

Training Program About Energy Efficiency in Existing Buildings

The MARIE Project experience

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ABSTRACT: A broad consensus exists on the need to develop new economic models and ways of life based on energy efficiency. To this end, the European Union has adopted a common policy for achieving the ambitious target of an increase of 20% in energy efficiency by 2020.

The MARIE (Mediterranean Building Rethinking for Energy Efficiency Improvement) project has emerged as a means for achieving this goal and obtaining an improvement in terms of energy efficiency renovation of existing buildings in the Mediterranean.

One of the key challenges of this program is to create a training program common to all Mediterranean countries. Each partner will identify and describe best practices in terms of energy refurbishment of existing buildings or urban areas. Once the data has been collected, an expert team will set up a training program in order to implement best practices across the Mediterranean area.

The aim of this paper is to present a profile of the training program as part of the MARIE project and a report on work in progress, with emphasis on the survey of best practices at the regional level, with a view to sharing the knowledge acquired with the scientific and technical community.

Keywords: MARIE project, Mediterranean countries, energy efficiency, training program, best practices

INTRODUCTION

Concerns about the process of sustainable development are becoming increasingly important. One of the main barriers to a global sustainable development is the growth of energy consumption and the impact of its use on the environment.

Part of the solution is to change the way energy is consumed by prioritizing an efficient use of energy. This challenge, common to all European countries, has specific relevance in the Mediterranean space, due to the current economic crisis.

Energy consumption in the Mediterranean region buildings is rising above the European Union (EU) average establishing a trend that is contrary to the EU2020 energy efficiency objectives. Achievement of the EU2020 target in the Mediterranean countries is therefore a considerable challenge that requires a coordinated and strategic institutional action and effective investment of European funds [1].

One of the main causes of this high energy-high-energy consumption in buildings is that they aren't energy efficient, mainly due to the age of the building stock. The majority of the buildings in the Mediterranean space were constructed before 1980, without insulation, and prior to the inclusion of energy efficiency criteria in building regulations.

In this context, it's particularly important to reverse the trend and promote energy efficiency in buildings, mainly through energy renovation, in order to achieve the objectives defined by the EU.

BACKGROUND AND OVERVIEW

Sustainable development is seen as a dynamic process where the exploration of natural resources, the management of investments, the orientation of technological development and institutional changes are made taking into account present and future needs [2].

This definition suggests the pursuit for a balance between the levels of development and the use of natural resources, so that the development takes place without harming the environment and without depleting the natural resources necessary for the future generations [3].

One of the biggest challenges for a global sustainable development is the current growth of global energy consumption and the impact of its use on the environment, especially in terms of greenhouse gas emissions and the usage of fossil fuels. The problems related to energy efficiency, energy performance of buildings and the price of energy have been constantly the subject of political debate [4], especially in the EU.

Nearly 40% of final energy consumption is in houses, offices, shops and other buildings causing the building sector to be a central concern to the EU energy efficiency policy. After the energy sector itself, buildings provide the second largest untapped and cost-effective potential for energy savings [5].

The construction sector is crucial to obtain a sustainable development in its three dimensions (social, economic and environmental). The sector is becoming

increasingly important in terms of comfort and quality of life given the fact that people spend, on average, 90% of their time inside buildings, either to live or to work [3].

Construction is also important for the economic development of society as it employs a large number of people. According to 2010 data, this sector employs 13,9 million people in the EU, equivalent to 6,6% of total employment and 29% in the industry. The activities in the construction sector represent 9,7% of Gross Domestic Product (GDP) of the EU [6].

From an environmental standpoint, the building stock is responsible for approximately 40% of the energy consumption, 30% of the natural resources, 20% of the water consumption and 10% of soil occupation, besides being responsible for 40% of the carbon dioxide emissions, 30% of solid residue and 20% of the wastewater [7].

The high energy consumption observed in the usage phase of buildings is due, in part, to the increased standard of living of the population and consequent demand for more comfortable environments, along with the poor quality of the building stock.

Analyzing the Portuguese housing stock (Fig. 1), as an example, it can be pointed out that 39,2% of the residential buildings have over 40 years of age, while only about a quarter of the existing buildings were built after 1991 [8], year in which the first Portuguese energy regulation became in force.

