MED beX.Live webinar

Topic: **How to implement sustainable policies with a cost-effective approach for construction and building renovation**

Date: **23-06-2020**

Host:

Mediterranean Renewable Energy Centre – MEDREC

National Engineering School of Tunis – ENIT

DISCLAIMER

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Med-EcoSuRe Project

Project Title	Mediterranean University as Catalyst for Eco-Sustainable Renovation
Project acronym	Med-EcoSuRe
Funding scheme	European Union under the ENI CBC Mediterranean Sea Basin Programme 2014-2020
Start date	September 1st, 2019
Duration	36 months

Med-EcoSuRe is a project funded by the European Union, under the ENI CBC MED programme 2014-2020. The programme is managed by the Autonomous Region of Sardinia (Italy) and aims to promote cross-border cooperation in the Mediterranean region.

The main objective of the project is to propose and implement innovative and eco-sustainable energy renovation solutions for Mediterranean university buildings and introduce an active collaborating approach for decision support, among key actors involved, in the framework of a Living Laboratory: MED beX.Live (Live the eXperience of university building environment).

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1. Target audience

- Energy managers and technicians from the "Infrastructure and Buildings" departments in universities;
- Decision-makers/managers within the Ministry of Energy in charge of energy efficiency in public buildings;
- Decision-makers /managers within the Ministry of Finance in charge of supporting energy projects;
- Professors and students interested in energy policies and regulatory and technical aspects of energy efficiency in buildings;
- Key Actors (experts, auditors, manufacturers, architects, etc.) with activities related to energy management in buildings.

2. Addressed Issues

- What approaches and steps have been adopted for the implementation of energy efficiency regulations in buildings in Tunisia?
- What are the technical, economic and social barriers for the adoption of a regulation on energy efficiency in buildings in Tunisia?
- What are the lessons learned from the approach adopted by Tunisia for the implementation of the regulatory framework?
- Recommendations for promoting energy managers' mission within universities and the implementation of necessary capacity building programs…

3. Presentation of the Mediterranean Renewable Energy Centre – MEDREC

Presented by Marco Polverari – MEDREC director

MEDREC, a non-profit Economic Interest Group, is an operational platform and a think-tank for regional cooperation created jointly by the Italian Ministry of Environment and the Tunisian Ministry of Energy. Its core mission is to support and boost collaboration for Energy Transition and Sustainable Development in the Mediterranean region through the realization of studies and the design then the implementation of projects with support from different funding agencies.

MEDREC has developed valuable expertise in the management and national/regional programs and projects and gained great experience through the implementation of pilot and demonstration projects (PROSOL, MEDISCO, IMPROWARE, Med-EcoSuRe,...), capacity building and dissemination of information. MEDREC is also the implementation agency of the Tunisian-Italian bilateral cooperation between the Italian Ministry for the Environment Land and Sea and the Tunisian Ministry of Agriculture (project REFAT).

MEDREC has a significant number of partners which are:

- Italian ministry of Environment - Italy
- Agence Nationale de Maitrise de l'Énergie - Tunisia
- Politecnico di Milano - Italy
- Centre International des technologies de l'environnement de Tunis - Tunisia
- Ministère de l'Agriculture, des Ressources Hydrauliques et de la Pêche - Tunisia
- Gestore Servizi Energetici - Italy
- Politecnico di Torino - Italy
- Ecole Nationale d'Ingénieurs de Tunis - Tunisia
- Caisse des Dépôts et consignations - Tunisia

4. The role and the mission of the Ministry of Development, Investment and International Cooperation of Tunisia in the cross-border cooperation

Presented by Fethi Ben Mimoun - General Director of Cross-border Cooperation at the Ministry of Investment, Development and International Cooperation of Tunisia

The role of the Tunisian Ministry of Development, Investment and International Cooperation (MDICI) is:

- The coordination between the different bodies of the programme;
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- The participation in the steering committees of bilateral cooperation projects and programmes;
- The coordination between the different stakeholders within the framework of this cooperation;
- Follow up of the development projects and participate in the preparation of the state budget as well as the evaluation of executed projects
- Strengthening the international cooperation at the economic, financial and technical level;
- Assisting the launch of the Tunisian program such as choosing the partners and supporting the application of the programs…
- Giving recommendations and advice to the project launchers to help them find partners. Hence, the main goal is to assure a good level of partnership and cooperation for the Tunisian participation in this programme;
- Monitoring of the implementation of projects financed within the framework of international cooperation (implementation difficulties: proposing solutions and contributing to their implementation ...)

