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# Binding EU with national energy policies for sustainability: A trans-boundaries comparative study on public buildings' energy renovation path

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***Abstract*— Energy renovation of buildings is a major challenge for every region and its public authorities as they are considered the best players to reach economy of scale in energy savings by renovating their building stock. Their huge potential however is hampered in each phase of the energy renovation process, due to various problems which prevent the formation of a durable strategy and the rise of awareness and skills on energy-related issues among civil servants.**

**This study presents preliminary findings of an EU-Interreg project and the derived Energy Renovation Path for public buildings aiming to highlight its' significant assistance to local authorities. Even though the focus area is the island of Crete in Greece, the results and implications to optimize effort by providing meaningful tools to technical departments of public regional and local authorities are relevant and applicable to every region with similar patterns of dependence in energy savings in their building stock. The research is based on interregional exchange experiences and thus the analysis is descriptive. Aim of this article is to point out an efficient way with concentrate resources in a set of measures for planning, implementing and monitoring renovation works, which local authorities in the EU and abroad could support regional growth enhancement and job-creating investments, with an emphasis on energy efficiency and sustainability.**

***Keywords*— Renovation, Energy Efficiency, Sustainability, Crete, EU project.**

## I. INTRODUCTION

T Energy is one of the keywords of the modern society. In the last decade the European Union has established several Directives regarding Buildings' Energy Efficiency, acknowledging the buildings' significance as a major energy consumer. These Directives underline the importance of the energy upgrading of buildings and the importance of long-term investment considerations for the renovation of the building stock. In addition, the overall environmental and energy target set by the European Union is summarized in the well-known 20-20-20, namely the 20% reduction in greenhouse gas emissions, 20% RES gas penetration in the energy mix and 20% by 2020.

In January 2014, the European Commission proposed a binding 40% greenhouse gas reduction target for 2030 and a 27% share of renewables in the EU energy mix, without setting a binding target for energy efficiency [1]. In July 2014 [2], they finally proposed the introduction of a corresponding 30% savings target to 2030 [1]. The overall objective of the European Union for 2050 is also ambitious and proposes a reduction in greenhouse gas emissions of 80-95% compared to 1990 levels [3], with buildings playing a vital role for this goal's achievement.

Energy efficiency is a principle that today permeates all aspects of the EU's energy policy and should be seen as an energy source in its own right, as it will play a key role in speeding up the clean energy transition and boosting growth and job creation [4]. According to the Energy Efficiency Directive 2012/27 / EE, the objective is to renovate each year 3% of the total surface area of buildings with a surface area larger from 500sqm. At the same time the energy system is undergoing significant changes as the geopolitical landscape of energy is quickly shifting and environmental concerns have shaken the system's foundations [5]. The 2016 Energy Efficiency Report, which keeps track of the Member State's progress in energy efficiency, highlights that in the building sector, which accounts for 40% of Europe's energy consumption, most member states reduced their energy consumption per square meter (on average, in 2005-2014). However, in order to reach the EU's climate goals, member states should continue to focus on renovating existing buildings [4].

Therefore EU environmental and energy policies are promoting energy efficiency retrofit actions, in spite of the fact that the renovation rate in the construction sector is very low [6]. On average the EU renovation rate is around 1% per year. This means that renovating the entire EU building stock would take roughly 100 years [4]. Hence there is a need to speed up the renovation of the existing building stock in order for the EU to be on track and reach its 2020 and the

newest 2030 targets. Taking under consideration nonetheless that there are both private and public buildings and urban areas which fail to meet modern aesthetic, social, economic, energy and environmental requirements in order to bring them to new high-quality level [7], this article is focused specifically on public buildings.

The literature review revealed that renovating and retrofitting (R2) rate of public buildings is constrained by several factors like those presented below.

TABLE I. FACTORS CONSTRAINING BUILDINGS' R2 (IN CHRONOLOGICAL ORDER)

| Constrain Factors | Source |
|---|---|
| Identification of the most cost-effective measures for particular projects. | [8], [9] |
| The lack of financing schemes. | [10], [11] |
| Regulatory aspects and social obstacles. | [6], [9] |
| Highly heterogeneous usages and structural specifications. | [11], [12] |
| Lack of Energy Performance Certificates. | [13] |
| Efficient information management. | [14] |
| Owner's awareness to promote the development of the existing building energy-saving renovation market. | [9], [15], [16] |

Therefore a strategy should be based on an assessment that considers not only buildings' various specifications, envelope characteristics and energy supply systems configurations [17], but also the effect of Energy Performance Certificates (EPCs) on the renovation of buildings [13] and their usages [12]. This strategy should provide efficient information management, which is key to success in energy renovation [14]. Tackling behavioural changes is also very important when designing building renovation strategies as the central role of occupants for achieving energy savings in buildings is increasingly recognized [12]. Therefore, in order to be effective, renovation strategies should include appropriate informative instruments at an early stage to support behaviour changes towards responsible energy consumption [18].