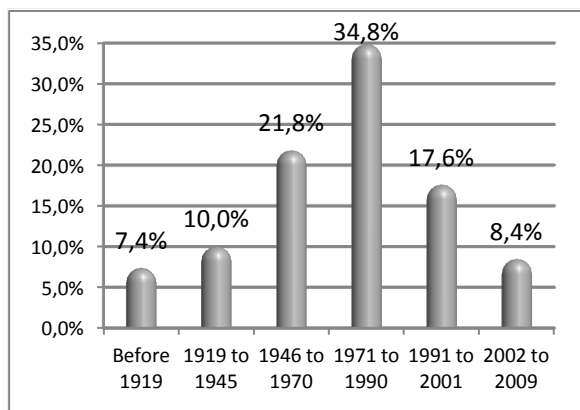


Figure 1: Percentage distribution of building by period of construction, in Portugal

Surveys conducted on the EU building stock have shown a need to improve the standard of housing in order to improve the health of the occupants and reduce energy consumption and CO₂ emissions. The current trend is to retain the existing buildings and adapt them to the needs of the current market, rather than to demolish in favour of new construction. As more buildings require energy efficiency upgrades, the need for refurbishment actions is increasing [9].

Studies show that the environmental impact of a life cycle extension of a building is definitely less than demolition and new construction. The retrofitting of residential buildings in particular provides considerable potential for energy conservation and further sustainable benefits [10].

Performance improvement measures are usually most cost effective ways to achieve pollution reduction. Some available options are reducing consumption, improving efficiency, de-carbonizing energy supply and shifting to non-conventional energy source [11].

Therefore, improving the energy efficiency of buildings through energy refurbishment should be a growing priority on the policy agendas of many countries and of the international community.

Energy efficiency is regarded as a key element in the upcoming energy policies and is also a headline target of the EU 2020 strategy for smart, sustainable and inclusive growth. The European Commission describes it as the most effective way to improve security of energy supply and reduce emissions. The Commission states that the housing sector has been estimated to represent 27% of the energy savings potential by the year 2020 [12].

According to Nuij [13], the current trend to 2020, in terms of achieving the EU2020 targets, isn't enough to reduce the energy use by 20% (Fig. 2). Therefore it's important to find solutions to overcome this situation.

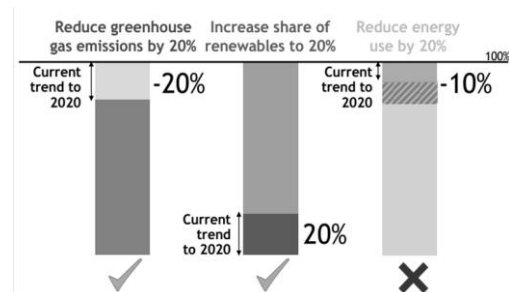


Figure 2: Current trend to achieve the EU 2020 targets [13]

MARIE PROJECT

The MARIE Project emerges as a way to facilitate the achievement of the EU 2020 targets. The strategic vision of MARIE is to achieve the professional, social and economic conditions, based on the latest EU policies, programs and standards, which are necessary for the improvement of energy efficiency in the Mediterranean buildings stock. In this way the project aims to overcome the main barriers affecting building owners, construction professionals, decision-makers, public administration, and financial institutions.

The main goals of MARIE are improving the energy efficiency in the existing building stock, and exploit the opportunities presented by EU policies and directives on

buildings energy efficiency. It's important to take into consideration the different characteristics of the Mediterranean countries, creating suitable socio-economic conditions in order to meet the need for new regulations and institutional tools in response the new EU Energy Performance of Buildings Directive recast. MARIE also aims to overcome the lack of financial mechanisms able to stimulate the energy refurbishment of buildings, and support the small and medium enterprises that dominate the buildings sector in order to stimulate innovation in the provision of adequate services and products for energy refurbishment.