The cooperation with the government involves communication with the auditor groups. Obviously, this task remains invisible to the financing beneficiaries. Those are bodies which have been involved in the implementation and success of the program and are bound by commitments of the state within the framework of the cooperation execution.

Samira Rafrafi - Director in charge of cross-border cooperation in the Mediterranean basin at the Ministry of Investment, Development and International Cooperation of Tunisia

Med-EcoSuRe is woking on the energy renovation and public building refurbishment. The building sector represents 1/3 of energy consumption in the Mediterranean partner countries and 40% of the total energy consumption in the European Union countries, so the countries participating in this program consider the exchange of experience and innovative technologies in this field very important for the Mediterranean cooperation.

Med-EcosuRe project is among the 41 projects financed by the European Union/ENI CBC MED program under the call for standard projects . There were 419 proposals in a positive and fair competition and the project was shortlisted and then selected to be financed.

5. Presentation of Med-EcoSuRe project, its objectives and main findings

Presented by Ines Khalifa – Coordinator of Med-EcoSuRe

Med-EcoSuRe is a project funded by the European Union (EU), under the ENI CBC MED programme. It is a standard project with the goal to promote innovative and cost-effective solutions, taking into account the type of buildings and the climate zones. The partner countries are; Italy, Spain, Tunisia and Palestine.

The total budget for this project is around 2.9 M€. The European contribution to the budget is about 90%, which comes from The European Union and the remaining 10% is a contribution of the project partners.

Officially, the project started in September 2019 and shall be spread over a period of three years. Med-EcoSuRe is the acronym for Mediterranean University as Catalyst for Eco-Sustainable Renovation.

Scope and objectives

The main goal of Med-EcoSuRe project is to give the Mediterranean universities a key role to play in environmental sustainable development to tackle the issue of climate change within the framework of its two main missions and this is through education, research and development. The mission of the project is to bring researchers, decision-makers, and different stakeholders together in order to propose and implement cost-effective solutions for the renovation of public buildings in general, and more particularly, university buildings. The project aims also to build a common understanding of the eco-sustainable buildings renovation issues by introducing a collaborative approach called “Living Lab”.

The Living Lab is a community or a network of people who have the know-how and the knowledge about a specific thematic, In the Med-EcoSuRe case, the renovation of the buildings. It brings together the different stakeholders and involves the building users as well as key actors to setup adaptive, innovative solutions into practice to tackle issues of the over energy consumption of the public buildings, particularly, university buildings through sustainable rehabilitation.

While introducing the LL initiative, the project will promote innovative energy solutions to boost and accelerate the implementation of thermal regulations and policies starting from the immediate environment of universities, which are the university buildings.

Partnership

Our partnership is mainly composed of universities in the different partner countries, which are the University of Tunis El Manar represented by ENIT "The national Engineering School of Tunis", The University of Florence, the University of Campania in Italy, the University of Seville in Spain and the University of An Najah in Palestine. The partnership includes also the Napolitan Agency of the energy and environment and the cluster Solartys, which is operating in the field of solar energy and the cluster Domotys , which main activity is the conception of the buildings .

Expected results

The two main expected results of the project are:

- The initiation and the creation of the living lab that involves the key actors, decision-makers, Professors, researchers, students, different stakeholders of the socio-economic world to back the planning and implementation of sustainable innovative measures in universities buildings.
- The development, participation and transfer of know-how about the implementation of energy renovation measures.

  Those two goals are quantified by the number of buildings opted for energy efficiency and by the amount of greenhouse reduction using different renewable energy and energy efficiency technologies.

  In the framework of the project a number of toolkits of passive solutions for buildings refurbishment will be developed. These tools will help decision-makers to achieve a strategic plan.

  For the renovation and rehabilitation of higher education buildings, energy audits, pilot action in 9 buildings of university partners and the deployment of two technological solutions are foreseen.