Additionally, the identification of optimal interventions is essential, as cost-effective solutions for energy R2 projects are of capital importance for owners, especially for the public sector who is dealing with large building stocks [19]. Thereupon this article makes another step closing the gap towards 2050, as the objective is to gradually coordinate the upgrading of the building stock, so that, by that time, all public buildings will have high energy efficiency and ideally zero and/or minimal energy consumption.

The aim of this study is to present the significant assistance that the proposed Energy Renovation Path - ERP (derived by a "Dip, Dive, Dig" approach), will provide to public authorities both within the EU and abroad for this goal's fulfillment. The ERP has also an international perspective as it will allow both policy makers and civil servants to approach in the most efficient way and with concentrate resources in a set of measures for planning, implementing and monitoring renovation works.

## II. RENOVATION FOR ENERGY EFFICIENT BUILDINGS PROJECT (REBUS)

REBUS is an "Interreg Europe" project that is promoted by the European Union that supports local authorities in planning, implementing and monitoring energy renovation works in public buildings by designing a model Energy Renovation Path (ERP). Interreg Europe, itself is a fund that will allow regional and local public authorities across Europe to exchange practices and ideas on the way public policies work, and thereby find solutions to improve their strategies for their own citizens. REBUS was funded under priority 3 – Low carbon economies that deals with the transition to a low-carbon economy. Regional policies in this field include support actions and investments to increase levels of energy efficiency, including in public buildings and the housing sector [20].

Globally energy systems are experiencing significant changes, driven by forces such as technological innovation, changes in consumption patterns, supply dynamics, and policy shifts [21]. Thus, the diverse challenges facing the energy system today cannot be addressed by a single government, industry, company or other institution alone. A broader variety of expertise, convictions and resources are required for effective action [5].

In order for EU energy efficiency targets to be met, concrete and widespread policy level improvements are needed within European regions, among the main sectors responsible for emissions - Buildings. To face this challenge Renovation for Energy Efficient BUildingS project (REBUS) brought together eight partners from eight countries (in alphabetical order: Germany, Greece, Hungary, Italy, Poland, Romania, Sweeden, UK,) who share the same need for improvements in policy in order to promote energy efficiency in public buildings [20].

Public authorities within EU have identified that the huge potential for energy savings in the public building stock is hampered in each phase of the local authority energy renovation process. Thus, the overall objective of the REBUS project is to outline a policy that will improve the capacity of public authorities in European regions to undertake efficient renovation works of their public building stock. The problems all stem from a basic need by public authorities to raise awareness on energy-related issues among civil servants.

REBUS uses interregional exchange among regional partners, together with communication and engagement activities in order to develop Action Plans resulting in:

- Improved policy instruments,

- Improved skills at individual, organizational and regional level,
- Involvement and engagement of stakeholder to create a system, in which improved approaches are understood, supported and disseminated.

REBUS aims to assist the public sector and to contribute to EU policies on energy efficiency by providing means and instruments to design an ERP for public buildings, by grouping identified good practices, analyzed and exchanged by partners. Based on the project's timetable 60 months will be required for its completion.

- In the first phase, from 2016 till 2019, the identification of local stakeholders and the collection of both experiences and Good Practices (GP) by all partners within their region and the continuous exchange of information between the partners will assist the consortium to design their ERP and eventually refine their Action Plans.
- In the second phase, from 2019 till 2021, each region starts the implementation of the action plan with the involvement of the relevant stakeholders. The action plans will be monitored and the results will be disseminated to the rest of the consortium, executives and policymakers from the regions and relevant institutions.

It will be realized that EU public authorities, all share the common problem of implementing EU legislation on energy efficiency. They will benefit from the project's approach to improve their energy policy content and management. The identification of stakeholders will contribute substantially to the successful implementation of a long-term energy renovation strategy for public buildings, both in Europe and within each participant's region in specific.

