Educational and Training Program to Increase SME's Energy Efficiency Skills

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***Abstract*—An Educational & Training Program was developed by a consortium of eight European countries through EU Horizon 2020 funding scheme. The program was certified by each country according with the ECTS requirements and is focusing to increase the SME's energy efficiency measures by using own-created financial tools. The uniqueness of the whole training program is proved by the application of the knowledge on different pilot sites or directly on trainee's company. The paper provides evidence especially regarding the designing and implementation of an energy efficiency training program in Romania. The aim of the course is the increasing of skills and competencies for the energy professionals within SMEs.**

Keywords— energy efficiency skills, SME, training program, Romania, case study, H2020 project

I. Introduction

From the establishment of the EU, the member countries set the focus on the continuous development and growth. Horizon 2020 is the EU's growth strategy that aims to ensure a smart, sustainable and inclusive economy, driven by five interrelated headline targets. These targets address education, employment, poverty and social exclusion, research and development as well as climate change and energy. Afterwards, specific targets were set that included achieving 20% of energy supply from renewable sources, a reduction of greenhouse gas emissions of at least 20% as compared to 1990 levels, and an increase of energy efficiency by 20% as compared to a baseline projection [1].

At the EU level, an European Energy Union was built which aims to reduce energy dependence on imports, guarantee a secure energy supply and pave the way for a climate-neutral economy as a long-term project for Europe [2]. Developed during the same time, the "Clean Energy for All Europeans package" (European Commission, 2018b) aims at providing a global energy policy to guide Europe towards a clean energy transition and achieve the goal of limiting global warming below 2°C [3], as established by the Paris Agreement. Efficient use of the energy is widely considered the backbone of a sustainable development in the future [4]. Exploring the existing literature in the field, it can be underlined that there is still place for improvements concerning energy efficiency in various domain, even in developed countries [5].

The operational field for energy professionals has become a very complex landscape, with requisite updated knowledge and skills crossing many fields beyond energy, including people management, environmental science and technology, finance, personal and enterprise communication, information and communication technologies and even teaching/training skills [6].

Educational and training programs have become a key issue both for increasing the implementation of the energy efficiency (EE) measures and increasing the level of awareness in the SME. Energy professionals and decision-making persons must play in the same team in order to obtain the best results for their organisation. It is hard to find a path that promotes constructive and creative discussion of possible solutions among different branches of knowledge, especially in a world where individual triumph is encouraged over the common good [7]. Designing tools that can be implemented as an educational and training method is a solution to create a balance within the organisation.

The main objective of the research is to design and implement an applied educational tool that can be used for the training of the energy professional or persons that have interest in the field, in global communities. The subsidiary objective of the research is to facilitate the implementation of energy efficiency measures based on high skilled employees.

II. Training need for Energy Efficiency courses

At the early stage of SMEmPower Efficiency project, it was conducted an applied research to determine the main needs existing inside the SME's and identifying the level of energy efficiency awareness among SMEs. In total, 213 SMEs responded to the survey from all the participating countries. The detailed research methodology is presented in [8]. Moreover, targeted workshops were organized in order to identify which are the main barriers (Legislative, Institutional, Technical, Financial, Communication) that prohibit the implementation of energy efficiency measures in SMEs and to propose solutions.

Following the survey and analysis of the collected data, it is worth mentioning that there are many similarities among the SMEs from different countries. For example, 57% of the questioned SMEs have not appointed an energy manager, 44% have not implemented environmental/ energy standards and energy audits have never been carried out in the 50% of the SMEs that participated in the survey. The results of the conducted survey confirm that SMEs do not put energy efficiency in high priority and that there is a need for training to increase the skills and qualifications of SMEs personnel.

The main barriers that limit investments in energy efficiency measures by SMEs according to the project's survey are shown in Figure 1. Besides the long pay-back period of some energy efficiency investments, other problems have also been identified e.g. difficulties in accessing financing or grants, bureaucratic organizational procedures, lack of budget for energy efficiency measures and lack of awareness or know-how, lack of knowledge for the EE suppliers [3].

