Miralem HADŽISELIMOVIĆ[1,2], Marko HABJANIČ[1], Stane BOŽIČNIK[3], Tomislav LETNIK[3], Bojan ŠTUMBERGER[1,2], Sebastijan SEME[1,2]

University of Maribor, Faculty of Energy Technology, Krsko, Hočevarjev trg 1, Slovenia (1),
University of Maribor, Faculty of Electrical Engineering and Computer Science, Maribor, Smetanova ulica 17, Slovenia (2)
University of Maribor, Faculty of Civil Engineering, Maribor, Smetanova ulica 17, Slovenia (3)

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The management and implementation of energy audits of small and medium enterprises

Abstract *Energy audits have become in recent years a basic tool for determining the current energy situation in the facility and determining the energy balances in the technological processes. It allows us, with the information about the current energy state, to set the objectives for the implementation of energy efficiency measures in a building or technological process. A way to carry out an energy audit is determined by the methodology issued by the Ministry of environment and spatial planning. Management, experiential decision making for appropriate measures largely depends on the experience and technical expertise of individual operators. In the new Energy Act is determined, that larger companies, as those defined in the regulations in the field of commercial companies implement energy audits every four years.*

Streszczenie. *Audyty energetyczne stały sie w ostatnich latach podstawowym narzędziem, pozwalającym określić stan energetyczny urządzenia oraz równowagę energetyczną w procesie technologicznym. Zezwala to, razem z informacją o bieżącym stanie energetycznym, ustanowić wskaźniki do zaimplementowania w pomiarach sprawności energetycznej w budownictwie lub procesach technologicznych. Sposób prowadzenia audytu energetycznego określony jest przez Ministerstwo Środowiska I Planowania Przestrzennego w Słowenii. Zarządzanie oparte na decyzji doświadczeniowej w dużym stopniu zależy od doświadczenia indywidualnych operatorów. W nowym Akcie Energetycznym (Słowenia) wskazano, że większe przedsiębiorstwa, jak te zdefiniowane w przepisach o przedsiębiorstwach komeryjnych, poddane są audytowi energetycznemu c cztery lata. (**Zarządzanie I implementacja audytów energetycznych w małych I średnich przedsiębiorstwach**).*

Keywords: energy efficiency, energy management, key performance indicator, small and medium enterprises.
Słowa kluczowe: sprawność energetyczna, zarządzanie energią, wskaźnik kluczowego działania, małe I średnie przedsiębiorstwa

Introduction

In the majority of companies, the energy represents one of the most important controllable costs. There are many possibilities for reducing energy consumption and thus energy costs. Achieved savings directly increase the standard of living in households, they raise the profits in enterprises and furthermore the reduction of energy consumption which brings significant benefits for the environment. [1]

Since we are talking primarily about energy consumption, the question arises whether it is possible to consume energy at all. From the physical point of view, this is not possible. The energy is not generated or consumed, also there is not more or less energy, and the energy is only converted to another form. In practice, there are forms of energy that are very effective and useful in many applications (e.g. process steam), and such forms of energy that are not so effective (e.g. low-temperature heat). If we summarize, when talking about energy consumption we mainly mean the use of high quality energy with conversion to waste heat. If we consume more energy of a certain form than is actually needed, the rest (surplus) does not disappear, but is transformed into low quality form of energy and is thereby devaluated. Under the term »consumption and waste of energy« we thus mainly mean the unnecessary devaluation of the high-quality forms of energy. [1]

Fig 1: How to determine the consumption, reduce costs and be competitive

Would you want to minimize the costs for energy and be competitive on the market? I think the question is redundant, I believe that very little percent of people would not want this. On the other hand, the studies shows that the potentials for energy savings and thus cost reductions are mostly unexploited. This applies to households and even more for the industry, where the potential energy savings, especially in technological processes, are very significant. Many of the measures that would make potentials become apparent or already achievable do not actually require significant investment, but smaller cash contributions and costs (e.g. for industry, this applies for identifying and eliminating leaks of compressed air, the efficient use of electric motor drives...). [1]

