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INDUSTRIAL MANAGEMENT PROJECT

USAID Industrial Management Project

FINAL REPORT: January 1, 2013 – December 31, 2016

CONTRACT NUMBER: AID-165-C-13-00001

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Abbreviations and Acronyms

ATF	Access to Finance
CEED	Center for Entrepreneurship and Executive Development
CEIP	Clean Energy Investment Project
CHP	Combined Heat and Power
CNG	Compressed Natural Gas
DPM	Deputy Prime Minister
EBRD	European Bank for Reconstruction and Development
EMS	Energy Management System
FI	Financial Institution
GDP	Gross Domestic Product
GHG	Greenhouse Gas
GoM	Government of Macedonia
IMP	Industrial Management Project
ISO	International Organization for Standardization
ktoe	kilo ton oil equivalent
LAN	Local Area Network
LEC	Local Engineering Company
LFO	Light Fuel Oil
LPG	Liquefied Petroleum Gas
OECD	Organization for Economic Cooperation and Development
PMP	Performance Monitoring Plan
REC	Regional Environmental Center
SME	Small and Medium sized Enterprises
UNIDO	United Nations Industrial Development Organization
USAID	United States Agency for International Development
USG	Unites States Government
VAT	Value Added Tax
WeBSEFF	Western Balkan Sustainable Energy Financing Facility

1 EXECUTIVE SUMMARY

Energy is a controllable resource. Using it efficiently helps to increase profits by reducing costs. Access to energy is becoming more costly and environmentally damaging. The era of cheap energy is coming to an end in many countries including Macedonia.

Investments in clean energy help countries adapt to climate change and achieve more sustainable paths to economic development, while helping to reduce current and future greenhouse gas emissions. Energy efficiency and renewable energy technologies are becoming whole new industries and areas for innovation in the twenty-first century. A growing number of companies are seeing improved energy efficiency and the application of renewable energy as business opportunities that can decrease costs and increase competitiveness.

The U.S. Government has been partnering with Macedonia for 23 years, and during that time, USAID has provided a wide range of economic and private sector development assistance including many programs in the energy sector. The energy sector is important; it stimulates development, creates new employment, galvanizes economies and serves as a vehicle to attract investment. As an element of economic infrastructure, energy represents the development basis of overall economic growth in Macedonia.

Energy efficiency is one of the simplest and most cost effective ways, not only to reduce energy costs for consumers and industry, but to combat climate change, clean the air we breathe, and improve business competitiveness. Statistics show that Macedonia's economy consumes more energy relative to GDP than most other European economies. This is primarily due to inefficient industrial production and the use of old and obsolete production technologies.

The inefficient energy use in Macedonian industry significantly affects the competitiveness of industrial products in both domestic and regional markets. It is believed that under current policies, in the next 20 years, two-thirds of the economically viable energy efficiency potential will not be realized. However, with the implementation of effective Energy Management Techniques and Systems it is possible to tap into this economic potential.

Inefficient energy use has a significant impact on the competitiveness of industrial products both in the national as well as in the regional and the European markets. It increases the total product price thereby reducing companies' profits. A considerable part of the private manufacturing companies use outdated technology as a result of the long transition period that Macedonian economy has been going through, and the level of investments in advanced technologies and process improvements is insufficient. Outdated technologies are energy inefficient and mostly do not contain possibilities for automatic operation of production processes, which has additional impact on non-rational energy consumption and increased production costs. All this weakens the competitive position of Macedonian industrial products. For this reason the provision of sustainable energy efficiency and reduction of energy consumption and costs are one of the key factors for increased competitiveness of industrial products.

To address this, USAID's Industrial Management Project (IMP) assisted the private industry to improve competitiveness and reduce greenhouse gas emissions by reducing energy consumption and cost primarily through introduction of a systematic and continuous energy management approach in the industrial sector. By USAID cost-sharing support, the Industrial Management Project helped businesses better understand opportunities to improve and introduce more effective energy management in Macedonian industry. With the installation of modern energy management systems,

seventeen industrial companies are now able to monitor energy usage and make more strategic decisions about energy efficiency upgrades. Moreover, the Industrial Management Project prepared feasibility studies and project plans that helped companies implement a series of energy efficiency upgrades including fuel switch, heat and steam recovery, increased efficiency in motor drives and air compressors, introduced high efficiency lighting systems, rehabilitated power and steam distribution systems, and utilization of roof-top solar photovoltaic systems for electricity self-consumption. The Industrial Management Project has implemented actions to close the implementation gap and facilitate private investments in energy efficient technologies.

With the installation of modern energy management systems in seventeen industrial companies throughout Macedonia, companies are now better able to regulate energy usage and make more strategic decisions about energy efficiency upgrades. The need for energy management is mostly felt by energy-intensive companies where energy is one of the critical factors for their competitiveness in the market, and in some cases for their survival as well. The industrial companies should analyse their way of energy consumption better, and they should adjust their organizational abilities to better manage its use. Saving energy, after all, means saving money.

The experience shows that energy savings of 5% to 10% in manufacturing plants can be achieved through small-scale interventions or organizational interventions. Higher energy savings, however, can be achieved through procurement of energy efficient equipment for energy transformation, control equipment for distribution networks, etc. The reduction of energy consumption is highly correlated with profitability of companies. Savings of about 10% in energy consumption can also imply increase of companies' profits by 1% to 5% depending on the size of production and the share of energy cost in the total production cost.

The key achievements of the four-year Industrial Management Project in Macedonia are as follows:

- Implemented energy management systems and trainings in diverse manufacturing industries including food processing, beverages, building materials, pharmaceuticals, marble extraction and processing, paper and printing, electronics, industrial gas production, and wood processing.
- Installed and commissioned Energy Management Systems in 17 pilot companies – Knauf Radika, Hi-Tech Corporation, Alkaloid, Promes, Specijal Produkt, Makprogres, Vivaks, Zdravje Radovo, Veze Sharri, Nova Refraktori, DS Smith, Kolid International, Kadino Industry Group, Messer Vardar Tehnogas, Swisslion, Mermeren Kombinat Prilep, and DIK Fagus.
- Conducted cost-benefit analyses, investment studies and energy audits as well as prepared project documentation for building envelope thermal insulation, heat and steam recovery systems, process optimization and enhanced controls, increased efficiency in motor drives and air compressors, introduction of high efficiency lighting systems, efficient utilization of industrial boiler plants, fuel switch, rehabilitation of power and steam distribution systems, reactive power compensation, power quality improvement systems, and utilization of roof-top solar photovoltaic systems for electricity self-consumption.
- Organized and delivered eight two-day trainings on ISO 50001:2011 key concepts and energy management best practices.
- Conducted two one-day trainings to nine local financial institutions on industrial energy efficiency opportunities for financing and on-lending practices including project financing modalities.
- Built capacity of two local engineering companies for EMS development, design, installation and maintenance.

The performance results of the four-year project as a result of USG assistance are as follows:

- 14% energy savings from energy efficiency upgrade projects and EMS activities at 17 pilot companies
- 17% reduced GHG emissions from energy efficiency upgrade projects and EMS activities at 17 pilot companies
- 44 candidate companies' prepared EMS cost specifications and project plans
- 17 pilot companies successfully installed and commissioned EMS
- $772,068 investment for EMS development, implementation and post implementation activities at 17 pilot companies
- 165 representatives from 116 organizations attended IMP trainings on energy management, ISO 50001:2011 standard and energy efficiency best practices
- 90 person-days of training on energy management services for two local engineering companies

The electricity market liberalization of about 240 eligible companies and organizations in 2014 and about 150 eligible companies and organizations in 2016 resulted in energy cost reduction of about 15% to 20%. These positive results were contributed to difference in methodologies of calculating current electricity market cost on the open electricity market compared to the electricity cost on the regulated national electricity market. The price difference, however, did not bring any actual electricity savings but only financial savings, which improves bottom lines of companies and organizations, and thus make them more competitive.

Over the course of 2015 and 2016, IMP offered technical assistance and access to finance support to pilot companies once energy management systems were installed and operational for at least several months. Based on the energy consumption and analysis, IMP worked closely with the pilot companies to identify and propose energy efficiency upgrade projects. In cases when the management boards were interested to pursue specific energy efficiency improvements as well as willingness to seek external financing for the implementation of the energy efficiency upgrade or provide equity financing, IMP signed agreements with pilot companies. By the end of the project, IMP fully completed energy efficiency upgrade projects at eleven pilot companies. IMP is proud to underline that in October 2015 Alkaloid's energy efficiency upgrade project prepared by IMP was awarded with a prestigious recognition "The best Regional Sustainable Energy Project" from a portfolio of 153 sustainable energy projects implemented in Croatia, Serbia, Bosnia and Herzegovina and Macedonia in total value of $43 million.

IMP completed a one-year data collection and monitoring of all 17 pilot companies. The findings showed that in general, pilot companies are committed to finding opportunities for energy savings and taking actions. However, some companies did not perform to the expectations claiming various reasons.

IMP developed an Excel-based EMS potential industrial clients' database with decision makers and their contact information. The database includes total of 492 candidate companies for potential EMS implementation in Macedonia including the IMP pilot companies.

Since 2014 IMP built capacity of two local engineering companies for EMS development, design, installation and maintenance. Moreover, the USAID Industrial Management Project helped create the service market for energy management solutions. Equipment suppliers and local design and

consulting companies have worked together with IMP to develop and implement energy management systems in industrial companies.

In cooperation with UNIDO, IMP organized six joint User training workshops and two additional workshops organized by IMP. Overall, the workshops were attended by 165 trainees from 116 organizations. In addition, IMP conducted two trainings on industrial energy efficiency due diligence and lending practices to local financial institutions.

Over the course of the project, each October IMP organized round tables in cooperation with the Macedonian Energy Association (MEA) within the Economic Chamber of Macedonia. The round tables gathered various stakeholders to discuss how companies can improve their competitiveness and foster a culture of continuous improvement through enhanced energy management practices. More than 120 participants attended round table events including non-participant industrial companies, government officials, Ministry of Economy, Energy Agency, non-government organizations, international donor community, financial institutions, industrial associations, and business sector.

IMP regularly used Macedonian national and local media as a tool to deliver messages to the public and gain wide public awareness of the project's activities, concepts, achievements and results. IMP activities and achievements were featured in national television, radio, business magazines and newspapers.

In addition to organizational abilities, it is necessary to introduce automated production, which given the existing technological equipment would imply incorporation of appropriate electric and communication equipment at machines' level, which could enable remote control and possibilities for program adjustment and management of production processes aimed at optimal and rational utilization of all used energy forms.

The IMP highlights by component are shown in the table below.

Table 1: IMP Highlights by Component

Component	Key Activities	Outcomes
Industry Selection	• Prepared materials describing the program and disseminated them to local chambers of commerce, industry associations, companies, government and non-government organizations in Macedonia • Established close cooperation with three local chambers of commerce, organized two joint events and participated on several other follow-on events • Developed screening criteria for prioritizing industries • Conducted Industrial Analysis based on statistical data – energy indicators and energy balances in Macedonia which resulted in high, medium and low priority industries • Disseminated information on ISO 50001:2011 standard and Energy Management Systems best practices through various channels including media events, seminars, and direct contacts with industrial companies	• Developed a database of more than 400 manufacturing candidate companies in Macedonia as a target group for EMS development and potential energy efficiency upgrades • Initiated dialog and networking among industries and associations on energy management through three chambers of commerce • Obtained commitment and support from project stakeholders • Selected (prioritized) 7 industrial subsectors to become part of project activities • Selected a pool of 53 industrial companies as potential project beneficiaries • Energy management (ISO 50001:2011 standard) concept and benefits disseminated to more than 200 industrial companies
Demonstration Projects	• Energy Management System procured, installed, tested and commissioned in the following companies: Knauf Radika, Hi-Tech Corporation, Alkaloid, Promes, Specijal Produkt, Makprogres, Vivaks, Zdravje Radovo, Veze Sharri, Nova Refraktori, DS Smith, Kolid International, Kadino Industry Group, Messer Vardar Tehnogas, Swisslion, Mermeren Kombinat Prilep, and DIK Fagus • Implemented Energy Management Systems in diverse manufacturing industries: food processing, beverages, building materials, pharmaceuticals, marble extraction and processing, paper and printing, electronics, industrial gas production, and wood processing • Developed EMS specifications (including blueprints) and cost proposals for additional candidate companies, which did not agree to continue with EMS implementation after initially given strong commitment by their top managements • Provided technical assistance and access to finance support to elven companies for energy efficiency upgrade projects • Conducted cost-benefit analyses, investment studies, and project documentation for fuel switch, waste heat utilization, load management,	• Increased investments in energy management • Contracted 17 pilot companies, procured, installed, trained and commissioned EMS with USG cost-sharing support • Trained technical personnel to utilize and manage EMS at 17 pilot companies • Developed project designs to additional 27 companies that can utilize them in future • Provided technical support and access to finance activities to eleven pilot companies • Raised awareness to other interested companies by sharing EMS examples • Initiated system integration by show case to large companies by vendors on local market

	thermal insulation of building, selection of equipment, and heating, ventilation and air conditioning system upgrade and roof-top solar photovoltaics for electricity self-consumption for pilot companies	
Training and Sector Development	• Selected 2 local engineering companies to receive training and practical experience on energy management project preparation, installation and maintenance out of 16 candidate companies • Cooperated with five specialized consulting and design companies to develop custom made technical solutions for energy efficiency project upgrades at eleven pilot companies	• Built capacity of two local engineering companies for EMS development, design, installation and maintenance • Strengthen capacity to local consulting and design companies for energy efficiency upgrades to be able to offer services on the local market after project close-out
Outreach	• Cooperated with UNIDO to deliver User trainings on ISO 50001:2011 energy management standard key concepts and energy management best practices globally • Organized eight two-day trainings on ISO 50001:2011 key concepts and energy management best practices that were attended by 165 representatives of 116 organizations including government representatives • Conducted two one-day trainings to nine local financial institutions (~50% of local financial market) on industrial energy efficiency opportunities for financing and on-lending practices including project financing modalities • Organized three round table discussions at Macedonian Chamber of Commerce • Participated on the 37th World Energy Engineering Congress in Washington DC in 2014 • Published several interviews for local prominent magazines and newspapers and participated on media (Telma, Nasha TV and MTV1) broadcasting to discuss IMP	• Trained 165 participants representing 116 organizations • Increased understanding of project financing in relation to energy saving project opportunities in industrial sector to local financial institutions • Presented IMP accomplishments on a round tables to more than 140 participants from various stakeholders including government officials, relevant ministries, Energy Agency, Energy Regulatory Commission, non-government organizations, international donor community, financial institutions, industrial associations and business community that attended three roundtable events • Presented the project and discussed progress at the USAID E&E Bureau in Washington DC, including representatives from the National Renewable Energy Laboratory (NREL) and the Department of Energy (DoE) • Increased awareness for industrial energy management • Discussed interest for EMS implementation to at least 200 industrial companies that met initial project eligibility criteria • Raised awareness to public institutions including Energy Agency, Ministry of Economy and Ministry of Environment, industrial associations, and other donor projects

2 BACKGROUND

The cost of inefficient energy use in Macedonian industry significantly affects the competitiveness of industrial products in both domestic and regional markets. It erodes capital and maintenance budgets, and increases total product cost thereby reducing profits. The energy import in the country is high, in the range of 46.2% in 2014, and has been increasing during the last few years. According to statistics, the final energy consumption per capita in Macedonia is three times lower than the consumption in OECD countries while the primary energy consumption per unit of GDP is almost four times higher. The reason for this high energy intensity can be attributed to the heavy use of energy across all industrial sectors in particular the metal processing, building materials, chemicals, ore extraction, and paper and printing industry; low-efficiency power generation, supply and consumption; and the prevalence of using electricity in all sectors.

Today Macedonian industry accounts for more than a third of the country's primary energy consumption and greenhouse gas emissions. It also accounts for more than 28 per cent of GDP and 30 per cent of the labor force. Ensuring sustained energy efficiency and performance improvement are key to industry success.

The Macedonian energy sector is in a transitional phase from a centrally planned and managed structure to a decentralized, regulated free market. On the demand side the key challenge of the country's energy sector is to improve the efficiency of energy usage, which has been held back by below-market pricing for all but the largest users. On the supply side the challenges encountered include limited range of options for energy supply – due to country's lack of oil, gas, or high-quality coal reserves – and aging energy generation facilities. Recent reforms are helping to address these issues, and the country is committed to further reforms to bring about the full liberalization of the energy market.

In recent years serious attention has been given to the need for rationalizing energy consumption. A major strategic and legislative framework for energy efficiency and renewable energy has been developed over the past few years. International support for developing an enabling environment for energy efficiency has been initiated. Small hydro, solar photovoltaic, and biogas power plants development are the most promising renewable energy initiatives in the country at present, mainly driven by private developers. However, energy management has not gained enough priority in industry. A specific structured and resourced action is needed to close the implementation gap and facilitate private investments in energy efficient technologies, especially in increasing industry competitiveness by reducing energy intensity of production processes.

Industrial manufacturing companies in Macedonia are quickly coming to the realization that energy and sustainability issues are a critical requirement for the competitiveness and even survival of their businesses. Using one third of all the energy consumed in Macedonia on an annual basis, with high price volatility and stiff regional and EU competition for market share, Macedonian industries need to better understand their energy consumption patterns and adopt organizational capabilities to better manage its use. It has become not only a company-specific issue, but a national imperative as well.

To address these challenges, an critical step is to prepare industrial companies to introduce and utilize energy management practices. They include organisational, technical and behavioural actions in an economically-sound manner with the objective to improve the energy performance of any organization. Energy management means systematic attention to energy with the objective of continually improving the energy performance of an organisation and maintaining these achieved improvements. This is not a difficult technical challenge; it is a challenge to how organizational

resources including energy and people are managed and awareness is raised. It requires focus, drive, a systematic approach and above all, a willingness to change to improve. It ensures that an organisation continually passes through the cycle of making policy (including evaluation of objectives), planning actions, implementing actions and checking results, reviewing progress and updating policy and objectives, as required.

Energy management system as an integral part of energy management practices, however, is a combination of hardware and software tools that help companies to track energy consumption, make analyses, bring decisions and take action to better rationalize their energy use and cost. The system helps to monitor, measure and analyze energy performance in order to understand how one can control the use of energy. It is the foundation of incorporating energy management practices in daily activities of production plants.

The use of energy management systems in Macedonian industry is important – on one hand, due to increasing energy costs – and on the other hand, due to efforts to sustain the competitive edge and concur new markets. Energy efficiency in production, in particular, helps companies increase productivity in their plants, which in turn improves their competitiveness in all sectors. Inclusion of well-structured energy management system as a systematic approach to track energy use and reduce costs will help industrial production plants in maintaining or increase their market share on domestic or regional markets.

The implementation of an energy management system is not an objective in itself. What matters are the results of the system: energy performance improvement by anchoring attention to energy in daily practice. Whether an energy management system works depends on the willingness of the organisation to manage energy use and energy costs and to make the necessary changes to their day to day operations to facilitate these improvements and cost reductions.

With the aim to improve Macedonia's competitiveness and energy security and reduce greenhouse gas emissions via greater clean energy investments, the USAID implemented the four-year Industrial Management Project. The project commented on January 13, 2013 and ended on January 12, 2017. The implementation of the IMP was managed by TimelProekt, as a Prime Contractor to the USAID, with PointPro Consulting and the Center for Entrepreneurship and Executive Development (CEED) as Implementing Partners.

3 INTRODUCTION

The underlying IMP objective is to introduce Energy Management Systems in 17 industrial pilot companies and further assist 11 pilot companies by providing technical expertise and access to finance for implementing energy efficiency upgrade projects identified based on EMS measurements and tracking energy. The EMS is a combination of software, data acquisition hardware, and communication systems to collect, analyze and display energy-related information to aid industrial energy managers, facility managers, production and financial managers in reducing energy use and costs in industrial plants. This technology helps perform key energy management functions such as organizing energy use data, identifying energy consumption anomalies, managing energy costs, optimizing energy demand, and build strategies for efficient and timely respond to anomalies.

The effective use of energy management system helps organizations of all sizes to manage their energy use in a sustainable way. This result in reduced costs, reduced environmental impact, and increased competitiveness. On a national scale, it reduces exposure to volatile energy prices and helps with security of energy supply by reducing dependence on imported energy sources, all of which is significantly important to Macedonia.

Improvements in energy management are important in order to reduce expenditures on energy. These activities will create new employment opportunities and modernize outdated and inefficient technologies.

EMS provides the following capabilities: collect and archive facility energy data, and visualize data in a meaningful fashion. It also enables companies to facilitate energy benchmarking, optimize energy procurement, and manage overall energy costs.

Once EMS is installed, the first step is understanding how much power a piece of equipment or a plant is consuming. The electric bill is not going to provide the level of detail required. Advanced power meters are installed, as they provide accurate real-time system values, and capture waveforms and power quality events to add intelligence and save costs. Meters identify the harmonics, voltage fluctuations, transient over-voltage conditions and other conditions, while also capturing power and energy data from equipment.

Meters keep a continual log of electrical parameters including volts, amps, watts, kilowatt-hours and power factor. Typically, meters are installed at the largest loads or so called significant energy users. Critical loads are also typically metered.

Power quality meters are first installed at the service entrance to establish the overall baseline and data points. This provides information on both the quality of the power the utility is delivering and the amount of power consumed. If there is a discrepancy between the utility charges and what is consumed, actual consumption can be demonstrated to the utility along with power quality data.

Telecommunication network along with intelligent protocols (modbus, profibus) and network communication technologies (RS 485/ RS 232, Ethernet, Wireless) are then used to collect energy and power data. The data is stored on a web-client server where a software system is installed to collect real-time data and generate custom-made reports, alarms and custom graphical representations of the monitoring system.

The complete, web-enabled, energy management solution for industrial operations helps to:

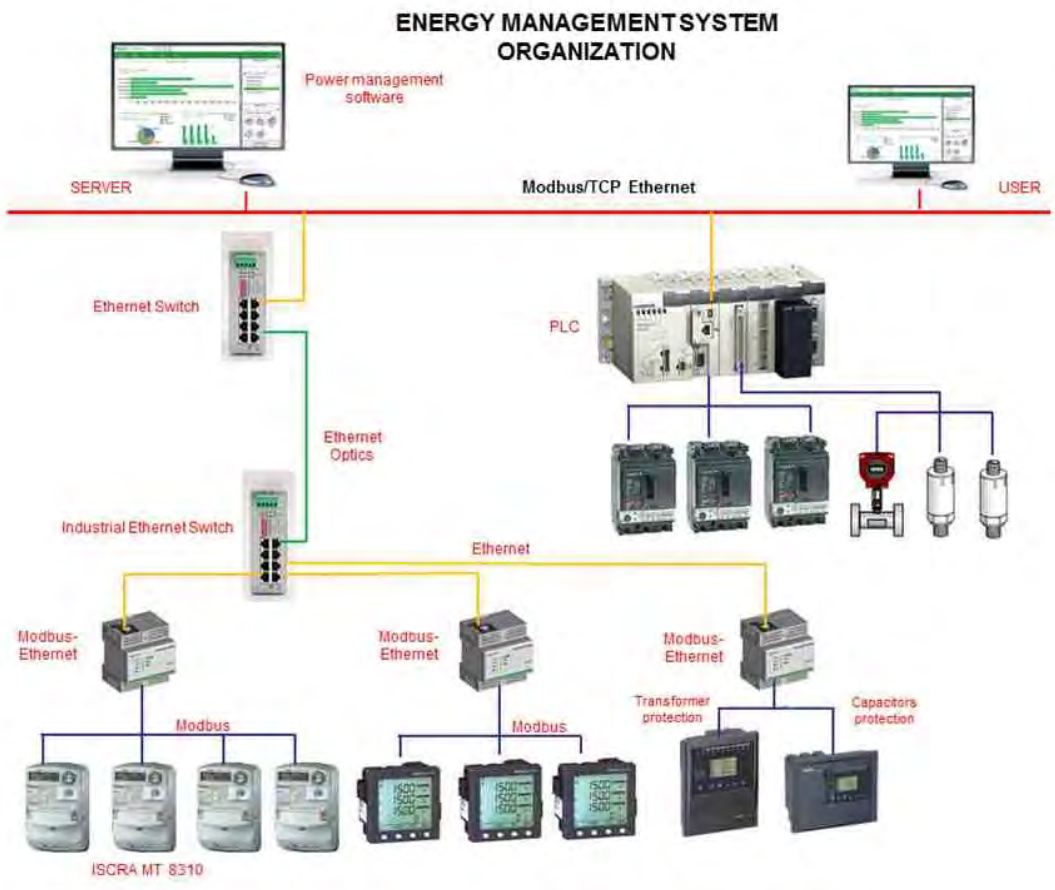
- Cut energy-related costs, avoid downtime and optimize equipment utilization

- Track real-time conditions, analyze power quality, and respond quickly to critical alarms
- Study historical trends to reveal energy waste or unused capacity
- Verify efficiency improvements and allocate costs to buildings, departments or processes
- Manage intelligent metering and control devices
- Provides a unified interface to display electricity and other consumable resources such as water, compressed air, gas or steam
- Automatically collects and stores data from key electrical distribution points
- Provides control capabilities that can be used to manage demand, power factor, loads, generators, etc.