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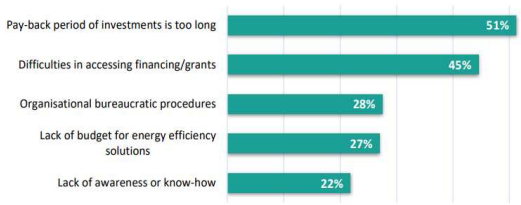

Fig. 1. Main barriers that hinder or limit investments in EE [8]

Another finding of the survey results analysis is that the SMEs staff are generally motivated to attend further training to improve skills and competences. Taking these into account, a novel training program was designed in SMEmPower Efficiency project, with a common curriculum in 8 countries, aiming to provide an in-depth multidisciplinary harmonised approach, in order that the qualified engineers graduated from SMEmPower courses to meet the expectations of a growing market. The proposed Educational and Training (E&T) Program will complement the European Commission's effort to promote energy efficiency actions also among small and medium enterprises (SMEs) in EU member states, and ensure the use of high quality, cost-effective energy audits and energy management systems to final customers. SMEmPower Efficiency courses will offer 3 editions of this professional E&T program with 30 trainees per edition (3 in each participant country) will be delivered during the project's duration; accounting for at least 720 trained professionals. This research refers to the first delivered edition.

According to the applied survey analysis carried out within in the project partners countries, even though the legislative framework exists for both energy auditors and energy managers, it does not oblige SMEs to assign an energy manager within their company, to conduct an energy audit and to implement the suggested energy efficiency measures. This might be the reason why the current level of energy management/energy efficiency within SMEs is low, and more than half of the SMEs (57%) in this sample had appointed Energy Manager (Romania-73%, Germany-52%, Slovenia-70%) and just 21% had appointed an energy manager in their companies. The implementation of an energy audit varies between the countries participated in the survey (Figure 2). Most SMEs have not carried out an energy audit (Slovenia – 70%, Romania – 57%, Spain – 55%, Greece – 53%), there are some SMEs indicated that are willing to undertake an energy audit.

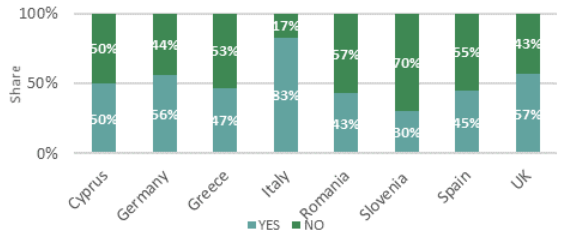

Fig. 2. Level of energy audit implementation

As presented in Figure 3, most SMEs in the participating countries, had implemented the suggested energy efficiency measures proposed by the energy audits (Spain-82%, Cyprus-81%, Germany-80%, Italy-80%, Slovenia-75%, UK-75%, Greece-58%).

In general, in all participating countries, the staff were motivated to reduce energy consumption (Germany-60%, Greece-60%, UK-38%, Slovenia-37%, Cyprus-30%). However, in some countries, there was only a sporadic motivation among the SMEs' staff to save energy (Spain - 57%, Cyprus-37%). In Romania the opinions were divided - the 31% of the respondents declared that the entire staff were motivated to reduce energy consumption on the other hand, 26% of the SMEs claimed that their team was not motivated to reduce energy consumption. One main conclusion of the survey regarding the staff motivation and knowledge is that the staff were not well-trained in the topic of EE, and most of them were not aware of the energy efficiency potential within their companies [8].

Fig. 3. Level of implementation for measures proposed in the energy audits

In this context, the Technical University of Cluj-Napoca, Romania, as part of SMEmPower Efficiency project consortium, in collaboration with all other consortium partners developed an integrated Education & Training (E&T) program in order to raise the awareness regarding energy efficiency potential within SMEs.

SMEmPower Efficiency E&T program aims to focus on the presentation of the possible energy efficiency measures, in strong relation with energy surveys and technical data to quantify the best energy saving possibilities. The uniqueness of the training program is given by the application of the knowledge, on the pilot sites or in each of the trainee's company.

The trainings will go beyond an energy consumption scan (basic energy audit), to effectively implement energy management techniques, instruments and solutions, to achieve energy savings, emissions reduction and welfare. The strategic target is to train SME key staff in a way to be able to use intelligent energy management solutions, design, propose and successfully find pathways to fund intelligent and affordable energy efficient investments, inflict a change in behaviour and gain the support of decision makers. An additional goal of the training program is to establish a strong foundation for an energy efficiency driven culture to increase the level of awareness concerning rational use of resources.

III. Educational & Training Program Design

A. Methodology of the program design

Another important activity of the SMEmPower Efficiency project was to carry out a comparative analysis of current implementation practices, tools and instruments related with the availability of training courses, certification/accreditation of energy managers/auditors, registration procedures and competent authorities within the different SMEmPower participating countries. Based on this analysis a major gap between energy professionals training courses and the specific market requirements was identified and highlighted. Most of the available training programs present a lack of modules e.g.:

onsite visits, practical case studies, as well as Monitoring & Targeting (M&T)/Measurement & Verification (M&V) instrumentation knowledge [9].

