Energy Management System Implementation: Case Study

ASTARTA-KYIV agri-industrial holding

Globino Bioenergy Complex, LLC

1 COMPANY OVERVIEW

The **Globino Bioenergy Complex, LLC** (hereinafter **Biogas plant**) is one of the largest ones in Ukraine by biogas production. This biogas plant is unique in that it generates thermal energy from biogas and the generated heat is then used for production needs by the Globino Sugar Plant and Globino Soybean Plant.

The complex processes three products: sugar beet pulp, cattle manure, and liquid organic matter.

Raw materials are received and sent for processing at individual stations.

Sugar beet pulp is delivered to the processing area by above-ground movable tables with a system of screw conveyors that later transport the pulp to mixers. From there the pulp is pumped via pipelines into tanks by SVN (self-priming turbine) pumps.

Cattle manure and liquid organic matter are unloaded from trucks into a liquid waste storage tank from where they are pumped to the production area in required quantities as per SOPs.

The mixing of input raw materials with a recirculation flow – substrate occurs in mixers. After mixing, the substrate is delivered to relevant digesters. To achieve maximum biogas output and guarantee a high degree of biotransformation in digesters, the substrate is sent to post-fermenters.

Total retention time in digesters and post-fermenters constitutes about 30 days.

Part of the generated biogas is used for the company's own needs (burned in boilers to heat fermenters). Part of it is sold to the Globino Processing Plant. It is transported via a gas pipeline, 3,000 meters in length.

2 INITIAL CONDITIONS FOR EnMS

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

Globino Bioenergy Complex, LLC 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 consumption was evaluated based on:

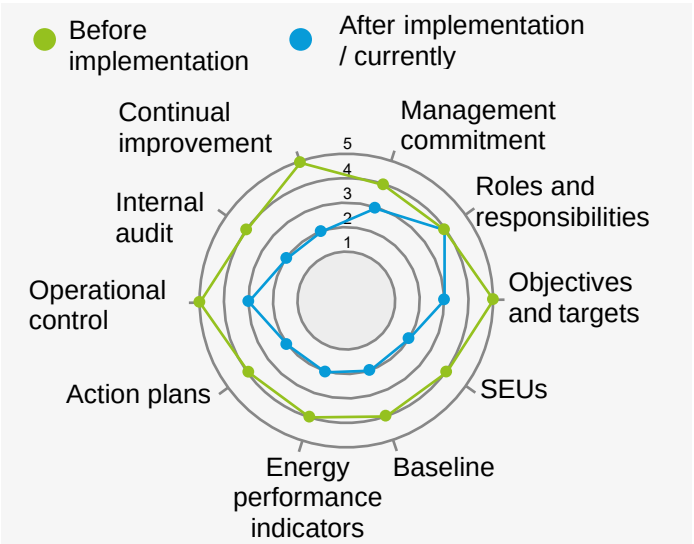
- Energy consumption trends.
- Comparisons with previous years.
- Calculation of specific energy consumption (SEC).

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 for the energy resources consumed by the company.

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 **Biogas plant** before and after energy management system implementation.



3 BENEFITS FROM EnMS IMPLEMENTATION

Within the **UKR IEE project**, the **Biogas plant** acquired both theoretical and practical knowledge of EnMS operation.

The training program was comprised of four 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.

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.

Through the project the company was exposed to some new approaches to calculating energy consumption, in particular regression analysis, which allowed it to assess its energy consumption and consequently energy performance more accurately from mathematical and statistical perspectives.

Upon completion of the training, the company recognized the need for expanding its submetering system to collect more accurate and detailed SEU energy consumption data. To that end, the company installed electricity submeters on gas blowers No.1 and No.2, inter-tank units 200 and 300, and in the warehouse.

4 IMPLEMENTED ACTIONS

An energy management team was formed at the company to implement the EnMS as part of the Corporate Integrated Management System (CIMS).

Team leader:	Responsible for CIMS (OHS Engineer)
Team members	**Chief Engineer** – responsible for operational control, procurement and design **Chief Technologist** - responsible for energy policy execution, communication (internal and external), operational control **Process Engineer** - responsible for energy review **Energy Engineer, Instrument Engineer** – responsible for monitoring

Based on the existing energy management system operating within the Corporate Integrated Management System, the company developed procedures and forms for presenting energy management objectives and targets.

The list of actions implemented within the EnMS in 2018 is provided below.

Energy saving measu	Month of 2018	Expected savings after implementation
1.Thermal insulation of steam pipelines		800 Gcal / year 543000 UAH
2.Installation of electricity meters		Detailed data on electricity consumption

5 IMPLEMENTATION RESULTS

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

The company implemented its energy management system as part of the Corporate Integrated Management System. Based on the existing energy management system, the company devised specific EnMS-related procedures.

