

NEW TOOL FOR PROMOTION OF ENERGY MANAGEMENT AND CLEANER PRODUCTION ON NO-CURE NO-PAY BASIS

Vladimir Dobes

EMPRESS, Na Rovnosti 1, 130 00 Praha, the Czech Republic, vladimir.dobes@iiee.lu.se,
+420603178642

Abstract

Even the enterprises with very advanced management systems often do not monitor efficiency of use of important energy and material flows within their processes and therefore, have difficulty to effectively manage their resource efficiency. This paper is built upon experiences from a pilot implementation of a new tool for promotion of energy management and cleaner production developed within the Energy Management and Performance Related Savings Scheme (EMPRESS) project to promote an effective energy management system in industrial enterprises on a no-cure, no-pay basis. Ten no-cure, no-pay contracts were implemented for introducing an effective energy management system financed from corporate system savings that also result in reduction of CO₂ emissions/unit of production and in savings on the overall operational costs of the enterprises.

The combination of “soft” managerial approaches (Monitoring and Targeting technical services) with financing provided on a ‘no-cure, no-pay’ basis created a new tool. This new tool named M&T/ESCO has not been, to our knowledge, used before. It enabled to test introduction of cleaner production projects with no technical risk and the need for financing for enterprises; therefore it removed some of the important barriers for implementing cleaner production. The paper distinguishes between auditing and accounting approaches in the promotion of cleaner production and argues that auditing approaches are not sufficient for completion of the learning needed for integration of cleaner production into an enterprise’s practice. It describes the new tool, M&T/ESCO which is a promising approach for more effective implementation of cleaner production . Experience from the pilot testing of the tool

is illustrated with case studies from the Czech enterprises and the broader implications are discussed in the context of widespread adoption of it.

Keywords

Energy management system, monitoring and targeting, cleaner production, no-cure, no-pay, energy performance contracting.

1 Introduction

Efficiency improvements to generate more economic output with less energy and material inputs are considered to be an important part of the strategy to achieve more sustainable development. This paper focuses on experiences from developing and testing a new tool for promotion of the “soft” managerial efficiency improvements in industry within a broader strategy of cleaner production (CP).

The “soft” organisational potential for efficiency improvements is often neglected in policies both at the macro and the micro level. In traditional policies the efficiency improvements are mainly related to the infrastructural and technological “hardware” changes: Major energy efficiency gains on the production site of the consumption-production system can be achieved through investment in broad restructuring projects – to revamp the entire production processes in the industrial settings. In these cases improved resource efficiency is only one of many factors involved in the selection of technologies by investors. Governmental support for improved resource efficiency therefore, as usually been focused on specific projects aimed at improving energy or material efficiency – for example by replacing outdated boilers, utilizing wasted heat or industrial gases, or installing more efficient process equipment.

Within this paper, the author focuses on the often neglected systematic approach of CP leading in the first stage to exploration of the “soft” organisational potential for efficiency improvements and optimisation of measures requiring investment promoted within the two above approaches. Systemic implementation of the CP strategy has often been found to be difficult in spite of high potential benefits, which are often inadequately explored.

Research on new tools and policies for CP implemented at IIIEE argued that an important barrier for adoption of CP at the enterprise level is lack of tools for completion of individual and organisational learning in this area. Middle and top managers perceive CP as a risky strategy and hesitate to devote their resources to CP implementation due to lack of verified

information on the real benefits of CP, so that they can compare them with benefits of traditional “hardware” solutions. Important research questions rising from this research included two which were addressed within the EMPRESS project analysed in this paper:

- 1) To what extent can organisational learning in the field of CP, be facilitated by an information system, which provides continuous information on real performance in the field of resource efficiency at the level of specific cost centres?
- 2) To what extent can CP be promoted by shifting technical risks of “soft” CP projects to providers of technical assistance based on an information system that ensures verification of implemented savings that result from implementing specific CP measures in that organisation?

2 Past experiences

CP projects implemented within the UNIDO/UNEP network of National Cleaner Production Centres (NCPCs) documented repeatedly the importance of the “soft” managerial and organisational measures for helping to ensure efficiency gains and continuous improvements in performance. For example the implementation of CP in the transition economy of the Czech Republic, in the nineties, showed the potential of organisational measures capable of reducing relevant material and/or energy flow by up to 25% while maintaining the same economic output. These good housekeeping improvements also led to optimisation of innovations requiring additional investments.

The major barrier for implementing the Cleaner Production Assessment (CPA) seemed to be the complexity of this approach and impossibility to guarantee results of its implementation beforehand. This was the reason why the Czech Cleaner Production Centre (CCPC) decided, in the 90ties, to implement a technical assistance contract for introduction of CPA based on a ‘*no-cure, no-pay,*’ principle inspired by the Energy Performance Contracting (EPC) utilised within promotion of the energy efficiency. The CCPC succeeded to sign a contract with industrial sites involved in CPA projects, which committed each enterprise to pay for the technical assistance based upon 25% of the savings, within the first year after CP measures implementation, that resulted from the non-investment (organisational) measures that were proposed by the CPA.

This experiment turned out to be a failure because most of the committed sites were obliged to pay CCPC millions of Czech Crowns, many times more than the actual costs of the assistance provided. This problem was easily solved by defining maximum possible payments, however, the major problem, which was not resolved, at that time, (and which is the major barrier for introduction of CP financed from savings approaches) was the inability to objectively verify the extent of actual savings achieved. This is due to the fact that CPA (as well as for example Environmental Management Accounting (EMA)) does not provide a detailed dynamic baseline for improvements, which is essential for tracking real improvements resulting from particular measures in industrial settings.

CPA is considered to be a very effective tool in promoting more sustainable processes, however, at the same time its image is not good for its marketing because potential users often consider it to be too complex a product, the benefits of which, are difficult to guarantee before the assessment is implemented. The old dream to overcome barriers linked to promotion of CPA by offering CP services on a ‘no-cure, no-pay’ basis has come true only later within the new M&T/ESCO service described in this paper.

3 Auditing and accounting approaches for making industrial efficiency improvements

Industrial efficiency improvements can result from better management of energy and material flows. This management is based on monitoring of relevant flows and on understanding causes of inefficiencies. We can distinguish two basic groups of tools that can be utilised for exploration of efficiency improvement potential:

Auditing approaches such as energy audit or Cleaner Production Assessment (CPA) which focus on exploration of the potential for efficiency improvements through understanding specific causes of losses. The disadvantage of these approaches is that in order to develop and implement cleaner production (efficiency improvement) measures the approaches provide only a static snapshot of the process within an audit and/or assessment at a given point in time. The dynamic nature of industrial processes creates difficulties in monitoring real benefits of implemented measures.

Accounting approaches such as Environmental Management Accounting (EMA) which tracks all environmental costs. EMA is a dynamic information system which makes it possible to allocate and in absolute terms also quantify the losses linked with non-product

output of processes – the losses we aim to avoid. However, EMA does not monitor the efficiency of the use of energy and material inputs on its own as the actual efficiency is a function not only of the use of material and energy flows accounted for within EMA, but also of the factors influencing energy and material consumption at a given place.