Main achievements during the first year of the project implementation period

In November 2019, the project was officially launched in Tunisia, with the presence of the project partners, the National contact points of ENI CBC MED, and the Branch office of Valencia.

The cross border "living lab" initiative was launched by implementing the organizational setting, and guidelines for the internal management of the lab, and then a database of the different stakeholders to be involved was created.

An online ICT platform is in phase of creation to facilitate the cooperation and co-creation in the Living Lab community; the platform will ensure the gathering of information among partners and stakeholders, the transfer of knowledge and best practices, and the cooperation and co-creation among the Living Lab community to produce research. Access to the platform will be granted to all the involved actors in the Living lab.

Simultaneously, the university partners have started the energy audit in the buildings identified as pilot sites. An Najah university in Palestine managed to complete the energy audit which includes immediate solutions and recommendations for reducing energy consumption on the premises.

A call for tender was launched to install a photovoltaics (PV) power plant at an Najah University. The plant will be delivered and installed by the start of the upcoming year.

The Spanish cluster Solartys launched a survey prospecting innovative technologies from the Spanish startups to share their solutions and developed Research and Development (R&D) products related with "Innovative Solutions addressing Energy Retrofitting of Universities' Buildings". Four solutions have been identified to be implemented in the different partner universities.

A series of webinars is launched within the framework of the cross border living lab activities. The topic of the first webinar is about challenges and recommendations for implementing regulations in public buildings, in particular, higher education buildings.

This webinar has two main objectives:

- Raise awareness among the decision makers and the key actors of public buildings;
- Deliver recommendations for promoting energy managers' mission within universities and the implementation of necessary capacity building programs.

Those two objectives are part of the key activities of the project which is the process of planning information and capacity building sessions which consists in informing and training energy managers at universities about best practices and policies for building renovation, as well as the development of decision making tools for better implementation of optimal solutions for building renovation.

This webinar aims as well to create synergies with different organizations interested in this thematic and also with projects within the framework of the "ENI CBC MED" program.

All the project achievements were published in our newsletters in March 2020.

6. Supporting sustainable energy policies in public buildings – Presentation of Green Building project

Presented by Marina Kouta - Project manager - University of Patras

The University of Patras is partner number one of the "Green Building" project. The project full name is "Minimizing Energy Consumption for Green Buildings respecting Present Uses and Public Needs". It is spread over a period of three years and involves partners from Greece, Spain, Lebanon, Tunisia and Jordan. It has a budget of 2.2 M€.

The partners of the project are the region of the Peloponnese and University of Patras in Greece, the Technological Center on Biodiversity, Ecology and Environmental Technology (BETA) in Spain, Moukhtara municipality in Lebanon, the management company of the Technopole in Borj Cedria in Tunisia, Jordan University of Science and Technology and Greater Irbid Municipality-GIM in Jordan.

How did the project start?

There were two projects that ultimately led to the development of the Green Building project. The first one is the Graspino project, which was financed by the EU through the Interreg med program within the framework of the first call for modular projects. This project aims to provide innovative green procurement solutions for energy efficient refurbishment of public buildings focusing on smart cities and communities.

The main goal of the project was to improve public authorities' capacity of managing energy efficiency in buildings, moving toward Nearly Zero Energy Buildings (NZEB), and to encourage Small and Medium Enterprises (SMEs) to enter the green energy market.

After Graspino, AUTONOMO project was co-financed by the EU, through the Greece-Cyprus programme to reduce energy consumption. This project started in September 2018. Its main purpose was to assist Greece and Cyprus in their common national strategic plans to reduce energy consumption, and to increase the use of energy from renewable energy sources through the adoption of best practices for creating green standards for smart nearly zero energy buildings in the selected area.

Finally, the Green Building Project was selected to be financed within the ENI CBC MED programme, which has as mission the contribution to environment protection by reducing energy consumption in public buildings while respecting present uses and public needs.

Specific objectives of the project

- Plan innovative building energy refurbishment plans and measures to increase the capacities of public institutions to tackle the negative environmental impacts of high energy consumption and to provide methods to increase the ability of users to use refurbished buildings effectively.
- Plan and support cost-effective energy refurbishment of public buildings in climate change affected areas of Greece, Tunisia and Jordan.
- Enhance and promote the ecological use of public buildings.