The overall integrated system allows facility managers to collect power and other energy data from a variety of equipment and access that information from a single point. All energy-related information is then stored on a server with an installed software package which uses a database to store data. Predefined reports are also transmitted to other company users at certain time (for example, by use of e-mail communication).

EMS provides metering of all electrical units by feeders as well as metering non-electrical units in real time where needed and data transfer to a server with installed software package. By metering and displaying energy consumption data by feeders or group of feeders it is possible to generate an overview of energy consumption and loads, comparison between planned and actual energy consumption, energy consumption reduction after implementation of energy efficiency improvement measures as well as organizational measures with actions taken by industry production personnel.

The figure below shows a typical configuration of an energy management system that IMP implements in industrial pilot companies.



Picture 1: Typical Energy Management System Configuration applied at IMP Industrial Pilot Companies

4 Objectives and Approach

4.1 Objectives

The USAID funded Industrial Management Project (IMP) is designed to support the USAID/Macedonia's primary objective 1.3 "Increased Job-Creating Private Sector Growth in Targeted Sectors". More specifically, the IMP activities are directed toward the accomplishment of the intermediate result IR 3.2. "Key Private Sector Capacities strengthened" and the Sub-IR 3.2.1. "Private Sector Producing Globally Competitive Products and Services" and include the following interventions in the energy sector as set forth in the USAID/Macedonia Strategic Plan 2011-2015:

- Domestic and foreign investment will expand;
- Exports from targeted competitive, value-added industries will rise;
- Employment in targeted sectors will grow;
- Business support organizations will offer new services;
- Macedonia will comply with the Energy Community Treaty; and
- Energy efficiency and renewable energy interventions will increase employment, investment, and new technology, and will reduce energy demand.

Ultimately, these interventions will lead to improvement of country's competitiveness and energy security and will simultaneously contribute to reduction of the greenhouse gas emissions.

Picture 3 below shows the IMP Results Framework.

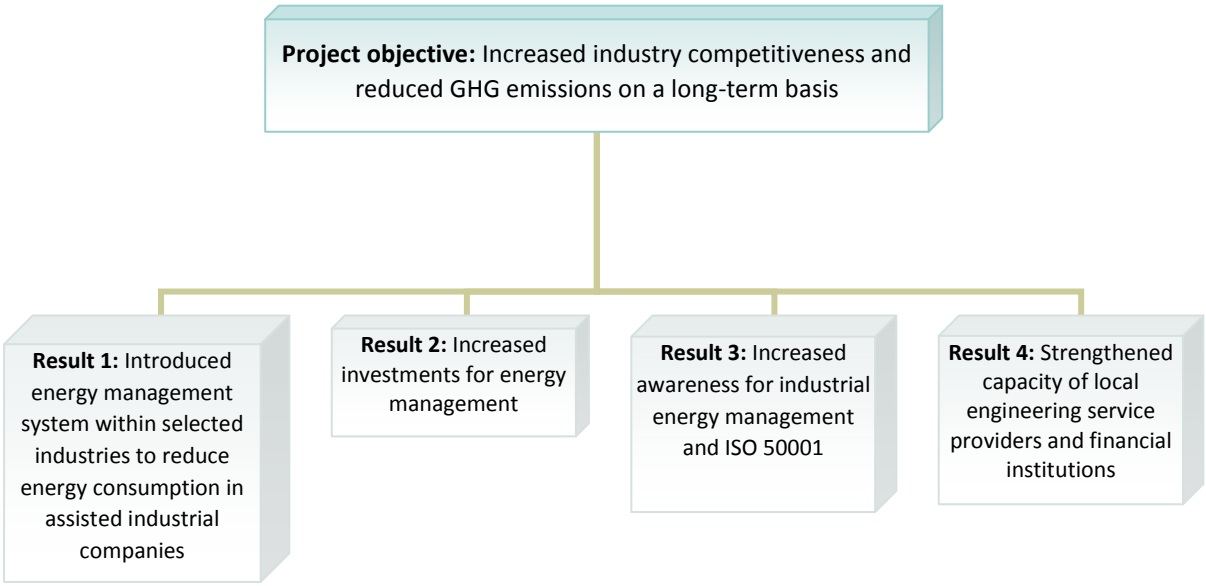


Figure 1: IMP Results Framework

The project defines the implementation framework that consists of two primary vertical tracks:

1. Increased industry competitiveness through reduced production (energy) costs, and
2. Reduced GHG emission on a long-term basis.

Furthermore, the project has four cross-cutting, horizontal tracks which contribute within the goals of the verticals, as follows:

1. Introduced energy management system within selected industries to reduce production (energy) cost in industrial companies;
2. Increased investments for energy management and energy efficiency improvements;
3. Increased awareness for industrial energy management and ISO 50001 principles;
4. Strengthened capacity of local engineering service providers for energy management systems and financial institutions for investments in industrial energy efficiency upgrades

4.2 Approach

The four major components of the IMP are: (1) Industry Selection; (2) Demonstration projects; (3) Training and Sector Development; and (4) Outreach. The primary beneficiaries of IMP are small and medium sized industrial enterprises (SME), with industrial business associations and financial institutions as secondary groups of beneficiaries. Other beneficiaries include energy utilities and NGOs. The Project aspires to cover as many of the country's regions and industrial sectors as possible.

The IMP approach is targeted towards energy consumption reduction using a systematic and sustainable way founded on ISO 50001 principles and methods. The industrial energy management is the practice of using energy more efficiently and effectively in industry's operations. Energy management provides an opportunity to optimize energy costs by understanding energy flow as well as procurement and economics of energy, and reduce its harmful impact on our environment. It is an ongoing process and must be reviewed at regular intervals and fine-tuned as required, from time to time.

The implementation of the project objectives is being accomplished by project team's approach that integrates the following key steps:

1. Introduction of Energy Management Systems (EMS) in industrial pilot companies from various industrial branches in the country. The management team and technical staff in pilot companies will receive training on the guidance, requirements and application of the ISO 50001 Energy Management Standard. Pilot projects for monitoring energy consumption by various energy types will be developed in cooperation with pilot companies. Relevant energy management systems will be installed and put into operation at the pilot companies. Designated energy managers from pilot companies will be trained on the use and maintenance of the installed system. The implementation of the energy management systems will be financed on a cost-share basis (50% of the overall cost or not more than $20,000) while pilot companies will cover the remaining cost.

2. Development of energy audits, project designs and implementation of energy efficiency projects in pilot companies. The energy efficiency projects will be implemented based on the collected data and system operation monitoring. IMP will also provide expert support for project financing by presentation of the EE projects to local financial institutions.
3. Provision of training of non-participant industrial companies from various industrial branches. The training will be carried out through several workshops. The companies will receive materials where, in addition to the educational part, information on the operation of and results obtained from introduced energy management systems will be also provided.
4. Provision of training for qualification of local engineering companies for development, installation and maintenance of energy management systems. The training will be carried out primarily on site at pilot companies for development and installation of the energy management systems.
5. Provision of training of local financial institutions on the needs and benefits of financing industrial energy management systems and EE development projects.

Project structure

Picture 4 shows the IMP organizational structure and project partners as a framework for successful project implementation.

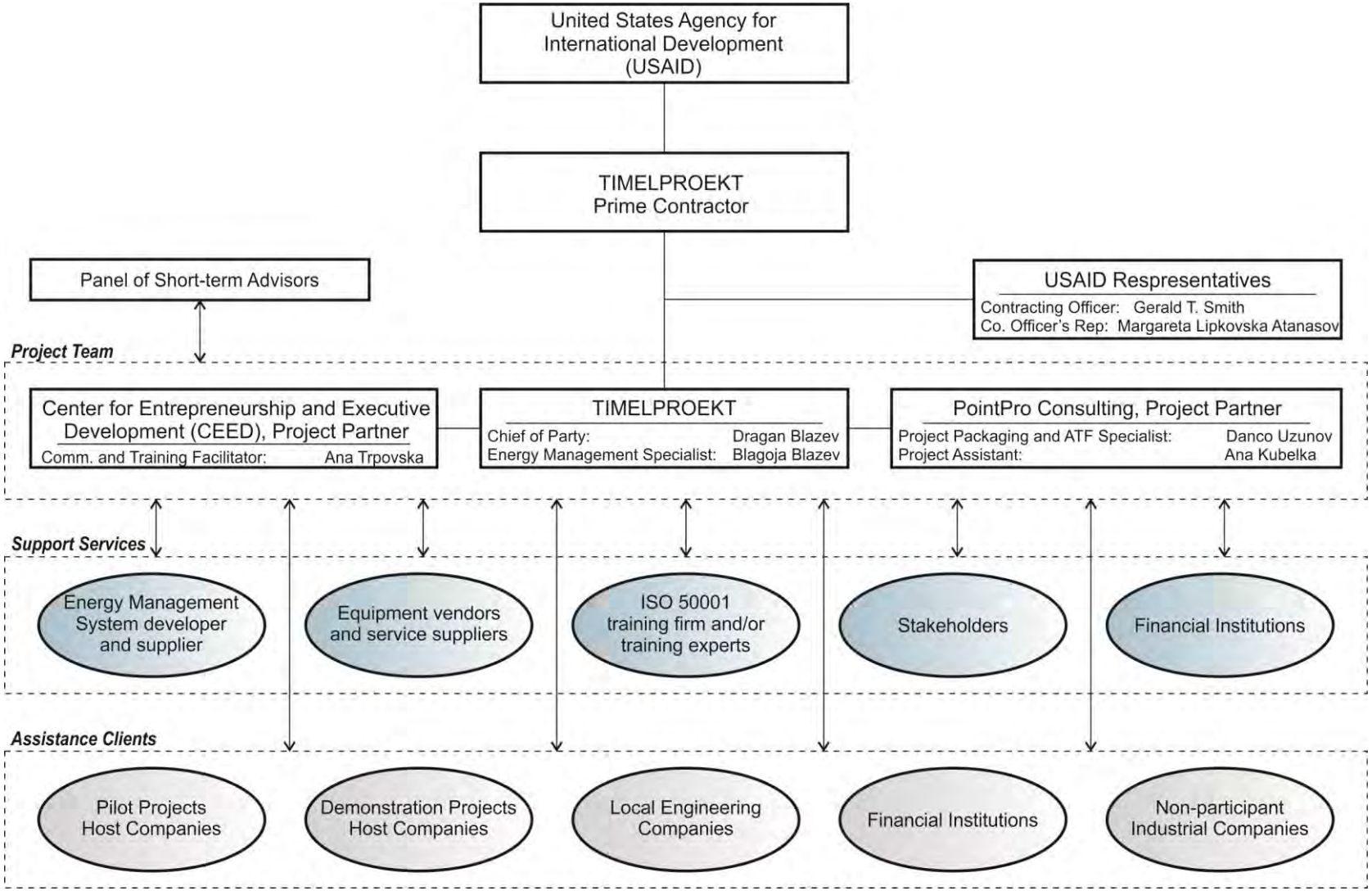


Figure 2: IMP Organizational Structure and Project Partners

5 ACCOMPLISHMENTS AND ACTIVITIES BY COMPONENTS

The four major components of the IMP are: (1) Industry Selection; (2) Demonstration Projects; (3) Training and Sector Development; and (4) Outreach.

This section provides an overview of key activities and accomplishments per component for the four-year implementation period of the project.

5.1 Industry Selection

Initial Outreach

After the project inception, a project team was mobilized and the project office established. As an initial step, the project team prepared IMP promotional materials that were further disseminated on meetings and events.

In order to promote the project, increase visibility, entice interest with business sector and select candidate pilot companies to implement Energy Management Systems in their production plants, the project team established direct relationships with four groups of stakeholders: 1) Equipment Vendors; 2) Chambers of Commerce and Associations; 3) Media; and 4) Potential Industrial Companies.

Equipment Vendors

IMP conducted a comprehensive and transparent step-by-step process to select credible equipment vendors that offer an integrated quality and proven solutions for introduction of Energy Management Systems in pilot companies. Considering that the EMS concept in industrial companies is new to the country, the IMP's objective was to select equipment vendors that offer quality equipment and software package and that are able to provide an integrated solution with close technical support by IMP engineers. The local presence of equipment vendors and their system integrators capable to support IMP from the development of a conceptual design through equipment supply and installation to dealing with troubleshooting and final commissioning was critically important in the selection process. Another important aspect was the ability of equipment vendors to offer technical support and maintenance including training of industrial personnel for the secure operation of the energy systems.

Based on market research and knowledge of availability of equipment vendors present on the local market or their representative offices, IMP invited several established and well-known companies to express interest. Equipment vendors that expressed interest are as follows:

1) ABB Representative Office Skopje
2) ABB Representative Office Bulgaria
3) ISKRA ATG Skopje
4) Schneider Electric Representative Office Skopje
5) Loging Electronics, Skopje (Representative Office of Janitza EMS)

6) Siemens Representative Office Skopje

7) Siskon, Siemens system integrator, Skopje

8) Nalco Systems, Siemens system integrator, Skopje

9) Menerga Skopje, Representative Office of Menerga Slovenia

10) EnergySolutions CSG, Representative Office in Skopje

Based on submitted documents and screening criteria, two equipment vendors were selected: Schneider Electric; www.schneider-electric.com and Janitza; www.janitza.com (represented by Loging Electronics, a local company). Both equipment vendors met project criteria and offered energy measurement systems with multilevel measuring devices supported by Ethernet (TCP/IP) and other protocols used as the backbone for data communication. The selected measuring devices with Ethernet/Modbus gateways and master/slave architectures ensure efficient systems with high transparency. Both vendors have in-house developed and tested professional software architectures that provide an integrated solution for industrial facilities in the country and could be customized based on specific production processes and requirements. Both companies ensured high quality standards and know-how in offering sustainable energy management solutions to industrial plants.

Chambers of Commerce

From the very beginning, IMP established close cooperation with the three chambers of commerce in Macedonia with an objective to reach out to industrial member companies, disseminate information and entice interest for project participation. IMP conducted meetings with the management boards at all three chambers of commerce and discussed project objectives and linkages to member companies. The chambers of commerce included:

- Economic Chamber of Macedonia;
- Macedonian Chambers of Commerce; and
- Economic Chamber of North-West Macedonia.

Picture 2: Presentation of IMP in Economic Chamber of Macedonia

Each chamber of commerce selected its own approach to reach out to member companies and disseminate IMP's project information and call for cooperation. The Economic Chamber of Commerce and the Economic Chamber of North-West Macedonia decided that the best approach was to organize events where targeted member companies were invited while the Macedonian Chambers of Commerce decided to use their own direct approach reach out to member companies.

Two events were organized in cooperation with the Economic Chamber of Commerce, and one other event was co-organized by the Economic Chamber of Commerce and the Economic Chamber of North-West Macedonia. As result, more than 100 industrial companies learned about benefits and opportunities for cooperation with IMP.

Media

In cooperation with the Economic Chamber of Commerce, IMP presented the project to the media on March 25, 2013. The event was a 30-minute presentation led by Dragan Blazev, the Chief of Party and Danco Uzunov, the Project Packaging and Access to Finance Specialist. Promotional materials were disseminated to all media present on the event. More than 20 media organizations covered the event.

Potential Industrial Companies

The target group of potential industrial companies is SMEs in the country that operate industrial production plants across different industrial subsectors from food processing and beverages industry, building materials industry, metal and electrical industry, wood and furniture industry, paper industry, metallurgy, to chemical and leather industry.

Potential industrial companies were invited to join the project by use of various channels including chambers of commerce, printed and broadcasted media, and various energy-related events. IMP

developed a questionnaire that was distributed to potential industrial companies by information dissemination or direct mailing.

Industry Analysis

IMP carried out an in-depth analysis of statistical data regarding present energy consumption specifics and trends as well as an overview of several specific macroeconomic indicators of the industrial sector in Macedonia. The analysis was conducted based on statistical data on energy use and selected macroeconomic indicators for the period 2005–2011, separately for ten industry sectors in the country. The industry sectors are based on the National Classification of Activities as defined by the State Statistical Office of Macedonia, and they include:

(1) Iron and steel industry
(2) Non-ferrous metal industry
(3) Chemical industry
(4) Glass, pottery and building materials industry
(5) Ore-extracting industry
(6) Paper and printing industry
(7) Textile, leather and clothing industry
(8) Food, beverages and tobacco industry
(9) Petroleum refinery
(10) Other industries, which include manufacturing of: wood and wood products; rubber and plastic; metal products, structures and parts; computer and electronics; electrical equipment; motor vehicles and parts; etc.

The main goal of the Industry Analysis was to provide baseline information regarding the current energy consumption specifics and trends coupled with an overview and analysis of several specific macroeconomic indicators of the industries in Macedonia. The specific objectives of the analysis were to:

- ✓ serve as a guidance – primary decision-making tool – for selection of pilot projects by the IMP;
- ✓ serve as a baseline of the Macedonian industry energy performance for further in-depth analysis to be carried out throughout the IMP implementation.

The Industry Analysis was primarily intended for use by the USAID and the IMP Team as a basic support and decision-making tool for further implementation of project activities. The analysis is strictly based on official statistical data and information regarding energy consumption, energy balances, macroeconomic indicators, etc. published by the State Statistical Office of Macedonia.

The key conclusions from the industry analysis are:

- The Macedonian economy is one of the most energy intensive ones in Europe. Energy intensity in Macedonia is 3.5 times higher than the average energy intensity of the EU-28 Member States, and it is twice the energy intensity of Croatia.

- The consumption of total energy per capita in the country is about 2.5 times lower, and the final electricity consumption per capita is two times lower, in Macedonia than the average final electricity consumption per capita in the EU member states.
- Over the period from 2005 to 2011 the energy intensity of Macedonia has decreased by 11%.
- The total energy demand in the country is covered by 45% import. This includes the overall needs of oil products, natural gas, coal and coke for the industry and one part of electric power consumption.
- Over 42% of the total consumed energy in the country is generated by petroleum products and 33% is electricity. Of the remaining, 10% goes to biomass and 5% is derived heat; natural gas use is very limited to merely 2% of the total.
- In 2011 the total final energy consumption in the country was 13.8% above the 2005 level. Electricity consumption was increased by 20.4%, oil products by 15.3%, biomass by 1.2%, and natural gas by 33.6%.
- The industry is the largest energy consumer in the country. In 2011 the industry share accounted for 34.0% of the total energy consumption, followed by households (28.4%), transport (25.1%), commercial and public sector (11.2%), and agriculture (1.3%).
- As regards to electricity balance, as an average for the period 2005 – 2011, 61% (max 64% and min 56%) of consumed electricity comes from domestic thermal power plants, 16% (max 28% and min 10%) is hydro energy, and the remaining 23% (max 30% and min 17%) is imported. Of the own electricity production, 79% is produced by mainly coal-fired thermal power plants, while the remaining 21% by hydro power plants.
- Over the entire analyzed period, the share of electricity consumption by households is in the range of 45% to 52%; industry 24% to 36%; the commercial and public sector 16% to 23%; and the remaining 0.6% to 1% goes to transport and agriculture.

Within the scope of the statistical data analysis and based on a set of independent energy and economic criteria, two major groups of industries were identified, selected and prioritized in: (i) four high, and (ii) three medium ranked industry (sub)-sectors that are of further interest for the IMP, and form the basis for pilot projects/companies selection. The following matrix summarizes the selected industries and their sub-industry structure.

Table 2: Industry Analysis – Selected industries and their sub-industry structure

Glass, Pottery & Building Materials	Manufacture of glass and glass products, refractory products, clay building materials, manufacture of other porcelain and ceramic products, cement, lime and plaster and manufacture of articles of concrete, cement and plaster.
Textile, Leather & Clothing	Manufacture of textiles, preparation and spinning of textile fibres, weaving and finishing of textiles.
	Tanning and dressing of leather, manufacture of luggage, handbags, saddleryand, harness, dressing and dyeing of fur and manufacture of footwear.
	Manufacture of wearing apparel, except fur apparel, manufacture of articles of fur, and manufacture of knitted and crocheted apparel.
Food, Beverage & Tobacco	Processing and preserving of meat and production of meat products, processing and preserving of fish, crustaceans and molluscs, fruit and vegetables, manufacture of vegetable and animal oils and fats, manufacture of dairy products, grain mill products, starches and starch products, and manufacture of bakery and farinaceous products.
	Manufacture of beer, malt, wine and non-alchocolic beverages.
	Manufacture of tobacco products.
Other Industries	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials, manufacture of rubber and plastic products, manufacture of fabricated metal products, except machinery and equipment, manufacture of computer, electronic and optical products, electrical equipment, machineryand equipment, manufacture of motor vehicles, trailers and semi-trailers, and manufacture of furniture.
I. Medium Ranked	
Chemical Industry	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms, manufacture of pesticides and other agrochemical products, manufacture of paints, varnishes and similar coatings, printing ink and mastics, soap and detergents, cleaning and polishing preparations, perfumes and toilet preparations, and manufacture of man-made fibres.
	Manufacture of basic pharmaceutical products and pharmaceutical preparations.
Ore Extraction	Mining of iron ores and non-ferrous metal ores, quarrying of stone, sand and clay, and support activities for petroleum and natural gas extraction.
Paper & Printing	Manufacture of pulp, paper and paperboard, and articles of paper and paperboard.
	Printing and service activities related to printing and reproduction of recorded media

The interest of IMP support and implementation to industrial companies was also strengthened by the electricity market liberalization in the country. Although the electricity market liberalization was initially scheduled on April 1, 2014 and then postponed in stages until 2020, this process triggered several industrial companies to express interest for introducing EMS by USG cost-sharing support, due to the fact that IMP offered support to their efforts to manage, measure, plan and balance energy use in their production facilities.

Company Selection

In 2013 IMP selected 53 potential industrial companies based on companies' expressed interest and partners' knowledge of potential industrial companies in the country. The industry analysis and findings were used as a framework of selecting the potential companies from different industrial subsectors.

5.2 Demonstration projects

5.2.1 Key issues

Introduction

With the USAID cost-sharing support IMP has successfully introduced Energy Management Systems in total of 17 industrial pilot companies. IMP continued to assist companies in selection of potential measures to improve energy efficiency at their production plants by preparing cost-benefit analyses and feasibility studies as well as conceptual designs and detailed engineering projects. Based on companies decision to finance projects, IMP continued to assist companies in access to finance activities to financial institutions as requested.

Energy management context

Energy management is still nascent in the Macedonian economy. The need for energy management is mostly felt by energy-intensive companies where energy is one of the critical factors for their competitiveness in the market, and in some cases for their survival as well. The industrial companies should analyse their way of energy consumption better, and they should adjust their organizational abilities to better manage its use.

In addition to organizational abilities, it is necessary to introduce automated production, which given the existing technological equipment would imply incorporation of appropriate electric and communication equipment at machines' level. This would enable remote control and possibilities for program adjustment and management of production processes aimed at optimal and rational utilization of all used energy forms.

Experience shows that increased energy efficiency in industry is achieved by changes in energy management practices in plants rather than by introducing new technologies. Every company should identify significant energy users as well as factors that consumption mostly depends on. This usually refers to electric motors, compressors, refrigerators, driers, boilers, and other devices and machines.

"You can't manage what you don't measure." Based on this fundamental principle, IMP provided cost-shared Energy Management Systems (EMS) for 17 pilot small and medium-sized industrial companies from diverse industry. Along with EMS, the project provided user-training to assigned energy managers and capacity building to local engineering service companies. The EMS that IMP introduced is a combination of software, data acquisition hardware, and communication systems. This technology helps perform key energy management functions such as organizing energy use data, identifying energy consumption anomalies, managing energy costs, optimizing energy demand, and building strategies for efficient and timely response to anomalies. It also facilitates energy benchmarking and helps companies optimize energy procurement.

The figure below shows an energy management system at Makprogres, a confectionary industry in Vinica, Eastern Macedonia.