This problem is overcome within a dynamic accounting approach called Monitoring and Targeting (M&T). M&T makes it possible to monitor the real efficiency of use of materials and energy inputs, in time, thus enabling assignment of accountability for efficiency to the people who influence it. This seems to be crucial for sustaining CP as a continuous approach for ongoing improvements within industrial settings. The EMPRESS project focused on introduction of this “soft” managerial approach based upon the solid information system of M&T and shifting the technical project risks fully to the provider of technical assistance within the M&T/ESCO scheme. The following sections describe the experience of the development of this new product and its pilot-testing in the Czech Republic.

4 Linking M&T and EPC within M&T/ESCO

Monitoring and Targeting (M&T) was originally an energy saving tool first developed in the UK that helps companies achieve and maintain efficiency improvements through the detailed analysis of their metered energy and/or material consumption data. Consumption data are analysed against related factors influencing energy and/or material consumption. This enables the identification, implementation and maintenance of cleaner production measures. The approach proved to provide good levels of savings at very low investment cost in a wide range of industrial and commercial environments. M&T involves installing a powerful information system (including meters and data analysis software) backed up by a technical consultancy that is responsible for designing and introducing the flow management system. Experience from the EMPRESS project documented that the initial capital costs of introduction of M&T are typically between US\$ 30,000 to US\$ 100,000 per industrial installation, including the cost of technical assistance, metering and software, depending on the size of the firm and the number of meters that have to be installed.

The cost saving measures identified generally require zero or low further investment and the introduction of M&T proved to have a short payback (typically within 1 year). This fact together with its inherent information system that enables the tracking of the actual efficiency and verification of savings proved M&T to be very suitable for providing guarantees for

savings through the method of Energy Performance Contracting (EPC) as described within the Energy Service Company (ESCO) concept.

An Energy Service Company (ESCO) is an entity that traditionally contracts with energy users, their agents, and utility companies to evaluate, design, and install capital and operating improvements in an existing building, facility or industrial process with the objective of reducing energy and operating costs over a contract period, typically of four to ten years. Many ESCOs provide financing to their clients. ESCOs bear the risks related to energy saving projects and guarantee the achievement of planned savings. They are paid a proportion of the savings from the reduced energy bill. The long-term nature of conventional ESCO contracts and the difficulty in setting up a baseline for verification of savings are the major traditional barriers in industrial situations.

At the time of its launch, the EMPRESS project was expected to remove these barriers within a new M&T/ESCO scheme. The EMPRESS project was funded by 'The Global Environment Facility' (GEF), that is managed by The United Nations Environment Programme (UNEP) and Basel Agency for Sustainable Energy (BASE). EMPRESS was implemented in the Czech and Slovak Republics with the assistance of consultancy firm ENVIROS promoting within its clients energy efficiency and cleaner production. This paper reflects on experiences gained from development and implementation of M&T/ESCO in the Czech Republic.

5 Methodology

A general scheme of the EMPRESS project and the methodology utilised for implementation of M&T/ESCO within 10 pilot sites is described in the following paragraphs.

5.1 The general project scheme

An institutional basis for the project activities was created in the form of the Czech Energy Management Centre, EMPRESS, which continues to promote M&T/ESCO beyond the project duration. It facilitated development of the M&TESCO. Four M&T/ESCO providers were established through linking M&T and EPC experts in the Czech Republic within the

following firms: ENESA, ENVIROS, MVV and SIEMENS. These companies provided both M&T consultancy services and the meters, instrumentation, and computer software necessary to undertake an M&T programme at an industrial site. Like a conventional ESCO, the new M&T/ESCO providers offer their new services at no initial cost to their clients and with guaranteed savings; they are paid through the enhanced revenue stream brought about by the energy and material flow savings, in effect providing a type of supplier financing to their clients while bearing the technical project risk.

The basic difference between a conventional ESCO and the M&T ESCO is the nature of the service provided. With a conventional ESCO the emphasis is on the energy equipment installed. After installation the ESCO typically maintains the equipment and monitors the savings. With an M&T/ESCO, the emphasis is on management and people issues within the client company (similarly to the traditional “soft” cleaner production projects), the implementation is backed up by a strong information system that focuses on efficient use of production inputs and by ensuring accountability of people responsible within the company for achieving the improvements in materials and energy efficiency. The equipment installed (meters, data collection instruments, and low cost sensors and controls) are the means to the end within this new scheme. These arrangements make it possible for the M&T ESCO to set up a management reporting system for the client and to work with the client's staff to change operating methods through training, mentoring and motivation. Savings are achieved without major capital expenditures and the contract periods are therefore, much shorter (up to 3 years) because of the short payback periods inherent in an energy and material flow management based approach.

An important document developed by EMPRESS is a blueprint contract between a site and M&T/ESCO provider. The blueprint contract ensures a guarantee of fairness of the M&T/ESCO arrangement to both provider of technical assistance and to its client. It was used by EMPRESS to promote the new M&T/ESCO scheme among potential clients. The blueprint contract proved to be very useful for trust building and for explaining details of the M&T/ESCO scheme to enterprises. It provided the required transparency to the promotional activities – set of seminars and company visits focussed upon signing pilot M&T/ESCO contracts. In case of positive results of an initial company visit (indication of potential for M&T/ESCO and interest of top management), Scoping Audits were implemented as a precondition for development of the legal commitment (based on the blueprint contract).

5.2 Overview of the approach developed

The step by step approach developed within the EMPRESS project and implemented in the 10 pilot sites is outlined as:

5.2.1 Strong initial review

The output of the initial review (Scoping Audit) is a quantification of the potential for pollution prevention and savings at two levels:

- best estimate (expected potential for improvements);
- guaranteed improvements (minimal savings which can be guaranteed by the technical assistance provider).

The review of good housekeeping potential is based on:

- a) a review of the existing management system of material and energy flows (with a focus on the information system and accountability) and
- b) a review of the physical potential for savings (based on input-output analysis and on regression analysis of historical data (use of energy and material flows and factors influencing their consumption – monthly data proved to be sufficient)).

The review of the potential for measures, which require investment is based on traditional expert techniques.

Based on the report from such an initial review, the provider of technical assistance can offer exploration of identified CP potential (including the option of the “no cure – no pay” service based on the guaranteed savings).

5.2.2 Introduction of CP management system

The “CP management system” refers to a management system based on a powerful information system for monitoring of efficiency of use of significant material and energy flows, which possesses significant potential for CP. The CP management system implemented

in the Czech Republic within the EMPRESS project is based on M&T, that enables it to among others things:

- To monitor real efficiency of use of material and energy flows at the significant cost centres;
- To set up a baseline for improvements;
- To set up realistic targets for particular cost centres, departments and for the whole enterprise;
- To make people influencing efficiency of use of material and energy flows accountable for this efficiency;
- To identify variations from standard process performance and to identify causes of better or worse performance – both can lead to the identification of valuable CP measures;
- To stimulate traditional generation of CP options and implementation of feasible CP measures;
- To monitor performance of implemented CP measures including objective verification of real savings achieved (against the base line set up based on the original performance of the technology) – this is important for maintaining effects of CP measures and also for implementation of the “no cure – no pay” arrangements, by using the baseline set up at the beginning.

