

1 COMPANY OVERVIEW

Novoorzhytskyy Sugar Plant, LLC was put into operation in 1978. In 2013, the company joined Astarta-Kyiv, LLC. Its production capacities allow processing upwards of 8,000 tons of sugar beets per day. The company's production 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 (white granulated sugar) and by-products (beet pulp and molasses). The company sells its products in both domestic and international markets.

The energy management system (hereinafter **EnMS**) was implemented and certified in 2016. It was integrated into the Corporate Integrated Management System (hereinafter CIMS) that already included such management systems as quality, environment, occupational health and safety, and food safety.

A series of internal audits of the CISM were conducted in 2018, the audit confirmed its compliance with ISO 9001:2015, ISO 14001:2015, OHSAS 18001:2007, FSSC 22000, and ISO 50001:2011. The audits also documented:

- 6 best practices.
- 17 nonconformities.
- 32 recommendations for improvement.

During 2019, CIMS was subjected to verification for 2018. According to the verification program and findings, existing management activities can reduce the significance of food safety hazards and risks.

The company has certified EnMS in accordance with the requirements of ISO 50001: 2018.

Supplier contracts incorporate requirements for providing product safety specifications.



2 INITIAL CONDITIONS FOR EnMS

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



Novoorzhytskyy Sugar Plant, was aware of the importance of building an EnMS and systematic energy consumption management even before joining the UNIDO-GEF project "Introduction of Energy Management System Standard in Ukrainian Industry" (hereinafter **UKRIIE 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 and normalization of energy consumption.
- 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 **Novoorzhytskyy Sugar Plant** before and after EnMS implementation.



3 BENEFITS FROM EnMS IMPLEMENTATION

Within the UKRIEE Project, the company acquired both theoretical and practical knowledge of EnMS operation.

The training program was comprised of 3 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.



The EnMS operation in 2018 resulted in:

- Reduction in gas consumption by sugar beets processing by 6.5% in comparison with actual consumption in 2017.
- Reduction in gas consumption for production granulated beet pulp by 5.2% in comparison with actual consumption in 2017.
- Reduction in electricity consumption by 13.75% in comparison with actual consumption in 2017.
- Increase in average daily processing of raw materials by 6.8% in comparison with actual processing in 2017.
- Partial implementation of internal control, quality and electricity metering systems.
- Implementation of control over energy consumption.
- Partial optimization of the compressed air system.

Due to the availability of EnMS discounts of 20-25% were obtained during the procurement of ten frequency converters.

The staff members are trained in accordance with the Staff Training Calendar, including topics for self-study, in-house and external training in energy saving and energy efficiency. A number of training sessions and workshops were held throughout the year.

4 IMPLEMENTED ACTIONS

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

| OBJECTIVES FOR 2017 | Actual completion date |
|--|------------------------|
| 1 Reduce natural gas consumption by 11 % in comparison with the previous year | ● 15.09.2017 |
| 2 Reduce electricity consumption for sugar production by 5 % in comparison with the previous year | ● 15.09.2017 |
| 3 Reduce natural gas consumption for beet pulp drying by 15 % in comparison with the previous year | ● 01.09.2017 |
| 4 Reduce service water consumption by 3% | ● 15.07.2017 |

| OBJECTIVES FOR 2017 | Actual completion date |
|---|------------------------|
| 1 Reduce natural gas consumption for beet pulp drying down to 3300 m ³ /year | ● 01.10.2018 |
| 2 Reduce electricity consumption by 110 kWh in comparison with the previous year | ● 15.09.2018 |
| 3 Reduce service water consumption by 0.05 m ³ / ton of beets | ● 15.09.2018 |
| 4 Introduce control over gas, steam and electricity consumption | ● 15.09.2018 |
| 5 Optimize the company's compressed air system | ● 17.08.2018 |



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 devised energy review procedures with the use of the UNIDO's EnMS Tool provided by the UKRIIEE project.

Based on the UNIDO EnMS Tool, the following baselines were established at the company:

- Natural gas consumption without beet pulp drying, m3.
- Natural gas consumption for beet pulp drying, m3.
- Electricity consumption (total), kWh.
- Electricity consumption (production), kWh.

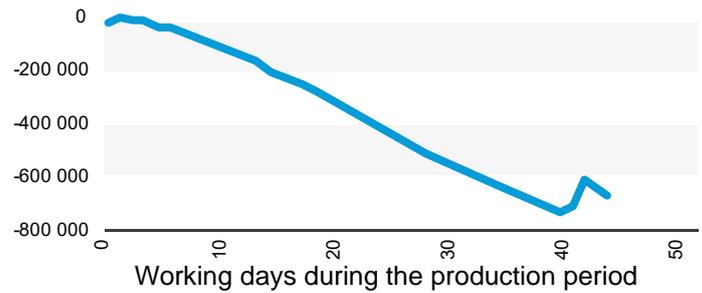
The baselines of consumption mentioned above were constructed using a regression analysis, which was based on an existing system of technical accounting for energy and non-energy factors.