Expected results of the project

The main expected results are:

- Enhanced capacity of public institutions to plan and implement sustainable energy policies and measures in public buildings;
- Reduced and cleaner energy consumption in public buildings through the use of renewable energy technologies.

Regarding the energy refurbishment of public buildings, the main existing problem is the increase in energy demand. The present project addresses this problem through the test and implementation of Renewable Energy systems and cost effective energy efficiency measures. Three buildings will be refurbished in Greece, Tunisia and Jordan. The first one the Laconia Prefecture built in 2008, which uses oil for heating. The second one is the greater Irbid Municipality building in Jordan. This building is twenty years old and is located in the old city center. Finally the building of the Institute Mohammed Kassab of Orthopedics in Tunisia which is a hospital built in 1971. It consists of two floors and operates 24 hours a day with 278 beds for patients.

Key outputs of the project

The key outputs of the project are as follow:

1. Energy certification of the buildings

2. The best practices outline for building energy refurbishment

3. A study for the energy refurbishment of the buildings

4. A Report on the energy refurbishment of the buildings

5. E-tools for the monitoring of each building

6. A manual for energy refurbishment in NZEB

Regarding the E-tool, it will be an application for smart phones that will ensure connection with energy measuring devices and will allow real time monitoring of energy consumption in the buildings.

Good practices collected related to what to include in Building renovation

- **Users and public training**

Based on some great national services, the actual energy consumption of residential buildings is directly related to occupants' behavior and to construction financial parameters. Greek office buildings have high average annual energy consumption, so energy efficiency is a strong concern. We need to train users and the public on energy efficiency policies.

- **Key performance indicators (KPIs)**

The second good practice is the use of typical Key performance indicators (KPIs) for optimizing energy performance. Some of the proposed ideas could be the energy KPIs which is measured during a period, like kW/h. Depending on the type of building use, the energy consumption over a period of time, could be normalized per visitor for public buildings.

One more KPI could be the comfort which expresses the feeling of comfort of people inside the building, by considering thermal comfort or by observing the occupants' behavior. One more KPI could be the green factor which is the fraction of energy used from renewable energy resources divided by total energy consumption.

- **Energy behavior**

This good practice in building renovation consists in recording the energy behavior, which includes the reporting of energy behavior of building users. This is critical because users significantly affect final energy consumption.

- **Energy upgrade scenarios**

The energy upgrade scenarios have to be defined also, which includes the definition of the renovation type (minor, medium , major and NZEB)..Since the Mediterranean area is privileged with daylight, PVs should be a main retrofit for public buildings.

- **Building Management System (BMS) and monitoring**

The building management system and monitoring is a sophisticated system for managing and monitoring system that controls building energy needs, including monitoring of refurbishment effectiveness through energy measuring devices that measure KPIs and energy efficiency after renovation.

Legislation

Regarding the EU legislation for valid performance certificates (Fig.1), the Energy Performance of building directive proposes the energy performance certificate as the first pillar in building renovation providing an accurate calculation of the building energy performance.

The Energy Performance Certificates (EPC) was introduced in 2002 as part of the directive 2002/91/EC on energy performance of buildings. It is mandatory for a new member state when constructing, selling or renting a building.

The directive 2010/31/EU on the energy performance of public buildings improved requiring the member states to ensure that an EPC is issued for buildings were the total useful area of a building is over 500 m², is occupied by public authorities, and frequently visited by the public. The directive was later extended and applied to the total useful area of 250 m².

The other directive was proposed in 2012. The EPC was mandatory for the purchase of buildings by the central government. The last directive of 2018 amended the two other directives on energy performance and energy efficiency, specified the databases for EPCs and allowed data to be gathered on the measured and calculated energy consumption of the buildings covered. It has been issued in accordance with article 12 of the same directive.