5.2.3 Risk sharing

The last important part of the CP promotion scheme within M&T/ESCO is sharing the technical (and related financial) risk arising from introduction of CP management system and/or other CP innovations including investment in environmentally sound technologies (ESTs).

Within M&T/ESCO the providers of services address two levels of EPC:

- The first EPC contract (M&T/ESCO implemented within the EMPRESS project) is related to introduction of the management system.
- The follow up EPC contract is related to introduction of ESTs and can be much bigger than the first EPC contract, which serves as a door opener, optimiser of ESTs parameters and which provides baseline for monitoring of the ESTs performance.

6 Results

The EMPRESS project proved that it was possible to overcome barriers consisting in lack of information on CP potential and in the natural resistance of industrial leaders to accept the project risk related to introduction of CP and energy management system.

Concerning the desired involvement of private money in introduction of CP in industrial sites, the well designed M&T/ESCO scheme led to commitment of ESCOs to invest their own funds in implementation of M&T, which can be considered a big success.

This resulted in practical pilot implementations of M&T/ESCO within ten sites.

The amount of CO₂ emission reductions achieved within these 10 sites through or in the aftermath of M&T efforts compared to the pre-project baseline is altogether more than 83,000 tons of CO₂. These results were not achieved in badly managed and highly polluting sites, the opposite was true: M&T/ESCO proved to work best in well managed enterprises.

The most successful implementation was a new installation built on a green field.

Implementation of M&T/ESCO is further illustrated on two case studies of the full scale M&T/ESCO implementation. The case study from CELESTICA represents a new, medium sized, enterprise. The site was newly build at a green field equipped with the most up-to-date technology; this was a pleasant surprise because at the beginning it showed very little potential for savings. The case study from PD REFRACTORIES provided interim results from a larger enterprise with many cleaner production opportunities. Both case studies were partially funded by M&T/ESCO providers and by a subsidy from the EMPRESS project (appr. 25% of the overall costs).

6.1 Case study from the newly build medium size enterprise

Company name: CELESTICA

Source: (ENVIROS, 2009)

Project name: Implementation of energy management using M&T/ESCO method

Duration of M&T/ESCO contract: 08/2006 - 03/2010

Contact: Celestica Kladno, s. r. o.

Project manager: Petr Náprstek – facility manager, Celestica; pnaprst@celestica.com

Technical assistance: ENVIROS, s. r. o., Member of the ENVIROS Group, Prague

ESCO financing: MVV Energie CZ, s. r. o., Prague

6.1.1 Core business

Celestica is premium worldwide provider of EMS - Electronics Manufacturing Services, primarily printed circuit board (PCB) completion for premium suppliers of computing technology and telecommunications. Celestica provides complete services, including design, assembly, quality assurance, packing, distribution, and post-sales service. The company is headquartered in Toronto, Canada. The company has more than 40 plants worldwide.

6.1.2 Premises and their management

The premises of Celestica Kladno were newly build at a green field and were comprised mainly of an assembly hall. From the functional point of view, the premises can be dividend into the following parts: production halls, warehouses, administrative part and energy centre. The enterprise possessed an effective management system including tools for optimisation of its operation via the Six Sigma approach.

6.1.3 Project focus

Celestica Kladno leases its premises, including employees to electronic manufacturers. An important part of energy costs relates to the provision of conditions required by these customers to assure production quality. This pertains especially to energy consumption for cooling, heating, moisturizing, and exchange of air, lighting and water supply. The first phase of the project therefore, focused primarily on the above mentioned areas of energy consumption.

6.1.4 Status of energy management before M&T implementation

In addition to the fact that the facilities were very new, an energy audit had been implemented before the project start up. However, the original energy consumption monitoring system did not support implementation of an effective strategic approach to energy management. Only the data from the measuring instruments used for invoicing of total consumption of natural gas and electricity were available. To be able to apply the energy management (M&T) method, secondary measurement of energy consumption and relevant driving factors also had to be installed.

6.1.5 Data gathering within M&T

Modifications within EMPRESS project included installation of new measuring instruments and connection to an automated data gathering system with archiving. Beside the particular energy consumptions there are also monitored the driving factors like the exterior climatic conditions to allow necessary targeting and the temperature and humidity of interior air to control real efficiency. The new system for gathering data about secondary energy consumption was commissioned in November 2006.

6.1.6 Establishment of energy cost centres (ECC)

Energy cost centres represent elements of energy management with precisely defined borders, whose energy consumption can be measured and for which data describing economic outputs or other factors driving energy consumption and conditions under which ECC was used are available. Each ECC has its owner, i.e. a person responsible for operation and energy consumption of the centre.

Structure of ECCs was proposed based on energy flows mapped already within the energy audit before the project start up. Consequently, the requirements were also defined for the installation of secondary monitoring of energy consumption at the level of ECCs.

6.1.7 Definition of independent variables and setting expected consumption/targets

After gathering sufficient data on the existing energy performance within each ECC, they started work on setting up targets for each ECC. Data were gathered on a weekly basis for almost six months in order to obtain statistically sufficient input for data processing and target setting. Target setting was based on the analysis of dependency between monitored energy consumption and its driving factors (variables), which have the biggest influence on energy consumption of the given cost centre and which are monitored together with the energy consumption.

In the case of natural gas consumption, data were reconstructed from the beginning of 2006, which allowed optimization of heating operation starting sooner than in case of the other cost centres.

The opposite was true in the case of the cooling system operation, where data were insufficient and therefore, the target was set only approximately, and could only be specified later.

Targets of centres with consumption that is directly related to volume of production were set as long-term average consumption during the period since monitoring has begun.

6.1.8 Routine M&T operation

In March 2007, setting of targets for individual centres was presented to the client's implementation team. After approval of the target setting report, targets became mandatory providing a start-up baseline for control and optimisation of the energy efficiency within the enterprise. The protocol agreement of the target setting report was part of the contractual commitment of the client to pay to ESCO its costs related to implementation of M&T from savings verified against the base line set up at his initial stage. This act also marked the beginning of next phase, routine M&T operation.

6.1.9 Identified energy saving measures

A database of energy saving options and feasible measures was created in the phase of routine operation of the M&T system which enables to control energy efficiency and to understand causes of its variations within the existing processes. The database was soon comprised of around 20 feasible measures.

The majority of implemented measures focused on optimized operation of heating, cooling, and exchange of air and included amendment of systems functions and operational parameters, utilising waste heat or modification of the system for more effective moisture control. The organisational and low-cost and some investment needing measures were implemented soon. Their results are regularly monitored to allow evaluation of achieved cost savings and to allow fine-tuning of the measures to achieve maximum benefits. The actual savings were evaluated depending on the targets (baselines) set in the phase of target setting.

Feasible measures were implemented accounting for over 10% reduction of the total energy bill within the first year of M&T operation. Figures illustrating the results of this case study include graphic analyses of energy consumption vs. independent variables, and the assessment of benefits of implemented measures in the form of graphs with cumulated savings.