The Project is led by the Government of Catalonia Department of Territory and Sustainability, Housing Agency of Catalonia, who is ahead of a team of 23 partners from 9 Mediterranean countries committed to work together in order to build a common vision and strategy to enhance the energy renovation of buildings in the Mediterranean area. To that intent, this team is developing, as the main output of MARIE, a common Mediterranean Building Energy Efficiency Strategy (MEDBEES), which will propose measures to promote energy refurbishments in the existing building stock through: regulatory frameworks, tools and institutional financial mechanisms that stimulate energy refurbishment; Measures to support small and medium enterprises (SMEs) and entrepreneurs in this area; Communication and training programs in order to disseminate the project; Pilot actions to test some innovative measures that will be included in the strategy; Political commitments in order to set up the strategy in the regions involved in MARIE.

In a sense MARIE aims to become a generator of synergies and partnerships that will allow changing the current trends in the Mediterranean countries in terms of energy refurbishment. To that end a web based platform was created to facilitate the interaction between public and private entities related to building energy renovation in the Mediterranean countries. The MARIE Associated Partner Platform is available on www.marieapp.eu.

MARIE, as an European strategic project, aspires to have an impact that goes far beyond the three year scope of the project (2011-2014), especially with the implementation of MEDBEES that is going to last until 2020. Only then the results should be evaluated taking into account the EU 2020 goals, and the impacts on all dimensions of sustainable development (Fig. 3).

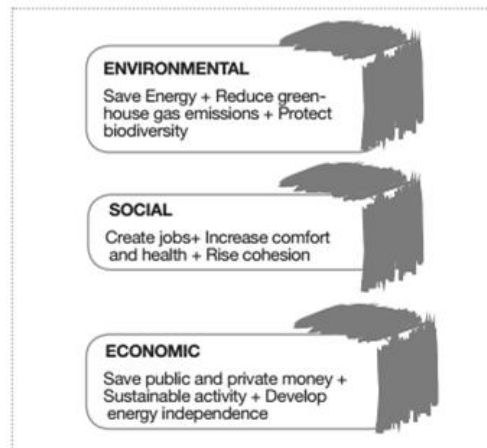


Figure 3: Potential impacts of MARIE that contribute to a more sustainable development [1]

Based on the previous challenges, and to improve the final output of the project, Pilot Actions will be developed, following the main lines of MARIE and around the energy efficiency renovation of some specific building typologies.

A Communication Program as well as a Training Program are crucial instruments for the application of the MEDBEES as some of the main barriers for its implementation include, not only, a lack of end user motivation for energy efficiency improvement and lack of awareness among user on the benefits of this investments in the long run but mainly a reduced technical skills set and know-how at the supply side and a low level of technical innovation in the building sector [1].

BEST PRACTICE COLLECTION

The main goal of the Training Program is to improve the skills of the agents involved in energy efficiency in buildings. Within this framework a collection of the best practices is being elaborated in order to identify the most interesting projects and training practices, existing and in progress, that could produce a significant impact accordingly with the goals of MARIE.

These projects will be the basis for the definition of communication actions, training actions, products and services improvement and legal agreements solutions.

To this intent, the job of collecting these best practices was delegated to regional providers, one for each country. The regional provider carried out the collecting of the best practices by contacting every available specialized channel, such as experts, professional associations, Universities, energy efficiency clusters, public administration, research institutes and specialized SMEs. This kind of contact is not only useful for the stated purpose but also as a way to disseminate the MARIE project and its goals.

The different experiences were collected systematically through a form, in order to make the results uniform. This form registers the different levels of impact of each practice in the relevant domains: energy efficiency improvement,; financial coverage and employability potential. It also identifies the difficulties encountered in the application of the practice as well as the agents involved.

One of the questions of this form and one of the main concerns of this collection is the existence of gaps in terms of energy efficiency training (training needs without any practical, tested and reliable answer), as it is important to know the state of the training supply as seen by the agents involved in the energy efficiency area.

As the good practices and training experiences are collected from the experts, the regional provider rates and evaluate the selection, sorting it out by potential impact if applied in other Mediterranean countries, barriers and conditions to their implementation, while also pointing investment proposals in order to assure their success.

Once the best practices are collected, an expert team within MARIE, will make a proposal to implement some practices from some of the regions to others of the Mediterranean.

All the best practices collected are available for consultation on the associated partner platform previously referred.