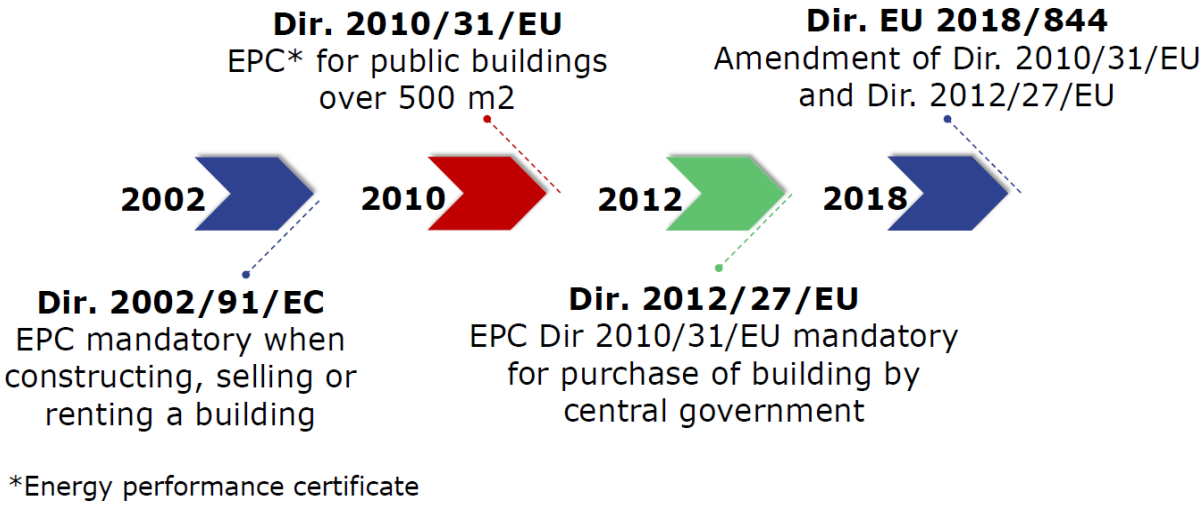


Fig.1: EU legislation for valid performance certificates

EU best Practices

Some European best practices have been collected from Italy, France, Germany, Slovenia and Croatia. It has been concluded that each EPC, energy practice and proposed practice for energy efficiency should be accompanied by specific training programs for energy managers or building users to be more effective, and to maximize the energy efficiency of the buildings.

7. Energy situation of the buildings sector in Tunisia and energy efficiency programs – Presentation of ESMES project

Presented by Samir Amara – Engineer at the National Agency for Energy Management (ANME)

The building sector is the third largest consumer of energy with 1 778 ktep after the transport sector and the industrial sector, but for electricity consumption it is the largest consumer with a 57% share which is equivalent to 764 ktep. If no energy efficiency measures are implemented it will become the first consumer of energy in 2030 with 5200 ktep.

Breakdown of the final energy consumption

The consumption of the final energy is unevenly distributed between the residential sector, with two thirds, and the tertiary with one third. For the Tertiary sector, air conditioning and heating are consuming the largest amount of energy. For the residential sector, refrigerators are the largest energy consumers with 45% of the total consumption.

Energy management policy & regulations in existing and new buildings

The next slide shows that the ANME must develop three types of measures: passive energy efficiency measures concerning the envelope of buildings, active energy efficiency measures for equipments, and the third type is about raising awareness and assistance for end users.

Starting with the regulatory measures, the project of thermal regulation of new buildings was initiated according to the law of The Ministry of Energy N° 2004-72 of August 2, 2004, as modified and supplemented by the law 2009-7 of February 9, 2009.

Construction projects for new buildings and extension projects for existing buildings must meet minimum technical specifications for energy management set by the joint decree of the Minister responsible for equipment and housing and the Minister responsible for Energy. Two texts have been published concerning buildings. The first text is set for office use and similar activities and was released in 2008, and the second text is a decree concerning the Building for residential use published in 2009.

There is a scale of energy performance of buildings with 8 levels/classes. The maximum level for private buildings is five and for public buildings is three. This scale is linked to the law of roofing and air conditioning.

Tunisia has three climate zones, the littoral zone "ZT1", the North West and Center West (ZT2), and the Southern zone "ZT3" (Fig.2). For existing buildings, there are restrictions on the level of glazing rate of the coefficient of roofs, and the coefficient of walls and glazing.