The implemented M&T system provides the management tool for continuous improvement of energy efficiency. In March 2009 the database of energy saving measures to be implemented as the follow up of the EMPRESS project, included among others, the following feasible measures:

- Accumulation of cold water in sprinkler tank and reduction of costs related to generation of cold water and electrical energy saving;
- Replacement of the current steam humidifiers by an adiabatic system;
- Photovoltaic power panels placed on the roof of the building (appr. 6,000 m²);
- Speed control of heating, ventilating, and air conditioning (HVAC) unit in the canteen and optimization of operation time of HVAC units within the workshop (two out of six will be switched off during low production periods);
- Workshop lighting - replacement of the current standard fluorescent tubes by more energy efficient (light intensity control was already implemented); Installation of desk lamps in offices while decreasing the space light intensity in the same area;
- Switching off the production equipment during non-operating hours;

Implementation of these measures could bring an additional 14% savings of the overall energy bill. The average payback period for the needed investments is over 6 years (after consideration of possible governmental subsidies). This includes a large investment in the photovoltaic power station with a payback 10 years (due to the governmental guarantees of the price of energy produced this is a very safe investment and it is being considered for implementation).

6.1.10 Project benefits

- The company gained control over the energy efficiency and costs at the level of individual cost centers.
- The company was able to reduce its energy costs without investing its own funds; according to the contract concluded with the ESCO, the company would incur no costs if implemented measures failed to reduce energy costs as guaranteed within the M&T/ESCO contract.
- Project implementation helped the company achieve the established goals in the area of cost reduction and in the reduction of negative environmental impacts despite the fact there was only very little potential seen, initially for feasible energy conservation measures..
- Employees responsible for operation of the cost centres have a tool for evaluation of their results in the area of energy efficiency.
- The project is a great example of how a quality energy monitoring/management system can support the results of an energy audit.
- The systematic approach to energy management was integrated into the enterprise's strategy and operation.

The project implemented in Celestica Kladno is a successful pilot project for other companies of Celestica group. The company's participation in the project is a good advertising opportunity and public relations benefit.

Here are some quotations of enterprise representatives evaluating Celestica experience:

- "Implementation of the EMPRESS project brought visibility of energy flows in our enterprise."
- "M&T opened new opportunities for energy conservation leading to savings."
- "M&T is an instrument for continuous improvement which is part of the Celestica values."

6.1.11 Project costs and funding

The total budget for the energy management system implementation, including specialized software and subsequent technical assistance at the client's site was EUR 92,000 (exchange rate 1EUR = 26 CZK). These costs were covered by the ESCO and partly also by EMPRESS. The enterprise's payback of the ESCO investment from the verified savings.

Contractually guaranteed savings potential

2,000 MWh / 36 months

92,000 EUR / 36 months

500 t CO₂ / 36 months

6.1.12 Achieved savings

The guaranteed savings are being achieved. Celestica already succeeded to reduce its overall energy bill by more than 10%. By implementing a new set of feasible energy conservation measures, some with a long payback period, the enterprise can achieve a total reduction of energy bill and CO₂ emissions by appr. 25% against their original baseline.

This potential for reduction of costs and CO₂ emissions was identified within a very new, modern and well managed site.

6.1.13 Graphical illustration of results

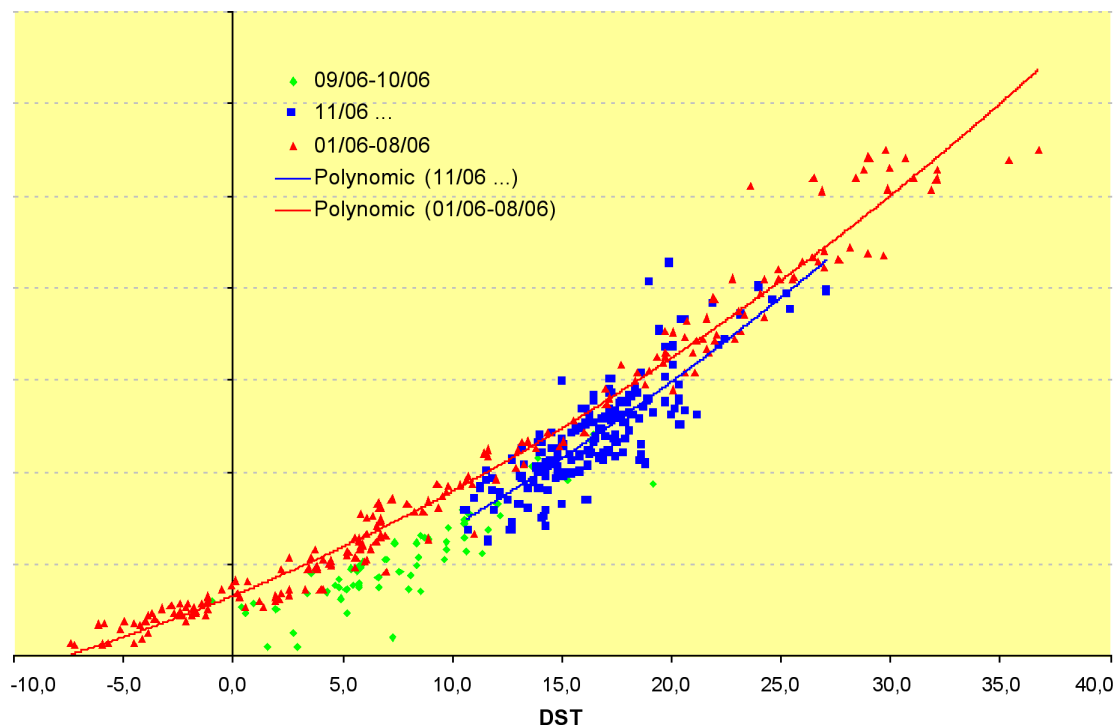


Figure 1: CELESTICA - Sample regression analysis for selected cost centres. The calculation factor for energy consumption are degree days (DST). Related energy use (the vertical axis) is consumption of natural gas.

