Nitrogénművek Zrt.

Saving Energy with Cleaner Production in the Fertiliser Industry

Business Case Study. The United Nations Environment Programme (UNEP) initiated a worldwide project promoting Energy Efficiency (EE) in industrial organisations through the use of the principles of Cleaner Production (CP). As a part of this effort, the Hungarian Cleaner Production Centre (HCPC) conducted an energy efficiency audit at Nitrogénművek Zrt., located in Central Hungary, the most significant representative of the Hungarian fertiliser industry.

The case of Nitrogénművek Zrt. demonstrates the importance of environmental protection in the chemical industry when leading technological solutions are combined with environmentally-conscious management practices. Analysis of material and energy flows and the subsequent implementation of energy efficiency measures not only improved environmental performance but also revealed a number of financially advantageous investment opportunities for the company.

THE COMPANY

Nitrogénművek Zrt. is the most significant representative of the Hungarian fertiliser industry. Its predecessors, Magyar Ammóniagyár (Hungarian Ammonia Plant) and Magyar Műtrágyagyár (Hungarian Fertiliser Plant) started operation in 1932 and were merged under the name of Magyar Nitrogen Műtrágyagyár Rt. in 1933 with the objective of supplying nitrogen fertiliser for Hungarian agriculture, and also produce nitric acid for use in explosive and gunpowder manufacture. The company, later renamed Péti Nitrogénművek (Pét Nitrogenworks), produced Pétisó and ammonium nitrate in its lignite-based ammonia plant (with a capacity of 20 MTPD, later expanded to 100 MTPD). In the 60's the company turned to natural gas as a raw material and new ammonia, urea and nitric acid plants were built and a central research laboratory was established. In the early 70's a world class ammonia plant with 1000 MTPD capacity was constructed, while the 80's witnessed the construction of a concentrated nitric acid plant using Japanese technology, and an argon plant. Fertiliser consumption reached its peak in the 80's when about 500,000 tonnes/year of ammonia was produced in Pétfürdő. At the end of the decade the collapse of the economy lead to the privatisation of Péti Nitrogénművek which was later re-established in 1990 as Nitrogénművek Zrt., taking over the machinery and staff of its predecessor. In spite of suffering from a chronic lack of capital in the agricultural sector reflected by a decrease in fertiliser consumption, the company re-designed its product portfolio and launched new projects aimed at enlargement of capacity, energy rationalisation and environmental protection.

CONTEXT & OBJECTIVES

Production of nitrogenous chemical fertiliser requires special technology because of complex and interconnected chemical reactions within the production system, some of which generate heat, while others require large amounts of heat. These requirements were the subject of examination through an energy audit conducted by the HCPC using UNEP's CP-EE methodology.
The production of liquid nitric acid produces large amounts of steam potentially valuable in other applications – such as the heating of buildings. However, as Nitrogénművek Zrt. has plans for reconstruction of the acid plant in the near future, this source of steam was not considered available and other sources should be identified. This development also results in a situation where existing heat-transfer appliances (radiators, air heaters, etc.) will no longer be able to fulfill their functions.
This situation provided an excellent opportunity to evaluate the efficiency of the then-used heating system and also to identify options which could increase energy efficiency when implemented as substitutes for part of the current system.

THE CP-EE PROJECT

To support efforts that integrate Cleaner Production and Energy Efficiency into private sector activities, UNEP's Division of Technology, Industry and Economics (DTIE) initiated the CP-EE Project.
Through a structured and integrated approach, the CP-EE Project aims to reduce industrial carbon-dioxide emissions by improving energy management practices and identifying new CP-EE investments for SMEs.
This business case was developed within this project, after a CP-EE assessment in the selected industry was conducted.

THE CP-EE METHODOLOGY

Cleaner Production (CP) and Energy Efficiency (EE) are established and powerful strategies that reduce costs and generate profits by reducing waste. Their integration supports synergies that broaden the scope of their application and gives more effective results, both environmentally and economically. Integration of these two powerful strategies can be facilitated using the structured methodology below.

THE CP-EE MANUAL

The Manual was developed under the framework of the CP-EE Project and presents an integrated Cleaner Production-Energy Efficiency (CP-EE) methodology based on proven CP methodology and combines this with factual information, technical data, worksheets, tools and resources that will allow both technical specialists and managers to take direct and effective action.

To download the manual visit:
www.unep.fr/energy/projects/cp-ee/manual.htm

PLANNING & ORGANIZATION

STEP 1
- Obtain commitment of top management
- Involve employees
- Organize CP-EE team
- Compile existing information
- Identify barriers/solutions to the assessment
- Decide the focus of the CP-EE-assessment

PRE-ASSESSMENT

STEP 2
- Prepare a process flow diagram
- Conduct a walkthrough
- Prepare material and energy input-output quantification and characterization
- Generate and finalize base data

ASSESSMENT

STEP 3
- Prepare a detailed material and energy balance with losses
- Conduct cause diagnosis
- Generate options
- Screen options

FEASIBILITY ANALYSIS

STEP 4
- Conduct technical, economic and environmental evaluation
- Select feasible options

IMPLEMENTATION & CONTINUATION

STEP 5
- Prepare CP-EE implementation plan
- Sustain CP-EE assessments

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APPROACH AND ACTIVITIES

Analysis of data from the company's historical records revealed that the company had significant potential for efficiency measures to reduce both resource use and environmental pollution. After discussions with company management and taking into account the company's own efforts, it was decided to concentrate on the steam production and utilization system and to pay close attention to potential energy savings in the heating of buildings.

