.

Benefits, lessons learned and value added by the EnMS training

Benefits

- The EnMS implementation at PESL created a high awareness of the management of energy, and the company is considering an ISO 50001 certification.
- The ability of department heads to understand energy consumption per department and to be able to troubleshoot more effectively.

Lessons

- The availability of accurate and timely data is vital for the efficient operation of the energy management system.
- Resources and time are required for the successful implementation of an EnMS.
- It is critical to determine the key factors affecting energy performance for each SEU.
- Improving energy performance makes good business sense. It saves money and reduces costs while increasing the reliability of plant and equipment. It also has a positive effect on productivity and enhances the reputation of PESL.
- Behavioural change is required to continuously improve energy management systems.

Value added

At the end of the UNIDO EnMS training module, participants were able to:

- create awareness at the top management level for the implementation of EnMS,
- gain an opportunity to begin measuring and collecting energy consumption and operational data from various parts of the factory,
- acquire knowledge with regards to EnMS application,
- identify SEUs,
- acquire the know-how to develop energy performance indicators using production and energy data.

Future plans

PESL is planning to:

- investigate the opportunity of no/low-cost interventions,
- explore the implementation of basic maintenance interventions,
- increase staff awareness of EnMS to ensure behaviour change,
- consider certification of the ISO 50001 standard.

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