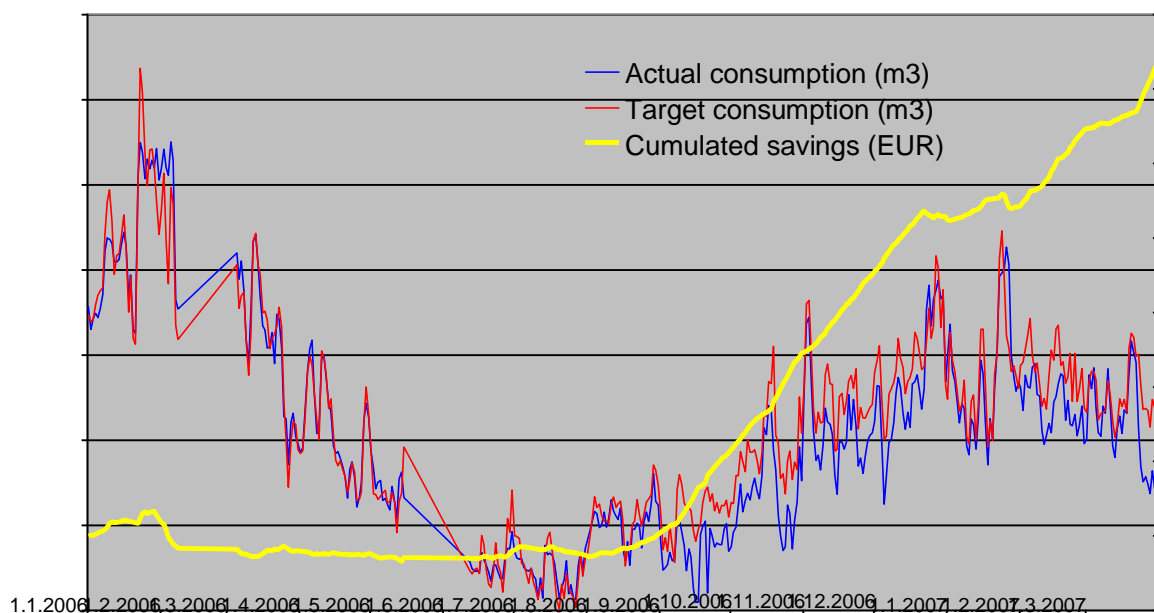


Figure 2: CELESTICA – Sample evaluation of results of energy saving measures implemented in Summer 2006 expressed as cumulated savings (yellow line). Target (calculated) consumption of natural gas is highlighted in red, actual (measured) consumption in blue.

6.2 Case study from a larger site

Company name: PD REFRACTORIES

Source: (ENVIROS, 2009)

Project name: Implementation of energy management using M&T/ESCO method

Duration of M&T/ESCO contract: 3/2006 – 6/2011

Contact: P-D REFRACTORIES CZ a.s., Velké Opatovice

Project manager: Contact: Ing. Pavel Ondra – Head of the Technical and Investment Development, P-D REFRACTORIES; ondra@msl.cz

Technical assistance: ENVIROS, s. r. o., Member of the ENVIROS Group, Prague

ESCO financing: MVV Energie CZ, s.r.o., Prague

This case study provides interim results of pilot implementation of the M&T/ESCO system in P-D Refractories CZ, Velké Opatovice.

6.2.1. The core business

P-D Refractories CZ a.s. is one of the biggest producers and suppliers of refractory products and raw materials. P-D Refractories produces and supplies complete or partial linings of the thermal aggregates, especially for coke ovens, blast furnaces (including hot blast stoves), glass furnaces, electrolyzers for the primary production of alumina and others.

The assortment includes fireclay bricks, high-alumina bricks, silica bricks, insulating bricks, refractory clays and grog, magnetite bricks for night-storage heaters, ceramic chimney pipes, refractory mortars, mastics and castables.

6.2.2 Premises and energy management before M&T system introduction

P-D Refractories CZ a.s. has three production plants. The EMPRESS project was implemented in Velké Opatovice (Division 01 - Old plant Velké Opatovice and in the Division 02 - New plant Velké Opatovice).

The original system of energy consumption monitoring used in the enterprise did not allow for the proper monitoring of the energy efficiency. It was necessary to improve substantially in their existing system of secondary measurements of energy consumption (at the level of energy cost centres (ECCs)), before it was possible to introduce the energy management (M&T). This created delays in start-up of M&T introduction as new measuring gauges had to be added and the existing inaccurate or inoperative ones were replaced with new devices (the need to do so become obvious in some cases only after their failure within the phase of setting up the M&T targets). All the monitoring instruments have been integrated within M&T within the new factory system of automatic data collection and storage.

6.2.3 State of production data collection

Production data are available from a few sources in the enterprise, including particularly the information system, that is aimed primarily at production monitoring and control.

This system is not a real-time data system and the data on processed material weights are derived from the pre-programmed distribution of input materials into particular final products; it also included the real proportion of non product output (waste).

6.2.4 Priority setting and establishment of energy cost centres

In cooperation with the Company's responsible members, the ECCs were created taking account of process flows (production units and performed operations), operated facilities and the location of significant energy consumers.

6.2.5 Team building and target setting

One of the most difficult and also most important stages of the energy management system introduction is setting of anticipated/target consumptions and dependences of energy consumption on monitored variables. Particular ECCs were grouped and teams formed by the enterprise members were created for establishing target at the beginning and on operation of the M&T system later. Working teams were responsible for ensuring data collection, interpretation of information provided by the M&T information system, corrective action and generation of energy conservation options etc.

In order to establish target values of energy consumption, regression analyses of energy consumption were used for a monitored period of six months (from the time of secondary measuring gauges installation). In some cases, it was difficult to find variables for monitoring, which would be systemically accessible and which would influence energy consumption within a specific ECC. In some cases a direct dependence of energy consumption and the monitored variables was not found. In such cases, the average consumption was used as a provisional target.

6.2.6 Routine M&T operation

The establishment of ECCs and improvement of monitoring simplified and clarified reporting about energy consumption and costs of main production processes. This reporting was split into the structure of enterprise divisions and production lines. What is crucial for energy management, the newly established information system revealed the real inefficiency of energy use for each ECC. Moreover, the daily course of specific consumption parameters for particular parts of production technology was made available.

Periodical meetings and work of the working teams showed the importance of energy efficiency management. These meetings (implemented regularly in two-week periods) are a platform for sharing information and also for decision-making. In some meetings the provider of technical assistance who provides needed training and expertise also participates.

6.2.7 Energy saving measures

Within the project frame the detailed documentation of collected data is kept in cooperation between the enterprise and the provider of technical assistance. Also evaluations of the data are made of the effect of adopted energy saving measures expressed in financial and physical terms. There were more than 25 energy savings measures which were documented in the database of energy saving measures. Many of the measures were no-less or low-cost organizational and small technical measures. Some investment measures were also identified and will be implemented. Measures identified within the first months of M&T full operation accounted for over 9% reduction of total energy costs. Examples of identified measures include:

- Fitting the flap valve to the original location of tunnel oven 3, control (reduction) of draught flue, reduction of natural gas pressure;
- Blocking of individual branches of dust separator when mixer is not running;
- Replacing of pressure regulators at compressors, reducing the pressure in the reservoir from 8.5 to 7 bar, replacement of defective safety valves, reduction of the use of compressed air for clothing or trolley cleaning, repair of detected leaks;

Graphs at the end of this case study show trends of energy consumption, and achieved savings due to implemented measures including a documentation of the accumulated savings.

6.2.8 Importance of team work

For project's success was due to the crucial commitment of enterprise staff and the close cooperation with the provider of technical assistance. This cooperation supported the successful and effective path for development and implementation of energy saving measures based on extensive experience of the enterprise members and their knowledge of the relevant technology. The process of energy saving option generation for the tunnel oven 3 is a good example of this. Within the phase of setting the target, it was impossible to find any dependence of energy on the common monitored variables (tons of production, firing temperature, number of trolleys, etc.). Other variables were tried such as atmospheric pressure and temperature to find the dependence and the only variable that had an influence on energy consumption was the pressure of natural gas to the burners, which was used for regulating the oven temperature. In the discussion about other possibilities of oven regulation, the employees reminded the team members that a flap valve had been installed within the flue gas installation, but many years earlier it was removed and never replaced

because of bad technical condition. The decision was made to fit a new flap valve to the original location and test it for regulating of the oven's consumption.