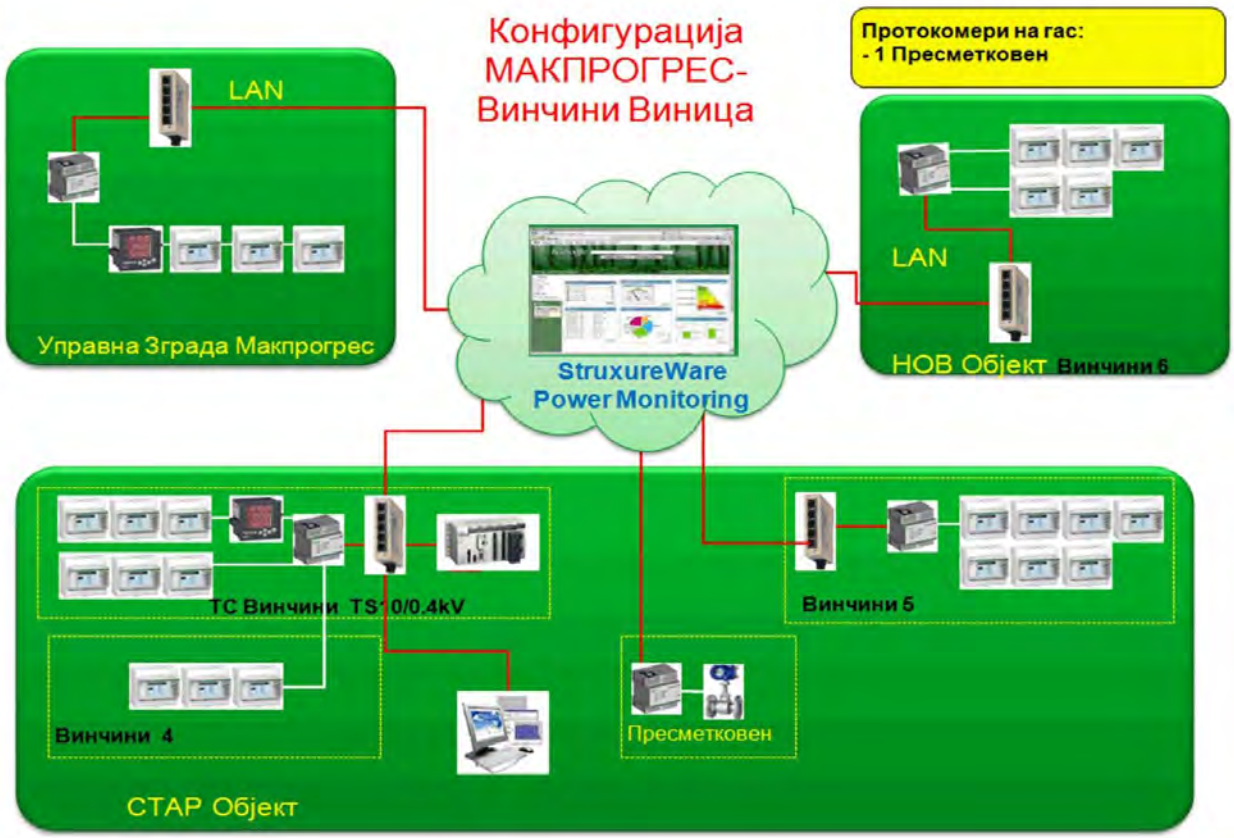


Figure 3: EMS configuration at Makprogres, Vinica

Electricity market liberalization

The electricity market liberalization of about 240 eligible companies and organizations in 2014 and about 150 eligible companies and organizations in 2016 resulted in energy cost reduction of about 15% to 20%. These positive results were contributed to difference in methodologies of calculating electricity consumption on the open electricity market compared to the regulated electricity market. The price difference, however, did not bring any actual electricity savings but only financial savings, which improves bottom lines of companies, and thus make them more competitive.

The next step of gradual opening of electricity market is scheduled on July 1, 2017 when companies that have electricity consumption of more than 500 MWh per annum will become eligible for the open electricity market.

Liquidity issues of Macedonian companies

Liquidity of companies and bed debts continued to be an issue in Macedonian economy. Macedonian companies, in particular SMEs, are challenged with liquidity issues when financing their operations. Amid shrinking exports caused largely by the European crisis, SMEs face tough time to secure financing given large requirements in collateral from banks extending loans. A large portion of Macedonian companies, in particular small enterprises, have frozen bank accounts because of their financial liquidity problems.

Local banks became more conservative in extending loans despite unchanged demand for credit from the private sector. Domestic companies secure financing primarily from their own cash flow, due to lack of corporate bonds or securities as alternative credit instruments. Because of the scarcity of other private financing, credit demand is high, affecting interest rates.

IMP worked with financial institutions and companies to increase visibility of energy saving projects and potential for profitable opportunities that exist in energy efficiency market.

5.2.2 Accomplishments

Under this component, the development of Energy Management pilot projects is the key component under the Industrial Management Project. Under this component, to the project end IMP accomplished the following results:

- Increased investments in energy management
- Contracted 17 pilot companies, procured, installed, trained and commissioned EMS with USG cost-sharing support
- Trained technical personnel to utilize and manage EMS at 17 pilot companies
- Developed project designs to additional 27 companies that can utilize them in future
- Provided technical support and access to finance activities to eleven pilot companies
- Raised awareness to other interested companies by sharing EMS examples
- Initiated system integration by show case to large companies by vendors on local market

Energy Management Systems

Over the course of the project, IMP installed cost-shared energy management systems and provided on-site training to plant managers and technical staff tasked with energy-management related activities at 17 pilot companies. The table below shows the pilot companies fully completed and commissioned energy management systems.

Table 3: Summary of completed EMS at 17 pilot companies

#	Company	Location	Equipment Vendor	# of Measurement Points	EMS Contract signed	Signed Statement of Acceptance for procured and delivered cost-shared Energy Management System
1	Alkaloid	Skopje	Schneider Electric	22	October 15, 2013	February 07, 2014
2	Hi-Tech Corporation	Skopje	Janitza Germany	22	September 10, 2013	February 03, 2014
3	Promes, Skopje	Skopje	Schneider Electric	11	November 22, 2013	March 25, 2014
4	Specijal Produkt	Skopje	Schneider Electric	13	November 21, 2013	March 18, 2014
5	Knauf Radika	Debar	Janitza Germany	45	December 16, 2013	February 19, 2014
6	Makprogres	Vinica	Schneider Electric	28	December 02, 2013	June 05, 2014
7	Mlekara Zdravje Radovo	Strumica	Schneider Electric	6	February 07, 2014	July 04, 2014
8	Vivaks	Skopje	Schneider Electric	13	December 17, 2013	July 01, 2014

9	Veze Sharri	Tetovo	Schneider Electric	18	April 29, 2014	December 05, 2014
10	Nova Refraktori	Pehchevo	Schneider Electric	3	September 01, 2014	December 12, 2014
11	DS Smith	Skopje	Schneider Electric	17	January 14, 2015	May 15, 2015
12	Kolid International	Strumica	Schneider Electric	10	March 23, 2015	June 25, 2015
13	Messer Vardar Tehnogas	Bitola	Janitza	9	March 24, 2015	June 24, 2015
14	Kadino Industry Group	Skopje	Schneider Electric	4	March 19, 2015	June 29, 2015
15	Mermeren Kombinat	Prilep	Janitza	5	June 25, 2015	August 25, 2015
16	Swisslion	Skopje, Resen	Janitza	28	April 20, 2015	August 31, 2015
17	DIK Fagus	Pehchevo	Schneider Electric	11	July 01, 2015	September 22, 2015

The table below shows the financial indicators for EMS implementation at 17 pilot companies.

Table 4: EMS financial indicators at 17 pilot companies implemented by IMP

#	EMS Pilot Company, Location	EMS			Preparation and post implementation activities for EMS[1)]
		USAID participation (VAT Excl.)	Company particpation (VAT Excl.)	Total (VAT Excl.)	
		US$	US$	US$	US$
1.	Alkaloid, Skopje	$20,000	$21,366	$41,366	$13,736
2.	Hi-Tech Corporation, Oreshani, Skopje	$18,506	$18,506	$37,012	$13,736
3.	Makprogres, Vinica	$20,000	$37,189	$57,189	$13,736
4.	Knauf Radika, Debar	$20,000	$28,190	$48,190	$13,736
5.	Promes, Skopje	$14,825	$14,825	$29,650	$13,763
6.	Specijal Produkt, Skopje	$18,353	$20,255	$38,608	$13,736
7.	Vivaks, Skopje	$13,679	$13,679	$27,358	$13,736
8.	Mlekara Zdravje Radovo, Strumica	$12,800	$12,800	$25,600	$13,736
9.	Veze Sharri, Trebosg, Tetovo	$17,155	$17,155	$34,310	$13,736
10	Nova Refraktori, Pehcevo	$10,431	$10,431	$20,862	$13,736
11.	DS Smith, Skopje	$20,000	$21,566	$41,566	$20,070
12.	Kadino Industry Group, Skopje	$4,202	$4,202	$8,404	$20,070
13.	Kolid International, Strumica	$11,312	$11,312	$22,624	$20,070
14.	Messer Vardar Tehnogas, Bitola	$5,400	$5,400	$10,800	$20,070
15.	Swisslion, Skopje	$15,368	$15,368	$30,736	$20,070
16.	Mermeren Kombinat, Prilep	$3,438	$3,438	$6,876	$20,070
17.	DIK Fagus, Pehcevo	$6,520	$6,520	$13,040	$20,070
	Total:	**$231,989**	**$262,202**	**$494,191**	**$277,877**

[1]) Preparation and post implementation activities for EMS include:

- Discussion with companies
- Screening and walk-through audit at candidate companies
- Preparation of technical design and project plans including EMS cost specification
- Contract preparation
- EMS commissioning
- Professional support to companies when needed
- Training of companies staff

Besides accomplishing the results above, IMP engineers conducted set of activities to prepare detailed EMS cost specifications in 27 candidate companies that expressed initial top management commitment but later on decided not to implement the systems. Activities included:

- Conducted energy consumption analysis (electricity and other energy consumables) in industrial companies;
- Performed on-site surveying of existing energy infrastructure network utilizing electricity and other energy consumables;
- Prepared technical documentation for the energy infrastructure network including single line diagrams, distribution panel boards and connections to consumers; technical data were communicated with and approved by technical staff from candidate industrial companies;
- Prepared technical solutions for EMS and its configurations including measurement and data acquisition devices and telecommunication equipment;
- On-site visit to all locations including selection of possible places for installation of EMS measurement and telecommunication equipment;
- Prepared scope of work with detailed cost specification for each EMS and submitted for companies' consideration.

The table below shows a summary of EMS cost specifications that IMP prepared for 27 candidate companies.

Table 5: Summary of EMS cost specification of candidate companies

No.	Industrial Company	EMS total value US$ (VAT excluded)	Number of metering points	Number of locations	Date of proposal
1.	Brako doo – Veles	62,614	44	1	July 17, 2013
2.	Frotirka Kompani AD – Delchevo	39,494	25	1	July 17, 2013
3.	Vardar Dolomit dooel – Gostivar	47,359	18	1	July 17, 2013
4.	Bato & Divajn Graphic Center - Skopje	41,617	21	1	July 31, 2013
5.	Pelagonija Separacija ad - Gostivar	25,516	9	1	August 19, 2013
6.	Konti Hidroplast dooel – Gevgelija	48,947	27	1	October 01, 2013
7.	Fabrika za kabli (FKN) dooel – Negotino	57,890	38	1	November 10, 2013
8.	Frotireks – Skopje (Skopje, Strumica)	34,093	13	2	November 22, 2013
9.	Zito Oriz – Kocani	33,985	15	2	November 26, 2013
10.	Vitaminka AD – Prilep	36,471	6	1	January 17, 2014
11.	Magroni doo – Skopje (Kratovo)	36,433	13	3	February 10, 2014
12.	Phoenix Farma dooel – Skopje	22,451	10	1	March 26, 2014

13.	Blagoj Gjorev AD – Veles	46,414	21	1	April 04, 2014
14.	Skopski Leguri dooel – Skopje	58,940	22	1	April 12, 2014
15.	Pelisterka AD – Skopje (Bitola)	23,513	8	1	April 25, 2014
16.	Elenica doo – Strumica	42,045	23	1	April 25, 2014
17.	Grozd ad – Strumica (Strumicko Pole, Grozd)	35,924	18	2	May 05,2014
18.	Wabtec MZT AD – Skopje	43,001	23	1	July 24, 2014
19.	Komfi-Angel – Prilep	54,876	32	1	October 02, 2014
20.	MZT Learnica AD – Skopje	41,187	8	1	December 12, 2014
21.	MZT Energetika AD – Skopje	35,304	13	1	December 12, 2014
22.	CD Fruit – Resen	17,954	12	1	February 23, 2015
23.	Donia doo – Prilep	12,123	7	1	February 23, 2015
24.	Tabernakul – Skopje (Skopje and Kocani)	13,209	9	2	February 24, 2015
25.	Zavar Kompani doo	10,109	5	1	February 26, 2015
26.	Mlekara Rudine MM dooel – Skopje	11,558	6	1	March 04, 2015
27.	Ruen-Inox Auromobile – Kocani	38,194	29	1	June 01, 2015
	Total:	**971,221**	**475**	**33**	

In addition, IMP discussed with management boards of more than 100 companies. Candidate companies where IMP conducted discussions and/or walk-through audits for potential EMS implementation include but not limited to: Ading – Skopje, Alpinkom – Delcevo, Bratstvo Galvanizacija – Skopje, Brilliant – Stip, Cermat – Bitola, Evropa '92 – Kochani, Geplastik – Gevgelija, Inter Construction – Gevgelija, Krin Proizvodstvo – Prilep, Krin KG – Prilep, Makitel – Ohrid, Marquart – Veles, Mebel Vi – Vinica, Mlekara Bimilk – Bitola, Pelagonija Mlin – Bitola, Pivara AD – Skopje, Lead and Zinc Mine Sasa – Makedonska Kamenica, Soloprom – Skopje, Svemek – Skopje, Tehnicki Gasovi – Skopje, Urban Invest – Kavadarci, Bas Tuti Fruti – Skopje, Rudnici Banjani – Skopje, and others.

Energy Efficiency Upgrade Projects

In the course of 2015 and 2016 IMP offered technical assistance and access to finance support to pilot companies once energy management systems were installed and operational for at least several months. Based on the energy consumption and analyses, IMP worked closely with the pilot companies to identify and propose energy efficiency upgrade projects. In cases when the management boards were interested to pursue specific energy efficiency improvements as well as willingness to seek external financing for the implementation of the energy efficiency upgrade or provide equity financing, IMP signed agreements with pilot companies. IMP was not responsible for funding or installing the energy efficiency projects under the USAID scope of work.

IMP considered a number of opportunities to reduce energy consumption and contributed to CO_2 emissions reduction. Some of opportunities are outlined below.

Examples of Industrial Energy Efficiency Upgrade Demonstration Projects

- On site co-generation of heat and electricity
- Rehabilitation of boilers (enhanced controls, economizers, improved insulation, regenerative burners, etc.)
- Fuel switch (light fuel oil, liquefied petroleum gas or compressed natural gas)
- Replacement of old gas boilers with condensing boilers
- Switch from electricity heating to fuel based direct heating
- Process improvements including enhanced automatic control systems (such as controllers)
- Rehabilitation of steam distribution systems: installation of steam traps, increased condensate recovery, etc.
- Installation of heat recovery from processes (such as installation of economizers for pre-heating purposes, heat recovery for space heating, heat recovery for drying, etc.), and/or air ventilation
- Installation of new or absorption chillies
- Installation of Variable Speed Drives (VSD) on selected electric motors
- Rehabilitation of compressed air systems (such as decentralisation and/or resizing of air compressors, replacing of old air compressors with new efficient ones)
- Rehabilitation of power distribution systems (such as replacement of old or oversized transformers, installation of capacitors to reduce reactive power consumption, etc.)

In regards to energy saving opportunities in buildings including industrial facilities, IMP looked into potential energy efficiency projects that are outlined below.

Examples of Buildings Energy Efficiency Upgrade Demonstration Projects

- Replacement of old and low efficient boilers by new efficient ones with or without fuel switching
- Rehabilitation of heat substations and implementation of heat meters
- Balancing of heating systems
- Replacement of existing windows with new, double-glazed windows, low-emission glazing
- Thermal insulation of the building envelope (external walls, roofs, basements)
- Replacement of existing heating system with a new one (thermal insulation of pipes, tanks and machinery equipment)
- Installation of heat recovery from air ventilation system and/or processes
- Frequency modulation of pumps, fans, drives and motors;
- Installation of rolling doors
- Implementation of renewable energy systems in buildings (including photovoltaics on rooftops, heating and/or cooling with or without heat pump, biomass boilers, etc.)

The implementation of the energy efficiency project upgrades are under full responsibility and willingness to invest by the pilot companies. The table below shows results of developed energy efficiency upgrade projects at 11 pilot companies. The status of the projects is marked as: *completed* (projects fully finished and operational by pilot companies), *planned* (projects scheduled for implementation within the next five years by pilot companies), *pending* (decision for investment for project implementation is to be made within the next six months by pilot companies), and *on-going* (projects are under implementation by pilot companies).

The success stories of all eleven energy efficiency upgrade projects are shown in Annex 1.

ID	Project Description	Service	Status	Estimated Annual Savings				Total Cost (EUR) VAT excl.	Payback (years)	CO_2 emission reduction (tonnes/ year)	Comment
				Electricity [kWh]	Fuel [kWh]	Type of Fuel	Cost (EUR)				
1	DIK Fagus 250 kW PV Plant Project	Electricity	Planned	296,000			33,600	252,000	7.5	271	
2	Alkaloid EE laboratory building refurbishment	Electricity, Natural gas	Completed	353,550	422,350	Nat. gas	44,740	200,000	4.5	320	
3	Makprogres 250 kW PV Plant Project	Electricity	Planned	280,000			17,130	250,000	14.6	256	The company is elegible customer on open electricity market
4	Nova Refraktori Fuel Switch Project	LPG, CNG	Planned			LPG, CNG	663,460	707,000	1.1	1,058	Fuel switch, no energy savings
5	Zdravje Radovo optimal EE opportunities improvement project: main steam pipelines repair, boiler replacement, and CHP introduction	Steam, Natural gas	Pending		803,000	Steam, Nat. gas	25,430	64,000	2.5	304	
6	DS Smith HVAC systrem upgrade, pneumatic system for waste transport improvement, and boiler house refurbishment	Electricity, Natural gas	Pending	83,120	1,000,230	Nat. gas	66,500	422,400	6.4	457	
7	Hi-Tech Corporation Power Quality Improvement Project (EQ210 kVAr)	Electricity	Pending	212,000			11,675	13,850	1.2	194	
8	Veze Sharri Reactive Power compensation and tariff system application upgrade	Reactive power	Completed				4,790	3,350	0.7	/	Reactive power compensation: 14,945 kVar
9	Messer Vardar Tehnogas Power Quality Improvement Project (EQ660 kVAr)	Electricity	Pending	249,000			16,580	29,850	1.8	228	
10	Kadino Industry Group EE upgrades : automation of large electric drives, independent off-grid PV plant, and CHP plant introduction	Electricity, CNG	Ongoing	135,000	970,000	CNG	52,380	391,140	7.5	139	
11	Kolid International EE upgrade project : LPG equipment, HVAC system and LED lighting installation	Electricity, LPG	Ongoing	25,510		LPG	7,650	99,100	12.9	30	Fuel switch, HVAC system introduction
	Total:			**1,634,180**	**3,195,580**		**943,935**	**2,432,690**		**3,257**	

The contribution to estimated CO_2 emission reduction from implementation of energy efficiency upgrade projects at pilot companies is as follows:

1) Alkaloid: Electricity savings (total emission reduction: 320 tones CO_2/a):

   26.2%; natural gas savings: 55.0% (based on the scope of retrofitted buildings); 242 tones CO_2/a reduction from electricity; 77 tones CO_2/a reduction from natural gas
2) Nova Refractory: Fuel Switch (LFO to LPG): 15% CO_2 emission reduction or 1,058 tones CO_2/a
3) Solid International (total emission reduction: 30 tones CO_2/a):
   - LPG installations: 9 tones CO_2/a
   - Underground LPG reservoir and new equipment for gas boiler station: 1 tone CO_2/a
   - Lighting replacement: 20 tones CO_2/a
4) Ladino Industry Group:
   - Soft motor starters and automation of large electric drives: 20 tones CO_2/a
   - Independent (off-grid) photovoltaic power plant for KIG: 119 tones CO_2/a
5) Messer Vardar Tehnogas:
   - Power Quality Improvement Project: 228 tones CO_2/a
6) Makprogres:
   - Introduction of roof-top solar photovoltaic system for home-based electricity consumption: 256 tonnes CO_2/a
7) DIK Fagus:
   - Introduction of roof-top solar photovoltaic system for home-based electricity consumption: 271 tonnes CO_2/a
8) Hi-Tech Corporation:
   - Power Quality Improvement Project: 194 tonnes CO_2/a
9) DS Smith (total emission reduction: 457 tonnes CO_2/a):
   - New location of axial ventilators for air intake: 79 tonnes CO_2/a
   - Replacement of existing steam heating system by new gas-fired infrared heaters in industrial plant: 47 tonnes CO_2/a
   - System for return and reuse of exhaust air in pneumatic system for waste transport: 79 tonnes CO_2/a
   - Replacement of insulation of steam and condensate installation: 123 tonnes CO_2/a
   - Putting in operation of degasser in the supply reservoir: 142 tonnes CO_2/a
   - Replacement of existing steam boiler unit: 66 tonnes CO_2/a
10) Zdravje Radovo (total emission reduction: 304 tonnes CO_2/a):
   - Repair and insulation of main steam pipelines: 117 tonnes CO_2/a
   - Replace existing boiler unit with a new 95% efficiency boiler unit: 187 tonnes CO_2/a
11) Veze Sharri reactive power compensation and tariff system application upgrade (no emission reduction)

Based on the data listed above, the total CO_2 emission reduction is estimated at 3,257 tonnes CO_2/a.

Data Collection and Monitoring

In 2015 and 2016 respectively, IMP completed one-year data collection and monitoring of all 17 pilot companies, which energy management systems were installed and commissioned in 2014 and 2015.

The findings showed that in general, pilot companies are committed to finding opportunities for energy savings and taking actions. However, some companies did not perform to the expectations claiming various reasons. Below is a summary of data collection and monitoring for all 17 pilot companies where EMS was implemented.

1) Hi-Tech Corporation

The company's energy cost accounts for 16.4% of the total annual production cost. Overall, it consumes about 6,000 MWh/a of electricity while the annual electricity cost amounts to $550,000. The corporate management continuously encourages initiatives for awareness rising about electricity savings and enhanced energy efficiency.

After analyzing EMS data, the management installed a soft start device on the machine Laufer. This action reduced the engaged power for around 70 kW, which resulted in reduction of the monthly cost for demand power for about 7.8%, while the total electricity cost for 2.9%, and accumulated annual monetary savings of about $13,200.

The organizational measures (operational control) that were taken since EMS installation for approximately one year period provided for reduction of the annual cost for about 10% or $55,000. The table below summarizes energy efficiency activities and results at Hi-Tech Corporation.

Table 6: Summary of energy efficiency activities at Hi-Tech Corporation for a period of one year

#	Industrial Pilot Company	Electricity savings		Monetary savings		GHG Reduction	Expected future savings potential
		Energy consumption reduction	Demand load reduction	Savings/Baseline	Savings		
		kWh/month	kW/month	%	$/year	tCO2/a	%
1.	**Hi-Tech Corporation, v. Oreshani, Skopje**						10%
1.1	Operational control			10,0%	55.000	412	
1.2	Demand optimization at Laufer machine	-	70	7,8%	13.200	/	

2) Alkaloid

Since EMS implementation in 2014, Alkaloid invested in two significant energy efficiency upgrade projects. IMP provided technical assistance and access to finance support to Alkaloid's team in preparing energy audit report and eligibility assessment of Alkaloid's investment for EE upgrade project of A1 building, which was fully implemented in 2014. In October 2015, Alkaloid was awarded with a prestigious recognition "The best Regional Sustainable Energy Project" from a portfolio of 153 sustainable energy projects implemented in Croatia, Serbia, Bosnia and Herzegovina and Macedonia in total value of $43 million.

After successful implementation and recognition of the first energy efficiency project, in 2015 Alkaloid initiated the second project entitled as ”Reconstruction of Quality Control Center and replacement of the lighting system in the Raw Material and Packaging Warehouse”. The table below summarizes energy efficiency activities and results from these two energy efficiency upgrade projects at Alkaloid.