### *A. Working Framework*

REBUS's overall objective is saving energy and public resources. For its achievement the design of an ERP for planning, implementing and monitoring renovation works in public buildings is required. The derived ERP, will allow public authorities to improve the following aspects of their energy policy content and management:

- Raise awareness on potential savings related to energy renovations of public buildings and improving their energy efficiency;
- Collect feedback and streamline data on energy efficiency needs in the public buildings;
- Use this feedback to select buildings for renovation;
- Draft tenders for renovation works that include energy efficiency baselines, targets and monitoring measures;
- Ensure correct execution, monitoring and verification of implemented energy efficiency measures;
- Manage the buildings in a more efficient way after renovation;
- Increase energy awareness and thematic knowledge of all key stakeholders; i.e. local administration, procured contractors, building managers and staff responsible for building maintenance, building users;

The project used interregional exchange among more and less developed regions to identify experiences to be included in the ERP, and will focus on 4 topics.

TABLE II: ENERGY RENOVATION PATH'S FOUR TOPICS (SOURCE: REBUS)

| **ERP – the 4 topics** | |
|---|---|
| ***Topics*** | ***Issues to be addressed*** |
| ***PLANNING*** | **Identification of building for renovation (prioritization, data collection):** Lack of reliable information, skills and effective decision – making structures hinders the process of prioritizing buildings to be renovated. |
| ***IMPLEMENTING*** | **Tendering & Financing: procurement rules, funding schemes available (including ESCO contracts / investments/ grants):** Affecting public tender process and subsequent works. |
| ***MONITORING*** | **Tools available on the market, means of verification:** Leading to difficulties in selecting/using tools that can monitor impact and consumption. |
| ***HORIZONTAL THEME: CAPACITY BUILDING*** | **Capacity building schemes for civil servants:** Raise awareness and build skills on energy-related issues among civil servants involved in the management of the building stock (i.e. those working in spatial planning and legal departments). |

Thus REBUS intends:

• to improve skills on the selected topics at individual (staff from spatial planning / legal departments; policymakers), organizational

(local/regional public authorities) and regional (stakeholders e.g. energy agencies, construction sector) level.

• to design, start implementing and monitoring Action plans detailing the local application of the ERP and developed on the basis of the experiences shared within the partnership and analysed to design their transfer process.

• to ensure dissemination of project results among relevant EU networks thanks to Policy learning Platform and REBUS communication tools.

The consortium consists of eight partners. One of the two Mediterranean partners is Region of Crete in Greece. Crete is not only the biggest island of Greece covering 6.3% of the total extent of the country but is also a major centre for research [22]. The island's harbours and airports constitute a significant asset. They both contribute to the fact the region produces 4.76% of the total GDP of the country, revealing the attractiveness of Crete as a partner of the REBUS project and as a fair representation of Greece and will be further presented in the next section.

### *B. The case of Greece – REBUS in Crete*

The Greek building stock mainly comprises residential buildings and a number of other tertiary sector buildings, which are registered every ten years throughout the country [1]. The most recent building inventory was carried out in 2011 [23] and its first results were released in September 2014, revealing that 55% of the building stock was constructed before 1980, thus classifying them as thermally unprotected. The correlation between the construction period of a building and its energy performance is confirmed by the statistics on Energy Performance Certificates (EPCs) [1], [24].

According to the 2014th report of Environment & Energy Ministry, the residential sector (domestic and tertiary), accounts for a large share of total energy consumption, representing 45% (7.751 ktoe) of domestic consumption for the year 2012 (17.129 in total) [1]. Similarly, the percentage of electricity consumed in the country's buildings is very high as according to the same report represents 36% (18.878 GWh) based on Public Power Corporation's records. Thus the Greek State has recently taken several important measures that affect the mobilizations of investment for building renovation, and are presented below:

1. Energy Efficiency Regulation of Buildings
2. Home Saving Program I and II
3. The Action Climate Change
4. Regional Authorities Saving Program I and II
5. Tax incentives
6. Urban motivation
7. Settlement of arbitrary fines with energy upgrades

Accordingly several significant local private and public stakeholders from the Region of Crete participated in REBUS consortium.

Region of Crete has as a main target energy renovation and the promotion of sustainable energy in the public buildings. Priority is given to those investments and interventions which are cost effective as they concern 500 various types of public buildings (e.g. hospitals, schools, sports facilities, offices etc.). This is additionally highlighted as one of the main priorities of the "Action Plan for smart specialization (RIS3)" of the Region of Crete is the development of the regional strength environment – comparative advantage in the sector of energy. Implementing effective energy technologies will attract activities and investments which will reinforce the "open innovation" model and will create new jobs. Nonetheless even though some data are available, civil servants lack the capacity to use them in an effective way. Furthermore, there is a need for a thorough strategy for the accomplishment of the national and EU energy saving directive obligations. So this work means to display an apparatus both for the Greek regional policy of energy upgrading of public buildings within Crete but also for attracting investment and for mobilizing private capital.