6.2.9 Project funding

The total budget for the energy management system implementation, including specialized software and the subsequent technical assistance at the client's site was EUR 110,000. These costs were paid by the ESCO and by EMPRESS. The Enterprise paid back the ESCO investment from the verified savings.

6.2.10 Contractually guaranteed savings potential

5,500 MWh / 36 months

EUR 110,000 / 36 months

1,150 t CO₂ / 36 months

6.2.11 Savings achieved already within the first year

3 747 MWh / year*

EUR 188 000 / year

1,851 t CO₂ / year

* the difference of reduction of energy consumption in comparison with the guaranteed savings is given by different structure of the potential utilised so far (there are higher savings of gas then electricity)

6.2.12 Graphical illustration of results

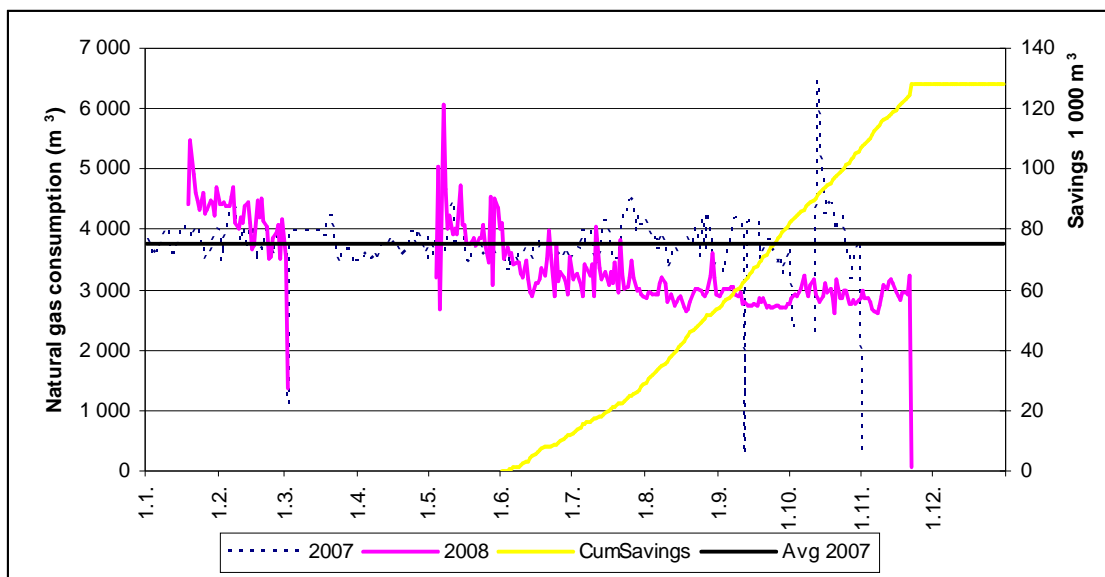


Figure 3: Tunnel oven 3 – consumption of natural gas (NG)

Figure 3 shows the day consumption of natural gas in years 2007 (blue dash line) and 2008 (shown in magenta), its anticipated consumption (in black) was established based on the average consumption in 2007. At the end of May 2008 a new flap valve was installed at the original location, then draught flue was controlled in a better manner, consequently, the natural gas pressure was reduced. The yellow line shows the accumulated savings of natural gas due this measure.

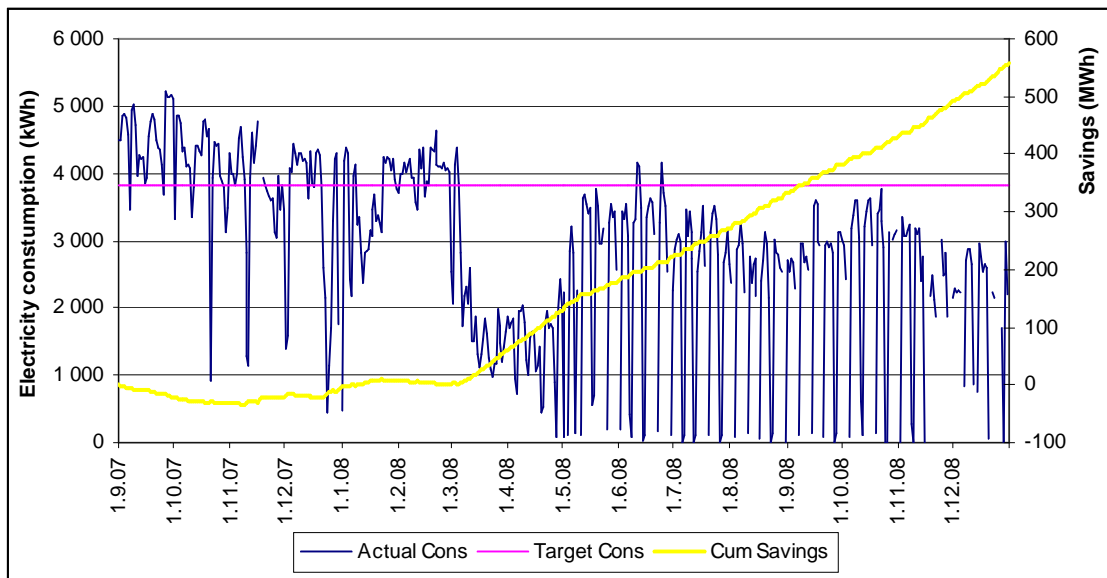


Figure 4: Dust separator - electricity consumption

Figure 4 shows the time course of actual consumption of electricity (shown in blue) and its anticipated consumption - set as the average from months 09/07 - 02/08 - (in magenta) of the dust separator. At the beginning of March 2008, the blocking of individual branches of dust separator were installed and used when the mixer was not running. The yellow line shows the cumulated savings of electricity due this measure.

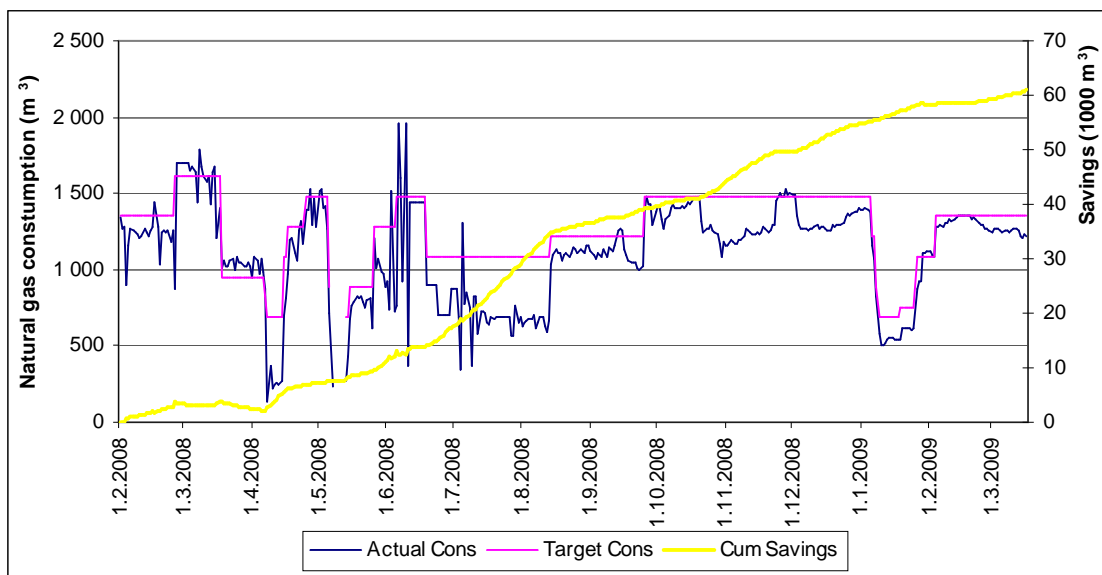


Figure 5: Dryers Keller - NG consumption - Actual & Target

Figure 5 shows the daily consumption of natural gas (blue dash line) and its anticipated consumption (shown in magenta). The operation of dryers is now more carefully monitored and some optimization has been achieved with this care (shortening of heat inflow into several dryers, lower temperature, etc.). The yellow line shows the accumulated savings of natural gas due this measure.