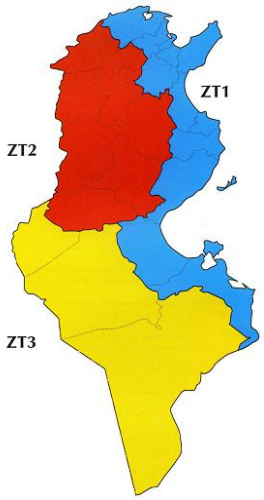


Fig.2: climate zones in Tunisia

Energy audit and energy audit based on building plan

Buildings with consumption greater than 500 TEP are obliged to carry out an energy audit every five years. For newly constructed buildings, the limit is 200 TEP. The new regulations grant 70% for the energy audit feasibility studies and assistance, with a ceiling of 30 kDT dinars and 70 kDT dinars for the assistance. In case of material investment, 30% is granted with a maximum of 200 kDT.

The energy audit must be carried out by auditors with expertise in energy sector. The energy audit based on building plan is a combined work carried out by architects and engineers who must be certified as well.

Energy saving programs and projects

The main energy saving programs carried out by ANME are:

- The energy audit
- The thermal regulation of new buildings
- The label "EcoBat" HPE (High Energy Performance) buildings, energy rehabilitation of existing buildings;
- The “PROMO-ISOL” program which will start soon;
- The “PROSO-ELEC” program;
- The “PROSOL thermique program” which will start by the end of the year 2020;
- The co-generation program which concerns principally the industrial sector. However, there are a number of projects for the hotels and the airport in Sousse and about ten projects for the program of air conditioning using natural gaz;
- A new program called “stockage du froid” (cooling energy storage) to avoid the electricity consumption peak in summer.
- The program of energy certification and labeling of household appliances which started in 2004 with refrigerators, then in 2009 with air conditioners. In 2018 the program included washing machines, and there is an ambitious program for this year and next year for lamps and lighting products.

There are projects that concern the buildings envelop, others that concern the equipments, and there are projects that concern both as well.

- **PROMO-ISOL project**

The project is in the start-up phase, and aims to promote the thermal insulation of the roofs of existing and new housings in order to reduce energy consumption for heating and cooling. ANME will grant 8 Tunisian Dinars (DT) per square meter for the existing buildings and 6 DT for the new buildings. A donation was also obtained in the framework of Italian cooperation for 6 more dinars per square meter.

The organizational diagram for the programme PROMO-ISOL is shown in Fig.3

The ministry has set up programs for sustainable use of refrigerators, air conditioners and washing machines. As for lighting, ANME has been promoting economical lamps and led lamps for years. Regarding the project transition strategy to efficient lighting, an agreement will start this year. A call for tender will be launched to purchase led lamps and to distribute them for free to households.

