Energy Management System Implementation: Case Study

ASTARTA-KYIV agri-industrial holding

Globino processing plant, LLC

1 COMPANY OVERVIEW

The **Globino processing plant, LLC (hereinafter Processing plant**), a modern integrated soybean processing complex in the town of Globino (Poltava region), was put into operation in early 2014.

The installed crushing capacity is 700 tons of soybeans per day or 220,000 tons annually. Annual production capacity is up to 160,000 tons of high-protein toasted soybean meal, 40,000 tons of soybean oil, and 9,000 tons of granulated shell.

The Processing Plant also features storage facilities for finished goods and a silo with a designed capacity of 42,000 tons, as well as all required engineering, road and rail infrastructure.

The plant is equipped with powerful water and air cleaning systems. Like the Globino Sugar Plant, the Processing Plant uses for production, inter alia, an environmentally friendly energy source – biogas supplied by Astarta's Bioenergy Complex.

Soybean processing is an export-oriented sector. Upwards of 80% of the plant's products are shipped to the EU and the countries of the Middle and Far East.

The bulk of soybeans are grown by the company's own agribusinesses. The remaining raw materials are purchased from partner organizations.

The company also has in place uncertified occupational health and safety management and environmental management systems.

2 INITIAL CONDITIONS FOR EnMS

The EnMS scope encompasses the entire organization. The energy resources consumed by the company include electricity, natural gas, biogas, and water.

The Processing Plant was aware of the importance of building an energy management system and systematic energy consumption management even before joining the **UNIDO-GEF project "Introduction of Energy Management System Standard in Ukrainian Industry"** (hereinafter **UKR IEE project**).

Prior to project participation, energy performance was evaluated based on:

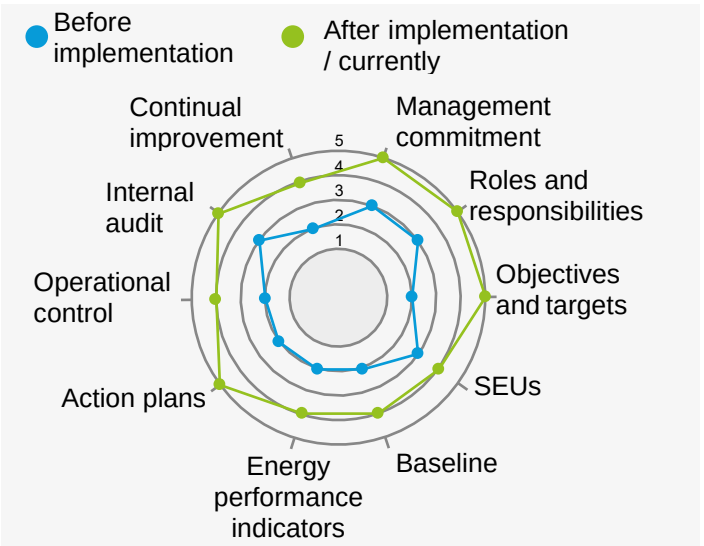
- Energy consumption trends.
- Comparisons with previous years.
- Calculation of specific energy consumption (SEC).

The following elements were not in place:

- Training in energy saving and energy performance improvement.
- Energy review.
- Evaluation of compliance with legal and other requirements.

Energy performance was basically not used as one of the evaluation criteria for procurement and design.

The diagram below depicts the level of compliance with ISO 50001 requirements at the **Processing plant** before and after energy management system implementation.



3 BENEFITS FROM EnMS IMPLEMENTATION

Within the **UKRIEE project**, the **Processing plant** acquired both theoretical and practical knowledge of EnMS operation.

The training program was comprised of five modules that encompassed all the requirements of the International Standard ISO 50001 and equipped the company staff to evaluate its actual energy consumption with regard to production output.

The general appearance of the company's pipelines after the implementation of thermal insulation measures is depicted in the picture below.

During the training, its participants also gained practical experience of conducting internal audits of the EnMS and were provided with a UNIDO EnMS Tool developed by UNIDO to facilitate EnMS management.