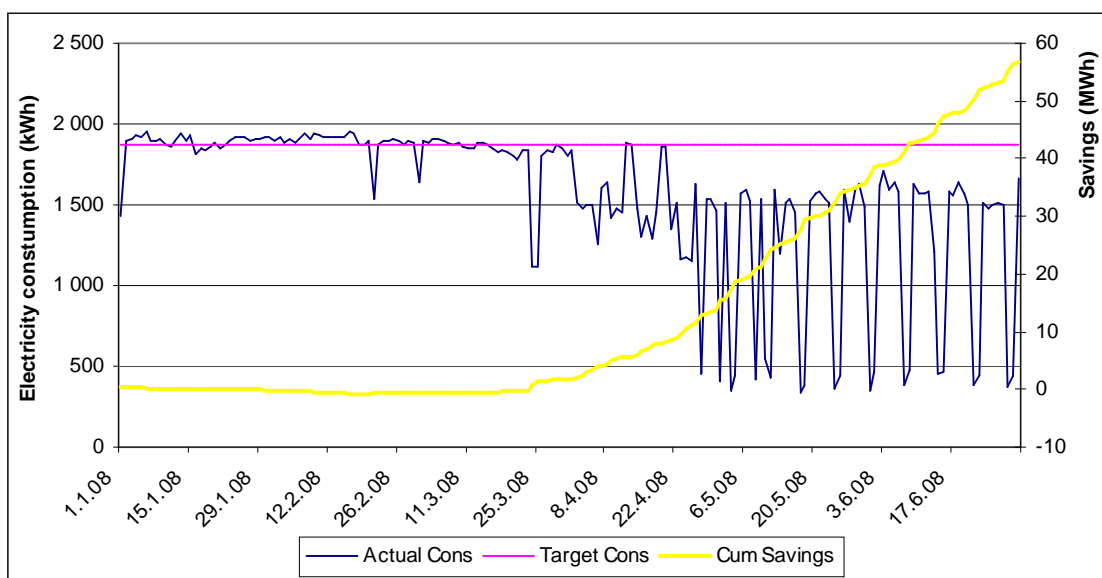


Figure 6: Air compressors - electricity consumption

Figure 6 shows the time course of actual consumption of electricity (shown in blue) and its anticipated consumption – established as the average - (in magenta) of the air compressors. At the beginning of April 2008 the compressor's pressure regulators and defective safety valves were replaced. Additionally, the pressure in the reservoir was reduced from 8.5 to 7 bar. The yellow line shows accumulated savings of electricity due this measure.

7 Findings

7.1 Problems and benefits of shifting the project risk

Implementation of the M&T/ESCO started by creating the needed capacities. Already, the M&T/ESCO formation process showed that the new scheme is a risky business for the vendors. Considering the related risks and the novelty of the scheme, the search for potential vendors had to be very proactive and in the end only the market leaders with power to invest within industrial settings were selected.

The company specific visits and scoping audits confirmed that there is a large potential for implementation of M&T/ESCO. Managers of the industrial sites especially appreciated that M&T will help to get control over the actual efficiency of their processes and will make the enterprise staff accountable for the improvements. They also appreciated that a professional body was willing to take the technical risks related to implementation of M&T. Additional benefits of the scheme for the enterprises included, for example, the appreciation that their site can mobilise funds for introduction of the energy management system without the necessity to go through investment approval processes within the enterprise (some enterprises appreciate it to be able to avoid investments in general as they affect the indicators of economic evaluation).

At the same time, practical experience from company visits confirmed the expectation that the process of obtaining the initial interest of an enterprise through the launch of the Scoping Audit to the full commitment for implementation of the M&T/ESCO scheme, is a lengthy process (given the experience from separate M&T and ESCO projects). The business of ESCOs is based on careful selection of the clients and on the trust, which both need time to develop. ESCOs are used to working mainly with the public sector (which is more stable), rather than with industry (where there is always a risk of industry recession). The pioneer implementation of the M&T/ ESCO within EMPRESS was a risky business for the vendors.

Recent developments in one of the M&T/ESCO pilot sites confirmed that ESCOs have a difficult position in providing their services to industry. Despite the fact that guaranteed savings are being achieved, one enterprise faced significant problems related to a decrease of production and it did not want to pay back the original ESCO investment as agreed within the contract with M&T/ESCO provider. The ESCO is suffering from risks related to core business of a client in this case and it looks like its investment will probably not be recovered. The solution for this type of risk is either to shift it to a bank or to increase the price for ESCO services, both alternatives lead to making M&T/ESCO scheme less available and less interesting to industry.

Also the sites were exploring the EMPRESS offer very carefully as they had to make significant commitments within M&T/ESCO scheme as well (cooperate on introduction of M&T, be responsible for its utilisation and pay for the costs from verified savings at the end). On the other hand the projects proved that the M&T/ESCO scheme brings significant value added to ESCOs, which want to expand their services to industry. While ESCOs focus on guarantee of the energy saving potential and on its exploration in well predefined investment projects, the M&T focuses on continuous improvement of energy performance within complex managerial approach. M&T is useful for ESCOs not only because it enables them to specify and verify the baseline in industrial facilities, but it also enables them during the initial analysis to document the amounts needed for implementation of EPC to be paid back (as M&T is an analytical tool which is able to payback its own introduction separately from the follow up investments).

7.2 Experiences from promotion of M&T/ESCO

The detailed evaluation of M&T/ESCO potential, in particular sites, achieved the following experiences:

The initial review revealed sufficient potential for savings for entering into the M&T/ESCO contract in 88% of the sites. It should be noted that the industry outreach program was targeted on enterprises where it could be expected that there was potential for emission reductions and savings. At the same time, sufficient potential was found also in smaller and even in very new installations (for example the case study in Celestica).

48% of all evaluated sites rejected entering into the M&T/ESCO contract despite the fact that there was sufficient potential for savings identified in their companies. We explain this high percentage by the barriers listed later in this paper.

Only 16% of sites were rejected for other reasons (high core business risk of the potential client that was not acceptable to the ESCO or other reasons for not entering into the

M&T/ESCO contract out of the control of the sites (in one case for example fire occurred within the enterprise)).