Overall the implementation of the REBUS' project results will improve the policy instruments for the Region of Crete through supporting new projects or modify/improve existing plans due to the inspiration provoked by the interregional cooperation, the success stories and best practices and by also avoiding mistakes pointed out by most advanced countries. It will also support new approaches to managing the policy instrument from lessons learnt from other regions, particularly in terms of the creation of a structured system to foster energy efficiency renovation. Advice and support to the public/ municipal authorities will be offered and relevant policy tools (manuals, methodological guides etc.) for effective and smart energy renovation of the public buildings will be developed. Additionally new models of smart financial tools will be applied. Therefore the capacity building of the relevant public/ municipal authorities will be supported, reoriented and assisted for further modernization.

The local Stakeholders will provide feedback in all steps of exchange to guarantee that the perspective of the final user is taken into consideration, thus ensuring that the policy instrument takes into consideration the most advanced practices on the theme. Even though the implementation of the REBUS' project results is still undergoing, as the project has a duration of 5 years, in the following sections the programs preliminary results, along with further explanation concerning the Greek partner and thus the Region of Crete, will be presented.

## III. RESULTS

REBUS addressed local authorities' needs in planning, implementing and monitoring energy renovation works in public buildings by designing an Energy Renovation Path aiming to overcome the most typical challenges encountered in the process. REBUS

used interregional exchange among different European regions to identify experiences that were included in the ERP, which is the tool REBUS proposes to address the identified needs. Experiences refer to energy efficiency renovations in public buildings, with the focus on four main topics: Planning, Implementing, Monitoring and Capacity Building [20].

The selected policy instrument aims to promote eco-efficiency and primary energy consumptions reduction of public buildings through interventions for the renovation of single or complex buildings, installation of smart telemonitoring systems, regulation, managing, monitoring and optimization of energy consumptions (smart buildings). Its significance and importance as a tool is featured by the fact that is based on knowledge and information derived from original experience in relevant cases and involvement in problem-solving not only from one region or country but a variety of specialists in various EU nations.

This phase's final objective was to improve the selected policy instrument based on lessons learnt through interregional cooperation activities (good practices and relevant experiences on smart grids) and has taken into account empirically determined crucial factors. Hence the presented ERP includes the Cretan case study and has been developed following a "Dip, Dive, Dig" approach. The achieved knowledge through the project's deployment was used by the project's working team to develop their learning through the initial 'Do's and Dont's' and list of actions (Dip), to learn more through the Experiences from each partner (Dive) and then to undertake detailed investigation through the Good Practice's highlighted (Dig). Table III presents the derived ERP including Actions (numbered and highlighted) and useful tips, results and guidelines on planning, implementing and monitoring renovation works in public buildings, relevant to the Region of Crete.

| **PLANNING** |
|---|
| ***Action 1: Definition of tools for data collection and setting up building inventory/database*** |
| A template was made following national legislation requirements and energy managers filled in all the characteristics of each building (energy consumption) in order to create the database. |
| ***Action 2: Collecting data on energy use, energy performance and past renovations of the public buildings*** |
| According to the Greek legislation an energy audit for each public building is mandatory since 2015. Its results and certificate should be publicly displayed and all data are gathered in a governmental database which aims to create the baseline of energy data use, and public buildings energy performance. However data from past renovations is something missing.<br>At the same time regional and local databases (using excel sheets) with maintenance and renovation costs exist but only at an informative level and are occasionally used and updated from the planning phase until the end. |
| ***Action 3: Understanding of all important land/ building ownership/ conservation issues*** |
| Greek legislation provides directions on the required permissions that a project must have prior any renovation action is set in place, based on the building's type or its residential environment. |
| ***Action 4: Ensuring necessary skills and capacities within local administration to successfully prepare, implement and monitor energy renovation project*** |
| Planning, implementation and monitoring of energy renovation projects, is ensured by each authority's technical service staff. If not a cooperation with external consultancies or other regional authorities is established. |
| ***Action 5: Assigning energy responsible on the building level*** |
| Each building should and in some cases have a person that is responsible for energy issues. Nonetheless this person is often overwhelmed by his/hers workload which prohibits its duties on energy. This could be if not avoided at least minimized by either assigning the task to an external expert, or by appointing a specific day per month that the assigned person would be occupied only with these specific duties. |
| ***Action 6: Ensuring that energy efficiency perspective is considered in all planning, investment and management activities related with public buildings*** |
| Energy efficiency is on the agenda of every project within the municipalities that participate in the Covenant of Mayor's initiative. Additionally the implementation of SEAP by regional authorities and the obligation to implement the EU directives incorporated in the Greek legislation minimizes the chances not to consider energy efficiency into all development decisions. |
| ***Action 7: Defining criteria for building selection (e.g. the biggest energy consumer in absolute terms or per m2)*** |
| For all the 44 buildings of the Region of Crete (owned and rented), all the available information has been gathered in a database. Specific selection criteria were set in order to make a comparative assessment between buildings, identifying the ones that there are multiple reasons to give them a priority for energy refurbishment. These are:<br>• Energy consumption/efficiency,<br>• Energy cost,<br>• Carbon emissions,<br>• Number of employees,<br>• Number of visitors, |