| Adjusted R ² | | |
|----------------------------------|------|---|
| Baseline | | Equation to determine energy efficiency |
| Electricity consumption, kWh/day | 0,95 | $29.2 + 0.049 \cdot (\text{Sugar production, t}) + 0.009 \cdot (\text{Sucrose on the machine, t}) - 29.2 \cdot (\text{Content of rotten mass in total beetroot mass}) + 0.452 \cdot (\text{Juice extraction, \% of beetroot mass}) + 0.010 \cdot (\text{Beets processed, t})$ |
| Electricity consumption, kWh/day | 0,88 | $60.9 - 0.027 \cdot (\text{Molasses production, t}) + 0.287 \cdot (\text{Dry beet pulp production, t}) + 0.236 \cdot (\text{Granulated beet pulp production, t}) - 2.47 \cdot (\text{Sugar content, \%}) - 0.752 \cdot (\text{Content of dry matter in pressed beet pulp})$ |
| Electricity consumption, kWh/day | 0,91 | $56,829.139 + 59.7 \cdot (\text{Sugar production, t}) + 9.22 \cdot (\text{Sucrose on the machine, t}) + 33.7 \cdot (\text{Molasses production, t}) + 122 \cdot (\text{Granulated beet pulp production, t}) + 57.7 \cdot (\text{Limestone consumption, t}) + 3,350 \cdot (\text{Coal/ stone ratio, \%})$ |
| Electricity consumption, kWh/day | 0,89 | $41,075 + 57.2 \cdot (\text{Sugar production, t}) + 12.4 \cdot (\text{Sucrose on the machine, t}) + 46.6 \cdot (\text{Molasses production, t}) + 54.8 \cdot (\text{Limestone consumption, t}) + 2,833 \cdot (\text{Coal/ stone ratio, \%})$ |

The baseline period was selected based on data obtained in 2017.

The consumption of natural gas without pulp drying determined by the Cumulative Sums (hereinafter CUSUM) in m³ is presented in the figure.

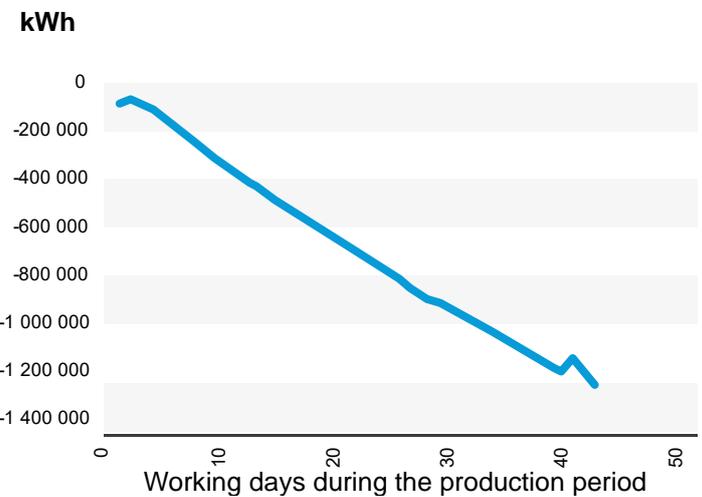
Natural gas consumption in m³ without beet pulp drying in 2018



According to the data above, savings constituted 8% of total natural gas consumption without beet pulp drying.

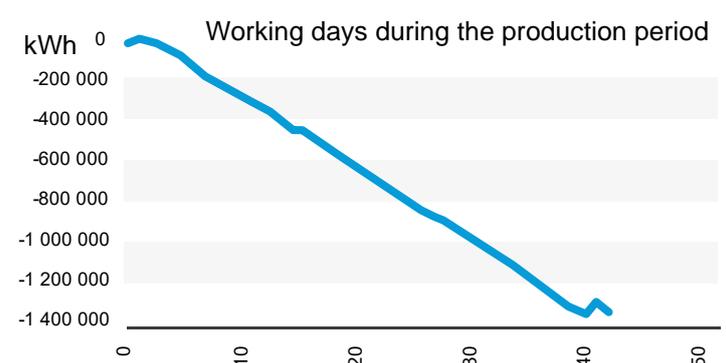
The CUSUM chart for electricity savings (total) in kWh is presented below.

Electricity savings (total) in kWh in 2018



According to the data above, savings constituted 17% of total electricity consumption.

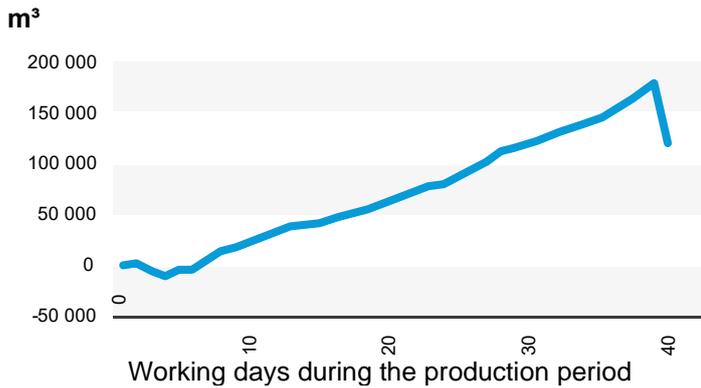
Electricity consumption (production needs) in kWh in 2018



According to the data above, savings constituted 19% of electricity consumption for production needs.

The CUSUM chart for natural gas consumption in m³ for beet pulp drying is presented below.

Natural gas consumption in m³ for beet pulp drying in 2018



According to the data above, overconsumption constituted 6% of total natural gas consumption for beet pulp drying.

The reason for the overconsumption of natural gas was the constant starts and stops of the beet pulp drying due to the setting of operating modes.

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CONCLUSIONS AND RECOMMENDATIONS

The training within the UKRIIE Project provided the **Novoorzhytskyy Sugar Plant** with the:

- theoretical and practical knowledge of EnMS development and implementation as part of energy planning processes;
- 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:

- to carry out consultative and informative work with employees of the enterprise on the importance of EnMS.
- Enlist the support of top management during EnMS implementation.

Results of EnMS's implementation were presented at the International Competition «CEM 2020 Energy Management Leadership Awards Program».