This experience provided empirical evidence that improved energy efficiency and/or cleaner production has difficulties to compete with other enterprise priorities even in situations where the benefits of feasible energy efficiency/cleaner production projects are guaranteed through a vendor which takes project risks and provides project funding. This observation is valid for an economy in growth with strong competitive pressures including an extreme pressure on increasing productivity through downsizing and with industrial processes based mostly on best available techniques.

7.3 Unexpectedly high unexplored CP potential

It could be argued that promotion of CP at the process level was already solved: Starting from the traditional CP assessment through integration of CP approaches into the management systems, initiating CP through EMA or by the transfer of environmentally sound technology and tools for overall productivity improvements like '*six sigma*' and other techniques, enterprises are pushed to utilise within the growing competition.

Despite all improvements already carried out, industrial processes even in a developed country with high competition remain an important area where the CP strategy can bring significant benefits. Utilising empirical data from within the EMPRESS project, we can distinguish two important reasons for this situation:

- a) CP potential is growing;
- b) CP has difficulties to compete with other enterprise priorities.

7.3.1 The growing CP potential

While being partially explored as described above, the CP potential is also further growing due to:

- further strengthening of environmental regulations;
- increased availability of information technologies (monitoring and regulation equipment - both software and hardware);
- increased availability of new CP techniques;
- in some cases also growing share of the process inputs on the production costs (rising prices of production inputs).

Compared to the potential for savings, the costs of energy system implementation were in most cases found to be relatively low. The costs of introducing the energy management system are decreasing (they comprise particularly the costs of completion of secondary

measurement systems, acquisition and installation of specialised software packages to support the M&T information system). These initial costs of system implementation and the general belief that the existing system of enterprise management is good enough constitute the main arguments obstructing a wider adoption of the M&T in industry.

7.3.2 Growing competition of other priorities

The experience from implementation of EMPRESS showed that despite the general appreciation of the M&T/ESCO scheme, there is significant potential for savings and the willingness of M&T/ESCO vendors to take the risk related to the existence and exploration of this potential, it is not easy to sell its practical implementation to industry. Industry tends to refrain from all voluntarily activities, which are not directly related to its core business due to many competing priorities. The main barriers to launching the M&T/ESCO scheme on the site of potential clients – industrial enterprises - were identified as follows:

- conviction that the company is already performing well;
- lack of company resources and internal pressure of many competing priorities (this shows a negative impact of the extensive downsizing experienced by the Czech enterprises within the last decade);
- resistance of the middle management to introduce a system, which would make their performance transparent and/or bring additional workload to them and/or to their staff;
- resistance of some people responsible for energy management in enterprises (in some cases they perceive M&T/ESCO as a threat to their existing power within an enterprise);
- novelty of the 'no-cure-no-pay' arrangement in the Czech conditions, related to the lack of understanding and suspicion that there has to be some "hidden agenda";
- hesitance to provide needed detailed information on processes (confidentiality of data is a major issue for some enterprises and can create barriers for smooth preparation and development of the Scoping Audits).

These barriers were overcome mainly by targeting promotion of M&T/ESCO on the enterprise's top management and by providing a high transparency and strong guarantees of confidentiality. Usually, repeated visits were necessary to implement at a potential site, the necessary conversations with its members, at different levels, even before the Scoping Audits could start.

8 Conclusions

There was created and successfully piloted, a M&T/ESCO scheme, which proved to be a new, effective product for promotion of cleaner production within industrial sites and institutional settings. It is facilitating desired organizational learning in the field of CP through providing feedback on real performance in the field of resource efficiency at the level of specific cost centers and through shifting technical risk of introduction even of “soft” parts of CP to providers of technical assistance. Introduction of these “soft” parts of CP (flow management system) enables them to see the potential for improvement, making people accountable for its exploration and obtaining verified results of implemented CP measures therefore resulting in completion of the learning cycle at the enterprise level at the double-loop learning level. This desired organizational learning is usually blocked by the lack of feedback on real improvements in resource efficiency within standard CPA projects.

Therefore project results could have impacts on voluntary activities of industry in the field of CP not only in the Czech Republic but also on an international level as there is high interest to replicate this scheme abroad. This interest is further stimulated by the M&T/ESCO vendors who are already being paid back by their clients, which is an important measure of success of the new M&T/ESCO product. Risks related to the core business of a M&T/ESCO client were expected and can be dealt with through traditional ESCO approaches.

However, at the same time, the EMPRESS project showed a big gap between the existing CP potential and the willingness to explore it, even in the situation where the enterprise does not have to undertake any technical risk related to its utilisation. This could have significant implications for the promotion of energy efficiency and cleaner production as there seems to be continuous need for support of improvements in energy efficiency/cleaner production implementation even in situations of seemingly optimal conditions for its natural uptake by industry (strong environmental regulations, growing pressure to decrease process costs and increasing prices of process inputs). Such support is well justified by the environmental benefits going hand-in-hand with microeconomic and macroeconomic benefits demonstrated within the EMPRESS project.

To sum up M&T/ESCO is on the one hand, opening the door for promotion of progressive approaches to industrial sustainability management on a qualitatively new basis, which is based on clever partnership of those who hold the required knowledge and are therefore, capable of assuming the technical risks related to desired innovations (M&T/ESCO providers) and those who possess the potential for reduction of environmental risks and

savings (industrial sites). However on the other hand the EMPRESS project showed that improvements in energy efficiency and/or cleaner production have difficulties to compete with other enterprise priorities even in situations where the benefits of feasible energy efficiency/cleaner production improvement projects are guaranteed through a vendor who takes project risks and provides project funding. Therefore, shifting technical risks of “soft” CP projects to providers of technical assistance as enabled by M&T/ESCO is not sufficient to bring the desired breakthrough in promotion of CP on its own.

References

Bertoldi, P., Rezessy, S. Energy Service Companies in Europe, European Commission, DG, JRC, Institute for Environment and Sustainability, Renewable Energies Unit, 2005

Cleaner Production and Energy Efficiency Manual (2004). Guidelines for the integration of Cleaner Production and Energy Efficiency, UNEP.

Cleaner Production and Energy Efficiency (CP-EE) – A natural Partnership, UNEP-DTIE publication.http://www.unep.fr/energy/activities/cpee/pdf/Factsheet_CPEE.pdf

Energy Management and Performance Related Energy Savings Scheme (EMPRESS), Annual Progress Implementation Review Reports, 2005, 2006, 2007, 2008 and 2009, UNEP, DTIE.

Dobeš, V., Henelová, V., Malý, M., Remtová K. (2005). Research on Support of Sustainable Consumption and Production, VaV ECZ4107, Prague, Ministry of Environment of the Czech Republic.

Dobeš, V., Vích J. (2007). EMPRESS Summary Report, Prague, ENVIROS Praha.

Lahbabi, A. (2010). Terminal Evaluation of the UNEP/GEF Project on Energy Management and Performance Related Savings Scheme (EMPRESS), Paris, UNEP

Pejter, J., Prouza, L., Sitný P. (2009). EMPRESS Case Studies, Prague, ENVIROS Praha.

Vine E. An international survey of the Energy Service Company (ESCO) industry, Energy Policy 33: 691-704, 2005