INDUSTRIAL ENERGY EFFICIENCY PROJECT IN GHANA

Energy management System (EnMS)

CASE STUDY

INDUSTRIAL DECARBONIZATION ACCELERATOR

Niche Cocoa Industry Limited
Tema, Ghana

Sector
Food processing industry

Location
Free Zones Enclave, Tema, Ghana

Date of implementation
2021—2022

Duration
15 months (June 2021 to August 2022)

Utility intervention
Energy management system (EnMS) implementation. Compressed air and chiller plant optimisation.

Company profile

Niche Cocoa Industry Limited is the leading privately operated cocoa processing company in Ghana established in 2011.

Niche produces high quality semi-finished cocoa products and confectionery for supply to the worldwide chocolate, ice cream and bakery industries. Semi-finished products include natural and deodorized cocoa butter, specialized cocoa liquor, and natural and alkalized cocoa powder. In confectioneries, Niche is a bean-to-bar producer of refined chocolate, chocolate drinks, and spreads.

With an installed capacity of 90 000 metric tons per year, Niche is the largest fully integrated cocoa processor in Ghana. With its state-of-the-art quality control and strict adherence to HACCP and FSSC22000 food safety management system standards. The safety and consistency of all products is assured. This focus on excellence led to Niche receiving the Presidential National Award as Exporter of the Year in 2013, 2014 and 2015.

Plant profile

The scope of the EnMS at Niche covers the processing of cocoa beans to cocoa liquor, butter and cake as well as the manufacture of chocolate.

The Niche Cocoa produces the following cocoa products: liquor, cake, powder and butter. These products are exported to cocoa traders and refiners around the world. Niche recently ventured into the confectionery market in Ghana and produces chocolate bars for sale domestically.

The simplified process employed at Niche's cocoa processing facility is described below.

> The cocoa beans are transported from the storage warehouse, where they are cleaned and other materials are removed from the raw material. Stones and ferrous material are removed. The cleaned beans are then pre-dried and winnowed to remove the shells from the nibs. These are then roasted, and ground to produce cocoa liquor.

> The cocoa liquor is further processed and then packed in cartons for distribution. Some of the cocoa liquor is pressed to extract the cocoa butter. The residue is a solid mass, or cocoa cake. This cocoa cake is further processed and packaged for distribution. Some of the cocoa cake is further processed to produce cocoa powder, which is then refined and packaged for distribution. The cocoa butter is removed from the cocoa mass in a controlled manner to produce cocoa butter of various levels of fat. This is then further processed and packaged for distribution.

Energy breakdown areas of significant energy consumption

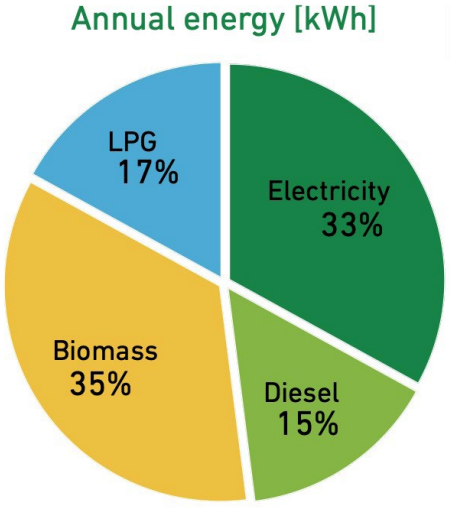
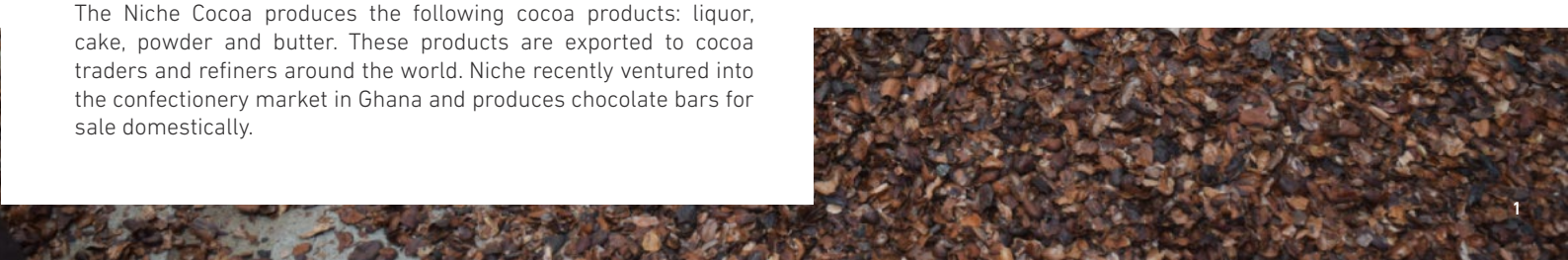


Figure 1: Annual energy consumption per source

For this first phase of the implementation of the energy management system, the focus was placed on electricity and liquefied petroleum gas (LPG). For electricity, significant energy users included grinding, HVAC and cooling, drying and cleaning, compressed air, and winnowing. For the gas (LPG), the significant energy users included drying and roasting.



Nature of the challenges

Niche Cocoa consumes a lot of energy, with annual utility bills skyrocketing. The increasing costs of energy was becoming a great concern to the company, implementing resource efficiency measures to improve energy performance became an important business strategy. The company was looking for efficient methods to improve energy performance of its major energy users to reduce the energy costs of production and reduce its carbon footprint. This prompted an energy systems optimization assessment. The UNIDO Training on ISO 50001 compliant Energy Management Systems (EnMS) was able to provide the necessary support and capacity building for the assessment and development of the energy system optimization project.