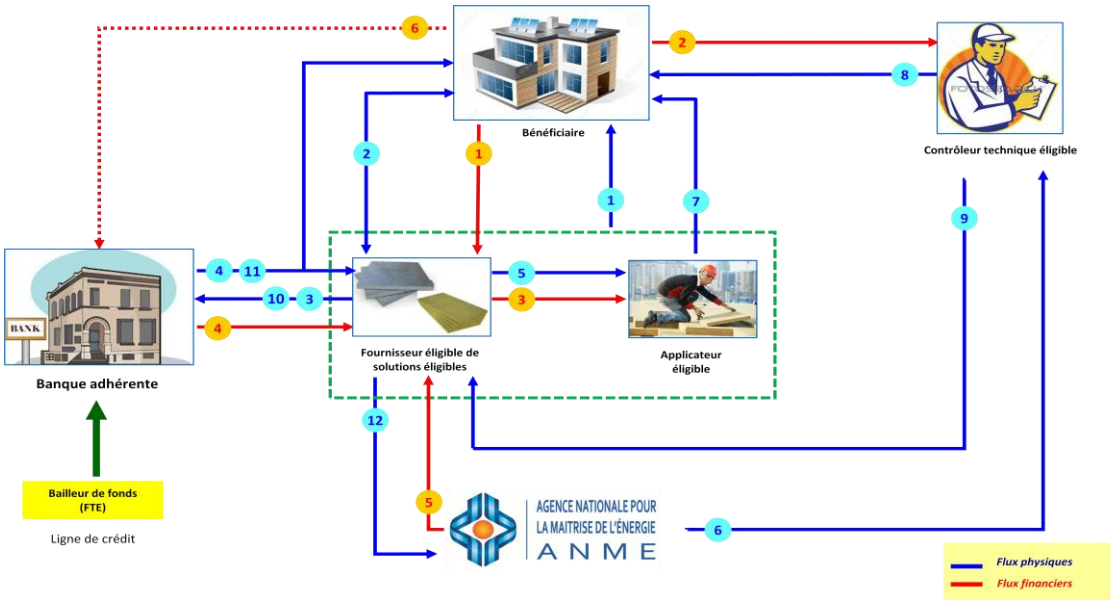


Fig.3: organizational diagram for the programme PROMO-ISOL

The regulatory framework will strengthened as well for the disposal of inefficient lamps.

- **PROMO-FRIDGE**

This program is similar to "promo-Isol" and it consists in reducing the electricity consumption of poor and energy-insecure households by replacing the dilapidated stock of energy-consuming refrigerators. An amount will be granted by ANME, which is being quantified in cooperation with the suppliers and the ANGED (National Agency for Waste Management) for recycling the old fridges.

- **PROSOL residential**

It is the first project carried out by ANME and it is progressing at a steady pace. The project is being implemented jointly with STEG (The Tunisian Company of Gas and Electricity).

- **PROSOL collective**

The project is set for collective buildings, especially hotels.

- **PROSOL ELEC**

The objective of this project is to promote High Energy Performance buildings in the residential and tertiary sectors, and it is progressing well.

- **ECOBAT-LABEL**

The "Ecobat label "is a program that was already launched for High Energy Performance and in this regard two requests have been received, one from a clinic and another one from a hotel for the implementation of an eco-label .

Presentation of ESMES project

ESMES project (Energy Smart Mediterranean Schools) is a network of intelligent schools.

The project focuses on the optimization of energy consumption in public schools through innovative, monitoring-based renewable energy and energy efficiency (REEE) pilot actions and will improve the capacity of public institutions in order to implement innovative energy rehabilitations.

The project's main expected results are:

- The Capacities of 5 public institutions to implement innovative energy rehabilitations in public schools through multilevel governance and the adoption of energy mix efficiency strategies;

- The Energy consumption in 10 public schools will be optimized through innovative, monitoring based REEE pilots;

- Around 120.000 people will be able to improve sustainable Energy habits through raising their awareness about energy saving habits, mutual influence, leading impact on broader public. Students will be trained on field and will get better sustainable Energy employment opportunities.

The coordinator of the project is the Institute for University Cooperation (Italy)

The other partners are:

Partner 1: German Jordanian University (Jordan)

Partner 2: Commune di Alcamo (Italy)

Partner3:Consorci de la Ribera(Spain)

Partner 4 : National agency for Energy Management – ANME (Tunisia)

Partner 5: The Lebanese Center for Energy Conservation (Lebanon)

Finally, the main activities to be carried out in Tunisia are:

- Realization of Energy audit of the Higher Institute of Applied Sciences and Technology of Sousse (ISSAT);

- Setting up a monitoring system connected between the 5 partner countries;

- Energy rehabilitation of ISSAT through the implementation of energy efficiency measures such as, PV panels along with other activities;

- 8 schools will be chosen in the region of Sousse for awareness raising campaigns for the students. Distance monitoring of energy consumption of the 8 schools.

Unfortunately, the project team fell behind the schedule because of the pandemic but the mentioned activities will be implemented soon.

8. Thermal regulation in public buildings in Tunisia

Presented by Ahmed Ben Othman - Director at General Directorate of Civil Buildings in the ministry of equipment in Tunisia

Definition of Civil Buildings

Civil buildings are defined, by the Tunisian Governmental Decree number "967" of the year 2017 in its first article, as the building which construction is undertaken by the State, local authorities, public establishments, and public enterprises, excluding some projects intended for strictly military use, inaccessible for reasons of national security, or those carried out within the framework of a concession contract or within the framework of real estate development operations. There are 6 categories of civil buildings from A1 to A6. The classification depends on the size of the project.