The results of the EnMS operation in 2017-2018 are as follows:

- 2017: increase in electricity consumption by 1% and natural gas consumption by 0.5% due to increased soybean moisture content.
- 2018: increase in electricity consumption by 2.63 kWh per ton of raw materials due to the operation of jet dryer fans (additional equipment required for the process flow) and power cuts (halting of the plant's operations); increase in natural gas consumption by 0.59 m³ per ton of raw materials due to the breakdown of the economizer on boiler #1 and power cuts (halting of the plant's operations).

4 IMPLEMENTED ACTIONS

An energy management team was formed to implement the EnMS. The composition of the team is presented in the table below.

Composition of the energy management team

Team leader	**Chief Engineer**
Team members	**Production/ Oil Extraction Manager** - responsible for production and operational control **Process Engineer** – responsible for operational control **Chief Energy Engineer** – responsible for energy review **Head of the APCS and C&I Section** – responsible for monitoring **Head of the OHS, EP and Certification Section** – responsible for energy policy execution, information sharing and communication (internal and external) **Boiler House Manager** – responsible for the energy supply of the main production

The list of actions implemented in 2018 is provided in the table below

Energy saving measure	Month of 2018	Expected savings after implementation
3. Thermal insulation of pipelines; thermal insulation of the oil pump house; installation of thermal cases on isolation valves		**Natural gas and biogas consumption of normalized 30 m³ per ton of raw materials**
2. Installation of electricity meters; replacement of membranes in the boiler house; installation of LED lights in the treatment section		**Electricity consumption of normalized 48 kWh per ton of raw materials**
1. Weekly maintenance planning; assessment of critical factors; implementation of the ordering system in line with the assessment findings		**Reduction of emergency shutdowns down to a maximum 1.5% of the total equipment operating time**

5 IMPLEMENTATION RESULTS

To assess implementation results, the company's performance was evaluated based on the main indicators and requirements of ISO 50001.

The company implemented its energy management system as part of the Corporate Integrated Management System.

For performance evaluation purposes, the company elaborated energy review procedures with the use of the methodology akin to the one applied in the UNIDO EnMS Tool provided to the company by the **UKR IEE project**.

Based on this approach, the following drivers of electricity, natural gas (biogas) and water consumption were identified at the company:

- Raw materials processed, t.
- Degree-days (15°C).
- Weight of soybeans sent for cleaning, t.
- Weight of soybeans sent for drying, t.
- Idle time, hours.
- Idle time + routine preventive maintenance, hours.

The following baselines were established:

- Natural gas and biogas consumption, m³.
- Electricity consumption (total), kWh.
- Water consumption, m³.

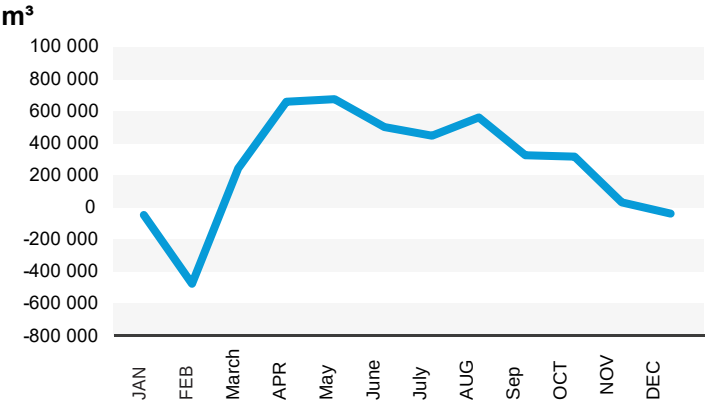
To establish the aforementioned baselines, the company conducted a regression analysis based on the existing sub-metering system for collecting data on energy and non-energy driving factors. The resulting adjustment formulas are provided in the table below.

Adjusted R^2

Baseline		Equation to determine energy efficiency
Natural gas and biogas consumption, m³/month	0,89	8,582 +30.6* (Soybeans processed, t) + 209* (Degree-days (15°C))
Electricity consumption, kWh/month	0,99	125,448+45.9* (Soybeans processed, t) – 11.8* (Weight of soybeans sent for cleaning, t) -165 * (Weight of soybeans sent for drying, t)
Water consumption, m³/month	0,81	1,985+0.63* (Soybeans processed, t) – 4.96* (Degree-days (15°C))

The CUSUM chart for natural gas and biogas savings in m3 is presented below.