In addition of this, development of the E&T program took into consideration potential risk and inequalities such as: (1) differences between participants such as: technical profile, practical experience, level of qualification (some of them are already PhD holders and some of them do not even have a university degree); (2) a lack of specific knowledge regarding various industrial technologies and mainly energy efficiency technologies, indicators, software, energy measurement procedures and tools; (3) a lack of specific knowledge in economic evaluation of energy efficiency impact; (4) a lack of practical training – including on-site visits and practical case studies during trainings; (5) a lack of specific knowledge in basic energy management and communication/cooperation and how to persuade senior/executive management; (6) and limited opportunities to upgrade their basic technical profile and information about recent energy legislation, many years after their own graduation.

In this context, an E&T Program was designed as a two-stage one: (1) In the first stage, lectures and tutorials that focus on technical and financial data required to prove that specific measures are cost-effective; (2) practical action in specific industries or services sector installations. In the second stage, the trained staff were encouraged to apply their acquired knowledge to their working environment as case studies.

B. Training Target and focus groups

The training program is open to all the interested qualified individuals who are or can be possible future SME employees. The trained staff (mainly those with Energy Manager responsibilities) will then move on to apply their acquired knowledge to their working environment as case studies.

A series of pilot locations, SMEs with their energy consumption infrastructure will be selected for study and analysis, based on an open call issued in each country. The pilot sites will benefit from technical support provided by the working teams and consortium partners, and above all will prepare together and receive reports detailing the proposed energy saving measures for their facility with financial indicators to enable cross-comparison.

C. Descritpion of SMEmPower E&T program

The training program is certified by the participating or associated Universities as life-long learning program with 5 ECTS (of EQF level 6) and/or other certification schemes. The training program is focused on the presentation of the possible energy efficiency measures, in strong relation with energy surveys and technical data to quantify the best energy saving possibilities, and by using financial tools, to prove the cost effectiveness of them.

The strategic target is to train SME key staff in a way to be able to use intelligent energy management solutions, design, propose and successfully find pathways to fund intelligent and affordable energy efficient investments, effect a change in behavior and gain the support of decision makers. The courses are adjusted to fit a six-unit program and to tackle the following topics, from an energy efficiency perspective [10]:

Unit 1 - European and national policies and legislation for energy efficiency corresponding targets, also the Support Schemes or other national instruments supported by the public authorities or other organisations. Other energy efficiency related legislations are going to be presented in this unit.

Unit 2 - Energy efficiency systems, measures & solutions – energy management opportunities cover the identification and description of the aspects associated with building energy efficiency, analysing also Passive design strategies. Green House Gas (GHG) emissions are also going to be an important topic together with the waste management practices.

Unit 3 - Basics of Energy Surveys & standards focuses on "empowering" the benefits of an energy audit, by presenting the basics of it and how to perform one, also correlated with management standards. The training will help the staff from SMEs to understand basic energy analysis from energy and production data.

Unit 4 - Tools for Monitoring & Managing Energy are going to offer a significant support for those passing the learning unit 3, with two main tools: Monitoring & Targeting and Measurement & Verification. The tools are going to be available on the project's platform where anyone can update relevant energy and production data which will generate relevant energy analysis but not an energy audit report. Also, it will be useful to understand day by day in-house energy consumption / generation and it will be a main tool for identify energy efficient and renewable energy source opportunities. Monitoring can be applied in aggregated level, e.g. total electrical consumption or individually per facility [11].

Unit 5 - Financing energy efficiency measures, tools and evaluation is coming in help in the topic of Cost Benefit Analysis – CBA and Life Cycle Assessment – LCA. This part is focusing on the financial schemes and other aspects related to financial benefits of the possible investments.

Unit 6 - Practical on-site Action is the "call to action" of the whole process as the participants are going to apply the knowledge obtained through previous units.

Selected pilot sites come to help the trainees during the E&T program to put in practice the actual knowledge gained, and using the specific tools developed within the project to perform energy surveys and propose specific energy saving measures for each pilot site. The SMEmPower concept highlights the importance of encouraging a large and vast community of SMEs to undergo energy audits and implement energy efficiency measures. In Romania, the aim is to reach at least 20 pilots until the end of the three editions of the E&T courses [12].