Table 7: Summary of energy efficiency activities at Alkaloid for a period of one year

#	Industrial Pilot Company	Energy savings			Monetary savings		GHG Reduction	Expected future savings potential
		Electricity savings	Natural gas savings	Fuel switch savings (HFO to NG)	Savings/Baseline	Savings		
		MWh/year	MWh/year	MWh/year	%	$/year	tCO2/a	%
1.	**Alkaloid, Skopje**							10-15%
1.1	A1 Building EE improvement	353	422		36,8%	49.300	320	
1.2	Quality Control Center EE improvement	210		395	37,3%	27.000	316	

HFO – Heavy Fuel Oil
NG – Natural Gas

3) Knauf Radika

The top management of Knauf Radika is highly committed to energy savings. After EMS implementation in 2014, the company tracks electricity consumption and takes actions to reduce it. It initiated and implemented three energy efficiency upgrade projects, as follows:

1) Procurement of heat exchanger in the plant for drying plasterboards. The total investment amounted to $754,000. Heat energy consumption in the plant is reduced for 6.72%. The payback period is 5 years.
2) Utilization of exhaust heat in zone 3 of the drier. The total investment amounts to $135,000. Energy cost was reduced for 2.0%. The payback period is 3 years.
3) The fuel switch from propane-butane, heavy fuel oil, and light fuel to compressed natural gas enabled reduction of energy costs in the company. The total investment for the realization of this project amounts to $895,000 with an estimated payback period close to 5 years.

The table below summarizes energy efficiency activities and results from the three energy efficiency upgrade projects at Knauf Radika.

Table 8: Summary of energy efficiency activities at Alkaloid for a period of one year

#	Industrial Pilot Company	Monetary savings			GHG Reduction	Expected future savings potential
		Savings/Baseline	Savings	Investment		
		%	$/year	$	tCO2/a	%
1.	**Knauf Radika, Debar**					15%
1.1	Heat exchanger installation	20,0%	151.000	754.000	/	
1.2	Exhaust heat utilization	33,0%	45.000	135.000	100	
1.3	Fuel Switch (LPG+HFO to CNG)	22,0%	197.000	895.000	2921	

LPG – Liquefied Petroleum Gas
HFO – Heavy Fuel Oil
CNG – Compressed Natural Gas

4) Specijal Produkt

Due to postponement of electricity market liberalization in the country, Specijal Produkt does not use the information obtained from the installed EMS with the required attention.

The data from the production facility and the dispersed small production units and shops in Skopje show that within the current organizational structure of electricity supply, the cost for the engaged active power has significantly high share (45-50%) in the total electricity bill for each individual location.

If electricity for all locations is purchased as a total amount which could be enabled with the liberalization of the electricity market, it can be expected that the electricity cost of the company shall be reduced for 10-15%, mostly due to the reduced total engaged active power for the whole company.

The table below shows the expected future savings potential at Specijal Produkt.

Table 9: Summary of expected future savings potential at Specijal Produkt

#	Industrial Pilot Company	Expected future savings potential
		%
1.	**Specijal Produkt, Skopje**	15%

5) Promes

The findings and data from the EMS use to date result in undertaking organizational measures (operational control) by informing and influencing more than 200 staff at all levels about rational use of electricity. It is assessed that as result of the undertaken organizational measures for rational use and control of electricity consumption, the monthly bill is reduced for about 4%, whereby the total annual monetary savings are about $3,300, or electricity savings from 45,000 kWh/year to 60,000 kWh/year.

The reduction of the monthly maximum active power demand for 20% may lead to monetary savings of 9% in electricity bills on a monthly basis.

The table below summarizes energy efficiency activities and results from the three energy efficiency upgrade projects at Promes.

Table 10: Summary of energy efficiency activities at Promes for a period of one year

#	Industrial Pilot Company	Electricity savings	Monetary savings		Expected future savings potential
		Electricity consumption reduction	Electricity Savings/Baseline	Electricity Savings	
		MWh/a	%	$/year	%
1.	**Promes, Skopje**				10-12%
1.1	Operational control	60	4,0%	3.300	

6) Makprogres

IMP completed and commissioned the EMS at Makprogres in June 2014. Since then the company runs the system and looks for energy savings opportunities.

The total electricity consumption of Makprogres is around 3,600 MWh/a. The electricity is used for lighting, cooling, electric appliances and motor drives. The production facilities (mills) comprise of few production lines operating by Liquefied Petroleum Gas (LPG) as a drive fuel in tunnel furnaces, except for the administrative building. The consumption of LPG reaches about 60,000 kg/month or 720 tonnes/year. The equipment installed for this purpose, such as: the buried tank of capacity V=40.0 m^3, the station for gas evaporation and reduction, gas distribution network and burners operate since 2009.

The energy cost participates with about 4% in the total production cost at Makprogres.

Makprogres has complete overview and control of energy consumption of significant energy users at both locations, management building and production plants including the recently opened production plant. Significant energy users include: technological lines, large motor drives, lighting system, etc.

At present, the management contemplates plans to introduce control of electricity consumption by installation of controllers in the power network that will enable local and remote control of individual significant energy users on the production floor. The control functions would integrate in the energy management system under operation.

Since the LPG consumption is significant part of the energy budget in the factory, the management announced that besides tracking the overall LPG consumption in gas form, it plans to introduce control gas meters at each tunnel furnace used for production. There are 6 to 7 control points that are observed for EMS extension.

IMP identified two energy efficiency improvement projects that Makprogres has analyzed in 2013 and prepared for future investment. The investments include energy efficiency upgrade of the lighting system in the production facilities and fuel switch from liquefied petroleum gas to compressed natural gas for the entire factory. The combined investment was estimated at $375,000. The implementation of the two energy efficient improvement projects will result in annual CO_2 emission reduction of estimated 200 tonnes.

The table below summarizes information about future planned energy efficiency upgrade projects at Makprogres.

Table 11: Summary of future expected energy efficiency upgrade projects at Makprogres

#	Industrial Pilot Company	Expected Future Energy Savings		Expected Future Monetary Savings			Expected Future GHG Reduction	Expected future savings potential of the plant
		Energy consumption reduction	Demand load reduction	Savings/ Baseline	Investment	Savings		
		kWh/month	kW/month	%	$	$/year	t CO2/a	%
1.	**Makprogres, Vinica**							15-20%
1.1	Lighting system replacement	50.800	12	11,1%	62.900,00	7.000	64,6	
1.2	Fuel switch (LPG to CNG)	-	-	51,9%	313.000,00	162.500	357	
1.3	PV plant	-	250	-	275.000,00	-	365	

LPG – Liquefied Petroleum Gas
CNG – Compressed Natural Gas

7) Vivaks

IMP completed the EMS at the newly built production facility of Vivaks in July 2014. However, since the new production plant was not built with technological lines in places, it was not possible for the system to be put in operation. Vivaks plans to activate all technological lines in the new production facility and thus operate the whole production process by the beginning of 2016. At that time, the installed EMS will start to operate as well. IMP and the system integrator will provide the full support and training to company operators to ensure continuous use of and data collection from the system.

Vivaks uses electricity and light fuel oil to operate the production facility. The annual electricity consumption is from 400 MWh to 450 MWh while the annual light fuel oil consumption is around 200 tonnes. Electricity cost amounts to €50,000 per year while the light fuel oil cot is about €161,000 per year, which total energy cost is about 7% of the total production cost of the company.

The fuel switch from light fuel oil to natural gas, which fuel is needed for generation of hot water and steam used in the factory technological process will contribute to energy cost reduction in the new production facility.

With the fuel switch, the company will have cost savings. The annual consumption of 200 tonnes of light fuel oil will be replaced by 211,160 Nm^3 annual natural gas consumption. It is estimated that the annual cost savings will be in excess of $56,800 or 32% reduction compared to the baseline.

The CO_2 emission reduction as result of fuel switch from 200 tonnes of light fuel oil (emission of 623 tonnes CO_2/a) to natural gas consumption of 211,160 Nm^3/a (emission of 471 tonnes CO2/a) is estimated at 152 tonnes CO_2/a, or 24.4% reduction compared to the baseline.

The table below summarizes information of expected monetary savings from energy efficiency upgrade project at Vivaks.

Table 12: Summary of expected monetary savings from energy efficiency upgrade project at Vivaks

#	Industrial Pilot Company	Expected monetary savings		Expected future savings potential
		Savings/ Baseline	Savings	
		%	$/year	%
1.	**Vivaks, Skopje**			15-20%
1.1	Fuel switch (LFO to NG) at new producton plant	32,0%	56.800	

LFO – Light Fuel Oil
NG – Natural Gas

As an industrial company, Vivaks is committed and dedicated to rational energy use and cost reduction.

8) Zdravje Radovo

IMP completed and commissioned the EMS at Zdravje Radovo in July 2014.

The dairy industry of Zdravje Radovo uses only electricity to operate their factories. The total electricity consumption amounts to 2,400 MWh/a while the total electricity annual cost is around $290,000.

The EMS used to function well in the period from its inception to the end of 2014, when change of company's ownership and management took place. The EMS integrates five production plants of the company at remote locations in the country. The system allows view of electricity parameters for each location and sum of parameters for the company as a whole.

Since the end of 2014 the company does not have appointed a responsible person (an operator) to control the system. All five locations function locally. It is not known whether IP addresses are maintained with the mobile operator, which addresses are used for data transfer from the remote locations to the main server, including production plants in Skopje, Kumanovo, Radovo, Vasilevo, and Sveti Nikole.

The table below shows expected future potential for overall energy and cost savings at Zdravje Radovo.

Table 13: Summary of expected future savings potential at Zdravje Radovo

Industrial Pilot Company	Expected future savings potential
	%
Zdravje Radovo, Skopje	10-15%

9) Veze Sharri

IMP implemented an Energy Management System at Veze Sharri. The system was completed and put in operation in December 2014.

Veze Sharri uses electricity as main type of energy provided from its own substation 10/0.4 kV, 1000 kVA. In the substation, there are three separate feeders supplying each of the company's production facilities: the poultry farm, the factory for production of meat products Lecker and Elektro Sharri – plant for electricity production by biogas. The electricity from EVN is used for home consumption of Elektro Sharri. The total annual electricity consumption of the company is around 2,500 MWh.

The EMS has 17 measuring points where the power meters are mounted (one power meter on low-voltage side of the substation 10/0,4 kV for metering of total company electricity consumption, five power meters in the distribution panel for poultry farm, six power meters in the distribution panel for the meat products factory Lecker, and five power meters in the distribution panel of Electro Sharri.

Veze Sharri commissioned the biogas power plant "Electro Sharri" with installed capacity of 999 kW. The planned annual power generation is estimated at 8,191,000 kWh, which translates to 8,200

hours of operation per year utilizing the installed capacity. The total expected income from power generation is estimated at €1,475,000. The indirect benefit is the utilization of waste heat from the generation process, which is used for heating the premises, utilization in the dryer for production of flowers fattening, etc.

The table below summarizes information about Veze Sharri's energy-related investments.

Table 14: Summary of information about Veze Sharri's energy-related investments

#	Industrial Pilot Company	Electricity	Monetary savings		GHG Reduction	Expected future savings potential
		Electricity generation	Electricity Savings/Baseline	Electricity Savings		
		MWh/a	%	$/year	t CO2/a	%
1.	**Veze Sharri, Tetovo**					10%
1.1	Reactive power compensation		66%	6.300		
1.2	Biogas power plant	8.191		1.620.000	7.500	
1.3	Operational control					5-10%

10) Nova Refraktori

The Energy Management System was implemented at Nova Refraktori by IMP. The system was completed and commissioned in November 2014.

Nova Refraktori uses following types of energy its production facilities – electricity, light fuel oil, heavy fuel oil, and coal (lignite). However, the company uses only light fuel oil in recent years.

Nova Refraktori supplies electricity through two substations: substation 1 – 10/0.4 kV; 2x630 kVA and substation 2 – 10/0.4 kV; 1x1000 kVA. The annual electricity consumption of the company varies and depends on the volume and the type of products.

The factory maintains six furnaces operating on light fuel oil. In addition, it maintains a boiler station used for heating purposes during the winter season, which also uses light fuel oil. In 2014 the total consumption of light fuel oil was 1,555,195 liters.

The company undertook measures to increase awareness with 130 employees about rational use of electricity. For example, the company cares about switching of lighting when there is no occupancy in plants or administrative offices.

The company estimated that the monthly electricity bills reduced for 2-3% as result of operational control and organizational measures for rational use of electricity consumption.

However, the company has plans to significantly reduce energy consumption by investing in fuel switch from light fuel oil to liquefied petroleum gas or compressed natural gas. At present, light fuel oil is used for combustion in several furnaces for production of fireproof ceramic products as well as in the boiler plant.

The table below summarizes future planned energy efficiency upgrade projects at Nova Refraktori.

Table 15: Summary of future planned energy efficiency upgrade projects at Nova Refraktori

#	Industrial Pilot Company	Expected Monetary Savings			GHG Reduction	Expected future savings potential
		Savings/Baseline	Investment	Savings		
		%	$	$/year	t CO2/a	%
1.	**Nova Refraktori, Pehcevo**					20-25%
1.1	Option 1: Fuel Switch (LFO to LPG)	41,4%	777.700	321.900	468	
1.2	Option 2: Fuel Switch (LFO to CNG)	36,1%	785.950	284.000	758	

LFO – Light Fuel Oil
LPG – Liquefied Petroleum Gas
CNG – Compressed Natural Gas

As an industrial company, Nova Refraktori is committed and dedicated to rational energy use and cost reduction.

11) DS Smith

The Energy Management System at DS Smith AD – Skopje was implemented by the USAID Industrial Management Project. The system was completed and put in operation in May 2015.

Since the installation and putting into operation of the Energy Management System, the company has realized EMS benefits and system's opportunities, which helps them to prepare an action plan. Employees have access to the reports generated by the EMS on a regular basis. The reports include consumption of energy carriers in selected time period. The company's management is committed to energy savings and looks for opportunities to reduce energy consumption.

The company employees including heads of departments, technological lines and the boiler room established an initiative for enhanced engagement in rational energy use. There are already specific, yet modest results such as:

1) By increased attention to excessive electricity consumption (electric lighting, motor drives and office equipment) the company managed to achieve energy savings by 3% per annum. This practically means reduction of electricity consumption by 34,000 kWh/a. and annual monetary savings of EUR 3,400.

2) By undertakings in the distribution network of water vapor in the two production plants (taking care of bottlenecks and replacing valves as well as installation of thermal insulation on the pipe system where it does not exist), the water vapor consumption is reduced by 2% in a year. Taking into account the coefficient of efficiency of the boilers in the boiler room, the company made a decrease of 2.25% of the natural gas consumption in the boiler room. The annual savings of natural gas is 14,850 Nm^3/a or annual monetary savings of EUR 7,340.

Since January 1, 2015 DS Smith is eligible electricity consumer which enables the company to supply electricity on the open market in accordance with the rule for open electricity market.

The table below summarizes energy and monetary saving from energy efficiency interventions in the company:

Table 16: Summary of energy and monetary saving over a period of one year at DS Smith

Achieved Measure	Type of Energy	Energy Savings	Energy Savings in %	Monetary Savings	Monetary Savings in %
1. Organizational measures for optimal electricity consumption	Electricity	34,000 kWh/a	3.0 %	3,400 €/a	3.0 %
2. Repairs and thermal insulation of distribution network of water steam in plants	Natural gas	14,850 Nm^3/a	2.25 %	7,340 €/a	2.25 %
3. Acquired status of eligible electricity consumer (liberalization of electricity market)	Electricity	-	-	27,200 €/a	16.0 %

The implementation of measures 1 and 2 reduce CO_2 emissions as follows:

- 34 MWh/год. x 1.078 tCO2/MWh = 36.6 tCO_2/year
- 14,850 Nm^3/год. x 1.9 kgCO2/Nm^3 = 28.2 tCO_2/year

or total CO_2 emission reduction is about 64.8 tCO_2/year.

12) Messer Vardar Tehnogas

The Energy Management System (EMS) at Messer Vardar Tehnogas – Bitola plant, was implemented by the USAID Industrial Management Project. The system was completed and put in operation in June 2015.

The Energy Management System has 9 metering data points where power meters are installed (one power meter on low-voltage side of each power transformer 630 kVA for metering its total electricity consumption, six power meters for metering electricity consumption of six compressor units, and one power meter for metering electricity consumption of the "new" plant).

Two CO_2 – 110 kW compressors and two freon – 90 kW compressors are connected to the power transformer 1 while one CO_2 – 250 kW compressor and one freon – 250 kW compressor are connected to the power transformer 2.

Due to the high electric bill, in 2015 the corporate management approached the USAID Industrial Management Project and asked for assistance to reduce electricity consumption and therefore electricity cost. IMP offered an integrated approach, which was composed of 1) installation of Energy Management System (EMS); and 2) follow-on technical assistance to allocate areas for customized energy saving opportunities based on EMS data collection and analyses.

IMP effort in the technical support to Messer Vardar Tehnogas was supported by Loging Electronics' expertise as Janitza system integrator. Loging Electronics is IMP's partner in EMS integration at Messer Vardar Tehnogas's plant in Bitola.

The scope of work for the IMP technical support includes:

- Real time monitoring and data collection of power quality at the two transformer units by power quality analyzer type ELSPEC BlackBox G4500
- Scenario analysis and technical solutions for reactive power compensation and power demand reduction

- Cost-benefit analysis
- Simulation of network parameters after implementation of proposed equipment
- Recommendation for implementation and results

IMP team supported by Loging Electronics team proposed the Equalizer as the technical solution for the client. The EQUALIZER is a transient-free power factor compensation system made by Israel's company of Elspec. It is a real-time system (RTPFC – Real Time Power Factor Compensation), which compensates reactive energy within typically 5 to 20 milliseconds.

The Equalizer improves the power quality at dynamic loads in real time by:

1) Power factor correction
2) Energy savings
3) Voltage support
4) Flicker reduction
5) Current spike reduction
6) Harmonic filtration

The table below summarizes the profitability parameters of installing the Equalizer at both transformers units, per scenarios (-2.5% and -5% voltage level correction).

Power transformer unit TR1	**Investment (EQ300kVAr), without VAT (EUR)**	**Payback period (years)**	**Net Present Value (NPV) (EUR)**	**Internal Rate of Return (IRR) (%)**
Scenario 1 (voltage correction- 2.5%, savings 3.27%)	20,500	13.8	- 2,056	3.8
Scenario 2 (voltage correction - 5%, savings 7.81%)		5.8	23,526	16.4
Power transformer unit TR2	**Investment (EQ660kVAr), without VAT (EUR)**	**Payback period (years)**	**Net Present Value (NPV) (EUR)**	**Internal Rate of Return (IRR) (%)**
Scenario 1 (voltage correction - 2.5%, savings 5.04%)	29,850	3.3	83,834	30.5
Scenario 2 (voltage correction - 5%, savings 9.52%)		**1.8**	**176,438**	**55.6**

Note: The calculations are made based on equipment economic lifetime of 20 years and real discount rate of 5%.

13) Kolid International

The USAID Industrial Management Project implemented the Energy Management System in Kolid International. The system was completed and put in operation in June 2015.

IMP monitoring findings are as follows:

1) The company continuously monitors the electricity consumption. Besides the EMS Operator, the General Manager is also committed to the monitoring process of electricity consumption at several significant energy users. On his initiative, the system has been upgraded with additional eight metering devices making a total of 18 metering data points.

2) The General Manager, through the Operation Managers and all employees started an initiative for rational electricity consumption through better organization of all staff and day-to-day operation.

The summary of the sub-projects in Kolid International are shown in the table below.

Kolid International Energy Efficiency Project Upgrades							
Investment		Energy consumption		Payback	NPV	IRR	CO_2 emission reduction
Energy Efficiency Sub-projects	EUR (VAT excl.)	Energy type	Monetary Savings EUR/a (VAT excl.)	Years	EUR	%	kg CO_2/a
1) LPG storage and installations	30,500	Liquefied Petroleum Gas (LPG)	3,512	8.7	23,340	11.0	8,512
2) Underground LPG reservoir and new equipment for gas boiler station	8,000	Electricity	549	14.5	416	5.5	1,230
Total:	**38,500**		**4,061**				**9,742**

Note: Calculations are made with the following input parameters:

- Economic lifetime of sub-projects: 30 years
- Real discount rate: 5.0%

14) Kadino Industry Group

The Energy Management System (EMS) was implemented in Kadino Industry Group DOOEL by the USAID Industrial Management Project. The System was completed and put in operation in June 2015.

Based on the monitoring data on electricity consumption collected five months after the EMS installation and operation in Kadino Industry Group, the management of the company and the IMP team agreed for preparation of a cost-benefit study for assessment of optimal energy efficiency upgrade projects at the company.

The purpose of the Cost-Benefit study (evaluation of project costs vis-à-vis benefits) for Energy Efficiency measures in Kadino Industry Group (KIG) is to formulate, financially evaluate and rank the several alternative concrete measures (projects), which if implemented, would bring the following results for KIG in the future:

- Improved energy efficiency in the production process in KIG, both in the milling plant and the plant for frozen filo pies.
- Increased stability in electricity consumption,
- Reduced energy costs and maintenance costs for the electric equipment

The interval of the solutions shall be within the limits specified by the following measures:

- Improvement of the electricity consumption pattern which shall result in smaller effective consumption, as well as lower cost per unit product;

- Reduction of the price per energy unit with analysis of alternative sources of energy;
- Replacement and/or upgrade of the electric drives with automatic components (soft starters and frequency inverters), which shall reduce the maintenance costs and the consumption shocks.

The following measures are considered for implementation at Kadino Industry Group:

1) Soft motor starters and automation of large electric drives (Measure 1)

Measure 1 refers to the introduction of two complementary investments in:

- Soft motor starters for large electric drives in the mill and bakery
- Automation for sequential start-up of the entire mill plant and avoiding high peak power

The total capital budget for Measure 1 has the following structure:

Capital budget	**nr.**	**unit cost**	**item cost**
Soft motor starters - mill	7	€ 1.750	€ 12.250
Soft motor starters - bakery	5	€ 1.800	€ 9.000
Soft motor starters - storage silos	3	€ 1.150	€ 3.450
Central monitoring and control system	1	€ 2.000	€ 2.000
Software application (2 licences)	2	€ 2.500	€ 5.000
Auxiliary materials and parts		10%	€ 2.470
Labor		10%	€ 2.470
Total capital budget			**€ 36.640**

Measure 1 has three distinct drivers of financial benefits:

- Savings in active energy of 2% of the active consumption in the mill and bakery. These savings in 2016 amount from € 1.700 to almost € 4.000 in 2025.
- Savings in maintenance costs on production machinery and equipment. It is suggested that future costs of maintenance and replacement of spare parts (current level of about 10.000 €/year) will be reduced for 15% of the future maintenance costs that are expected to increase with a growth rate of 3% per annum. The savings will range from €1.700 in 2016 to €2.100 in 2025.
- Savings in costs from reduced peak power and reduced service charge until 2017. These are the largest savings during 2016-2017 and amount to 14.500 €.

2) An independent (off-grid) photovoltaic power plant for KIG (Measure 2)

Measure 2 represents a system to produce own electricity from a renewable energy source, i.e. by photovoltaic power plant which is not connected to the distribution network of EVN (off-grid).

The concept of this PV plant is closely related to the pattern and dynamics of the electricity consumption in the bakery. As explained in the technical part of this study, there is a huge difference between the basic load in the bakery in the range of 10-20 kW demand power (when only the cold rooms for maintaining the frozen pastry are working) and peak power requirements in the range of 80-100 kW during first shift hours (6:30 to 15:00) when filo pies are being frozen in freezing tunnels (so called shock chambers). The idea of this system is to meet this peak load through renewable source of energy from photovoltaic panels with a rated power of 108 kW connected in a system with

significant storage capacity of batteries at nearly 300 kWh, and capacity for three interrelated functions:

- Effective daily accumulation of the available photovoltaic energy which is produced through a system of photovoltaic panels, and
- Accumulation of power in the third, night shift at a low rate, if needed during cloudy winter days and low solar irradiation.
- Leveling of the curve of daily solar irradiation diagram with the consumption pattern of the bakery.

The total capital budget for Measure 2 has the following structure:

Capital budget	**Power**	**Price**	**Price/power**
	[kW]	[Eur]	[Eur/kW]
Metal container for battery storage		€ 3,500	€ 32
Inverters, controllers, switches, components		€ 31,000	€ 287
PV solar panels	108	€ 73,800	€ 682
Batteries VRLA gel, 243A/12V		€ 15,300	€ 141
Transportation and commissioning	10%	€ 12,360	€ 114
Total capital budget		€ 136,000	**€ 1,256**

Measure 2 distinguishes 2 essential drivers of financial benefits:

- Savings from avoided cost of buying active energy i.e. electricity produced from the photovoltaic plant as permanent savings. The annual production (conservative estimate) is approximately 110.000 kWh/year or annual savings in the range of €9.000 – 11.000 depending upon the year and the price of electricity.
- Avoiding compensation for peak power service charge during 2016-2017 of total 100kW peak power. The annual savings are significant €12.000 or amount to €24.000 for the two year period (2016-2017).