Possibilities for efficient use of energy and energy savings

Low energy consumption also means lower costs. Therefore the energy saving benefits primarily those who are saving with energy. In Slovenia we have adopted the Regulation about efficient energy use in Buildings (published in the Official gazette of Republic of Slovenia no. 93/2008), which specifies the requirements for thermal performance of buildings, power generators (heating / cooling), use of renewable energy sources, technical requirements for ventilation and air-conditioning systems, lighting, etc.. Different techniques and measures by which we can check the energy efficiency of built-in materials as well as the functioning of individual systems, enables us the determination of project solutions and implementation of performance analyses of individual energy consuming devices. In this segment, we talk about energy efficiency measures that can be defined through the review of the entire building in terms of built-in materials and the review of all energy-consuming systems. Thus, we are talking about an energy review, which includes a review of the building, all the systems in a building and in the business environment as well as an overview of the energy consumption in technological processes, and proposes measures to increase energy efficiency. [1], [2]

Energy management

After the implementation of an energy audit, energy consumption should be monitored in the context of pursued objectives in certain measures of an energy audit. For example, if there were some organizational measures defined, it is necessary to identify them within the energy consumption monitoring (in terms of lower energy consumption). [1], [2]

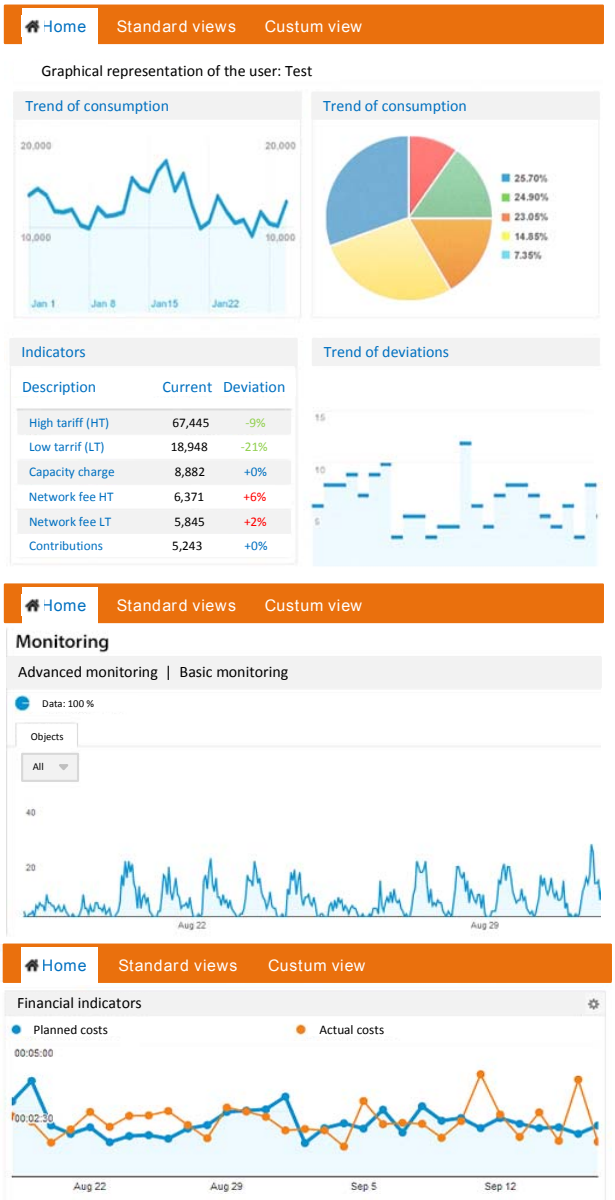

Fig 2 An example display of an energy information system

Energy management is thus a necessary measure during an energy audit and after, but requires some specific knowledge and experience. In general, operators of buildings and managers of enterprises lack of such knowledge, so they can opt for external companies that are offering professional counseling and help in this segment and are offering, as an external service provider, so-called energy management. Within the implementation of these services a person is identified (energy manager) responsible for energy management with an appropriate specific knowledge background. Energy manager is responsible for monitoring, supervising and implementing energy efficiency measures in the context of certain technological processes and technical aids. [1], [2]

Another option is the adoption of the company decisions to deploy the standard BS EN ISO 50001:2011, which enables companies to establish themselves an effective energy management system. [3]

The basic principles for management and control of energy consumption are the management of energy accounting and installation of control and energy management systems. In addition to these tools, some other approaches are also important, such as the determination of energy efficiency indicators targeted monitoring of energy consumption and the establishment of an energy information system. [2], [4]