For energy performance evaluation and improvement 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:

- Sugar beet pulp, t.
- Dry matter (hereinafter – DM) in beet pulp, t.
- Silage, t.
- DM in silage, t.
- Total DM, t.
- Biogas for the boiler house, m³.
- Total biogas, m³.
- Electricity, kWh.
- Degree-days (15°C).

The following baselines were established:

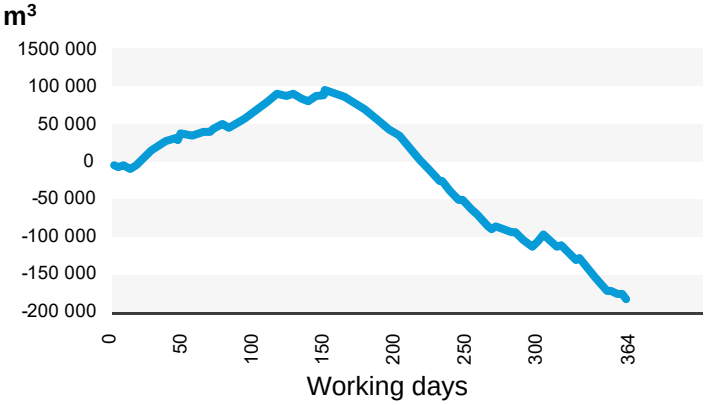
- Biogas consumption, m³.
- Electricity consumption (total), kWh.
- Water consumption, m³.

Adjusted R²

Baseline		Equation to determine energy efficiency
Biogas consumption, m³/day	83	2,536-12,2 * (Biogas for the boiler house, m³)+161* (Degree-days (15°C))
Electricity consumption (total), kWh/day	85	1,966+36,6·* (Total DM, t)
Water consumption, m³/day	82	30.6+0,38 * (Total DM, t) + 0,001 * (Total biogas, m³)

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

CUSUM biogas consumption (savings), m3 in 2018

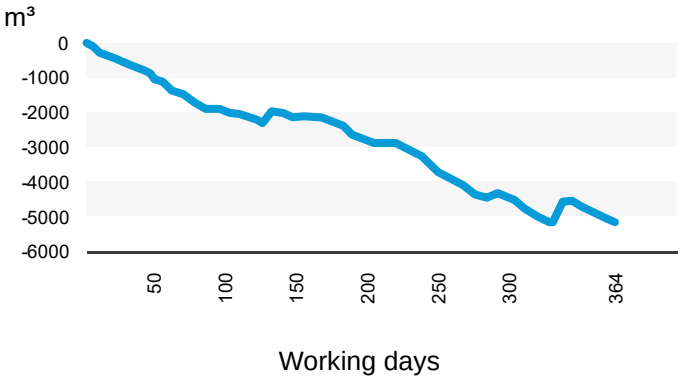


According to the data above, biogas savings in 2018 constituted 15 %.

It is required to update and give greater detail to the methodology for biogas consumption evaluation to account for available metering systems and a larger number of relevant variables.

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

CUSUM water consumption (savings), m3 in 2018



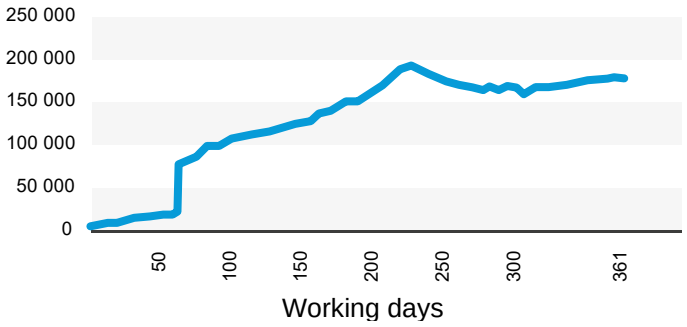
According to the data above, water savings in 2018 constituted 20 %.

The methodology for water consumption evaluation requires research and greater detail with the use of the submetering system with the aim of identifying SEUs and establishing the relevant number of baselines.

The updated methodology based on the aforementioned information and operating characteristics of equipment will allow detailing and singling out significant energy uses and consequently reducing their consumption.

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

CUSUM electricity consumption (savings), kWh in 2018



According to the data above, electricity overconsumption in 2018 constituted 13%.

The methodology for electricity consumption evaluation requires research and greater detail with the use of the electricity submetering system with the aim of identifying SEUs and establishing the relevant number of baselines.

The updated methodology based on the aforementioned information and operating characteristics of equipment will allow detailing and singling out significant energy uses and consequently reducing their consumption through targeted energy-saving measures.

6 CONCLUSIONS AND RECOMMENDATIONS

The training within the **UKR IEE project** equipped the **Biogas 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.

Recommendations before and during the implementation of EnMS:

- Enlist the support of top management during EnMS implementation.
- Conduct a comprehensive energy audit.
- Develop a procedure for motivating staff to achieve results that are higher than goals set in energy policy.