Energy Management System Implementation: Case Study

ASTARTA-KYIV agri-industrial holding

Globino Sugar Plant of Tsukoragroprom, LLC

1 COMPANY OVERVIEW

The main production of the **Globino Sugar Plant (Tsukoragroprom, LLC) (hereinafter Globino Sugar Plant)** is based on the manufacturing of sugar from sugar beets. The technological process of sugar production includes a stage-by-stage process of processing raw materials (sugar beets) to obtain the main product (sugar) and by-products (beet pulp and molasses).

Sugar beets are delivered by a hydraulic conveyor from the beet pile field to the cleaning facility for root crops where they are subjected to washing and separation from any remaining soil and beet leaves. Clean roots are then weighed and transported to a beet cutter to obtain chips (cossettes). The latter are delivered to beet diffusers where sugar is extracted and diffusion juice is created.

The diffusion juice is fed to the treatment facility for defecosaturation that is based on the application of limewater and carbon dioxide produced from limestone burning in a gas-fired lime kiln with the use of coking coal.

The next stage includes juice filtration and its treatment with sulfur dioxide produced from burning sulfur in a furnace.

The filtered juice is delivered to evaporators for thickening.

The thickened syrup is then subjected to boiling.

The energy management system was implemented and certified as per ISO 50001 requirements in 2017.

In 2018, the company reduced its gas consumption per ton of sugar beets by 6.1%, electricity consumption – by 36%, and service water consumption by 10% in comparison with the 2017 baseline.

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.

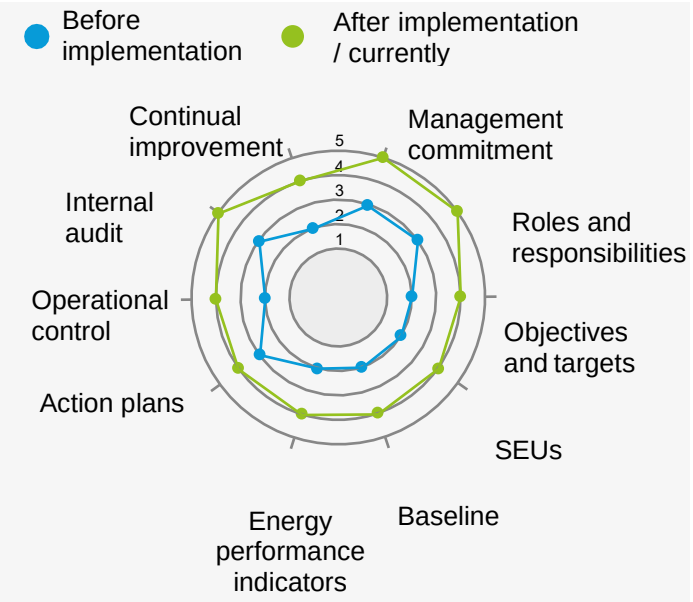
The Globino Sugar Plant was aware of the importance of building an energy management system and systematic energy consumption management even before joining the **UNIDO-GEF project "Introduction of Energy Management System Standard in Ukrainian Industry" (hereinafter UKRIEE project).**

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 **Globino Sugar Plant** before and after energy management system implementation.



3 BENEFITS FROM EnMS IMPLEMENTATION

Within the **UKRIEE project**, the **Globino Sugar 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 company's products are shown below.

To support the EnMS and continual improvement, the company's management in person of CEO Yuriy Matsak formed an energy management team and introduced the position of Energy Manager that did not exist at the company before EnMS implementation.

The EnMS operation in 2018 resulted in the reduction in electricity consumption by 36% in comparison with the 2017 baseline, while natural gas consumption dropped by 6.1%.

The company regularly uses the UNIDO EnMS Tool provided by the **UKRIEE project**. The Tool is helpful in supporting the EnMS operation and delivering successful recertification audits.

From September 11 till October 11, 2018, a series of two CIMS internal audits were conducted that confirmed its readiness for certification to ISO 9001:2015, as well as its compliance with ISO 14001:2015, OHSAS 18001:2007, FSSC 22000, and ISO 50001:2011.

The audits also documented:

- 3 positive findings.
- 8 nonconformities.
- 25 recommendations for improvement.

4 IMPLEMENTED ACTIONS

Based on the existing energy management system operating as part of the Corporate Integrated Management System (CIMS), the company elaborated procedures and forms for presenting its energy objectives and targets.

The list of EnMS actions implemented in 2017-2018 is provided in the table below.

Energy saving measure	Month of 2017/2018	Expected savings after implementation
2017		
Reconstruction of the heating system		Reduction in gas consumption by 1 %
2018		
1. Purchase and installation of energy-efficient pumps		Reduction of installed capacity by 60 kW
2. Purchase of frequency converters		Reduction of installed capacity by 70 kW
3. Upgrade of the sugar melting system II		Reduction in normalized gas consumption by 0.1 m³/ ton of beets
4. Purchase and installation of energy-efficient lighting in the beet processing section		Reduction of installed capacity by 5 kW

5 IMPLEMENTATION RESULTS

The company implemented its energy management system as part of the Corporate Integrated Management System. For performance evaluation purposes, the company devised energy review procedures with the use of the UNIDO EnMS Tool provided by the **UKRIEE project**.