A feedback loop will be applied in order to continuously improve the educational program during the project's work. In this process, Universities, market players and of course attendees will provide valuable inputs. Updating of the contents will be made at the end of each edition.

IV. TRAINING PROGRAM IMPLEMENTATION

A. Consortium overview

The administrative process of Course Accreditation (as a postgraduate programme consisting of at least 5 ECTS) for E&T program was finalized in October 2020. Course advertisement for the first edition started in September 2020 in some of the countries, with dedicated significant efforts to contact professionals from SMEs and to distribute course information to former students and potential participants.

During the 1st Edition of the E&T program, a total of 211 graduated participants (62 female and 149 male) have been trained in theoretical and applied activities in accordance with the certified SMEmPower efficiency E&T Program.

Courses were organised online but, in some countries (Cyprus and Italy), despite of pandemic conditions, there took place also face-to-face meetings, offering different alternatives to professionals with interest in energy efficiency. From the total number of attendees, 148 participants were SMEs employees, significant part of them having responsibilities in the field of energy management.

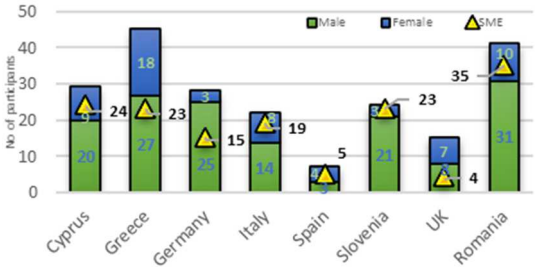

Fig. 4. Graduated participants

Courses received great interest across the different European countries, proved by more than 300 persons registered. At the end of the program, 211 persons graduated the course. It can be highlighted that the interest for the energy efficiency issues is highly requested by the SME area (more than 50% of the graduated participants are employed in SMEs). In the same context, it can be noticed that more the 75% of the graduated participants are energy professionals or their activity are related to the energy efficiency sector.

Course evaluation was carried out by means of questionnaires to continuously improve the educational & training program during the project's work. All the graduated participants responded to the questionnaire at the end of the course.

The issues on which the participants' opinion were requested were:

- E&T Program content (objectives, topic, relevance and usefulness of the information provided by the program etc.);
- Program materials and teaching techniques (clearness of the materials, up to date of the used references, teaching techniques and used methods etc.);
- Program instructors (level of expertise, teaching ability and their interaction with the participant etc.);
- Quality of delivery (quality of the location and the used infrastructures);
- Improvements suggested by the participants.

Overall, the first edition of the course had a positive outcome in all delivered countries, especially because allowed a varied audience of SME participants and post graduate students to collaborate and establish valuable connections for the future. Various participants have expressed their interest in continuing collaboration with the SMEs involved. Additionally, various participants expressed interest in future collaboration opportunities across the SMEmPower Efficiency consortium.

Assessment of the course, according to attendees' feedback, can be described as good to very good with variations from one country to another. The average grade of the course, presented under the form of "needs fulfilment" percentage as it was previously presented, reflects the hard work and pro-active involvement of the SMEmPower Efficiency consortium in the preparation of the teaching materials which were based on the identified needs of each country.

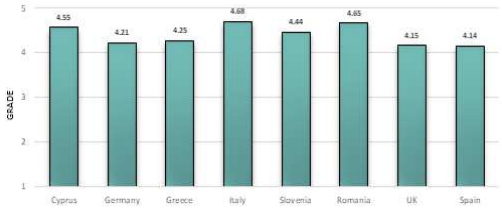

Fig. 5. Average satisfaction rating of the training program

The structure and the contents of the E&T course LUs clarified from the very beginning the importance of the energy efficiency (EE) in SMEs, starting from the legislation, continuing with the technical and economic analysis, and finally concluding with the practical action, in order to apply all the gained knowledge.

A Training Handbook was translated in all partner languages and was available for all the participants through online platforms. The lectures integrated the training material with some practical applications, which were much appreciated by the participants, and with other information relevant for the respective national context. The Handbook provides a modern and easy to use training for the participants of the SMEmPower Education & Training Courses, to gain a better knowledge about the information that is presented during the SMEmPower education & training program. Therefore, the handbook is available for attendees and all the interested professionals as an open access document, during and - after the end of the project - on the SMEmPower project website and on its education & training portal.

The M&T and M&V tools prepared in the framework of the project were both used for the preparation of the final reports, to propose and analyse targeted measures for the energy efficiency improvement in the engaged SMEs.