- Work schedule,
- Area of the building,
- Construction year
- Comfort conditions for the users / social needs
- Refurbishment need
- Financial resources
- Visibility / urban planning strategies
- Energy behaviour

These criteria provided the required information for fulfilling the prioritization process.

***Action 8: Identifying and selecting reliable and prepared energy and other experts for ER planning and execution***

During the planning phase a municipality's ER team consists of staff that deals with energy-related projects and hence their experience is progressing per project. Within the team the energy manager has a significant role in keeping things on the right track.
If a municipality does not have the required personnel/experts they can hire external consultants.

***Action 9: Assigning roles and responsibilities and establishing communication regime***

The latest L.4555/2018 obliges all public authorities/services to create clear job descriptions. Its implementation will eventually create a solid base for clarifying each personnel's role and responsibilities and at the same time will minimize the response time when an issue emerges.

***Action 10: Ensuring the all necessary building and project-related documentation is gathered and analysed***

Since the implementation of L.4412/2016 each project must have all the required documentation that shows that is "mature" in order to proceed to the implementation phase. This means that all possible drawback related to documentation should be lifted prior to moving to the next phase (especially when funding is requested).In addition the new Regulation on the Energy Performance of Buildings (KENAK 2017) sets an integrated energy design in the building sector that promotes energy efficiency documentation of buildings.

***Action 11: Ensuring involvement of building users from the very beginning***

Building users, maintenance and operation staff is consulted during project preparation. The ER team visits the building and discusses the current conditions, problems and future needs of the users.

***Action 12: Ensuring that planned ER project will be appropriate to business and users' needs***

In terms of business the needs and energy saving requirements are met by the ER team which makes certain that all technical and legislative standards are fulfilled.
In terms of user needs during the energy renovation a timetable is constructed including the best solutions in order to avoid users' disturbance. The existence of a step by step approach would minimize risks.

***Action 13: Selection of energy saving solutions and technologies***

The Regulation on the Energy Performance of Buildings (KENAK) introduced an integrated energy design in the building sector to improve the energy efficiency of buildings, energy savings and environmental protection. Each ER project is approached based on:

- Law 3661/2008, which incorporates all the provisions of the Directive 2002/91/EC of the European Parliament
- Ministerial Decision D6/B/14826/2008, which sets specific standards and regulations for the control and maintenance of heating/cooling of the buildings which house services in the public and broader public sector, and standards for internal lighting and ventilation conditions that should prevail in buildings.
- Law 4122/2013, which provides measures, funding programmes and other means to improve the energy efficiency of new and existing buildings and sets out the rules relating to the preparation of national plans for increasing the number of buildings with almost zero energy consumption.
- Law 4342/2015 on energy efficiency, which sets several milestones demonstrating the trend of compliance with the recommendations of the 2012/27/EU Directive.

All the above are interconnected with the required market research that updates the ER team's options concerning the latest energy-saving technologies.

***Action 14: Ensuring strategy which will prevent from working with just low hanging fruits***
***Action 15: Identifying and selecting the best financing options***

Public authorities in Greece use regional, national funds to cover 100% of the expenses (or in some limited cases loans).

***Action 16: Identification of potential hold-ups i.e. environmental, structural, ecological***

Crete is an area with great archaeological heritage and thus the ER team must always take into consideration this aspect in order to comply with the national legislation. Hence the required authorizations

should be in hand prior to moving on the next phase in order to limit the risk of unexpected hold-ups.

