ISVH Ltd.

Saving Energy with Cleaner Production in the Heat Treatment of Metal Products

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 Indukciós és Védőgázos Hőkezelő Kft. (ISVH Ltd.), a small but significant representative of the Hungarian heat treatment market, located in Budapest.

The case of ISVH Ltd. shows the potential of small and medium-sized companies to increase their efficiency hand-in-hand with an improvement in their environmental performance. As a result of the continuous development supported by the CP-EE process implemented by the HCPC, ISVH Ltd. has realised significant financial and environmental gains and at the same time improved the quality of its services and the confidence of its customers.

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THE COMPANY

Before being established in 1989, Indukciós és Védőgázas Hőkezelő KFT. (ISVH Kft: Induction and Protective Gas Heat Treatment Ltd.), operated as a heat treatment company - part of one of the biggest Hungarian companies, Szerszámgépipari Művek (SZIM), producing tools and machines for domestic and international markets. SZIM introduced protective gas and induction heat treatment technology to Hungary and has now accumulated more than 50 years of professional experience. As a result of growing confidence in the services of the company, from the year 2000, ISVH Ltd. developed and purchased new CNC and other equipment in an attempt to develop its protective gas, induction, nitridizing and vacuum heat treatment capability and raise the technical level of its services. Besides a significant extension in capacity, the goals of the reconstruction were to improve the quality of the operation of the company and to increase efficiency.

As a result of its long experience in inductor sizing and production, ISVH Ltd. is able to carry out all kinds of induction quenching jobs depending on capacity and size of equipment available. From a domestic viewpoint, the plant can be considered complete, and available capacity can be operated simultaneously. A new computer-based system which controls the protective gas treatment process guarantees a high quality standard of service from ISVH Ltd.

CONTEXT & OBJECTIVES

Analysis of data from the company's records revealed that the single most important environmental impact of the company is the burning of natural gas in order to heat the furnaces used for the treatment of different metal products. After discussions with company management it was decided to concentrate on these energy-intensive processes and implement the CP-EE process to uncover opportunities for energy efficiency and cleaner production improvements.
The objective of the assessment was to minimise resource consumption and, as a result, reduce emissions of harmful substances with a special focus on reduction of Greenhouse Gas emissions.

APPROACH & ACTIVITIES

To conduct the CP-EE assessment, the HCPC obtained the commitment of top management and set up a team of experts including energy specialists from the company and the HCPC. The methodology used during the assessment can be seen below. As a result of the process, several potential CP-EE measures were identified and analysed in detail, taking into account their technical, environmental and economic aspects.

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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IDENTIFIED OPTIONS

As a result of the pre-assessment carried out according to the CP_EE methodology, the focus was put on the company's protective gas heat treatment process. Protective gas heat treatment increases the carbon concentration of iron-based metals in an oxygen-free environment, using an approximately 20% carbon monoxide gas medium, with 30 mm VO pressure at 860-930 °C. After the heating process the materials are cooled down by using a special oil. The most important environmental impacts of the technology include:

- Heat Emissions
- Emissions of nitrous-oxides and carbon monoxide
- Oil contamination, hazardous waste
- Water contamination
- High energy requirements

As a result of the assessment, five significant energy saving options have been identified – as shown in the table which follows:

SITUATION	EFFICIENCY OPTIONS
The required temperature for hardening is achieved with the use of radiating tubes. Fuel gas is lit by a flash from the safety torch. Such torches are constantly operated and have a gas consumption of 0.1 m3/h/unit. This operation is currently carried out by a 7.5 kW blower which can supply both the radiating tubes and the torches.	Air for combustion can be provided by a 2.6 kW ventilator, while the safety torches can be powered by a 0.37 kW blower in each furnace. In this case the output control of the ventilators would be based on frequency control.
The protective gas furnaces are ignited from the top by safety torches. Another role of these torches is to burn harmful toxic and explosive gases which would otherwise leak from the furnaces to the outside environment	The combustion environment can be closed by siting the ignition next to the appropriate part of the radiating tube thus rendering the use of torches unnecessary.
The high temperature (900-1100 °C) flue gas produced is lead through a recuperator before leaving the combustion space. The recuperator uses most of the heat content of the flue gas to pre-heat the gas mixture, but the technology does not allow for total mixing.	The temperature of the flue gas leaving the recuperator can provide enough heat to pre-heat combustion air (from 25 °C to 100 °C). The higher air temperature, besides reducing the amount of natural gas required, facilitates better mixing – thus also increasing combustion efficiency.
Oil cooling takes 4 hours a day with a tube heat exchanger, utilising oil as a cooling agent. In turn, the heat-exchange unit is cooled down through immersion in a water tank. The heat energy of the water is not utilised.	The heat content of the oil cooling agent can be used to provide communal warm water. During winter, the warm water could additionally be used to heat office and hall space.
The reconstruction of one of the workshops of the company provided an excellent opportunity to install state-of-the-art lighting which is safe, economical and more environmentally-friendly.	With the installation of sensors and relays in the new lighting system, lights will automatically switch on and off according to changes in natural light and the pre-set requirements of the workshop.

	Investment (USD)	Payback (years)	Energy saved
Replacement of torch blowers	11 958	1.2	186 MWh
Conversion of furnace ignition (not implemented)	17 435	6.8	7 200 m3
Utilisation of the heat content of flue-gases	2 660	9.3	2160 m3
Recovery of heat component of cooling-oil (not implemented)	2 315	1.5	11647 m3
Installation of energy saving lighting	478	1.0	10MWh

IMPLEMENTATION & BENEFITS

The environmental and financial benefits of the measures suggested by the HPCP are detailed in the table above. As can be seen, several options have a short payback period – which demonstrates the financial benefits of the measures implemented. According to the company energy expert, the CP-EE audit provided useful findings leading to better energy management and reasonable technological modifications. ISVH Ltd. started to implement the measures developed in coordination with HPCP and has achieved significant reductions in energy consumption.

After the project period ended the company carried on with replacing the torch blowers and modernising the lighting system based on the suggestion contained in the CP-EE energy assessment.

While the environmental benefits of these measures are obvious, a significant increase in the activities of the company over the last four years cancel out the reduction of specific (in relation to product volume) GHG emissions of the assessed technology.

Further to the above-mentioned measures, ISVH Ltd. is replacing its old protective gas heat treatment furnaces over the long-term with high-tech vacuum furnaces. The company has already installed two new furnaces which resulted in GHG emission reductions. The financial payback from this measure was about 6 years, while total related GHG emission reductions amount to 300 tonnes/year from the power plant side.

GHG REDUCTION - TONS

No. 1	No. 2	No. 3	No. 4	No.5
61.5	34.5	3.85	22.44	1.73

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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