In a second phase, the regional providers will validate the proposals of the external best practices that may be suited for their regions, evaluating the impact that every new best practice proposed can generate on the creation of jobs, financing models and improving energy efficiency of existing buildings in its region.

With all the material that results from these evaluations, a Training Program will be elaborated with training actions to implement in all the Mediterranean area as part of the MEDBEES.

PORTUGUESE EXPERIENCE

The University of Évora, one of the MARIE partners, is in charge of coordinating the best practice collection in Portugal.

In order to optimize the task, a pre-selection of the entities involved in the energy efficiency area was made, prioritizing energy efficiency clusters, universities, public administration and professional associations.

A total of 62 entities were contacted, mainly via telephone or personal meetings. Besides of the main purpose of collecting best practices, these contacts were also useful to disseminate the project and its goals, as well as the associated partner platform. Along this process, a total of 10 practices were collected.

Best Practice 1 – Energy Management System

In order to reduce the electrical energy bill, a control system that controls the lighting circuits, HVAC and the plugs was implemented in an office building resulting in a reduction of energy consumption of approximately 6% (in 2008 the electricity consumption was of 616386 kWh and in 2009 was of 579773 kWh).

Although this practice is effective and can account for results with little effort, it doesn't have the potential to create any jobs and falls short of the expectations in terms of energy improvement.

Best Practice 2 – Upgrade of energy certificate in Lisbon, through total lighting replacement

Upgrade of Portuguese Energy Certificate from class B to class A (according to ADENE classification) in an office building, through complete replacement of ceiling lighting. The TL-5 and TL-D lamps were replaced for MASTER ECO TL-5 and TL-D lamps, totalizing 1129 lamps. The energy consumption in 2011 (552107 kWh) was reduced by 5% approximately when compared to the consumption in 2009.

Albeit being effective, this practice is a low impact measure on itself. It would produce more relevant results if applied in combination with some other measures, such as the management of the energy systems, or the HVAC control.

Best Practice 3 – Upgrade of energy certificate in Setubal, through total lighting replacement

Upgrade of Portuguese Energy Certificate from class C to class B- (according to ADENE classification) in an office building, through complete replacement of ceiling lighting. The TL-5 and TL-D lamps were replaced for MASTER ECO TL-5 and TL-D lamps, totalizing 963 lamps. The energy consumption in 2011 (459841 kWh) was reduced by 4% approximately when compared to the consumption in 2010.

This practice falls in the same category than the previous one. It would work better as part of a bigger plan rather than applied alone.

Best Practice 4 – Intelligent meters to efficient decisions

This practice promotes a behavioural change through the installation of telemetry systems that allow the visualization of the electricity consumption profile via local displays and internet platforms. 250 residential dwellings and 10 service buildings will be in the first phase of this project and a special effort will be developed in supporting the consumers based on analysis of their personal consumption profile. This project is still undergoing, so at this stage it's impossible to quantify the results obtained.

This project enhances the level of consumer information, aiding the decision-making on energy choices. Using this information to improve the energy management can translate in savings of 10% to 20%

both in residential and service buildings depending on the baseline.

Best Practice 5 – “Enerescolas” project

The ENERESCOLAS is an interactive multimedia application which aims to direct the school’s community attention to the issue of energy efficiency. This application, installed in the school, serves as an interface to access and explore a telemetry monitoring system of several consumption parameters and environmental variables.

With this information children can learn the basics about energy efficiency and gain awareness about sustainability from a very early age, which they can transmit into their households.

This project is also yet to be implemented in full scale. Therefore it’s impossible to quantify the results.

Best Practice 6 – “Remote Manager” project

The Remote Manager consists of a systematic analysis of power consumption profiles through a computing platform developed for the treatment of this information, producing monthly reports with recommendations for the implementation of measures that will reduce the electric bill. The impact of this project reached 50% reductions in consumptions in the order of the GWh/year, but reductions up to 15% are the most common.

This kind of project provides detailed information on how and where the energy is being used, which is the first step to take in order to reduce consumptions.

In this case the project is managed by a single company (Lisboa E-Nova) that guarantees the service free of charge for the entities as part of their associates program. To ensure the success of the project, when applied to other countries, it should be based on the same model. An energy services company (ESCO) could guarantee the service, having some return on their investment with paid implementation of measures that would reduce consumptions and improve the energy efficiency.