3) Plant for combined heat and power (CHP) generation (Measure 3)

Measure 3 is an innovative and modern concept in the industrial practice in Macedonia and presents an investment in a plant for combined heat and power energy production (CHP) fired on compressed natural gas (CNG). It is an internal combustion reciprocating engine, placed in a metal container for protection from atmospheric impacts and noise reduction. In this case, energy efficiency refers to the efficient and simultaneously generated power and heat, where heat is recuperated from the engine cooling system in the form of hot water with a temperature of about 100 °C. Thus, from 100% of the energy from the natural gas, 40% refers to the production of electricity, 50% refers to the production of heat energy, while 10% is discharged as inevitable heat loss as a result from thermodynamics principle.

A key assumption for the cost-effectiveness of this measure is to sell the generated heat to a consumer who needs industrial heat energy throughout the year. The assumption in the case of Kadino is the neighboring company Pekabesko, a company that is in constant need of heat due to its key business segment in meat processing. The assumption in this analysis is that the investment will include construction of hot water installation to the nearby Pekabesko's boiler plant. The illustrative

plant for the CHP engine model is a selected KTE 330 model from a manufacturer TEDOM, a renowned brand from the Czech Republic (www.tedom.com), with sales office in Macedonia. The nominal electrical output of the plant is 330 kW.

The total capital budget for Measure 2 has the following structure:

Capital budget	**Power**	**Price**
	[kW]	[Eur]
KTE 330 (container type)	330	€ 198,000
Natural gas supply system	1%	€ 1,500
Electrical and wiring works and components	3%	€ 6,500
Hot water supply system	6%	€ 12,500
Total capital budget		**€ 218,500**

Measure 3 distinguishes 2 essential drivers of financial benefits:

Savings in avoided costs for buying active power in the entire future period of operation of KIG. Avoided cost of electricity during 2016 is around 970 MWh, while until 2025, shall be 1,500 MWh. IN terms of value of avoided costs this is a saving of €77,000. But, as a compensation of the avoided purchase cost of power from EVN or other provider, this measure requires regular annual operating costs for purchasing new energy source, etc., compressed natural gas transported and stored in special steel containers under high pressure of over 200 bars. The price of CNG provided by a local provider from the Republic of Macedonia (who in the same time invests in CNG containers) is around 330 USD/1,000 m_n^3 of gas. That price is expected to drop with the expansion of this CNG supply in the industrial zone Ilinden, Kadino and Petrovec. The purchase price of the CNG in 2016 is around €80,000. In general, the avoided cost of buying power is slightly higher than the benefit from the purchase cost of CNG.

15) Swisslion

The Energy Management System (EMS) at Swisslion integrates the Skopje plant and Resen plant. It was implemented by the USAID Industrial Management Project. The system was completed and put in operation in August 2015.

Furthermore, the EMS provides data for both production plants in Skopje and Resen that enables the company to:

- define electricity cost by metering point in the production processes and overhead expenses in warehouses, administration etc.;
- have detailed overview of electricity consumption by certain consumers, lighting and the substation for compressed air. It should be noted that thanks to the EMS, the company receives accurate data on the cost of the produced compressed air. This information enables the company to plan the use of the substation for technical air. Which of the two existing compressors for production of technical air will be operational depends of the following factors:
    - production plant operating mode;
    - power supply; and
    - opportunities for rational use of electricity and electricity savings.

The monitoring data and information provided by the EMS gives the technical staff an insight into the quality of the electrical network in the company and of the input parameters in the substations. The sources and time of occurrence of the harmonics can be located. The points of demand of reactive power can also be located. At present, several analyses are carried out that support possible future interventions for improvement of voltage fluctuations, power factor, and harmonics.

In the next period the company plans to install LPG flow meters in the LPG networks at the production plants, with particular interest for Resen. This way the company will obtain necessary information on the gas consumption at several metering points in the production plants. The monitoring data from the flow meters will be available on the existing software package GridVis Service.

In 2015 Swisslion became a qualified electricity consumer and procures electricity on the open electricity market. Having in mind that the total electricity demand of the company in greater than 4,500 MWh/a, Swisslion significantly reduced its energy costs by procuring electricity on the open electricity market.

The above said activities regarding the EMS data collection and analysis are aimed at further electricity savings and reduction of electricity costs. The company plans are to reduce the energy consumption by 3% to 5% (i.e. by 195-225 MWh/a) which corresponds to monetary savings of 10,800 €/a to 18,000 €/a.

16) Mermeren Kombinat Prilep

The Energy Management System (EMS) at Mermeren Kombinat – Marble mine Sivec, was implemented by the USAID Industrial Management Project. The system was completed and put in operation in August 2015.

At this phase, the EMS has 5 measuring points where the power meters are installed (one power meter on the low-voltage side of the power transformer 400 kVA for metering its total electricity consumption, four power meters for metering electricity consumption of four motors in the mine).

Since the first contacts and communication regarding the EMS installation in Mermeren Kombinat Prilep, the client decided to implement the system only in the marble mine Sivec. As IMP implementer, TimelProekt continues the communication with the client to understand and realize the need and importance for EMS upgrade in the processing plant for sells polished slabs and tiles, located several miles from the mine in Prilep.

The client insisted to limit the EMS implementation in their company only to installation and monitoring of the four engines in the bracer machine located at the marble mine, with total installed capacity of 30 kW. There is also a possibility for monitoring of electricity consumption at the mains transformer with installed capacity of 400 kVA.

In the period from putting the EMS in operation (August 25, 2015) up to now, the user did not requested professional interventions from the project implementer and System integrator.

The main purpose of the EMS is to allow the client continuous insight of the operation of the four above mentioned motors of the marble crushing machines. Having in mind their total capacity of 30 kW, these machines are not significant energy users in regard to mine's total electricity consumption.

Therefore, at this moment the company doesn't consider the options for possible reduction of electricity consumption as priority (similar like the motive for EMS installation). The main motive was the awareness of the functionality and the deployment time of the crushing machines engines.

The company plans to further increase the number of measuring points at several energy users in the mine.

17) DIK Fagus

DIK Fagus DOOEL implemented an Energy Management System (EMS) provided by the USAID Industrial management Project. The system was completed and put in operation in September 2015.

IMP monitoring findings are as follows:

1) The company continuously monitors its electricity consumption.
2) The company undertakes organizational measures for optimization of electricity consumption.
3) The company management continuously considers opportunities for energy savings and reduction of energy cost by using alternative own sources for electricity generation.

After EMS commencement, the client started to continuously monitor the electricity consumption at all metering locations especially at the two power transformers.

As requested by the client, the USAID Industrial Management Project prepared feasibility study and project design for photovoltaic plant 250 kW in DIK Fagus – Pehchevo.

The study provides an overview of the technical and financial feasibility of the PV plant and should support the client in the decision making weather, when and how to invest in this project.

There are four scenarios that are analyzed in the feasibility study. The economic parameters for each scenario are shown in the summary table given below.

	Scenario Description	Payback (years)	Net Present Value (EUR)	Internal Rate of Return (EUR)
Scenario 1:	PV Plant with preferential status of electricity generator	7.1	247,407	13.5
Scenario 2:	PV Plant electricity generation is used for in-house consumption while the company is a tariff electricity consumer	7.5	223,041	12.7
Scenario 3:	Scenario 2; the excess generated electricity is delivered to power distribution grid	7.1	247,126	13.5
Scenario 4:	The company is qualified customer and supplies electricity on open market; PV Plant electricity generation is used for in-house consumption while excess generation is delivered to grid	12.9	22,351	5.9

EMS potential industrial clients database in Macedonia

IMP developed an Excel-based EMS potential industrial clients' database with decision makers and contact information. The database includes total of 492 candidate companies for EMS implementation in Macedonia including the IMP pilot companies. IMP build-up and used the database to promote the project and offer USAID cost-shared assistance, invite companies on workshops and round tables discussions, and discuss opportunities for energy efficiency improvements.

According to official statistics, there are about 70,659 active companies in Macedonia, of which about 7,675 or 10.9% are manufacturing companies. Out of them, about 6,780 or 88.3% are companies that have up to 19 employees. These small companies usually have insignificant energy consumption and often lack interest in investment of energy efficiency upgrades. IMP was primarily focused on small and medium sized companies that have opportunities for energy efficiency improvements and management commitment for change. The database developed includes this focus group of companies, where project results in the 17 pilot companies should trigger interest and willingness to improve energy efficiency in their production plants.

Testimonials by EMS champions

IMP utilized the pilot projects as good examples to showcase their satisfaction and results to help generate references and referrals to other potential customers. The experience of EMS at pilot companies is very positive, and as such can be used as strong reference to other companies, a marketing tool that IMP was lacking when the project started. Once EMS are installed and running, pilot companies help IMP sell to others by offering positive testimonials and leveraging a refer-a-friend campaign created by the positive experience. Below are few references of testimonials given by pilot companies.

DS Smith's testimonial for EMS installation and its benefits

> The introduction of this system in our company started a process of analysis of the consumers according to which appropriate conclusions are drawn and appropriate measures are being undertaken for more efficient operation and rational utilization of electricity and gas…
>
> In the production process, every type of cost is an important item in the global cost structure in the company. Specifically in regard to energy costs, we are proud with the fact that in 2014 our costs for energy and natural gas consumption were 265,000 Euros, while in 2015 ending with the month of September these costs were in the amount of 167,000 Euros at the same level of production, and the expectation for the total annual energy costs is approximately 225,000 Euros. This means that we have successfully managed the energy consumption in the current year.
>
> **Olgica Krzheva, CEO of DS Smith - Macedonia**

Kadino Industry Group's testimonial for positive experience with the USAID Industrial Management Project

Our experience with USAID is excellent and of course we would recommend to the other companies to invest in energy consumption management systems. By means of the monitoring provided by this system, companies would be able to manage energy consumption more easily, and in this manner they will simultaneously make savings.

Todor Gjorgjevski, CEO of Kadino Industry Group

Nova Refraktori's testimonial for energy efficiency upgrade project

Through USAID Macedonia, and in association with TIMELPROEKT-Skopje and FILBIS-Skopje, for the requirements of NOVA Refraktori - Pehcevo, a pre-investment feasibility study was prepared for assessment of the economic viability to replace the liquid fuel-extra light heating oil with liquid oil gas or compressed natural gas. The result of the feasibility study is encouraging and once this project is implemented, the existing monitoring system will be upgraded with the possibility to monitor and optimize the consumption of gaseous fuel.

Boban Angjelevski, CEO of Nova Refraktori

5.3 Training and Sector Development

Under this component, IMP helped towards market development of local service providers for EMS development, installation and maintenance services.

In 2013, IMP selected two engineering companies for training, Filbis and Energoproekt MIGO. They signed contracts with IMP to join the project and use the benefits of theoretical learning and gaining practical on-site experience on development, installation and maintenance of energy management systems.

FILBIS's main operations are related to design of energy installations including gas installations, design of industrial processes and installations, storage of liquid fuels and gas (CNG, LNG, LPG, oil, etc.). The company's portfolio includes design of HVAC systems, geothermal installations, solar panels, biomass, and energy efficiency upgrade projects. Filbis is based in Skopje and it was established in 1998. The company looks for opportunities to increase sales and introduce new business processes in their core operations.

Energoproekt MI-GO's core business is design, installation and supervision of electrical installations. The company is based in Skopje and it was established in 2012. Activities include electrical installations in hospitals, municipal projects, alarming systems, and energy monitoring systems. The company seeks opportunities for expansion and growth and considers Energy Management Systems to provide great opportunity for development.

The training process of the local engineering companies consists of theoretical training and practical on-site training.

During the preparatory period Filbis and Energoproekt MI-GO trainees had the opportunity to learn about the technical systems and software solutions (packages) of EMS systems implemented in industrial companies by the two EMS suppliers selected by the USAID Industrial Management Project: Schneider Electric - France and Janitza - Germany.

Training topics from Schneider Electric systems included:

- StruxtureWare Power Monitoring software
- Benefits from power monitoring system
- Global reach in energy management
- Introduction to Power Logic Device Communication
- System Design of StruxtureWare Power Monitoring
- EMS Hardware including data metering and available technical solutions

Training topics from Janitza systems included:

- Janitza Energy Management Systems
- GridVis energy management software
- Increased transparency in energy distribution

The on-site hands-on experience for EMS development and installation of Filbis team included two pilot companies: Knauf Radika in Debar and Nova Refractori in Pehchevo.

Figure 4 shows the configuration of the installed EMS in Knauf Radika while figure 2 shows the configuration of the installed EMS in Nova Refractori.

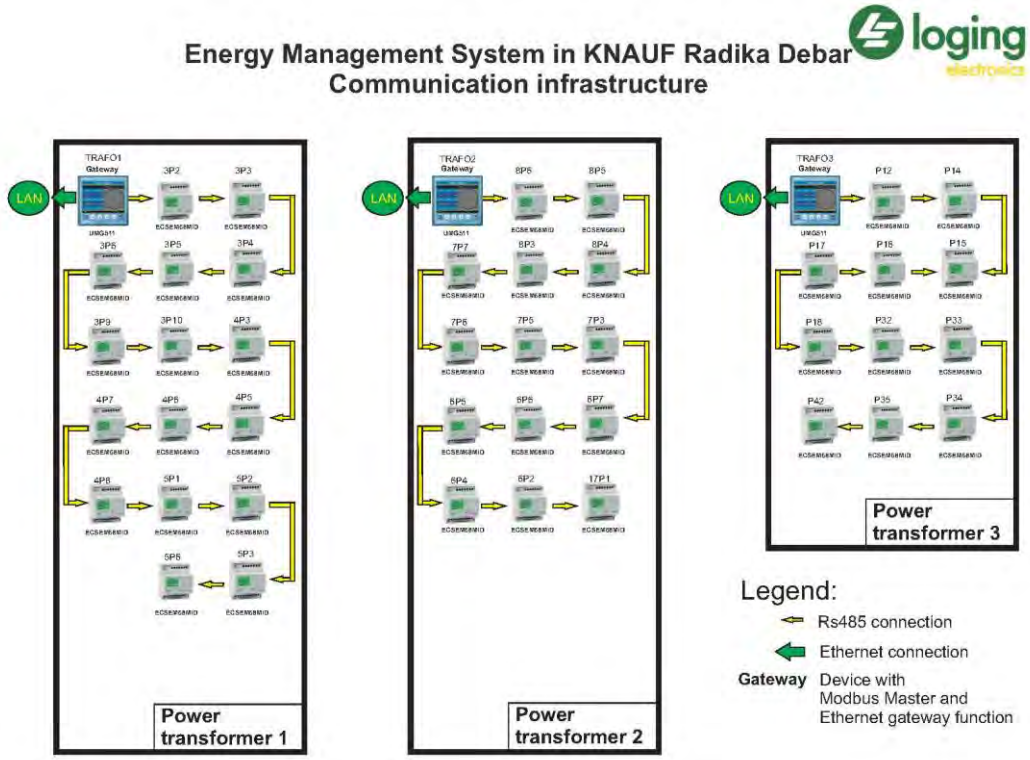


Figure 4: Configuration of EMS in Knauf Radika - Debar

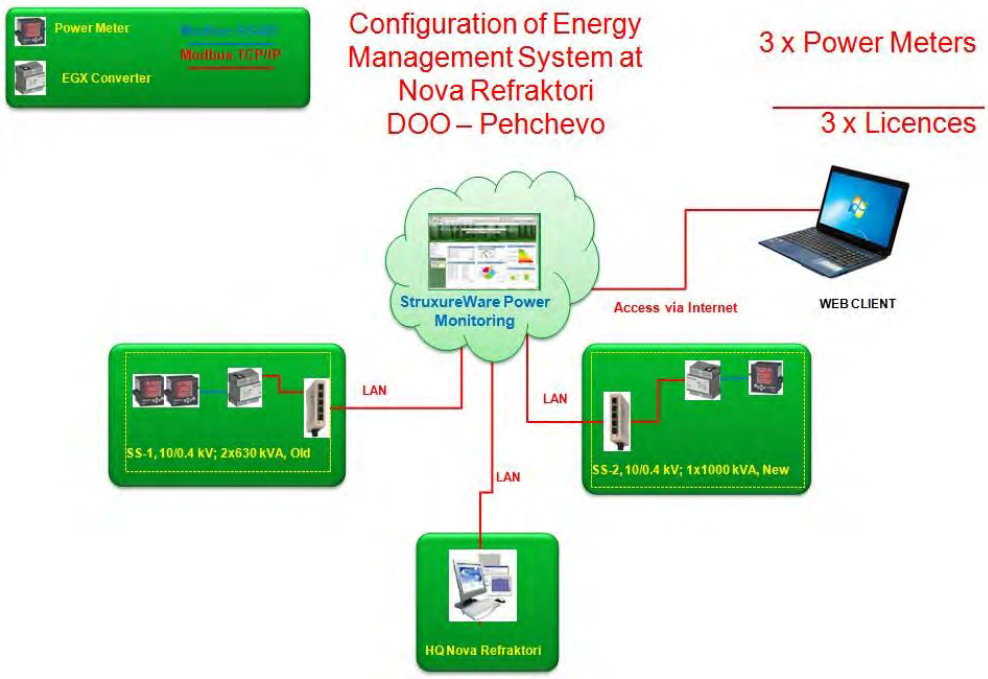


Figure 5: Configuration of EMS in Nova Refractori - Pehchevo

Energoproekt MIGO gained knowledge from the training and qualification for the development and performance of EMS during at the pilot companies of Veze Sharri in Trebos, Tetovo and Mermeren Kombinat in Prilep.

The figure below shows the EMS development scheme at Mermeren Kobminat Prilep.

Figure 6: EMS configuration in Mermeren Kombinat - Prilep

As result of the training, both companies succeeded to perform well on the market by offering their energy management services and implementing projects.

Filbis developed other projects for energy efficiency upgrades. The projects include:

1. In 2013/2014, Filbis was engaged in Knauf Radika Debar to revise the Project for warehouse and autoloader for compressed natural gas (CNG) with total volume of 3 x 130 = 390 m^3, developed by Energosistem company - Skopje, and later hired to supervise its implementation;

2. In 2014, Filbis was engaged in fuel switch study in Nova Refractori – Pehchevo as part of the cooperation with the Industrial Management Project. Filbis engineers developed a Pre-investment study for cost savings by substitution of extra light fuel oil with Liquefied Petroleum Gas (LPG) and/or Compressed Natural Gas (CNG).

3. In 2015, following the successful implementation of the cost-shared Energy Management System at Kolid International in Koleshino village nearby city of Strumica, Filbis was hired under IMP technical assistance to develop basic engineering design projects including:

    a. Mechanical Basic Engineering Design: A storage for Liquefied Petroleum Gas (LPG) V=10 m^3 including evaporation plant and LPG installations in the production plant for cookies and sorbet tulumba cakes.

    b. Mechanical Basic Engineering Design: An underground reservoir for Liquefied Petroleum Gas (LPG) V=2.7 m^3 including LPG installations and selection of new equipment for the

gas boiler station to provide heating of administrative premises in the production facility.

c. Mechanical Basic Engineering Design: Heating, ventilation and air-conditioning (HVAC) system in the production plant for cookies and sorbet tulumba cakes.

4. In 2016, Filbis was hired to develop Energy Efficiency Pre-Investment Study for Industrial Plant and Boiler House at DS Smith AD. The objective of the energy efficiency pre-investment study is to identify opportunities for energy savings and CO_2 emission reduction and recommend measures for improvement in the industrial plant and boiler house of DS Smith AD, Skopje.

As result of gained knowledge and experience from the IMP training and capacity building, Energoproekt MI-GO continued to develop and perform Energy Management Systems (EMS) to other clients.

Energoproekt MI-GO was hired to install Siemens' energy management system in Tineks markets across Macedonia. Over a six-month period, it installed and put in operation equipment consisted of Power Meter SICAM P850, temperature and humidity detectors connected through SPPA-T3000 Control System and existing internet connection to one central server located in Tineks' main office in Skopje.

Moreover, Energoproekt MI-GO was contracted to install three geothermal pumps made by Daikin, two solar panels of 1,000 liters boilers' heating capacity, and three Daikin chambers at Zebra hotel in Skopje. By installing the equipment, the hotel enabled 24 hours supplement of hot water that does not have to be hated up more than 15 ^{O}C even in the coldest days of the year. The investment return was less than two years.

Besides these two local engioneering companies, IMP cooperated with five specialized consulting and design companies to develop custom made technical solutions for energy efficuency project upgrades at evelen pilot companies. IMP strengthened capacity to local consulting and design companies for energy efficiency upgrades to be able to offer services on the local market after the project close-out.

5.4 Outreach

5.4.1 Key Issues

The Industrial Management Project conducted outreach and communication activities as part of the project's fourth component. The focus of these activities was two-fold:

- ✓ to promote and disseminate information on project approach and objectives, implemented activities and accomplishments among project stakeholders – manufacturing companies, engineering service companies, chambers of commerce, Ministry of Economy, Ministry of Environment and Physical Planning, Macedonian Energy Agency, environmental NGOs, international donor organizations and the public at large; and
- ✓ to raise awareness on energy management practices

For these purposes, the project organized various promotional events - round tables, workshops, press conferences and media interviews; produced and disseminated information via promotional materials including case studies, brochures, sharing of experience, results and lessons learned in industry practice, and prepared press releases and press clippings about IMP's work.

Besides the main message that IMP conveyed in each of its promotional activities, the project also branded all materials and events in accordance with the Project's Branding Implementation Plan and Marking Plan.

5.4.2 Accomplishments

IMP accomplishments in outreach and communication activities include workshops, round tables, conferences, publications, media interviews, and other events.

USAID – UNIDO cooperation on USER Training workshops

The project included a user training component through which both participant and non-participant companies were trained on the principles of the ISO 50001 Energy Management Standard and energy efficiency best practices. Participant companies, which introduced the energy management system, were trained on system operation, energy monitoring and data collection, identification of opportunities for energy performance improvement and reporting. Non-participant companies were trained on workshops where they learnt about good practices and project experience through information sharing and lecturing. IMP partnered with the UNIDO-GEF Industrial Energy Efficiency project to conduct the trainings.

Over the course of the project, IMP delivered eight two-day trainings on ISO 50001:2011 key concepts and energy management best practices, which were attended by 165 representatives of 116 organizations.

The offered trainings focused on energy management principles and ISO 50001 standard, including development of energy information and plans, presentation of energy metrics and energy performance indicators, discussions of management commitment, checking, management review and project planning. The companies were also familiarized with the basic concepts of project

financing and financial analysis for project comparison. The selected EMS vendors Schneider Electric from France and Janitza from Germany presented the concept, operation, benefits and advantages of the energy management systems they offer.

Liam McLaughlin, a UNIDO's expert with extensive professional experience on ISO 50001 Energy Management Standard, led the joint training.

The figures below show the execution of the workshops.

Picture 3: Liam McLaughlin presentation at workshop on June 22, 2015

Picture 4: Participants discussion on the USER Training workshop – Skopje, November 27-28, 2014

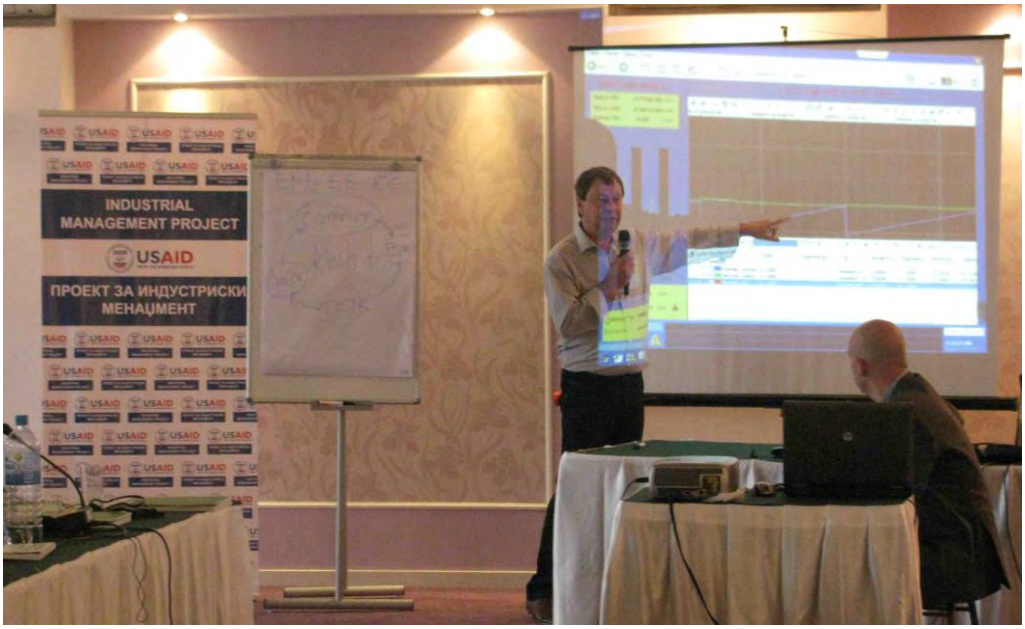
Picture 5: Handing over a certificate for attendance to participant on October 6, 2015

Picture 6: Handing over a certificate for attendance
to participant on October 19, 2016

The target audience was represented by industrial companies that have potential for energy conservation measures and potential interest to introduce energy management systems in their production plants. However, the target audience was enlarged to include energy consulting and engineering companies, agencies, government and non-government institutions.