Industrial Energy Efficiency capacity building programme

Selected employees attended the EnMS training organized by UNIDO and the Ghana National Cleaner Production Centre during 2021. This has resulted in significant benefits for the company, as they are now better equipped to conduct energy performance assessments, identify significant energy users, identify savings opportunities, propose methods of improving energy performance as well as quantify savings.

Key achievements

Implementation period	June 2021 to August 2022
Total number of projects	**2** (1—consolidation of compressors and installation of VSD compressor, 2—consolidation of chillers).
Monetary savings in GHS (for 11 months)	GHS 712 947
Energy savings in GJ (for 11 months)	2 440 GJ
Total investment made in GHS	GHS 790 182
Overall % of total electrical consumption saved	1%
Payback time period in years	• 1.77 year (compressed air project) • 0.52 year (chiller project)
GHG emission reduction (ton CO_2e)[1]	291 434 tCO_2e

1 kWh to tCO_2e Conversion Factor set at 0.43 as per the EPC.

2 For the kWh rate use GHS1.1475 /kWh.

Implementation of an energy management system

The following phases of the energy management systems have been implemented or are in the process of being implemented:

Phase 1: Preparation and commitment

- Policy drafted
- Management representative and energy rep appointed
- Responsibility and authority matrix in development

Phase 2: Planning – energy review

- Legal and other requirements in development
- Energy sources identified
- Significant Energy Uses (SEUs) identified
- Baseline and Energy Performance Indicators (EnPIs) – in progress for all energy sources
- Objectives, targets and action plans – in progress for all energy sources

The following are in the planning and development phase:

- Operational controls optimization
- Measurement plan – to allow better submetering of SEUs

Phase 3: Implementation and operation – focus on SEUs

- Operational training (in development)
- Procedures (in development)
- Energy performance improvement – some EnPIs developed and now being tracked
- Full integration into an integrated management system (IMS) (future plan)

Phase 4: Audit and management review

- Full integration into the internal IMS audits (future plan)
- Certification stage 2 (future plan)

Implementation challenges

EnPI development

Performance indicators were developed for electricity. Production output versus electricity consumption was used to establish the baseline (using data from 2020) which gave a good R2. Upon review of the technicalities of the process, analysis of the various SEUs presented a challenge since SEUs are not metered separately and individual consumption calculations were made based on machine data sheets and motor nameplate ratings. Sub metering is therefore needed to accurately measure consumption for each SEU for electricity.

For steam, the company has recently switched to using biomass as a fuel input. The company will monitor the biomass consumption in the coming months to establish a new baseline for biomass consumption. This period will also be used to monitor boiler fossil fuel consumption savings achieved following the fuel switch to a biomass source. It should be noted that the biomass source was previously regarded as a waste product.

Steam challenges

The steam pipeline lagging is still in progress; hence savings will reflect in the next period.

Highlights of operational/ESO interventions

Summary of all electrical energy interventions

Energy uses/users	Intervention	Utility saving period	Investment (GHS)	Savings (GHS)	Pay back (Yrs.)	Utility Saving (GJ)	GHG emission reduction (tCO_2e)
Compressed Air (Elec)	Consolidation of air compressors to a new area and installation of new VSD compressor	Jun 2021 to May 2022	595 644	336 777	1,77	1 152,60	137 666,26
Chiller plant (Elec)	Chiller Consolidation	Sep 2021 to Aug 2022	194 538	376 169	0,52	1 287,41	153 768,70
Total			**790 182**	**712 947**	**1,11**	**2 440,01**	**291 434,96**

Figure 2: Data from EnMS tool

Highlight of energy interventions

Compressed air

Compressors were relocated to a different part of the plant. This eliminated some of the leakages and pressure drops along the piping network. Piping could also be reconfigured at the compressor room to reduce losses.

In addition, a new VSD compressor was purchased. This new VSD was then used in instead of an existing fixed speed compressor, resulting in additional savings.

Chiller plant

The plant consisted of three separate chiller systems, each feeding a different part of the plant (butter, liquor and powder). The chillers were reconfigured to work in parallel through a common chilled water network. Consolidation of the chillers eliminated the need to operate the third chiller.

Benefits and lessons learned

Benefits

- Niche's EnMS implementation provided the necessary framework and awareness, urging the company to consider ISO 50001 certification.
- Consolidation and collation of energy management information that hitherto was not in a format available for data use.
- The opportunity to begin to measure and collect energy consumption and management data from various parts of the factory.
- The development of young engineers (engineer-in-training).

Lessons learned

- More accurate, accessible, and consolidated data for monitoring and measurement are critical to the EnMS success and ongoing implementation. Sub-metering is thus required.
- Formalized training can assist in overcoming people's resistance to change. Skills required for implementing energy efficiency projects are frequently lacking – something that training can help with.
- Changes in behavior have a significant impact on energy consumption. This is responsible for many of the gains made. Communication and awareness about the EnMS are critical for mitigating such resistance.
- Providing adequate resources and support for Energy Manager is vital for the continuity of the EnMS. The EnMS needs to penetrate the organisation further and ownership expanded in roles and responsibilities, such that each Department can take up responsibility for continuous energy performance improvement.

Future plans

In the long term the company has been considering certification to the ISO 50001: 2018 standard. In the short term a number of other interventions are being considered and planned.

Steam projects

- Energy system optimization (ESO) training
- Fix all leakages
- Replacement of heat exchanger at the Pre-Dryers
- The installation of a steam meter
- Blowdown Heat Recovery
- Lagging steam pipelines
- Installation of a second biomass boiler

Electrical projects

- Sub metering for large electrical machines and departments
- Daylight harvesting
- VFD installation on utility pumps
- Solar energy and other renewable energy alternatives
- AC temperature setpoint control
- Reduce compressed air system setpoint to 8 bars

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