***Action 17: Establishing an efficient monitoring regime***

The majority of Cretan Municipalities participate in the Covenant of Mayors and thus are obliged to have SEAP. The implementation of long term energy saving strategies and the design of relevant action plans or Low-Emission Development Programmes, are mandatory and inspected every two years.

***Action 18: Ensuring synergies with other projects, policies, paths***

As the creation of calls/policies is the responsibility of the regional authorities, activities and investments implemented in SEAPs or other plans is rewarded. Nonetheless prior final call announcement guidelines on investment coordination and project planning seem to be essential in order municipalities' needs to be fulfilled and time to be gained.

***Action 19: Ensuring leadership commitment to providing long term support and resource after project completion***

All public entities have an annual budget for building maintenance. Based on Greek legislation the energy manager of the renovated building should provide the required maintenance cost, so as to be included in that annual budget.
Also repairs/adjustments of renovated structures/systems projects are covered by a 15$^{th}$ months guarantee offered by the contractor which is obligatory by law.

**IMPLEMENTING**

***Action 1: Definition of clear procurement rules stating energy benefits/performances to be reached after work (preferably using green and innovative public procurement principles)***

Each call has very clear procurement rules stating energy benefits/performances to be reached after works. Nonetheless there is not much experience yet when it comes to ESCOs.

***Action 2: Decision on the procurement type (traditional, PPP, ESCO) and development of procurement documentation***

Public-private partnerships have already been developed for street lighting. It is now implemented for energy renovation in school buildings.

***Action 3: Ensuring that contractor has a duty to examine and repair all snagging issues, working directly with building technical staff and users***

It is obligatory by the law to have a 15 month period for snagging issues.

***Action 4: Training of and regular meeting with the contractor***

The appointed project manager sets regular meetings with the contractor in order to assure the project's proper implementation and set a cooperation protocol.

***Action 5: Contracting or appointment of a good and reliable Construction Supervisor***

The construction supervisor/s (which in some cases could be the energy manager) is appointed by the public authority and has the appropriate qualifications (mechanical or civil engineer, architect).

***Action 6: Putting in place measures for quality assurance and control (in case of larger projects or parts of larger projects)***

The Greek legislation (L.4412/2016) foresees that there is quality control in every step of the implementation process.

***Action 7: Ensuring that energy efficiency is prioritised throughout the whole process and the whole lifetime of a building.***

Since 2008 Greek legislation designated that the energy managers should update and train in set intervals the buildings' users on energy efficiency issues as the population sometimes alters.

***Action 8: Taking advantage of Good Practices available for public administration***

Greek Regional Authorities acts as a central database for GPs collected by their participation in National and European calls. Later on they disseminate their acquired knowledge towards the local authorities (e.g. municipalities).

***Action 9: Taking into consideration different budgets used to finance the building, its operation and investments.***

Annually each local/regional authority issues its budget considering the construction of new buildings, the renovation of existing ones and the maintenance of both buildings and infrastructure.

***Action 10: Ensuring that the project as implemented meets all the formal and other necessary requirements***

The Greek legislation not only foresees regular inspections by the authority's project manager but also set a security clause for meeting all the necessary requirements appointed during the planning phase. For doing so a guarantee letter is issued by the contractor for a specific amount (5% of the project's budget) and attributed to the project owner (i.e. the municipality).

***Action 11: Ensuring involvement of key stakeholders, including technical staff (mechanics, electricians, engineers, etc.) in the whole process, also through the organisation of periodic meetings (particularly relevant for large construction projects)***

During the planning phase those affected by the renovation are taken under consideration before finalizing the proposal. Hence their involvement on set steps of the implementation phase is pre-scheduled. Also as in some cases the relevant parts are not removed from the site their participation and involvement is a "defacto".

**MONITORING**

***Action 1: Establishing monitoring structures and regime***

***Action 2: Clear definition of the regime/system and method (i.e. web) for reporting monitoring results***

The Euronet 50-50 project created a web-based platform that allows online free access feedback of the recorded data. Thus you can be informed for buildings hourly/daily/monthly electrical consumption, (http://www.euronet50-50max.eu/en/energy-savings-calculation-tool).
Also within the University of Crete Campus the in-plant control systems (BMS) uses central software controllers and I/O modules monitors that present the data from air conditioning of buildings control (Central Air Conditioning Units - Heat Pumps), data from the lighting of communal areas, various auxiliary systems as well as power consumption and current quality via electronic multi-instrument. It also presents the automatic control of amphitheatres' illumination and on/off and dimming data, so that there is no misuse of lighting.