The objectives of the workshops were as follows:

- communicate to the relevant audience - local industrial companies - the energy management principles and ISO 50001 standard;
- present the concept of the Energy Management System and the benefits of its introduction in the production plants;
- create a platform for information exchange among participants about the effective use of the energy management system and the energy efficiency upgrade projects that ultimately helps companies to increase their competitiveness and reduce environmental impact.
- familiarize companies with the basic concepts of project financing and financial analysis for project comparison;
- present the EMS integrated solutions offered by the selected vendors Schneider Electric and Janitza under the USAID Industrial Management Project;
- serve as a matchmaking and networking opportunity among main project stakeholders (local manufacturing companies) and the two vendors selected by the project for installation of EMS solutions in the industry sector.



Picture 7: EMS integrator presents its software to participants in the workshop

The training enabled productive discussions among participants about the effective use of the energy management system that helps companies to manage their energy use in a sustainable way. They also discussed management commitment, possible improvements in currently used technologies and best practices in order to achieve sustainable cost reduction in energy use in their companies, which further leads to increased companies' competitiveness and reduced environmental impact.

IMP provided training materials to all participants which included all presentations from the workshop. In addition, all participants received the *Practical Guide for implementation of Energy Management System* and the *Excel User toolkit*. These materials were prepared in 2013 for

promotion of ISO 50001:2011 standard and were disseminated to participants on workshops and other IMP's events.

The *Practical Guide for implementation of Energy Management System* is based on the approach and structures of a number of energy management system standards, including ISO 50001:2011 standard. The energy management system approach has a long and proven success record across all industry sizes and sectors. The information presented in the practical guide has been structured to align with other popular industry management system standards such as those for quality (ISO 9001), occupational health and safety (OHSAS 18001), food safety (ISO 22000), and environmental management (ISO 14001). Organisations can thus integrate an energy management system with their existing management system(s).

The figure below shows the principle of continuous performance improvement through the ISO 50001 process improvement cycle.

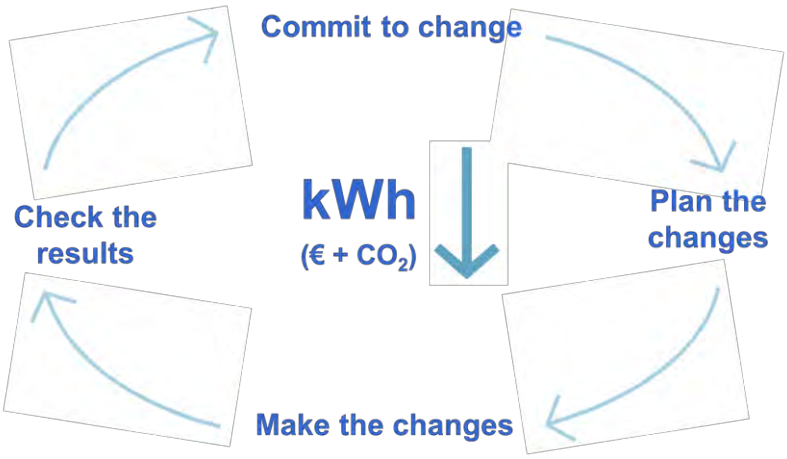


Figure 7: ISO 50001 process improvement cycle

Process and systems operations improvement is fundamental to business management. It is how companies improve competitiveness and bring forward a culture of continuous improvement. IMP introduced standardized process-improvement methodology that assesses the operational performance of beneficiary companies. When all of the major players are involved, they can collectively focus on eliminating waste of money, human resources, materials, and time. The ideal outcome is that jobs can be done in less time, at reduced cost, with enhanced safety, and greater ease.

The trainees were thought about the ISO process improvement cycle. It starts with securing the commitment of top management. The commitment is more than a statement of support – it establishes accountability and reinforces it with the submission of regular progress reports. The next step involves establishing an energy management team. Once members are assigned clear roles and responsibilities and given training, they can begin to identify opportunities for improvement, design a roadmap, take actions according to that roadmap, and monitor their progress. The process requires focus, drive, a systematic approach, and above all, a willingness to change.

The ISO 50001 steps are shown on the figure below.

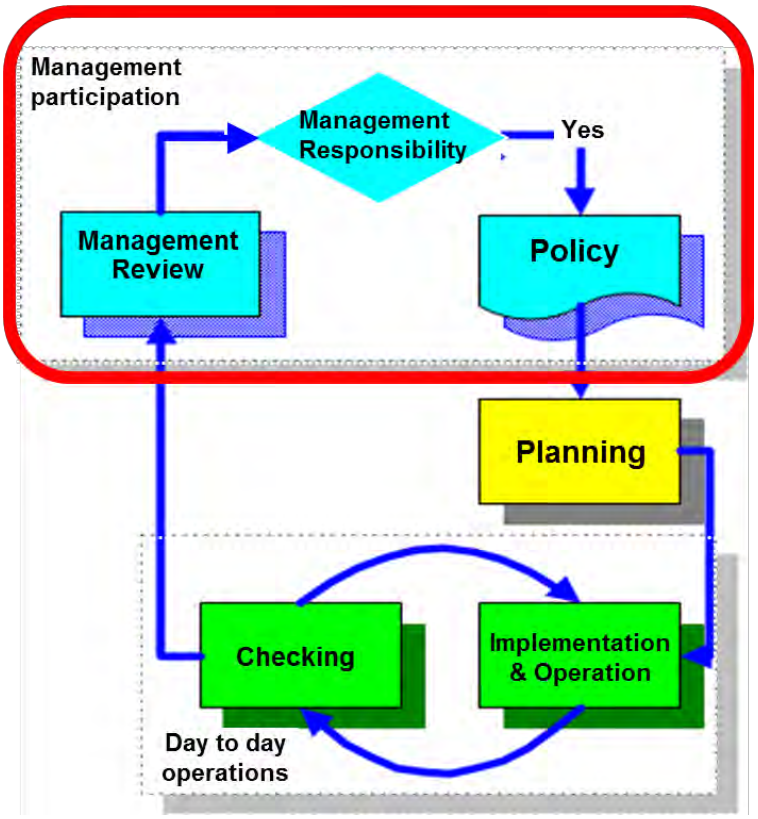


Figure 8: ISO 50001 steps

Training of financial institutions on Energy Efficiency due diligence and lending practices

Over the course of the project, IMP organized two practical trainings of local financial institutions. The trainings on energy efficiency due diligence in industrial companies and lending practices to local financial institutions were held at CEED premises in Skopje on October 30, 2013 and March 6, 2015.

Target participants were middle managers from various financial institutions in the country (commercial banks, leasing companies, and other institutions) that offer financial support to energy efficiency development projects. IMP has identified several financing facilities that intend to target when assisting pilot companies in access to finance. Representatives from several financial institutions attended the training - ProCredit Banka, Ohridska Banka, Komercijalna Banka, NLB Tutunska Banka, NLB Leasing, Uni Banka, Kapital Banka, Crimson Capital, and others took active participation on the one-day training. Overall, representatives from nine local financial institutions (50% of Macedonian banking market) attended the two trainings.

The purpose of the training was two-fold. First, to familiarize the participants with the Energy Management System (EMS) concept, discuss opportunities for project financing aspects of energy efficiency improvements in industrial companies, and introduce basic concepts of ISO 50001:2011 Energy Management Standard. Second, to establish relationship with the banks as potential clients to IMP's pilot companies for financing energy efficiency upgrades in their production facilities, which followed after EMS implementation.

The pictured below show the trainings at CEED's premises.

Picture 8: Training of financial institutions – Skopje, October 30 2013

Picture 9: Simon Avramovski - Training of financial institutions – Skopje, March 6, 2015

Picture 10: Dragan Blazev - Training of financial institutions – Skopje, March 6, 2015

These tailor-made trainings for financial institutions provided insights on the following aspects:

- ✓ Types of industrial energy management projects;
- ✓ Importance of energy use data acquisition and in-depth data analysis;
- ✓ Energy efficiency/management technology considerations;
- ✓ Assessment of specific energy management project-related sensitivity and risk issues impeding access to finance: bottlenecks and sustainable solutions;
- ✓ Overall financial considerations and profitability expectations from financing of energy management projects.

Round Tables

Over the course of the project, IMP organized three round tables in 2014, 2015, and 2016 respectively. The round tables were held each October and were primarily used to present the IMP's key findings, results and lessons learned from each of the project year as well as to disseminate information to participants.

First Round Table

On December 16, 2014, the USAID Industrial Management Project (IMP) in cooperation with the project's stakeholder Macedonian Energy Association (MEA) within the Economic Chamber of Macedonia hosted a round table discussion about how Macedonian companies can improve their competitiveness and foster a culture of continuous improvement through enhanced energy management practices. Mr. James Stein, the USAID Macedonia Mission Director, Mr. Steven Burns, USAID E&E Bureau Chief of Energy from Washington DC office, and representatives from the private sector made remarks. About 50 participants from various stakeholders including government

officials, relevant ministries, Energy Agency, Energy Regulatory Commission, non-government organizations, international donor community, financial institutions, industrial associations and business community attended the event.

Picture 11: Representative of EMS beneficiary company shares its experience on the event

On the event representatives from the project pilot companies Alkaloid, Knauf Radika, and Hi-Tech Corporation presented their experiences and achieved results. Alkaloid discussed the accomplishments of using their energy management system, specifically focusing on the already completed energy efficiency refurbishment of their laboratory building, which was financed through the EBRD's Western Balkan Energy Efficiency Financing Facility (WeBSEFF II) loan approved by NLB Tutunska Bank. This project was supported by IMP's technical assistance and access-to-finance services. Knauf Radika presented anomalies in their production plant detected by use of the energy management system as well as plans how to correct them and further improve their operations. Hi-Tech Corporation discussed about the significance of running such system and its impact when competing on international markets.

"Once we installed the energy management system we were able to see the real picture and thus, to take further steps. Now we use less energy, and we also installed new equipment. Our first-year accomplishment is about 10% reduction in our energy consumption. This is a very positive initiative."

MR. SAVO STANKOVIK, GENERAL MANAGER
HI-TECH CORPORATION

The objective of the round-table was to discuss benefits of introducing energy management in industrial companies and to look into possibilities of scaling-up energy management best practices in Macedonia.

Second Round Table

On October 28, 2015 the Industrial Management Project, in cooperation with the Macedonian Energy Association within the Economic Chamber of Macedonia, hosted the second round table.

Picture 12: Round Table Discussion – October 28, 2015

More than 40 participants attended the event including non-participant industrial companies, government officials, Ministry of Economy, Energy Agency, non-government organizations, international donor community, financial institutions, industrial associations and business sector. The audience also heard testimony from project pilot companies about their overwhelmingly positive experiences using energy management systems in their production facilities.

> Our Industrial Management Project is helping companies better understand, and therefore reduce, their energy use and its associated costs. To date, we've installed Energy Management Systems (EMS) in 17 companies. Each of them has demonstrated that with only a few small scale, low cost adjustments, they're able to save up to 10% on their energy costs. We hope that in spreading the news about these results, we will inspire broad use of energy management systems throughout the industrial sector and we encourage the Government of Macedonia to facilitate investments in them. Doing so will help it achieve three of its strategic goals: improved energy efficiency, greater private sector development, and reduction of greenhouse gas emissions.
>
> **James Stein, Director of the USAID Mission in Macedonia**

Picture 13: Representative from DS Smith A.D. Skopje, EMS beneficiary company shares its experience on the event

Third Round Table

On November 23, 2016, the USAID Industrial Management Project, again in partnership with the Macedonian Energy Association, hosted the third round table discussion on successful implementation of Energy Management Systems that reduce energy consumption and greenhouse gas emissions. Again, the aim of the event was to reach project counterparts and partners, to raise their awareness and increase effectiveness of project activities and accomplishments as well as to inform the general public. The event received extensive coverage by national and local media.

Picture 14: Round Table Discussion – November 23, 2016

Picture 15: Round Table Discussion – November 23, 2016

IMP Publications

Recognizing the need of development of materials that will further promote introduction of a systematic and continuous energy management approach in local industrial private companies in order to increase their energy efficiency, the IMP designed and printed a brochure "Have You Consider Other Ways To Boost Your Competitiveness?". The brochure consists of three main sections - Process and System Operations Improvement, Energy Management Systems, and Investment Opportunities. It documents project activities, achievements, expected results and their impact on the country's private sector development as well as on the environment.

The brochure was used to promote the Industrial Management Project and the concept of continuous energy management improvement within the USAID HQ in Washington DC, at the World Energy Engineering Congress held in Washington DC on October 1-3, 2014 as well as at various project promotional events.

By promoting the benefits to pilot companies, the IMP team contributed to increasing the interest for involvement of other candidate companies in the project.

Participation on U.S. Event on Energy Development

Dragan Blazev, IMP Chief of Party and Ana Kubelka, IMP Project Assistant, participated on the 37th World Energy Engineering Congress (WEEC) that was held in Washington, DC from October 1-3, 2014. Organized by the Association of Energy Engineers (AEE), the WEEC is well-recognized as the most important energy event of U.S. and international scope for end users and energy professionals in all areas of the energy field. This annual event featured a large, multi-track conference agenda, a full line-up of seminars on a variety of current topics, and a comprehensive exposition of the market's most promising new technologies. The conference and expo explored a complete spectrum of technologies and services of great importance including, but not limited to: energy efficiency and energy management; renewable, green and alternative energy; smart grids and electric metering

innovations; integrated building automation and energy management solutions; energy services, energy procurement and project financing; solar and fuel cell technologies; etc.

The pictures below show the congress event in Washington, DC.

Picture 16: World Energy Engineering Congress – Washington, DC, September 2014

Picture 17: 2014 WEEC Expo

Project presentation in USAID E&E Bureau in Washington, DC

IMP representatives networked with groups and individuals at the event and distributed a brochure presenting IMP as a proven way to boost companies' competitiveness and bring forward a culture of continues improvement. The brochure was well received and raised interest among attendees.

IMP representatives presented the project and discussed progress at the USAID E&E Bureau in Washington, DC. The discussion was closely followed by representatives from the National Renewable Energy Laboratory (NREL) and the Department of Energy (DoE).

Media outreach

The Industrial Management Project regularly used Macedonian national and local media as a tool to deliver messages to the public and gain greater public awareness of the project's activities, concepts, achievements and results. Over the course of the project, IMP activities and achievements were featured in national television, radio, magazines and newspapers. Public events, conferences, and presentations organized or attended by IMP received extensive media coverage in major national media, including Kapital daily, Dnevnik daily, Utrinski Vesnik daily, Vecer daily, Economy and Biznis, Kurir, Business Info, Denar, Vesti24, Kanal 5, Sitel TV, Macedonian National Television (MTV), Macedonian Radio, Telma TV, Alfa TV, AlSat M, Sky Net and many others. Several press releases were released to media to announce major IMP events.

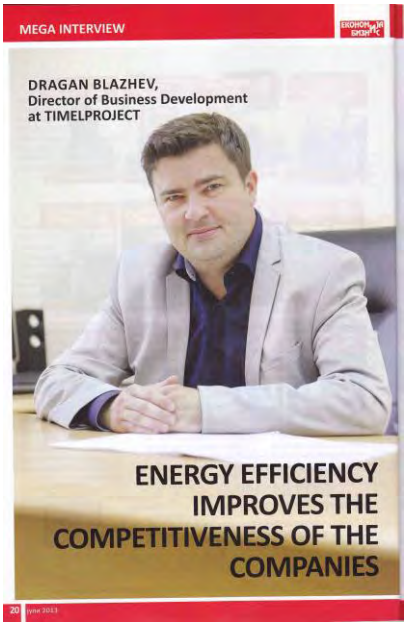
Picture 18: Media coverage by Mr. James Stein, USAID Mission Director – Second Round Table, October 28, 2015

Nova TV Profit series on Industrial Management Project and Improving Industrial Energy Efficiency

Shortly after project commencement in 2013, Dragan Blazev, COP and Danco Uzunov, project packaging and access to finance specialist had interviews for the Nova television series. Both interviews took about 60 minutes where the team members discussed energy efficiency improving aspects in industrial companies in the country. They presented the USAID industrial management project describing its components including demonstration of several examples and case studies to support the industrial energy management concept.

Mega interview in Economy and Business monthly magazine

In mid-July 2013, the COP Dragan Blazev was invited by the management that prepares the monthly magazine "Economy and Business" to discuss energy sector development in the country and opportunities for improvement. In his mega interview for the month of July, Dragan Blazev discussed the energy related condition in the country including resources, potentials and accomplishment as well as provided suggestions for energy sector development.



Interview in BI.mk

In January 2014, the Project Chief of Party Dragan Blazev had an interview on the BI.mk website where he comprehensively explained the project components and its expected results giving, at the same time a brief overview on the situation in the energy sector in the country and the reasons for initialization of and USAID support to this project. Mr. Blazev also emphasized the benefits for the local private industrial companies involved in the project. The link to the interview in Macedonian is given below.

http://bi.mk/so-namaluvanje-na-potroshuvachkata-na-en/

Press Conference

The Industrial Management Project publicly presented the results achieved during the first year of its implementation on a press conference held in the Macedonian Chamber of Commerce premises on April 7, 2014. More than 13 media attended the conference where they had a chance to hear not only about project accomplishments but also about the advantages that each company would have by increasing its energy efficiency through introduction of a systematic and continuous energy management approach. The importance of the introduction of the energy management approach in the industrial companies was also emphasized by Mr. Danco Vidov, Corporative Development and Export Director at Zdravje Radovo, a Macedonian company for dairy products. As representative of one of the industrial pilot companies that have fully installed Energy Management Systems by USAID cost-sharing support, Mr. Vidov emphasized the importance of planning and management of energy efficiency measures that led to reduced energy costs, decreased product costs and ultimately, to improve his company's competitiveness on the local and regional markets.

Picture 19: Project Press Conference at the Economic Chamber of Macedonia – April 7, 2014

Picture 20: Project Press Conference at the Economic Chamber of Macedonia – April 7, 2014

Project promotional materials were disseminated to more than 20 media outlets present on the event.

Interview in Economy and Business monthly magazine

IMP continued its cooperation with the monthly "Economy and Business". In the April 2014 magazine's issue, the COP Dragan Blazev gave an overview how the introduction of an Energy Management System can help industrial companies become economically more advanced. He also emphasized the activities and project results achieved under the USAID IMP and explained the project development process.

BUSINESS PROJECTS

ENERGY MANAGEMENT SYSTEMS CREATE ECONOMICALLY ADVANCED INDUSTRIAL COMPANIES

Energy efficiency in industry contributes to the economic growth and has positive impact on the environment. At the same time, the implementation of energy efficiency measures leads to reduction of energy consumption, energy intensity and improvement of the industrial companies' competitiveness. Industry is responsible for more than one third of global primary energy consumption and energy-related carbon dioxide emissions. Industrial energy use is estimated to grow at an annual rate of between 1.8% and 2.1% over the next 25 years. In many countries this tendency often creates disbalance between economic development goals and constrained energy supply. According to the International Energy Agency, industry has the technical potential to decrease its energy intensity, and hence GHG emissions, by up to 26 per cent on global level.

Improving energy efficiency in industry is one of the most useful and cost-effective measures to help emerging countries reduce energy import dependence, increase economic growth and diminish environmental degradation. As a country whose economic development is based on development of energy sector and on reduction of the dependence from electricity and other energy resources import for domestic needs, the promotion and investments in energy efficiency is crucial for the Republic of Macedonia.

Beginning of 2013, as part of its Mission economic growth strategy for the Republic of Macedonia and based on the findings of previously conducted analysis that significant results can be achieved by better energy management and more efficient energy use by industrial companies, the USAID Macedonia has commenced with implementation of the three-year Industrial Management Project. Timeprint, a local private consulting and engineering company, has been contracted by USAID to implement the project. This is a first case in the region where a local private company has been directly awarded a USAID project, given that all previous USAID direct contracts are signed with non-governmental organizations from the region. PointPro Consulting and the Center for Entrepreneurship and Executive Development – CEED Macedonia are implementing partners in the project.

The overall objective of the Industrial Management Project is to improve the competitiveness of industrial companies by reducing energy consumption and energy costs as part of the total production costs that will further lead to reduction of greenhouse gasses (GHG) emissions on a long-term basis. More specifically, the project aims at improving energy

Dragan Blazev
Chief of Party, USAID Industrial Management Project

Interview in InStore

In April 2014, the monthly magazine "InStore" approached IMP asking for an expert opinion on the benefits that the recent electricity market liberalization in the country brings to the Macedonian companies and the economy in general. In its May issue, this regional monthly magazine that covers the entire industry in the country, published the IMP Chief of Party view on the benefits and challenges that the Macedonian companies as qualified electricity market users face with the liberalization of the electricity market.

20 INSTORE мај 2014 www.instore.mk

мислења и коментари

АНАЛИТИЧКИ СТАВ

Драган Блажев, директор за индустриски менаџмент на проектот УСАИД

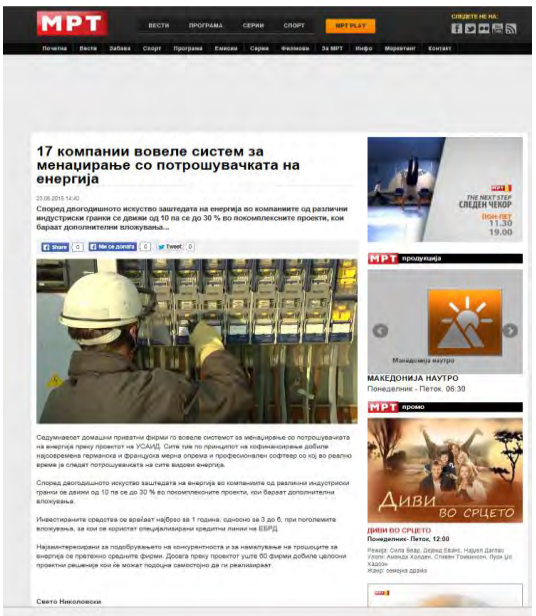
На македонските компании што станаа квалификувани потрошувачи и склучија билатерални договори со регистрирани снабдувачи на електрична енергија, либерализацијата на пазарот на електрична енергија од 1 април 2014 година им донесе понисока цена за потрошена електрична енергија, во споредба со регулираните цени што тие плаќа претходно. Пазарната цена се одразува во согласност со предвидените на отворениот пазар на електрична енергија и е зависна од повеќе фактори. Тоа се понудата и побарувачката на електрична енергија и моќноста во реално време. Од тој аспект, сегашната состојба на компаниите што влегоа на либерализираниот пазар на електрична енергија е поволна. На тој начин тие ја зголемуваат конкурентноста на пазарот, преку намалување на трошоците за електрична енергија како дел од вкупните производни и услужни трошоци. Тоа придонесува за понисока и поконкурентна цена на нивните производи и услуги.

Како најголем недостаток на либерализираниот пазар на електрична енергија е фактот што Македонија засега не располага со берза за тргување со електрична енергија, што претставува значаен фактор за креирање на конкурентна пазарно-енергетска средина. Постепеното процес на либерализација на електроенергетскиот сектор и отворањето берза за тргување со електрична енергија се основните постулати за ефикасно и економично функционирање на енергетскиот пазар. Со помош на берзата ќе се остварат повеќе позитивни ефекти, како што е создавање на транспарентен и реален индекс на цените на електричната енергија. Тоа ќе придонесе за долгорочно намалување на цените, намалување на разликите за учесниците на енергетскиот пазар, транспарентност во понудите, намалување на трошоците и многу други можности. Креирањето на берза за тргување со електрична енергија ќе придонесе за ефикасно и нормално функционирање на либерализираниот пазар на електрична енергија.

Изградба предвиди дека овој сегмент зајема значаен дел од економијата во земјата, отворањето берза ќе придонесе за зголемување на интересот за инвестирање во нови производни капацитети во земјата, како и во обновливата енергетска извори.

Informal gathering with media

The USAID Mission Office organized an Informal gathering with journalists and chiefs editors in Skopje on June 23, 2015. During the gathering, IMP had on opportunity to pitch a story to the media and raise journalists' interest about activities and project outcomes. The IMP team distributed promotional materials to the journalists and chiefs editors present at the meeting. As a result of the communication with the journalists during the meeting, the article below was published on MTV1.