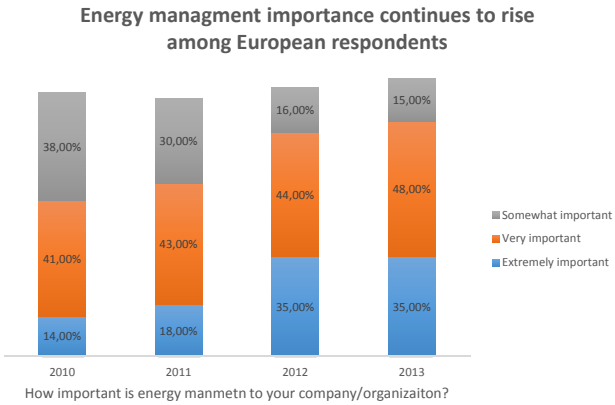

Fig 3 Importance of energy management in Europe [5]

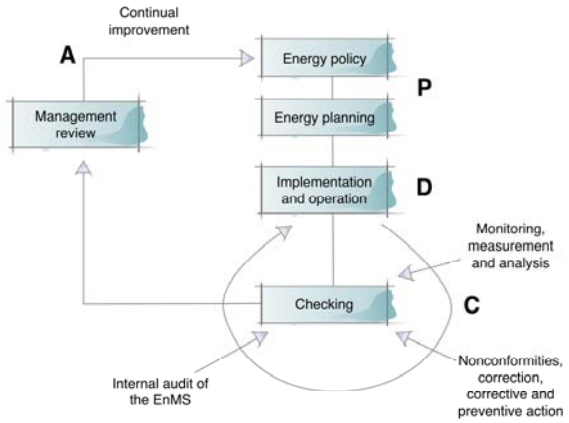

Fig 4: Presentation of the basic processes in the context of the implementation of the standard SIST EN ISO 50001:2011 and the PDCA cycle (Plan-Do-Check-Act)

About energy efficiency indicators

Energy efficiency indicators are an important tool for analysing the interactions among economic and human activity, energy use and CO2 emissions. International Energy Agency (IEA) is an autonomous organisation, which works to ensure reliable, affordable and clean energy. The main objectives of IEA are also to identify the main sectorial indicators and the data needed to develop these indicators. The IEA role is to assist and co-ordinate countries' efforts through the maintenance of transparent international databases, the development of state-of-the-art energy indicators and collaboration with other international organisations. [2],[4]

The IEA has since 1997 developed a series of energy indicators to study energy-use developments and analyse factors behind changes in energy use and CO2 emissions. Energy indicators (and the underlying databases) reveal key relationships between energy use, energy prices and economic activity. This insight is crucial when assessing

and monitoring past and present energy policies, and for designing effective future action. This work on indicators also aims at increasing the transparency, quality, completeness and timeliness of energy-related data. [2] and [4]

A list of key performance indicators (KPI) defined by one of the main objectives of CO-EFFICIENT project is given in table 1.

Table 1: List of Key Perfomance Indicators [6]