The objective of the assessment was to minimise resource consumption and, as a result, reduce emissions of harmful substances with a focus on Greenhouse Gas emissions.

To complete the CP-EE assessment, the HCPC obtained the commitment of top management and set up a team of experts, including energy experts from the company and the HCPC. The team identified and analysed potential options and impediments to increasing energy efficiency at the company. The assessment followed the CP-EE methodology provided in the previous page. As a result, recommendations have been made to the company management with regard to the modernization of the heating system of the company.

IDENTIFIED OPTIONS

In order to cope with the new arrangement resulting from reconstruction of the acid plant, the following heating–system related modifications were suggested to the management of the company, based upon an available supply of steam:

Since the amount of steam available with be reduced drastically, the use of steam for heating must be concentrated at the heat-transfer appliances (after their improvement). The heat content of the condensing water should be used to heat office and changing room space. Currently, the heat content of the condensed water which accumulates on the remote heating stations is sufficient to heat ten thousand cubic meters of air.
In the permanently-used halls the heating system should be renovated and the transition to hot-water heating should be carried out. In the longer term, heating of the halls should be resolved on an individual basis using energy from the natural gas network.
Efforts should be made to utilise the waste heat produced from the heating of the production plants, especially in relation to the heat content of condensed water.

BENEFITS

According to these recommendations the heat centres of the buildings will be supplied from the hot water pipes which traverse the plant area. Heat centres will be equipped with plate valve exchangers, circulating pumps, regulating valves and programmable control automation. In the majority of buildings, heat-transfer appliances will be radiators – or, alternatively, the radiative surfaces of the radiators currently used for steam heating will be increased according to hot water requirement parameters. In some rooms the energy (heat) source of first-floor workshops will be switched to natural gas, while the top-floor area will receive hot water radiator heating.

Before the reconstruction, steam consumption of the premises was 30,677 tonnes/year, equivalent to 67,490,000 MJ/year. According to calculations, half of this amount (33,745,000 MJ/year) can be saved as a result of the recommended measures.
Based on HUF 30 price/cubic meter natural gas (typical of industrial consumers), the resulting saving would be 28,924,200 HUF/year (about 115,700 EUR). Calculating with a total reconstruction cost of HUF262 million, the payback period of applying such an option would be 9 years. Although this value is rather high, continually increasing gas prices mean the option will become more attractive. In terms of greenhouse gas reductions, the suggested investment was calculated to result in a net emission reduction of 1893 tonnes of carbon dioxide per year.

	Investment (USD)	Payback (years)	Energy saved (m3)
Heating Reconstruction	1 300 000	9.0	964 000
End-gas purification in the nitric acid plant	600 000	3.0	1 100000
Further reconstruction of the heating system	650 000	4.0	891 000
Installation of new acid and ammonium-nitrate plants	160 000 000	n.a.	n.a.

OTHER IMPLEMENTED MEASURES

Parallel to the work of HCPC, Nitrogénmüvek Zrt. has conducted a number of assessments concerning energy utilisation during its processes and has identified options which would provide both environmental and economic benefits.

As a result of installing new technology for purification of the acid plant's flue gas, Nitrogénmüvek Zrt. could cut its gas consumption by 1.1 million cubic meters. The investment cost is relatively high (600,000 USD) but the payback period quite short (only 3 years).
The reconstruction of the heating system of the old buildings and simplification of the steam distribution lines beyond those suggested by the CP-EE project is another goal for the near future. Nitrogénmüvek Zrt. has already contracted those tasks and work has started. The predicted GHG emission reduction from this measure is about 1700 tonnes/year.

The implementation of the two further measures has recently started. While the main objective of these is to increase production volume and improve quality they also have a significant impact on energy consumption which will be

ENVIRONMENTAL AND FINANCIAL BENEFITS

Environmental and financial benefits of the suggested and implemented options are shown in the table above.
As indicated earlier, reconstruction of the heating system as recommended by HCPC achieves a GHG emission reduction of 1893 tonnes/year. Further heating reconstruction of the company's own initiative adds another 1700 tonnes/year reduction to the total.

The end-gas purification option in the nitric acid plant also has a significant impact on the GHG emissions of the company and results in a reduction of 209 tonnes/year.

Other changes planned by the company (to be implemented in 2007) – namely, the installation of a new acid and a new ammonium nitrate plant – will also affect the GHG emissions of the company but concrete figures have not yet been calculated for this.

Yearly GHG emission reductions are shown in the table below.

GHG REDUCTION - TONS

No. 1	No. 2	No. 3	Total
1893	2098	1700	5691

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HUNGARIAN CLEANER PRODUCTION CENTRE
8 Fovam ter, Budapest
1093 Hungary
Phone: +36-1-482-5251
E-mail: hcpc@uni-corvinus.hu

CONTACT