Best Practice 7 – Consumption monitoring – ISCTE buildings

This monitoring consists of a systematic coordination and management of the acclimatization equipment, adjusting set points with the weather, controlling occupation and utilization of the different areas in the campus (3 different buildings) and adjusting lighting and acclimatization accordingly. On top of this some lighting points considered excessive were turned off or replaced with low energy lamps.

This practice resulted in electricity consumption reductions that range from 8% to 33% depending on the building.

This project shows that an effective practice with good results can be applied with little investment.

ISCTE, which is a public university, implemented the practice while using only the pre-existing budget for maintenance. This was achieved by changing lamps at the end of their life, and training the maintenance staff so they could manage and control the acclimatization and energy systems.

Best Practice 8 – ECO.AP

ECO.AP is an evolving program, promoted by the government that translates on a set of energy efficiency measures for short, medium and long term implementation on services, agencies, and public facilities and aims to change behaviours and promote a rational management of the energy services.

For this purpose an ESCO will provide measures to improve the energy efficiency in the facilities, assuming a certain degree of financial risk, basing their remuneration on the achievement degree of the energy efficiency improvement and the satisfaction of other criteria for energy performance, which may be contractually fixed.

This project is still undergoing and the first phase (2012-2015) is expected to cover about 300 buildings with 700 GWh of energy consumed annually and 75M € of annual energy bill. During this first phase the potential savings are around 14M € per year.

Although this project is not a best practice in itself, it entails several best practices within it. It includes training and funding by the government and the ESCOs. It promotes energy efficiency with a clear goal of 30% improvement for 2020. It is also expected to have a great impact in employability, promoting the market for energy service companies which can result in an increased recruitment of professionals in this particular area.

Best Practice 9 – Academia ADENE

ADENE, as the Portuguese national energy agency, offers a wide range of training for skill enhancement in the areas of renewable energy, energy management, interior lighting of buildings, HVAC systems and hot water heating, ventilation and indoor air quality. Thus, the “Academia ADENE” is a centralized source and an entity of excellence for the training of technicians specializing in energy efficiency and renewable energy.

Although the contribution of this practice for the energy efficiency improvement is not quantifiable, all of the training available in this academy is designed in a way to improve energy efficiency, through the design, control and management of the facilities and solar and electric installations.

This project is not similar to any of the other practices gathered, and in a way it doesn’t fit in definition of best practice used for this collection. Despite that fact, the “Academia ADENE” is still a really relevant project for training on energy efficiency, which is the main theme of the training program.

Best Practice 10 – Sustainable Campus – Green University

This is the largest project of decentralized energy production in Lisbon, and was installed in the heart of the city on the University of Lisbon facilities. It allows this institution to attain patterns of energy efficiency and renewable energy use in line with the best reference practices in educational institutions around the world. This energy production is assured by four photovoltaic plants, with an installation of 2627 photovoltaic panels, resulting in an installed potency of 644 kW. This installed potency results in the production of 1028480 kWh per year.

This practice is based essentially in the use of renewable energy, which wasn't used elsewhere in this collection. The execution of this project was only possible due to the collaboration between the ESCO, who supported the financial investment, and the university that provided the physical space. The profits are split between the two parties involved.

CONCLUSIONS

This paper presents a general description of MARIE project, its training program, and more specifically, it describes the collection of best practices undertaken, with emphasis on the Portuguese experience.

This collection has allowed to identify identifying relevant practices that improved the energy efficiency of existing buildings. Knowing the existing best practices and replicating successful projects is essential for the application of the Training Program as part of MEDBEES.

The contact with experts was also important to disseminate MARIE, its goals and the Associated Partners Platform, which has been constructed to be a permanent platform (beyond the end of MARIE) to facilitate the implementation of MEDBEES.

Buildings and their energy performance are crucial to the EU prosperity and to achieve EU 2020 energy saving targets. Therefore the application of the Training Program along with MEDBEES is key to improve energy efficiency while boosting sustainable investments and job creation, especially in SMEs, across the Mediterranean countries.

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