***Action 3: Determination of monitoring tools – setting up a reliable monitoring system (i.e. BMS)***

There are many projects involving the implementation of BEMS that could be imitated: New building within the Technical University of Chania (https://www.tuc.gr/index.php?id=3879); University of Crete (http://www.ucnet.uoc.gr/nea-anakoinoseis-deltia-typoy/interreg-ellada-kypros-energeiaki-exoikonomisi-se-dimosia); New airport terminal building of Sitia (https://www.youtube.com/watch?v=L5AdnT2XrxA).
Also an e-monitoring system regarding electricity consumption is placed in several municipality buildings (e.g. Lim. Hersonisou) within the context of Euronet 50-50 project, transmitting real-time data.

Nonetheless apart from the positive experiences there are also actions that should be avoided like the following case. Venizeleio Hospital is one of the two main public hospitals in Heraklion. In 2001 during the building's first expansion a BMS was implemented for lighting scheduling and centralized monitoring and control of air conditioning units, as also for monitoring electrical substation. Nonetheless during the second expansion the new BMS couldn't collaborate with the initial one, leaving the engineering team to improvise solutions and measures in order to make all vital repairs and keep the system in good condition.

***Action 4: Establishing a work process with the contractor(s) (Gantt chart – who, how, when?)***

According to the Greek legislation during the procurement phase a Gantt diagram along with an organizational chart and a job description chart is a prerequisite and if not followed fines are implemented. The contractors can alter these documents during the implementation phase in order to have the final documentation in place when the monitoring phase starts.

***Action 5: Securing funding, both for monitoring and for carrying out repairs and maintenance***

Each regional authority has a specific budget appointed in its annual budget for buildings' repairs and maintenance. However for applying monitoring systems (when there were not any during their construction phase) in a building is a decision that has to be taken year by year depending on the available self-funding.

***Action 6: Identification of data sources, data collection and analysis, benchmarking***

With the process for Energy upgrade of the Central Administration Building of the Region of Crete, the entire building stock of the Region of Crete were recorded and an integrated database was made including various information (e.g. the type of the building, schedule of use, year of construction and renovation, energy characteristics etc.) prior and after renovation resulting thus to one database.

***Action 7: Ensuring efficient monitoring process***

Within the Campus of the Technical University of Crete in Chania the monitoring actions implemented were:
1. Enabling electronic access to PPC telemetry data and e-bill service. The Technical Service gained a direct view of the monthly electricity consumption.
2. Establishment of electronic heating oil receipt log.
3. Procurement and installation of 18 electric telemetry devices placing them at the focal points of the Polytechnic University. Development of data logging and analysis software.
4. Creation of an energy map with a display of energy consumption of the main units.
5. Dissemination of the results at: http://www.tuc.gr/5496.html.
6. Installation of energy meters in the student's rooms.

***Action 8: Seek feedback and ensure a transparent process for responding to feedback***

Within the region of Crete there are 16 municipalities that participate in the Covenant of Mayors. In this context regular meetings of the working team (some of them open to the public) are set not only as communication procedures but also as the mean for formal feedback between technical staff.

***Action 9: Ensure efficient cooperation with specialists from various fields of activity (both within and outside local administration) for monitoring performance indicators***

Due to the Covenant of Mayors SEAP's report is re-submitted every two years. This allows and also obliges participants to make all the required meetings (internally) and cooperation (internally and externally) in order to monitor and discuss their energy performance in total.

***Action 10: Making practical use of monitoring data***

The existence of monitoring data is something rare for the time being for the majority of public buildings, as not many monitoring systems have been in place. Nonetheless efforts are made to install monitoring systems either by national / self or EU funding. In the case of hospital buildings BMS provide data that assist their energy managers to verify the impact of

| |
|---|
| energy renovations along with the users' habits and energy behaviour. |
| ***Action 11: Using accessible, non-technical language to inform decision makers, building users and the general public of project progress and outputs*** |
| Several municipalities in the region of Crete participate with ROC's involvement and support, in EU projects (e.g. Sherpa, Stratenergy, Clean, Euronet 50/50 ) that assist their staff to acquire and disseminate knowledge and information relevant to energy saving and sustainability to the end users through workshops and informative material (e.g. leaflets, emails). |

At this point it should be mentioned that such a study has all the weaknesses of a self-report study. Even though the contributors could be influenced by their perception of what is a desirable response, the consortium reminded frequently and in each step of ERP's creation that experience and knowledge should be included. Regular communication, discussions within workshops and Bilateral Exchange Rounds were key points to accomplish the objective. Nonetheless given these limitations the results were interpreted with some circumspection prior included. Hence the reason that the authors decided to present ERP including data concerning the Region of Crete was to point out that Table III is not just another academic document but rather one created by people who also intend to use it and therefore was based on their fieldwork in-depth knowledge and experience (with the contribution of their stakeholders). By connecting a simple phrase with the reality of energy R2 framework adds value to the proposed idea and brings it closer to experiential knowledge.