МРТ

17 компании воведе систем за менаџирање со потрошувачката на енергија

Според двогодишното искуство заштедата на енергија во компаниите од различни индустриски гранки се движи од 10 па се до 30 % во покомплексните проекти, кои бараат дополнителни вложувања...

Седумнаесет домашни приватни фирми го воведе системот за менаџирање со потрошувачката на енергија преку проектот на УСАИД. Сите тие по принципот на кофинансирање добиле најсовремена германска и француска мерна опрема и професионален софтвер со кој во реално време ја следат потрошувачката на сите видови енергија.

Според двогодишното искуство заштедата на енергија во компаниите од различни индустриски гранки се движи од 10 па се до 30 % во покомплексните проекти, кои бараат дополнителни вложувања.

Инвестициите средствата се враќаат најбрзо за 1 година, односно за 3 до 5, при поголемите вложувања, за кои се користат специјализирани кредитни линии на ЕБРД.

Најзаинтересирани за подобрувањето на конкурентноста и за намалување на трошоците за енергија се претежно средните фирми. Досега преку проектот уште 60 фирми добиле целосни проектни решенија кои ќе можат подоцна самостојно да ги реализираат.

Света Николовски

МАКЕДОНИЈА НАУТРО
Понеделник - Петок, 06:30

ДИВИ ВО СРЦЕТО
Понеделник- Петок, 12:00

Interview in Nova Makedonija daily

In October 2015, the Chief of Party Dragan Blazev had an interview in *Nova Makedonija* daily newspaper where he gave an overview of the significance and positive impact of energy efficiency in the industrial sector of the country's economy, more specifically on the local companies' competitiveness and the environment. Mr. Blazev also explained the energy efficiency system solutions offered by the project and the benefits of their implementation in the local private industrial companies.

НЕОПХОДНО Е ЗГОЛЕМУВАЊЕ НА ЕНЕРГЕТСКАТА ЕФИКАСНОСТ ВО ИНДУСТРИЈАТА

Со заштеда на енергија до поголема конкурентност

Катерина Панчевска

Драган Блажев

Индустриски-от сектор учествува со повеќе од 28 отсто во бруто-домашниот производ и вработува над 30 отсто од сите вработени во земјата. Прекумерните трошоци за енергија што се резултат на нејзината неефикасна употреба значително влијаат врз конкурентноста на производите на индустриските компании на пазарот

Потребно е систематска и континуирана посветеност во наоѓање решенија за заштеда на енергија

СИСТЕМСКИ РЕШЕНИЈА ЗА ЕНЕРГЕТСКА ЕФИКАСНОСТ

Со финансиска поддршка од УСАИД во изминатите осумнаесет месеци се воведа системи за мониторинг и управување со потрошувачка на енергија во 17 индустриски компании од приватниот сектор

ЗАШТЕДИ ДО 30 ОТСТО

http://www.novamakedonija.com.mk/NewsDetal.asp?vest=1021151551349&id=10&setIzdanie=23596

Interview in Economy and Business monthly magazine

In its November 2015 issue the magazine published a comprehensive interview of the IMP COP Dragan Blazev on the activities, project results and accomplishments achieved by that time. He emphasized energy savings potential and cost reduction opportunities that could improve companies' profits and image as well as stimulate the working environment. Statements from beneficiary companies that have successfully implemented the EMS in their production plants were incorporated in the article.

Dragan Blazev

Chief of party for the USAID Industrial Management Project

ENERGY MANAGEMENT SYSTEMS BRING HIGHER PROFITS AND COMPETITIVENESS TO FIRMS

■ Mister Blazev, you are part of the "Finalprodukt" company from Skopje and at the same time you are Chief of party for the USAID's Industrial Management Project. Tell us more about the Project, when was it started and what are its objectives? In what stage of implementation is it?

D. Blazev: As part of the strategy of its mission for economic development in the Republic Macedonia, the United States Agency for International Development – USAID has been implementing the Industrial Management Project, for a third consecutive year. The objective of the Project is to increase the competitiveness of industrial companies by reducing the energy consumption and costs as a part of the total production costs, thereby leading to a reduction of emissions of gases that cause the greenhouse effect in the long run. Specifically, the Project basically refers to an introduction of energy management in industrial companies in our country through a systematic and continuous dedication to finding solutions for saving energy and reduction of costs for this purpose, on the basis of the principles of the standard ISO 50001.

With the financial support provided by USAID, in the past eighteen months we introduced energy consumption monitoring and management systems in 17 industrial companies from the private sector, from different industrial branches. In this period we help companies by providing

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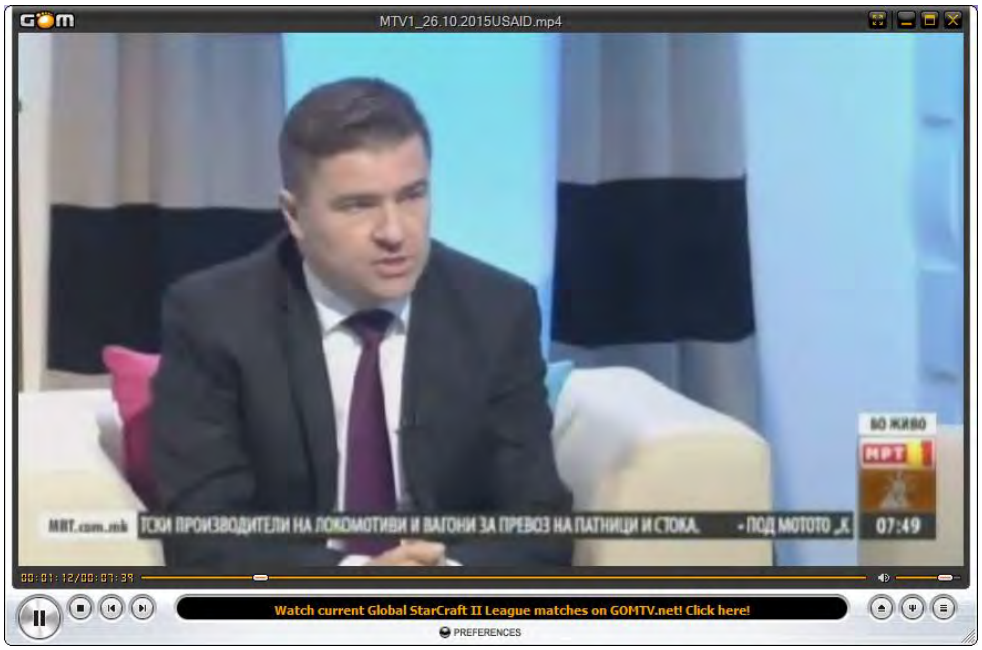
Interview on the National Macedonian Television

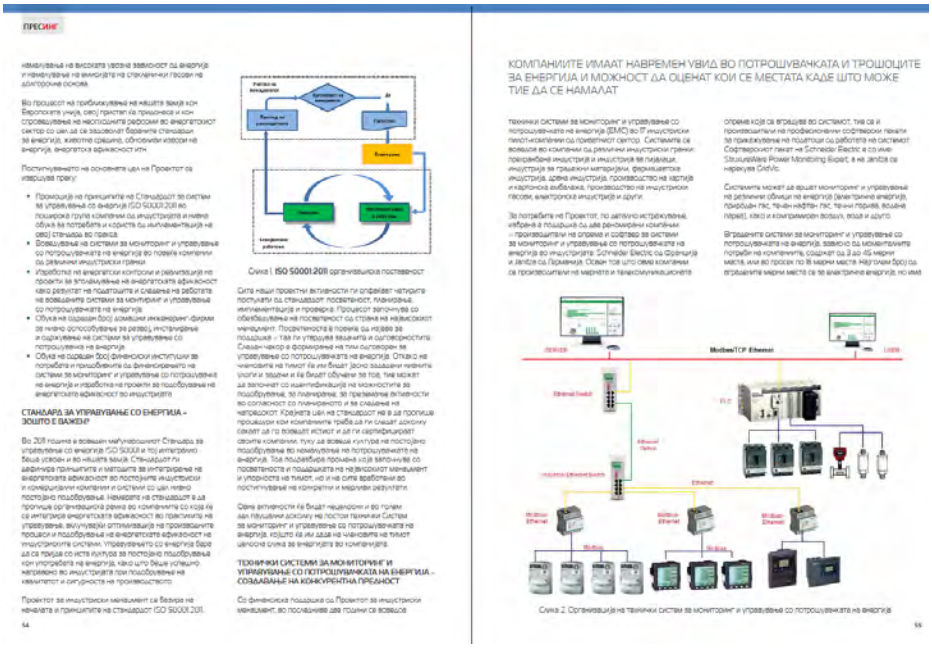
The project CoP had an interview on the National Macedonian Television morning program in October 2015 presenting the latest developments and achievements of the USAID Industrial Management Project and promoting the forthcoming round table held on October 28, 2015.



Picture 21: Print screen of the article published on: http://mrt.com.mk/node/24170

Interview in PRESING

In February 2016, the CoP Dragan Blazev had an interview in the monthly magazine *Presing* explaining the ISO 50001:2011 Standard for Energy Management Systems and gave an overview how the introduction of an Energy Management System helps companies improve bottom lines.



Picture 22: Article published in *Presing*

IMP appearance on TELMA television

As the Industrial Management Project has already started with the preparations for two USER training workshops, the project used the media to announce the events. The IMP Chief of Party was a guest on *TELMA* morning program on September 23, 2016. Besides presenting the project's activities that support local manufacturing companies increase their competitiveness through improved energy management practices, Mr. Blazev invited local industrial companies to participate on the workshops.

Picture 23: Print screen of the IMP CoP appearance on TELMA TV

IMP Project promotion on USAID country website & Facebook page

Over the course of the project, the USAID Macedonia website regularly posted news about the Industrial Management Project events, activities and presentations. The project also used the Facebook page of the USAID mission in Macedonia to timely inform the public about its activities. The link to the USAID Macedonia Facebook page is as follows:

https://www.facebook.com/USAIDMacedonia

USAID's Chief of Energy and Infrastructure Unit at the USAID's Bureau for Europe and Euroasia visits IMP's pilot company

Mr. Steven Burns, Chief in the *Energy and Infrastructure Unit* within the USAID's *Bureau for Europe and Euroasia* visited Hi-Tech Corporation in July 2016. It is one of the IMP pilot companies that constantly fosters a culture of continuous improvement through enhanced energy management practices. During the visit, Mr. Burns had a chance to become familiar with the operation of the energy management system installed in the factory as well as of the company's benefits gained from its use. Mr. Savo Stankovic, CEO of Hi-Tech Corporation explained how the EMS helped the company raise awareness about the need for rational energy use in the production plant. The staff is now better informed and educated about possible electricity savings and are encouraged and stimulated to make energy saving initiatives.

Picture 24: Hi-Tech Corporation staff explains Mr. Burns benefits from EMS installation

Pictures 25-26: Hi-Tech CEO Savo Stankovic meets USAID, IMP and Loging Electronics representatives

Final Closing Event

IMP marked its four-year successful implementation during the closing event organized in Skopje on December 22, 2016. Over 100 representatives of the business community, government institutions, and international organizations participated at the event. They were able to hear about the U.S. government's assistance to Macedonia's economy and environment through the implementation of the Industrial Management Project as well as about the project's impact on the improvement of the industrial competitiveness in the country, energy security strengthening, clean energy investments support, and mitigation of climate change effects by reducing greenhouse gas emissions. Three project beneficiaries shared their positive experience cooperating with the IMP, shared their lessons learned and discussed the benefits from energy management in industry.

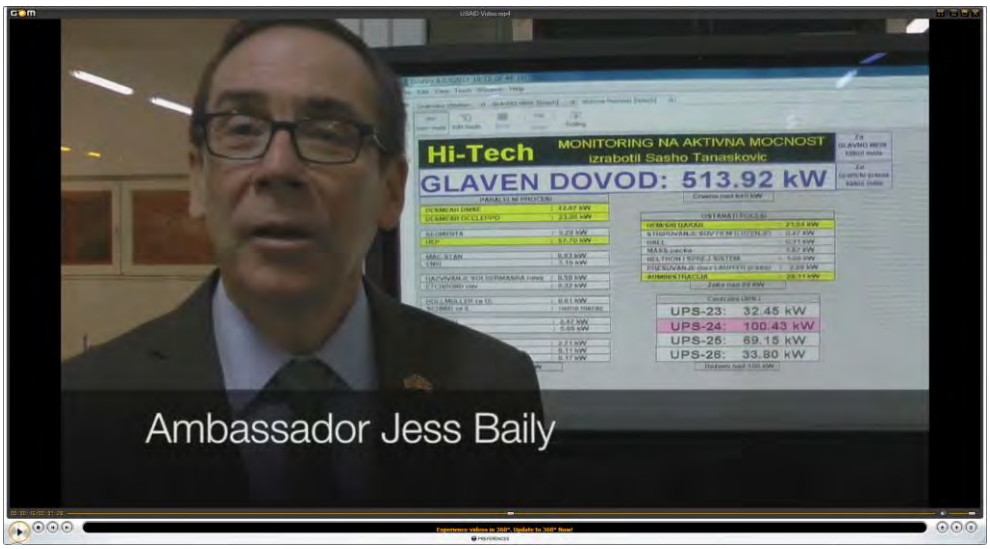
I would like to thank all the representatives from the private and public sector present at today's event. By learning from each other's experiences, sharing best practices, and discussing implementation strategies, I am sure you will see the value and potential of energy management, not just for your bottom line but for mankind.

We hope that that these successful results will inspire the broad use of energy management systems and energy efficiency upgrades throughout the industrial sector and we encourage the Government of Macedonia to facilitate investments in them. Doing so will not only help industrial companies to improve their competitiveness, but also help Macedonia to achieve energy security, greater private sector development, and a cleaner environment.

James Stein, USAID Mission Director for Macedonia at the closing event

Pictures 27-29: IMP Final Closing Event at Holiday Inn Hotel in Skopje

IMP presented a short video speech of the U.S. Ambassador Jess Baily filmed at Hi-Tech Corporation as one of the most successful pilot companies under the IMP portfolio. The Ambassador Baily stressed the accomplishments of the project and the importance of replicating IMP's results to every company in Macedonia.



Picture 30: The U.S. Ambassador video speech at Hi-Tech Corporation

6 PERFORMANCE MONITORING AND EVALUATION

The Industrial Management Project carried out continuous monitoring in order to ensure systematic assessment of the performance and progress of IMP interventions toward achievement of results. The IMP monitoring efforts track the technical assistance and resulting outcomes from IMP activities aimed to increase competitiveness of industrial companies through reduced production (energy) costs and to reduce GHG emission on a long-term basis. The Information obtained from the monitoring activities provides the project's management with an indication of the degree of project progress and is used as a basis for decision making and taking action in order to timely achieve the anticipated project results.

The monitoring process incorporates different methods to measure the outputs, outcomes and impact of IMP activities, such as structured questionnaires, surveys, regular visits and maintenance of good relationship with client companies, updated company profiles, etc. Once the necessary data is collected and analyzed, the project will produce different types of reports and statistics for presentation of the results.

The results of estimated energy savings and GHG emission reduction in 17 pilot companies is shown in the table below.

6.1 IMP progress against Performance Monitoring Plan Targets

In order to perform more efficient and effective monitoring, IMP developed a Performance Monitoring Plan that provides summarized information on the project components and deliverables, indicators for achievement, their definition, unit measure, disaggregation, data source and collection methods, timing and frequency of data collection, methods of analysis, and targets to be achieved. The project activities outlined in this report are organized on the following measurable project performance indicators:

1. **Percentage of reduced GHG emissions as a result of USG assistance** – The reduction in GHG emissions by pilot companies before and after the USG assistance is measured and recorded on annual basis. This indicator is measured in percentage after the implementation of energy efficiency measures, as a comparison between the actual and baseline GHG emissions. The results by the end of 2016 are provided in the table below. The result is a weighted average of estimated GHG emissions reduction in 17 pilot companies based on results estimated by energy efficiency upgrade projects. By the end of 2016, IMP estimated reduction of 17% GHG emissions.

2. **Number of companies that expressed interest for EMS implementation** – The project visited a number of companies that expressed interest to participate on the project. Total of 44 companies were subject to preparation of walk-through energy audits, cost specification and project plans for EMS implementation until contracts were signed with targeted 17 pilot companies.

3. **Number of companies that successfully install EMS as a result of USG assistance and cost-sharing** – This indicator defines the number of companies that signed contract for EMS

installation as a result of USG technical assistance and cost-sharing. Total of 17 pilot companies signed contracts for EMS implementation and all of them were completed by IMP accordingly.

4. **Percentage of energy savings in pilot companies** – The energy savings in assisted companies, measured as percentage of energy savings before and after measures is reported on annual basis after pilots' implementation. This indicator is calculated as a ratio of energy savings after implementation and the baseline condition. The result is a weighted average of estimated energy savings in 17 pilot companies. Additional data is provided for other energy savings besides electricity such as savings in heating energy, liquefied petroleum gas, light fuel oil, etc. By the end of 2016, IMP estimated reduction of 14% energy consumption.

5. **Value of investments for installation of EMS as a result of USG assistance** – Estimated investments for development and installation of EMS in selected companies as a result of USG technical assistance and cost-sharing. The investment includes procurement, installation, testing, training and commissioning of EMS at 17 pilot companies. It also includes cost for preparation and post implementation activities for EMS implementation. The total contracted value for EMS implementation in all 17 pilot companies commissioned by the end of 2015 amounted to $772,068.

6. **Number of organizations that received training on Energy Management, ISO 50001 and EE best practices** – IMP provided training to non-participant companies, other organizations and agencies on industrial energy management and ISO 50001 standard including best practices learned from demonstration projects. Non-participant companies are industrial companies from different industrial branches that meet criteria from IMP industrial analysis prepared during the project inception phase. The overall number of trainees by the end of 2016 is 165 representatives from 116 organizations.

7. **Number of person-days of training on Energy Management services for two local engineering companies (LEC)** – During the project implementation two local engineering companies received 90 person-days of training and practical experience on energy management project preparation, energy management system installation and maintenance and energy use data collection. A person-day is defined as 6 hours a day. The training included theoretical and practical part.

The table below provides an overview of IMP targets and performance by the end of the project.

Table 17: PMP Summary Table – Targets and Results for the four-year project period

#	Performance Indicator	Descriptioin	2013		2014		2015		2016		TOTAL	
			Targeted	Actual	Targeted	Actual*	Targeted	Actual	Targeted	Actual	Targeted	Actual
1	Percentage of reduced GHG emissions as a result of USG assistance	Cumulative percentage of reduced GHG emissions by pilot companies before and after USG assistance, as a comparison between actual and baseline GHG emissions. Weighted average of operational pilot projects results.	0%	0%	3%	TBD	7%	12%	n/a	17%	7%	17%
2	Number of companies that expressed interest for EMS implementation	Number of companies that expressed interest and received cost specifications & project plans for EMS implementation as result of project intervention.	15	17	10	15	0	12	n/a	n/a	25	44
3	Number of companies that successfully install EMS as a result of USG assistance and cost-sharing	Number of companies that signed contract for EMS installation as a result of USG assistance and cost-sharing.	10	7	7	4	0	6	n/a	n/a	17	17
4	Percentage of energy savings in pilot companies	Cumulative energy savings in assisted companies measured as percentage of energy savings before and after measures. Weighted average of operational pilot projects results.	0%	0%	3%	TBD	7%	8,5%	n/a	14%	7%	14%
5	Value of investments for installation of EMS as a result of USG assistance	Investments made for installation of EMS in selected companies as a result of USG technical assistance and cost-sharing.	$350.000	$375.552	$250.000	$183.616	0	$212.900	0	0	$600.000	$772.068
6	Number of organizations that received training on Energy Management, ISO 50001 standard and EE best practices	Number of organizations that received training on industrial energy management and ISO 50001 standard including best practices learned from demonstration projects.	5	20	20	39	20	27	0	30	45	116
7	Number of person days of training on Energy Management services for two local engineering companies (LEC)	Number of person days of training and practical experience on energy management project preparation, energy management system installation and maintenance and energy use data collection that local engineering companies received.	0	0	60	60	0	0	0	30	60	90

Notes:

Indicator 1: Percentage of reduced GHG emissions is calculated as a weighted average of total energy savings from 17 pilot companies.

Indicator 4: Percentage of energy savings is calculated as a weighted average of operational control and energy efficiency investments in 17 pilot companies.

Indicator 5:

- Value of investments of EMS in 2013 is for 7 pilot companies: Alkaloid, Hi-Tech Corporation, Makprogres, Knauf Radika, Promes, Specijal Produkt, and Vivaks
- Value of investments of EMS in 2014 is for 4 pilot companies: Mlekara Zdravje Radovo, Veze Sharri, Nova Refraktori, and DS Smith
- Value of investments of EMS in 2015 is for 6 pilot companies: Kadino Industry Group, Kolid International, Messer Vardar Tehnogas, Swisslion, Mermeren Kombinat Prilep, and DIK Fagus

ANNEX 1

IMP Success Stories:

1) Alkaloid: Energy efficiency refurbishment of laboratory building
2) Nova Refraktori: Fuel switch
3) Kolid International: LPG installations, underground reservoir, new equipment for gas boiler station, HVAC system introduction and replacement of existing lighting by LED lighting
4) Kadino Industry Group: Soft motor starters and automation of large electric drives, and independent off-grid photovoltaic power plant
5) Messer Vardar Tehnogas: Power Quality Improvement Project
6) Makprogres: Off-grid solar photovoltaic plant
7) DIK Fagus: Off-grid solar photovoltaic plant
8) Hi-Tech Corporation: Power Quality Improvement Project
9) DS Smith: New location of axial ventilators, replacement of existing steam heating system by new gas-fired infrared heaters, replacement of insulation of steam and condesate installations, and replacement of steam boiler unit
10) Zdravje Radovo: Repair and insulation of main steam pipelines, and replacement of boiler unit
11) Veze Sharri: Reactive power compensation and tariff software application upgrade

USAID FROM THE AMERICAN PEOPLE

INDUSTRIAL MANAGEMENT PROJECT

Alkaloid AD Skopje invests in energy efficiency refurbishment of laboratory building

The leading Macedonian pharmaceutical company Alkaloid AD Skopje has over 80-year experience in the field of manufacturing drugs, cosmetic, chemical products, and processing of raw materials. As a company with around 1,250 employees in the country and 350 employees in subsidiaries and representative offices abroad, Alkaloid is constantly devoted to improved performance and increased environmental protection.

With USAID Industrial Management Project (IMP) assistance, Alkaloid AD Skopje successfully implemented a cost-shared Energy Management System for monitoring of the company's energy consumption. Following six months of monitoring consumption, the project provided technical assistance to the company in preparation of a detailed energy audit and application for financial support for renovation of a laboratory building in the company's compound.

The objective of the *Energy Audit* was to analyze and recommend the most cost effective measures for energy efficiency improvement in the company's industrial laboratory building based on the baseline energy consumption and the existing condition of the building. The project included a detailed examination of the building, analysis and estimation of the present condition, as well as presentation of various measures for reduction of energy consumption and indoor comfort improvement. Proposed measures suggested attractive energy savings, high profitability, and reduced greenhouse gases emissions.

Taking into account the recommendations provided in this audit, Alkaloid decided to apply a building envelope thermal insulation on the industrial laboratory, which included: installation of thermal insulation on outside walls, construction of new roof with thermal insulation, and installation of new energy efficient windows.

For this purpose, IMP provided an access to financial support by preparing a *financing eligibility assessment* for this particular project. The company selected the EBRD's WeBSEFF II regional financing facility as the most viable option to request financial support for implementation of the energy efficiency improvement project.

Investment	EUR 200,000
Annual Monetary Savings	EUR/a 44,739
Energy Savings Ratio	36.8 % (774.90 MWh/a)
Internal Rate of Return	22.3 %
Payback Period	4.5 years
GHG Emission Reduction Ratio	30.1 % (319,746 kg CO_2/a)

The implementation of the project reduced the energy costs and pollution to environment caused by burning fossil fuels to generate electricity and natural gas in the company, resulting in benefits to local and global environment.

Photo: Renovated laboratory building at Alkaloid AD

USAID FROM THE AMERICAN PEOPLE

INDUSTRIAL MANAGEMENT PROJECT

Fuel switch at Nova Refraktori brings energy cost savings and paying back the investment in up to two and a half years

Nova Refraktori is a manufacturing company that produces fireproof ceramic products including roof tiles, bricks, fire resistant bricks, and porcelain. The production is based in Pehcevo in southeast Macedonia.

Located far from the existing primary gas pipeline in the country, it is necessary for the company to seek for solution to enable utilization of a "green" and economically sustainable energy alternative to meet its high energy demand. This issue may be resolved by utilization of Liquefied Petroleum Gas (LPG) and Compressed Natural Gas (CNG) as ecologically justified fuels.