B. Case study - Romania

1) Description os E&T Program activities

The first edition of SMEmPower Efficiency E&T Program delivered in Romania recorded a very good appreciation among the professionals who actively participated in the actions carried out within it. The program was organized as a postgraduate training program through Long Life Learning Department (DECIDFR) of Technical University of Cluj-Napoca (TUCN) (www.decidfr.utcluj.ro).

The E&T Program was announced firstly using targeted invitation sent by e-mail to collaborators who are part of the professional area that the course aims to develop (energy representatives from SMEs, energy auditors, teachers from other technical universities in Romania, PhD students etc.). Public announcements were made on the official website of TUCN and on the different social media. This way the information has been shared with a large number of people in the target group of the course, ensuring a diversity of professional experience and expertise among the participants.

The program received great interest, proven by more than 50 persons registered from all over Romania. It can be highlighted that the interest for the energy efficiency issues is

highly requested by the SME type of organizations (more than 50% of the graduated participants are employed in SMEs). In the same context, it can be noticed that more the 75% of the graduated related to the energy efficiency sector. It is also important to underline that all people from all levels of education were interested in improving their skills and competences in the field of energy efficiency (Figure 6).

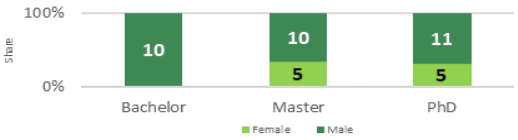

Fig. 6. Education level of the participants

Due to COVID-19 restrictions the course was delivered fully online, which allowed to have participants (including SMEs) from different parts of the country. This would not have been possible otherwise. Although the online nature of the course has led to some challenges in communication between lecturers and participants, one positive aspect must be considered: the fact that it has allowed a more diverse cohort of participants to get in touch and collaborate on the courses, as well as the increase in project awareness throughout the country.

Among the material provided were the project training handbook (translated in Romanian) and any other relative material used by the instructors. The first part of the E&T Program was structured based on the five learning units (LU), constituting the theoretical part of it.

The conclusion of the theoretical part was followed by the practical action in accordance with LU6, in collaboration with the engaged SMEs. Participants were divided into 9 working groups, each one assigned to work with a specific SME out of the engaged ones, under the supervision of an expert having experience in the energy audits and belonging to the delivery team. Moreover, representatives of the pilot sites participated in the procedure in order to facilitate the provision of the necessary input data and the description of the production process, of the SME equipment and of the energy consumption centres.

The SME representatives will transfer to the SMEs the outcomes of the pilot work regarding the implementation of energy savings measures and any further outcome regarding the behavioural change by the engaged SMEs employees.

Unfortunately, because of the pandemic context, the practical action was also conducted exclusively online. The members of each one of the practical action teams communicated through separate teleconferencing, to exchange contact information and to be informed on their assignment by their supervisors. M&T and M&V tools prepared in the framework of the project were both used for the preparation of the final reports, to propose and analyse targeted measures for the energy efficiency improvement in the engaged SMEs.

As final evaluation of the program attendees, theoretical knowledge was evaluated combining either short-answer questions, multiple choice questions or/and open-ended questions, one evaluation per learning unit. In addition, practical learning was assessed with the delivery of the high-quality practical report and its presentation. Both the report and the presentations were made following the imposed template in order to provide all the relevant information about the analysed pilot site: brief presentation of the pilot project, technological process, energy profile, thermo-energetical installations, building characteristics, lighting system, energy audit and energy management status, energy efficiency proposed measures, economic efficiency of the proposed measures analysis, possible financing sources and energy management plan. Another important graduation condition was the attendance of the participants to at least 80% of courses.

At the end of the program, 41 persons graduated the course (Female-10, Male-31) out of over 50 persons registered in Romania.

2) Evaluation of the program

Analysing the feedback of the participants, strong points and areas for improvement were identified, related especially to program content, practical actions, course lecturers and quality of delivery.

The main objectives pursued by the implementation of the questionnaire were: (1) the usefulness and applicability of the presented information; (2) up to date and relevance of the content; (3) directions for improving and optimizing course materials.

Based on the overall satisfaction evaluation by the participants of the course, according to attendees' feedback, this can be described as very good. The average grade of the course, presented under the form of "needs fulfilment" percentage, reflects the hard work and the pro-active involvement of the SMEmPower Energy Efficiency consortium in the preparation of the teaching materials which were based on the identified needs of each respective country.