Thereupon, the final ERP has two versions. One short (24 pages) and one longer (99 pages) aiming to become a useful "manual" that can be placed both on your "desk and on your library". Even though the program is still in progress, the preliminary fieldwork results, in the presented within this study focus area, suggest that an improvement of the existing policy instrument for the Region of Crete has already been accomplished through:

- ✓ Supporting new projects or modifying existing plans as a result of the inspiration provoked by the interregional cooperation, the presentation of success stories (e.g. Nearly Zero Public Buildings), good practices (e.g. smart metering displayed to the public) but also mistakes made by other advanced countries.
- ✓ Supporting new approaches to the management of the policy instrument caused by lessons learned from other regions, particularly in terms of the creation of a draft but structured system to foster energy efficiency renovation.
- ✓ Offering advice and support to the beneficiaries' public and municipal authorities.
- ✓ Developing relevant policy tools (manuals, methodological guides etc.).

This study rather than introducing radical new "grand theory" paradigms, adapted the idea that most theory contributions in strategic management extend, clarify, or apply received theories in new and interesting ways [25] As theory usually begins with a research question this study's result offers a response to the question "what path should be followed by public authorities (regional and local) to overcome the appearing bottlenecks during their energy renovation process".

Even at this early stage an ERP can assist the regional government to prepare project proposals for renovation works in their buildings, when the next national call opens. Because having a well-prepared proposal increases the chances of funding.

## IV. Conclusion

The global trend toward urban sustainability shows no sign of slowing. Over half the world's population now lives in cities and Europe appears ahead of the curve, with the proportion of urban inhabitants reaching as high as 75 per cent (from about 60 per cent in the 1960s) [26]. These urban trends are having profound consequences for the renovation policy for the EU and more specifically of Greece's building stock.

Greece an EU country so harshly hit from the economic deflation since 2009 and with an advanced economy (based on the European Bank for Reconstruction and Development definition) is a unique case for exploring public sector governmental authorities' ability and capability to take into account this study's results when it comes to the energy renovation of their buildings:

• the building stock consists of many old buildings that were built with anachronistic operating regulations and are often not thermally insulated, requiring very large amounts of energy to ensure acceptable levels of comfort,

• for a successful energy building renovation an applicable path for all parts (authorities, owners, users, stakeholders etc.) should be outlined,

• it is necessary to know your baseline in order to comply with the special rules for the protection of the cultural and architectural heritage that characterize many residential complexes in every country,

• it is crucial to create a low energy consciousness and awareness: nationally; regionally and individually.

The above refers not only to the Greek case study but also to other Mediterranean countries and internationally. As climate change is a major challenge for coastal regions, the proposed ERP is a sustainable initiative that will have an impact not only on people but also on society's ability to respond to the significant challenges that public authorities are facing.

Renovating the building stock to achieve high energy efficiency is one of each country's most strategic investment areas. Apart from saving energy

and reducing carbon dioxide emissions, additional benefits are gained in other economic and social sectors, such as employment, health, energy security and the fight against energy poverty. Also the energy upgrade of the public sector could operate as an exemplar for others.

It is a fact that the vision of Sustainable Building Stock is not easily attainable in the short term. The way in which energy projects are implemented and financed plays an important role, especially for the renovation of public buildings and infrastructures, as well as housing, hospitals, hotels and other energy-intensive facilities, drawing on the experience of recent years that demonstrates that the Member States of the European Union increasingly use cohesion policy funding for energy efficiency. Undoubtedly actions are required at all levels to overcome obstacles and barriers. First of all, the necessary political will is required. Incentives are required both for the public and private sector and, importantly, there needs to be appropriate funds available. It is hoped that Rebus will not only provide help by means of its ERP, but also contribute to the change in the energy consciousness of building users, which is gradually evolving and requires continuous information and awareness actions.

The energy efficiency policy framework for buildings up to 2030 is shaped by institutional actions that mainly concern the implementation of the European Directives. Under the new EU programming period, energy efficient buildings prioritise the transition to a low-carbon economy. They are very challenging. Rebus' ERP is designed to help.

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## NOTES

www.interregeurope.eu/rebus/

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