CUSUM natural gas and biogas **consumption (savings)**, m3 in 2018



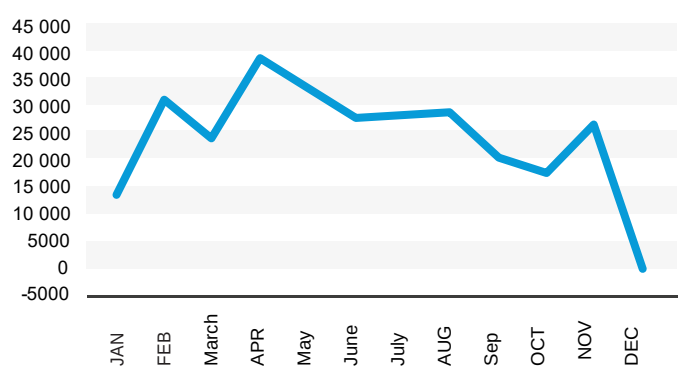
According to the data above, savings in 2018 constituted 1% of total consumption. Good performance was observed in the winter, summer, and fall. The spring months were characterized by poor performance.

The methodology for natural gas and biogas consumption evaluation requires further research and update. It is necessary to consider separating consumption by areas of use. It would be also desirable to separately calculate standard thermal loads of the process flow and buildings. Since soybean moisture content has a considerable effect on energy consumption, it is recommended to set up an adequate system for metering and documenting moisture levels to incorporate this relevant variable into the regression model.

There is a need for developing a methodology to account for natural gas consumption in emergency cases.

The CUSUM chart for electricity savings in kWh is presented below.

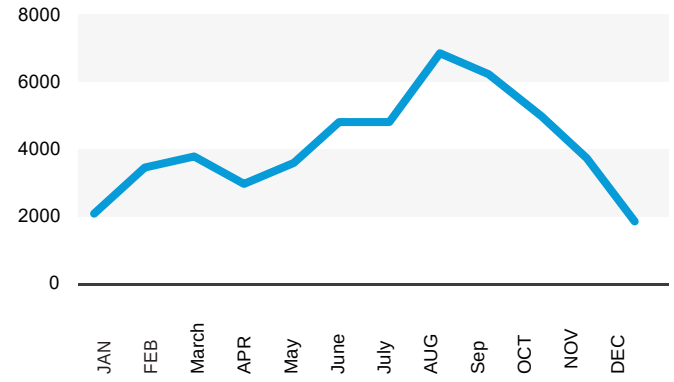
CUSUM electricity consumption (savings), kWh in 2018



According to the data above, savings in 2018 constituted 1% of total consumption. Good performance was observed in the winter, summer, and fall. The spring months were characterized by poor performance.

The CUSUM chart for water savings in m3 is presented below.

CUSUM water consumption (savings), m³ in 2018



According to the data above, water overconsumption in 2018 constituted 1.1% of the baseline**.**

The methodology for water consumption evaluation requires further research and update. It is necessary to consider separating consumption by areas of use (process flow/ housekeeping needs).

6 CONCLUSIONS AND RECOMMENDATIONS

The training within the **UKRIEE project** equipped the **Processing plant** with both theoretical and practical knowledge of energy management system development and implementation as part of energy planning processes, as well as with a more detailed understanding of the use of statistical methods, in particular regression analysis, as a tool for comparing energy consumption under normalized conditions.

The key implementation benefits include:

- Improved culture of energy consumption.
- Use of normalization to account for driving factors.
- Identification of legal and other requirements for energy consumption.
- Improved operational control and its analysis.
- Incorporation of energy performance into procurement and design.

Currently the company uses a modified version of the UNIDO EnMS Tool provided by UNIDO for EnMS support and energy performance evaluation purposes.

Recommendations before and during the implementation of EnMS:

- Conduct a comprehensive energy audit.
- Develop a procedure for motivating staff to develop energy-saving measures.
- Develop a methodology to account for electrycity consumption in emergency cases.
- Conduct consultative and information work with employees of the company on the importance of EnMS.