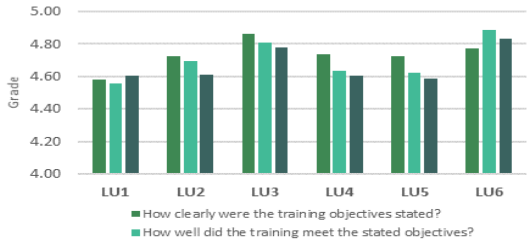

Fig. 7. Usefulness and applicability of the training program

Some of the most appreciated aspects related to the E&T program content was the variety of topics presented, the relevance of the course in the context of energy use reduction and energy efficiency and the opportunities to interact with professionals of different backgrounds, with the represented industry (SMEs), and with the lecturers.

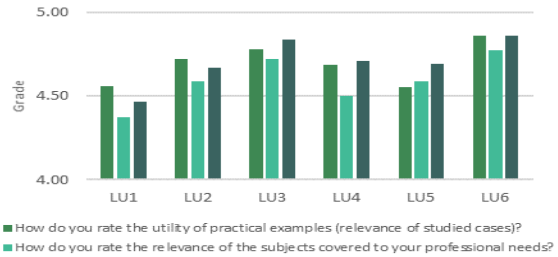

Fig. 8. Up to date and relevance of the delivered content

The structure and the contents of the E&T course LUs clarified from the very beginning the importance of the energy efficiency in SMEs, starting from the legislation, continuing with the technical and economic analysis, and

finally concluding with the practical action, to apply all the gained knowledge.

Lecturers were one of the strongest points of the program; the highest scores were found in this section of the questionnaire. They were from various sectors such as: academia, business environment and policy, with high expertise in their field of activity. They delivered valuable theoretical and practical knowledge, through LUs highly appreciated by the participants.

Compared with the average score recorded at the consortium level, for the analysed dimension, Romania scored above the average line. This can be due to the fact that in Romania this type of training courses is not prevalent / developed, and due to the rising interest in the topic.

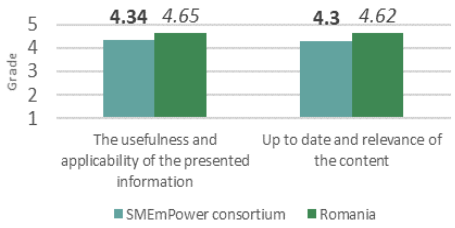

Fig. 9. Comparative analysis Romania vs. Consortium

In comparison with the SMEmPower consortium, the training course structure was appreciated above the average in Romania. The training program it was rated as almost excellent by most of the participants in terms of usefulness and relevance of the delivered information.

3) Feedback qualitative analysis

Even though well structured, the topics presented in each one of the LUs were many, covering a wide range of technologies, to be totally comprehensive, especially for those not having a proper technical background. Thus, the LUs presented could be perhaps refined to include and focus on the most important topics.

More explanation should be given on the calculations; more exercises could be performed by the participants during the course presentations to be clear to all who are not engineers or have no prior exposure to such topics.

Related to practical actions, duration allocated to this activity could be increased to enhance the participants involvement, without affecting their overall daily employment schedule.

V. Conclusions

Energy tends to be included in the core business of the companies. Awareness of the benefits of rational use of resources, along with increasingly difficult economic conditions have led to changes in the behaviour of SMEs and in terms of energy used. To withstand current conditions, SMEs are optimizing their use of resources and engaging in training programs that can help achieve strategic goals in terms of energy and energy efficiency.

Following the research carried out within the project, the need for programs regarding energy efficiency skills was highlighted. Such courses are useful and attract the attention of professionals in the field. The professional interest is high in terms of the need to improve their skills in the field and to be up to date with the latest tools for analysis and monitoring of energy consumption within the SME.

The implementation of the training program revealed that in the SME sector practical courses are needed which can offer to the employees the possibility to increase and practice their skills. The education & training program's LUs and overall approach can represent the backbone of a multidisciplinary Masters field.

The presented results show the potential of the SMEmPower Efficiency project and its objectives to "empower" European SMEs to undergo energy audits and take into consideration the importance of energy analytics as energy and cost saving opportunity. The presented topic focused mainly on the current situation identified among the Romanian SMEs, in some cases compared to the partner countries.

The online nature of the course provided an added value, by allowing for a more diverse cohort of professionals to participate in and collaborate on the course, as well as raising awareness for the project throughout Europe.

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