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

Based on the UNIDO EnMS Tool, the following drivers of electricity and natural gas (biogas) consumption were identified at the company:

- Beets processed, t.
- Content of rotten mass in total beetroot mass, %.
- Juice extraction, % of beetroot mass.
- Sugar production, t.
- Sugar content in beets, %.
- Power generation, kWh.
- Degree-days (15°C).
- Surface water consumption, m³.

The following baselines were established:

- Natural gas and biogas consumption, m³.
- Electricity consumption, kWh.

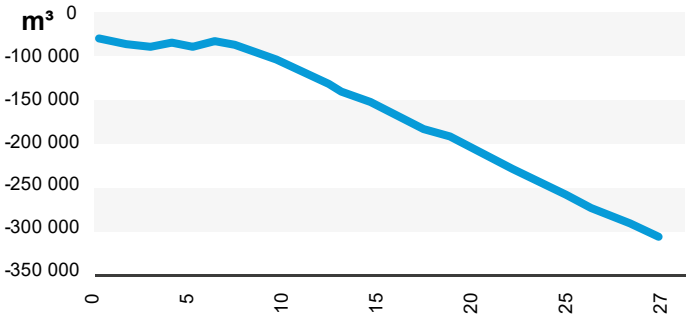
The list of adjustment formulas for each of the established baselines during the 2018 season is provided in the table below.

Adjusted R^2

Baseline		Equation to determine energy efficiency
Natural gas and biogas consumption, m³/day	0,92	54,338+4.01*(Beets processed, t) +414* (Juice extraction, % of beetroot mass) +69.1 * (Sugar production, t) -832* (Sugar content in beets, %) -2.45* (Surface water consumption, m3) +69.1* (Sugar production, t) -832* (Sugar content in beets, %) -2.45* (Surface water consumption, m³)
Electricity consumption (total), kWh/day	0,95	7,234+19.2* (Beets processed, t)
Water consumption, m³/day	0,95	4,432.14+0.49*(Beets processed, t) -2.8* (Sugar production, t) -22.6 * (Degree-days (15°C))

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

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



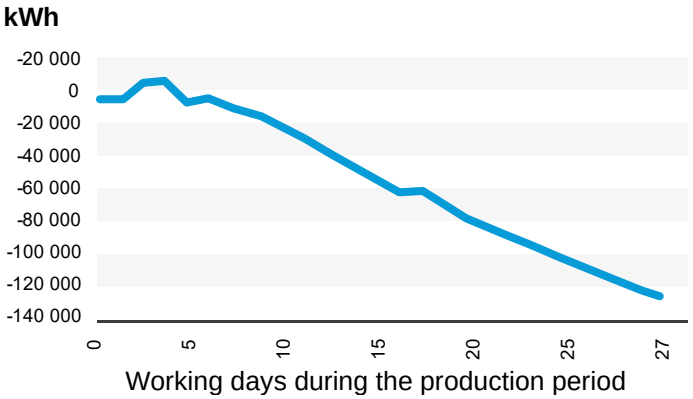
According to the data above, savings in 2018 constituted 8% of the baseline.

Only one day of the plant's operation was inefficient.

While evaluating the regression model, it was recommended to research and update (if needed) the methodology for establishing and assessing baselines and special consumption periods.

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

CUSUM electricity consumption (savings), kWh in 2018



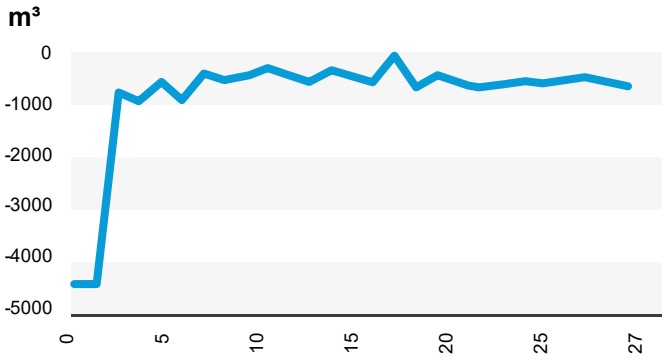
According to the data above, electricity savings in 2018 constituted 4% of the baseline.

While evaluating the regression model, it was recommended to research and update (if needed) the methodology for establishing and assessing baselines and special consumption periods.

Performance at the beginning and at the end of the season requires further research.

The CUSUM chart for water consumption in m^3 is presented below.

CUSUM water consumption (savings), m^3 in 2018



Working days during the production period

According to the data above, water savings in 2018 constituted 19% of the baseline.

The analyzed baselines and performance indicators show that it is necessary to research and update (if needed) the methodology for establishing and assessing baselines and special consumption periods.

6 CONCLUSIONS AND RECOMMENDATIONS

The training within the **UKRIEE project** equipped the **Globino Sugar 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:

- Use of normalization to account for driving factors.
- Identification of legal and other requirements for energy consumption.
- Improved operational control and its analysis.

Recommendations before and during the implementation of EnMS:

1. Enlist the support of senior management during EnMS implementation.
2. Conduct energy audit and data collection.
3. Conduct consultative and information work with employees of the company on the importance of EnMS.