KPI	Description
KPI01 - Energy consumption of the company per year.	The indicator shows the total final energy consumption for a period of one year.
KPI02 - Energy costs per year	The indicator represents the cost of total final energy consumption for a period of one year.
KPI03 - Energy consumption per employee	The indicator shows the total final energy consumption in the company in relation to the number of employees. This indicator enables the company to control power consumption by changing the number of employees.
KPI04 - Energy cost per employee	The indicator shows the final energy consumption costs per employee. This indicator enables the company to control energy costs by changing the number of employees.
KPI05 - Energy consumption in relation to the annual turnover of income	The indicator shows the ratio of energy consumption and the company's revenues within their business activities.
KPI06 - Energy cost in relation to the annual turnover of income	The indicator shows the ratio of energy costs and revenues of the company. In this way, the company can keep control of energy consumption in business processes.
KPI07 - Energy consumption for the administrative part	The indicator shows the necessary amount of final energy in the context of basic needs for the operation of the business.
KPI08 - Energy cost for the administrative part	The indicator shows the energy costs in the context of basic needs for the operation of the business. In this way, the basic minimum costs for the operation of business can be determined.
KPI09 - Energy consumption for the technological part	The indicator shows the energy consumption for the execution of technological processes and technological work activities. In this way, the company can define the purchase amount of final energy with suppliers.
KPI10 - Energy cost for the technological part	The indicator shows the energy costs in technological processes (technological part of the activities). Indicator enables the optimization of consumption and therefore more competitive product price.
KPI11 - Energy consumption per square meter	The indicator shows the final energy consumption per unit of surface area. This indicator represents the basic indicator, which is primarily linked to the heating surface area.
KPI12 - Energy cost per square meter	The indicator shows the final energy costs per unit of surface area. This indicator enables the company to control the costs in the context of increasing or decreasing the production capacities.
KPI13 - Energy consumption per volume	The indicator shows the required final energy in relation to the volume of the production areas.
KPI14 - Energy cost per volume	The indicator shows the costs of final energy consumption in relation to the volume of production areas. By monitoring this indicator, the company can optimize the actual need according to size of production facilities.
KPI15 - Energy consumption for the technological part - preparation of heat	The indicator shows the actual final energy needed for the preparation of heat in the technological part of production.
KPI16 - Energy cost for the technological part - preparation of heat	The indicator shows the energy costs required for the technological part of the production. Monitoring the indicator enables the optimization of energy consumption for the preparation of heat in the technological part of business (particularly for the optimization of heat generators in technological part).
KPI17 - Energy consumption for the technological part - preparation of domestic hot water	The indicator shows the energy consumption for the preparation of hot water in technological processes. The purpose of this indicator is the determination of structure of energy consumption for an individual technological part of business.
KPI18 - Energy cost for the technological part - preparation of domestic hot water	The indicator shows the energy costs for the preparation of hot water in technological processes. This indicator enables the cost analysis of individual technological part of business in the context of energy consumption.
KPI19 - Energy consumption for cooling	The indicator shows the energy consumption for the whole cooling process in the company. It enables you to specify the share of energy consumption and the possibility for optimizing the use of energy for cooling.
KPI20 - Energy cost for cooling	The indicator shows the energy costs for cooling. This indicator enables the energy cost analysis for cooling in the company.
KPI21 - Energy consumption for ventilation	The indicator shows the final energy consumption for ventilation.
KPI22 - Energy cost for ventilation	The indicator shows the final energy costs for ventilation. This indicator enables the cost analysis and the possibility of modernization of ventilation system.
KPI23 - Energy consumption for lighting	The indicator shows the final energy consumption for lighting in the company. This indicator shows the share of energy consumption, which entitles the optimization of lighting system by using more efficient lighting or management mode.
KPI24 - Energy cost for lighting	The indicator shows the energy costs for lighting. This indicator allows you to specify payback periods in case of the optimization requirements and technological modernization of lighting.
KPI25 - The share of renewable sources in relation to total energy consumption	The indicator shows the share of energy consumption from renewable sources in relation to total final energy consumption. In this way the company shows sustainable orientation and awareness for the efficient use of energy.

Conclusion

The Ministry of environment and spatial planning encourages the development and implementation of energy audits. Energy audits, as a measure, are also co-financed by energy suppliers in the context of the Regulation about ensuring energy savings among final consumers (published in the Official gazette of Republic of Slovenia no. 114/2009). It is possible to obtain non-refundable grants of up to 50% of the estimated costs for the implementation of an energy audit. The amount of subsidy depends on the size of the company and the possibility of potential savings.

Indicator	Status	Indicator	Status
Electricity and Natural Gas Efficiency Program Budgets		Disclosure of Energy Use In Buildings	
Annual Saving from Electricity And Natural Gas Efficiency Programs		Appliance and Equipment Performance Standards	
Energy Productivity		Energy Intensity of the Industrial Sector	
Mandatory Energy Efficiency Resource standards (EERS)		Combined Heat and Power in Industry	
Greenhouse Gas Emissions		Energy Intensity of Freight Transport	
Energy Intensity in Residential Buildings		Fuel Economy of New Passenger Vehicles and Light Trucks	
Energy Intensity in Commercial Buildings		Use of Public Transit	
States with Updated Building Codes			

Fig 5: An example of displaying energy indicators

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***Authors**: Miralem Hadžiselimović, Marko Habjanič, Bojan Štumberger, Sebastijan Seme, University of Maribor, Faculty of Energy Technology, Hočevarjev trg 1, 8270 Krško, Slovenia, E-mail: miralem.h@um.si*

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