Following the successful implementation of the cost-shared Energy Management System in the production plant, the management board asked the USAID Industrial Management Project for technical assistance in developing a Fuel Switch Investment Study. The study examines opportunities for energy savings by substitution of Light Fuel Oil (LFO) with gas oils - LPG or CNG for primary energy use in their factory.

The first model refers to substitution of currently used LFO to LPG, and includes three scenarios with different average annual LFO consumption. The total investment cost required for implementation of this model is €707,000 (without VAT), while the estimated results are shown in the table below.

The second model implies substitution of LFO with CNG. The total investment cost for implementation of this model is 714,500 € (without VAT).

Both models show that these are extraordinary cost-effective investments. The other benefits include reduced time of the firing period of about three hours and the improved utilization of energy required for space heating and energy that is currently used in the boiler plant. Implementation of these measures can result in total cost savings for more than 10-15%. Nova Refraktori expects that realization of these measures will improve the competitiveness of production and cost-effectiveness of the factory.

In addition to these benefits, the investment opportunity will provide number of ecological achievements. Considering that the factory is located in an urban area, this investment is important for both the micro environment on the factory site and the entire urban area, as well.

	Unit	Scenario 1	Scenario 2	Scenario 3
Before fuel switch				
1. Light Fuel Oil (LFO)	t/a	1,000	1,500	2,269.5
2. Unit price (LFO)	€/t	803	803	803
3. Total cost (LFO)	€/a	803,000	1,204,500	1,822.408
4. CO_2 Emissions	t/a	3,113	4,670	7,065
After fuel switch				
1. Liquefied Petroleum Gas (LPG)	t/a	805	1,208	1,828
2. Unit price free of excise tax (LPG)	€/t	634	634	634
3. Total cost (LPG)	€/a	510,370	765,872	1,158.952
4. CO_2 Emissions	t/a	2,645	3,970	6,007
Output				
≠ Cost savings	€/a	292,630	438,628	663,456
≠ Payback period	years	2.42	1.61	1.07
≠ Internal Rate of Return (IRR)	%	41.4	62.2	94.1
≠ Net Present Value (NPV)	€	2,929,837	4,747,458	7,544,980
≠ CO_2 emissions reduction	t/a (%)	468 (15.0)	700 (15.0)	1,058 (15.0)

USAID FROM THE AMERICAN PEOPLE

INDUSTRIAL MANAGEMENT PROJECT

Energy Savings by installing LPG equipment, HVAC system and new LED lighting in Kolid International confectionery plant

Led by customers' satisfaction as its utmost priority, the Macedonian producer and distributor of confectionery products *Kolid International* continuously strives to offer a variety of high quality products at affordable prices. In order to do so, the company based in Koleshino village nearby Strumica, considers various ways to increase its efficiency, reduce costs, and enhance market competitiveness.

With the support of the USAID Industrial Management Project, the company implemented an Energy Management System to perform key energy management functions such as identifying energy consumption anomalies, optimizing energy demand, and managing energy costs. As a result of energy consumption monitoring, the USAID Industrial Management Project prepared several mechanical and electrical basic engineering design projects as technical assistance that not only increased Kolid's competitiveness on the market, but also brought positive environmental mitigation and improved working environment. The design projects include:

I. Mechanical Basic Engineering Design for LPG storage for the evaporation plant and LPG installations in the production plant.

II. Mechanical Basic Engineering Design for LPG underground reservoir including installations and new equipment for a gas boiler station to provide heating of administrative facilities.

Photo: Power meters for incoming power supply feeder, chiller at warehouse and new cake facility

The main purpose is to improve the working conditions for employees in the production plant.

III. Mechanical Basic Engineering Design for heating, ventilation, and air-conditioning (HVAC system) in the production plant.

IV. Electrical Basic Engineering Design for replacement of existing electric lighting with LED lighting in the production plant.

The energy savings potential and investment profitability with implementation of all four sub-projects are shown below.

Kolid International used the engineering designs to apply for a building permit. Three sub-projects are already implemented and fully financed by the company from its own resources.

Kolid International Energy Efficiency Project Upgrade							
Investment type		Energy consumption		Payback	NPV	IRR	CO_2 reduction
Energy Efficiency Sub-projects	Investment cost (EUR)	Energy type	Monetary Savings (EUR/a)	Years	EUR	%	kg CO_2/a
1) LPG storage and installations	30,500	Liquefied Petroleum Gas (LPG)	3,512	8.7	23,340	11.0	8,512
2) Underground LPG reservoir and new equipment for gas boiler station	8,000		549	14.5	416	5.5	1,230
3) HVAC system	55,000		/	/	/	/	/
4) Lighting replacement	5,600	Electricity	3,585	1.56	49,359	64.0	19,682
Total:	**99,100**		**7,648**				**29,424**

Reduced energy cost by investment in optimal energy efficiency opportunities at Kadino Industry Group

Kadino Industry Group is a company with a 23 years long tradition in production of milling products, freshly frozen filo pies, and filo pastries (traditional burek). Today, Kadino has a modern milling capacity for 70 tones of processed wheat within 24 hours, with 50 full-time and 50 part-time staff. The vision of the company owners is the company to grow into large international organization.

The USAID Industrial Management Project assistance to Kadino Industry Group was twofold: the project successfully implemented a cost-shared Energy Management System,, and following a twelve months of monitoring electricity consumptionprovided technical assistance in preparation of a cost-benefit study for assessment of optimal energy efficiency sub-projects in the company.

The proposed sub-projects are as follows:

Sub-project 1: Soft motor starters and automation of large electric drives - a financially attractive measure with a good return. Due to the substantial savings from both active energy consumption (25,000 kWh on average p.a.) and compensation in peak power in the first 2 years, it is expected that the investment return period will be between 6 and 7 years. The Net Present Value of €10,000 or 28% from invested capital is significant. The internal rate of return is 16%. This rate presents an average return for the project which indicates that the project profitability has a reserve over the average cost of capital of 10%.

Sub-project 2: Independent (off-grid) photovoltaic power plant - represents a system to generate electricity from a renewable energy source for self-consumption. The sub-project 2 distinguishes two essential drivers of energy savings and thus financial benefits:

- Savings from decreased purchase of active energy, which due to electricity generated from the photovoltaic plant. The annual production is approximately 110,000 kWh with annual cost savings in the range of €9,000 to €11,000.
- Avoided compensation for peak power service charge during 2016-2017 of 100 kW peak demand. The annual savings amount to €12,000 or €24,000 for the two year period (2016-2017).

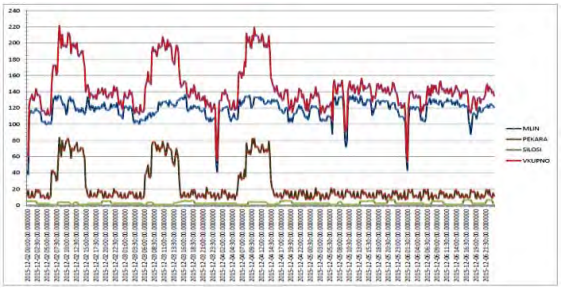


Figure: Weekly electricity consumption in Kadino

Sub-project 3: Plant for combined heat and power (CHP) generation - an innovative and modern concept in industrial practice in Macedonia. This investment includes a plant for combined heat and power energy production, run on compressed natural gas (CNG). This is a financially attractive measure that has sound return on investment.. The projected NPV is €106,500 or 49% from initial investment. The cumulative cash flow is expected to be positive during the 8th year. The internal rate of return at 16.4% is very attractive. However, the project execution depends on the final negotiations with the heat user (adjacent factory) and pending to be completed in 2017.

Electricity Savings by Power Quality Improvement Measures at Messer Vardar Tehnogas

The Messer Group, based in Germany, is one of the leading manufactures and suppliers of oxygen, nitrogen, argon, carbon dioxide, hydrogen, helium, inert welding gases, special gases, gases for medicinal use, and a wide variety of gas mixtures to various industries. It supplies various industries with its products including the steel and metal, , chemical, food and pharmaceutical, autommotive, electronics , medical, and environmental..

As a branch company established in Macedonia in 1997, Messer Vardar Tehnogas manufactures and supplies carbon dioxide and freon to the local market.

The USAID Industrial Management Project (IMP) provided technical assistance for reduction of the company's electricity consumption and cost. IMP offered the company an intergrated approach, which was composed of 1) implementation of Energy Management System (EMS) at its production facility in Bitola; and 2) follow-up technical assistance for development of customized energy saving opportunities based on EMS data collection and analyses. The objective of the IMP technical support was to reduce kW demand by real-time reactive power compensation and optimization of voltage parameters.

The technical solution that the project team proposed to the company was installation of Equalizer, a transient-free power factor compensation system. Introduction of the Equalizer at each of the two transformer units in the power substation, results in **e**lectricity savings due to current spike reduction, reduction in harmonic distortion, and reduction in voltage level at transformer units.

The total electricity savings potential at transformer unit 1 by installation of the Equalizer *EQ300kVAr* is estimated at 3.27% (by voltage level reduction of -2.5%) and 7.81% (by voltage level reduction of -5%). The electricity savings potential at transformer unit 2 by installation of the Equalizer *EQ660kVAr* is estimated at 5.04% (by voltage level reduction of -2.5%) and 9.52% (by voltage level reduction of -5%).

Photo: Equalizer

The profitability parameters resulting from installation of the Equalizer at both transformer units, per scenarios (-2.5% and -5% voltage level correction) are shown in the table below.

Messer Vardar Tehnogas intends to invest its own equity funds for Equalizer's implementation.

By reducing energy consumption, the company will reduce both energy costs and CO_2 emissions that impact climate change. In so doing, Messer Vardar Tehnogas will not only increase its competitiveness, but also help the environment.

TR1, (EQ300kVAr)	Investment without VAT (EUR)	Payback period (years)	Net Present Value (NPV) (EUR)	Internal Rate of Return (IRR) (%)
Scenario 1	20,500	13.8	- 2,056	3.8
Scenario 2		5.8	23,526	16.4
TR2, (EQ660kVAr)	**Investment without VAT (EUR)**	**Payback period (years)**	**Net Present Value (NPV) (EUR)**	**Internal Rate of Return (IRR) (%)**
Scenario 1	29,850	3.3	83,834	30.5
Scenario 2		1.8	176,438	55.6

The calculations are made based on equipment's economic lifetime of 20 years and real discount rate of 5%.

Confectionery industry installs energy management system and designs off-grid solar PV plant for electricity self-consumption

Makprogres is a privately owned manufacturing company that produces confectionary and processed agricultural grains. The company has over 300 employees.

The total electricity consumption of Makprogres is around 3,600 MWh/a. The majority of electricity is used for lighting, cooling, electric appliances, and motor drives. The production facilities (mills) comprise of production lines operating by use of LPG in tunnel furnaces. The LPG consumption is about 60,000 kg/month or 720 tonnes/year. The energy cost is about 4% of the total production cost.

In 2014, Makprogres became a pilot company for Energy Management System (EMS) implementation by joining the portfolio of 17 industrial companies financially supported by IMP. As a large energy consumer, the company installed EMS to monitor the electricity and liquefied petroleum gas consumption that feed the entire manufacturing complex. As a a beneficiary company, the management approached and requested IMP to prepare a feasibility study and a detailed design project for development of a photovoltaic power plant on the plants' rooftops. The designed capacity of the PV plant is 250 kW.

IMP developed a feasibility study and a detailed design project that covers the rooftops of three facilities with a total available area of about 2,000 m². The PV plant is made of poly crystalline modules that are fixed on the rooftops. The project includes:

Figure: Dashboard of the software package for electricity consumption in Makprogres production facilities

- Photovoltaic modules installed on fixed metal construction on rooftops
- 10 three-phase 25 kW invertors with output voltage of 0.4 kV
- Connection cables
- 0.4 kV switchgear in the new substation of 10(20)/0.4 kV; 1000 kVA

Input information on solar irradiation is used from data made available by the EU Joint Research Center for various locations in Europe. The estimated average annual electricity generation is about 280,000 kWh, while the total estimated cost for the PV plant amounts to EUR 250,000 without VAT.

The feasibility study analyzes three scenarios. The financial indicators are shown in the summary table below.

The management board will decide on which scenario to pursue. The intention of the management board is to finance implementation of the PV Plant from its own equity.

	Scenario	Payback (years)	NPV (EUR)	IRR (EUR)
Scenario 1:	PV Plant with preferential status of electricity generator	7.4	222,412	12.8
Scenario 2:	PV Plant electricity generation is used only for in-house consumption while the company is an eligible consumer on the open electricity market	15.4	- 21,583	4.1
Scenario 3:	Scenario 2; the excess generated electricity is delivered to power distribution grid of EVN Macedonia	14.6	- 8,592	4.7

INDUSTRIAL MANAGEMENT PROJECT

Furniture company installs energy management system and designs off-grid solar PV plant for electricity self-consumption

DIK Fagus is a privately owned company that processes wood and produces high quality furniture from beech wood. DIK Fagus is one of the leading furniture production companies in the country, and it is fully export oriented. With over 300 employees, it is the largest company in the city of Pehcevo and the southeast region.

Photo: DIK Fagus (www.fagus.mk)

In 2015, DIK Fagus implemented an Energy Management System (EMS) and joined the portfolio of 17 industrial companies financially supported by USAID through the Industrial Management Project (IMP). As a large electricity consumer, the company installed EMS to monitor electricity consumption from two substations that feed the entire industrial compound. At the owner's request, IMP prepared a feasibility study and a detailed design project for construction of a photovoltaic power plant (PV) on a company's plant rooftop. The designed capacity of the PV plant is 250 kW.

The PV plant will cover a rooftop area of 1,716 m². It is made of poly crystalline modules that are fixed on metal construction on the rooftop.

The project includes:

- Photovoltaic modules installed on fixed metal construction
- 10 three-phase 25 kW invertors with output voltage of 0.4 kV
- Connection cables
- 0.4 kV switchgear in the existing substation

Input information on solar irradiation is used from data made available by the EU Joint Research Center for various locations in Europe. The estimated average annual electricity generation is about 296,000 kWh, while the total estimated cost for the PV plant is around EUR 252,000, without VAT.

The feasibility study analyzes four scenarios. The financial indicators are shown in the summary table.

The company expressed interest to finance implementation of the PV Plant by its own equity.

In addition, the IMP developed a report on Macedonia Photovoltaic Plants – current status and future opportunities for project development. The report should help the management to better understand the PV development status in the country and make informed decision.

	Scenario Description	Payback (years)	Net Present Value(EUR)	Internal Rate of Return (%)
Scenario 1:	PV Plant with preferential status of electricity generator	7.1	247,407	13.5
Scenario 2:	PV Plant electricity generation used for in-house consumption while the company is a tariff electricity consumer	7.5	223,041	12.7
Scenario 3:	Scenario 2; with the excess generated electricity delivered to power distribution grid	7.1	247,126	13.5
Scenario 4:	The company is eligible customer and supplies electricity on the open market; PV Plant electricity generation is used for in-house consumption while excess generation is delivered to grid	12.9	22,351	5.9

USAID FROM THE AMERICAN PEOPLE

INDUSTRIAL MANAGEMENT PROJECT

Electricity Savings by Power Quality Improvement Measures at Hi-Tech Corporation

Hi-Tech Corporation manufactures prototypes and series of Rigid, Flex and Rigid-Flex Printed Circuit Boards (PCB) up to 36 layers. The company is a successful business which sales on the European and U.S. markets. The company exports almost 100% of its PCB production to customers from automotive, telecommunications, consumer and industrial electronics, power, and medical markets.

As the company's energy cost accounts for 16.4% of the total annual production cost. Hi-Tech Corporation priority is efficient energy management and rational energy use.

Through the Industrial Management Project, the USAID supported the implementation of the Energy Management System (EMS) at Hi-Tech Corporation. Based on energy performance monitoring of the company's production facility in Oreshani, a village nearby Skopje, IMP applied an intergrated approach to develop a targeted state-of-the-art, energy saving solution which is based on power quality improvement measurements, cost-benefit analysis, and simulated results.

IMP team proposed an Equalizer, a transient-free power factor compensation system as the technical solution for electricity savings at Hi-Tech Corporation.

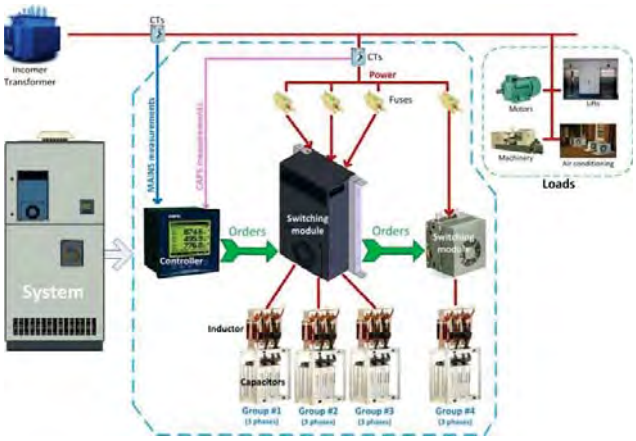


Photo1: Energy Management System at Hi-Tech Corp.

The implementation of the Equalizer at substation level will result in electricity savings due to current spike reduction, reduction in harmonic distortion, and reduction in voltage level at transformer units.

Table 1: Total electricity savings by voltage level reduction of -2.5%

Parameter correction	Savings (%)
Current reduction	**-0.03%**
Harmonic distortion reduction	**N.A.**
Voltage level reduction at -2,5%	**-3.34%**
TOTAL ESTIMATED ELECTRICITY SAVINGS	**-3.37%**

Table 2: Profitability parameters from installing Equalizer EQ210kVAr at transformer unit

Power transformer unit 10 (20)/0,4 kV; 1000 kVA	Investment (EQ210kVAr) without VAT (EUR)	Payback period (years)	Net Present Value (NPV) (EUR)	Internal Rate of Return (IRR) (%)
Voltage correction-2.5%, electricity savings 3.37%	**13,850**	**1.2**	**131,353**	**84.3**

The calculations are made based on equipment's economic lifetime of 20 years, and a real discount rate of 5%.

Photo2: Energy Management System Software

USAID FROM THE AMERICAN PEOPLE

INDUSTRIAL MANAGEMENT PROJECT

DS Smith AD introduces energy management practices to reduce energy consumption and contribute to cleaner environment

DS Smith AD Skopje is a corrugated packaging and paper recycling manufacturer. It is a member of *DS Smith Group* - the leading European provider of corrugated and plastic packaging, supported by paper and recycling operations worldwide. DS Smith Skopje has annual revenue of €10 million and 121 employees.

The company's energy costs accounts for about 9% of its total annual production costs. As eligible electricity buyer on the liberalized electricity market, DS Smith AD Skopje is committed to finding solutions and implementing measures that could improve its energy efficiency. In this regard, the USAID Industrial Management Project (IMP) supported DS Smith AD Skopje in the installation of an Energy Management System that helps the company to continuously monitor its energy consumption, which includes electricity, natural gas, water steam, and compressed air. IMP assisted the company to identify and recommend the most cost effective measures for energy efficiency improvement in its corporate administration building. The results from the energy auditing of the building show an energy savings of 277 MWh/year and an investment payback of less than 7 years. The CO_2 emissions reduction achieved by implementation of all measures is estimated at 136.4 tonnes/year.

Following twelve months of monitoring, IMP assisted the company to identify opportunities for energy savings and CO_2 emission reduction, and provided recommendations for improvement in their industrial plant and boiler house. The feasibility study identified the following key opportunities:

1. Energy efficiency improvement of the Heating, Ventilation, and Air Conditioning (HVAC) system in the industrial plant with an investment of €91,750, annual natural gas savings of 51,720 Nm^3, annual cost savings of €20,375 and payback of 4.5 years;
2. Analysis of pneumatic system for waste transport with an investment of €150,000, annual natural gas savings of 34,700 Nm^3, annual cost savings of €13,670 and payback of 11 years;
3. Supply of new equipment for operation on light fuel oil or natural gas in the boiler house with an investment of €98,500, annual cost savings of €20,410 and payback of 4.8 years.

Based on IMP's technical assistance, the company's management decided to build fully automated high energy efficiency boiler room inside the factory, which shall further reduce their energy distribution costs.

Based on the knowledge gained through trainings facilitated by IMP, the company's management decided to implement the ISO 50001:2011 Energy Management Standard in near future.

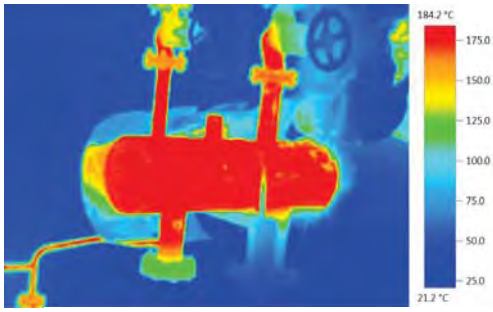


Photo: Heat loss in the steam distribution system and its thermal insulation

Optimal energy efficiency project opportunities increase competitiveness at dairy factory of Zdravje Radovo

During their 14 years of existence, the regional producer and one of the largest dairies in Macedonia, Mlekara Zdravje Radovo puts significant effort into continuous product development and enlargement of its product range of over 60 dairy products. Today, Zdravje Radovo Dairy located in Kumanovo, is a leader in the sale of white cheeses, with a market share of over 60%. The company is also among the top sellers of yellow cheeses, and sour-milk products e that includes yoghurts, sour cream and soured milk.

With USAID cost-sharing support, the company installed an Energy Management System for monitoring of its electricity consumption. In addition, the USAID Industrial Management Project helped the company formulate, financially evaluate, and rank several alternative measures (projects) which would improve the efficiency of the company production processes, increase stability in heat and power energy consumption, and reduce company production cost. The study elaborates the engineering concepts for three measures:

1. Repair and insulation of the main steam pipelines from the boiler plant to two production plants for sour-milk products and cheese. This measure, with capital budget for initial investment of €10,500, helps the company to increase savings from heat energy losses that occurs due to aged and damaged insulation of the steam pipelines. By implementing this measure, the loss from distributing thermal energy is decreased by 75-80%. The measure was implemented in November 2016.

2. Investment in replacement of the existing boiler with a new high efficiency boiler with efficiency of at least 95%.

Photo: Measuring point of electricity in Radovo plant

This results in savings in efficiency between the existing and the new boiler plant, as well as the total maintenance costs. The total capital budget for this measure is €53,500, while, the return of investment is projected to be up to 3 years. The Net Present Value of 2.25 times of the initial investment makes this measure extremely cost effective. The internal rate of return is significant at 44%, which indicates a high return and low level of risk in the implementation of the project and certain volatility in key financial variables: investment amount, O&M cost savings, and cost of capital.

3. Investment in a plant for combined heat and power energy production (CHP) for individual use. This CHP plant is planned to run on compressed natural gas that should lead to significantly reduced costs per energy unit. However, due to: (i) t significant capital budget of nearly €210,000, (ii) very low cost of current electricity price, and (iii) uneven demand in heat and power requirements, the ROI is unattractive and project execution has been postponed.

Reactive power compensation and tariff software application upgrade improves energy management practices at Veze Sharri

One of the leading domestic poultry companies Veze Sharri, successfully has sold its products on the local and regional markets for more than 15 years. In 2007, the company extended their business operations by establishing its daughter company Lecker, which processes chicken and beef with use of domestic raw materials. In 2015, Veze Sharri built the first biogas power plant in Macedonia, with an installed capacity of 1 MW.

The USAID Industrial Management Project (IMP) helped install an Energy Management System at Veze Sharri. The project committed to provide targeted technical assistance that will help the company to reduce electricity consumption and related costs. The support was focused in two areas:

1. IMP prepared an engineering design for an automatic reactive power compensation system for the Elektro Sharri biogas production plant. The system provides automatic control of compensation units, thus maintaining the power factor close to a value of 1.

   Based on the collected data for generated reactive power at Elektro Sharri,, the capacity of the compensation system was determined at 125 kVAr. The system is designed with automatic relay that has 6 steps of control. The investment in this system has payed of itself in less than 1 year.

2. Following the implementation of the energy management system at Veze Sharri, the company collected data and analyzed the electricity consumption at all three production units - Lecker, Poultry Farm, and Elektro Sharri.

Photo: Panel board with power meters in Lecker meat factory

In order for the company to have clear idea of electricity consumption, IMP provided technical support for development of a custom-made upgrade to the existing software package that generates electricity consumption by tariffs, as follows:

- High (day) tariff: 7:00 AM – 10:00 PM Monday – Saturday
- Low (night) tariff: 10:00 PM – 7:00 AM Monday – Saturday
- Low tariff: 0:00 AM – 24:00 PM Sunday

The upgraded software application helps the management and technical staff to have better understanding of the power distribution and electricity consumption in each production plant.