The general direction of the civil buildings, at the Ministry of equipment, housing and the territorial development is ex officio the delegated contracting authority for the realization of category A1 projects. Therefore, it oversees the projects executions. i.e. studies and follow-up of the works through architects, engineering consulting firms, design offices and qualified companies, and it concludes in this respect study contracts, work contracts in accordance with the regulations and the execution of these projects.

For the categories A2 to A6, the Ministry of equipments may also be delegated as project owner, but only based on the decision of the Head of Government or based on the project owner's request. The ministry executes also projects through its general directorate of civil buildings and in the different regions in Tunisia through its regional branches.

Thermal regulations in civil buildings

The Tunisian decree number 7 of 2009 is a law that was amended by the law 72 of 2014. It stipulates in its article number 10, that the construction projects of new buildings and the extension projects of existing buildings must meet minimum technical specifications for energy control set by a joint decree of the Minister in charge of equipment and housing and the Minister in charge of energy.

The first decree of 2008 concerning office buildings was promulgated and amended by the joint decree of 2010. This decree sets the minimum technical specifications of thermal performance to which are subject the construction projects of new buildings for office use or similar activities. The decree covers both public and private buildings. The technical performance specifications are evaluated through the annual energy needs of the building related to thermal comfort expressed in kW.m^2/year. For the public building, the decree required that its energetic needs must not exceed 95 kWh.m^2/year (class3). For the private sector, it is allowed to go up to 125 kWh.m^2/year (class 5).

To be able to implement this decree, the verification process of provisional consumption should be defined. Any applicant for a building permit or the construction or extension of a building for office or similar use (for residential use) must attach to the permit file a technical sheet concerning the building to be constructed or the extensions to be introduced. This paper specifies the thermal performances of the building. The process of checking the data and the information included in the paper is the role of the technical commission of the building permit. The building permit is not delivered in case of non conformity of the data with the minimum technical specifications fixed in the decrees. If the provisional consumption exceeds class 3 for a public building project, the design must be reviewed in order to identify the appropriate solution to improve the energy performance of the building including insulation measures to reinforce the quality of the envelope, orientation…. This is the role of the project designer (architect) which consists in adding the necessary measures to make the building compliant with the regulations.

The project managers in this case are the architects and engineering offices. The decree proposed flexibility for small projects and projects that are not complex, and this is called the prescriptive approach, which means that it is not required to carry out a detailed energy study, and defining the technical specifications is sufficient, depending on the thermal zone of the project. If the project is a little more complex, the performance approach is mandatory. An energy study should be carried out by engineering and design office or a specialized consulting firm. The study must prove that thermal comfort needs are lower than the limit stated in the decree.

The Ministry achievements

It was found that 90% of the projects carried out by the General Directorate of civil buildings met the obligations of the decree aforementioned. In fact, the General directorate was in charge of the realization of A1 type projects and this category of projects must generally be carried out through innovative architectural competitions during which the architects are asked to share their ideas and their choices based on energy saving criteria.

Regarding the technical lots, they are generally carried out by qualified design offices and Consulting Engineers with specific skills and experience. So right from the start, the projects implemented by the General Directorate of civil buildings met appropriately the decree's obligations in terms of energy quality.

- **Nano technology Centre of Sousse**

The Nano technology Centre of Sousse is a project launched in 2010. The first version of the project was not energy efficient and acceptable though. Following simulations using CLIP software (Conception et Labellisation d'Immeubles Performants), it turned out that the thermal needs are equal to 123 kW/h for thermal comfort i.e. in class 1. So, a number of improvements were implemented to the terraces while adding polystyrene insulation. The thermal needs reached 103 kWh/m^2 by using double glazing, and were further reduced to reach 76 kWh/m^2 corresponding to class 2.

- **Headquarters of the Ministry of Industry**

This project was designed but not completed. However, in terms of studies, the initial version of this project was classified as class 1 with 70 kWh/m^2 of thermal needs.

Following the implementation of some measures including the upgrade of the building envelope, the project's thermal needs were reduced to 38.2 kWh/m^2 in one year.

- **Higher Institute of Arts and Crafts of Tataouine**

In this project, the thermal needs were initially equal to 78 kWh/m^2, and after introducing improvements to the envelope, the team in charge was able to reach class 1, with 72 kWh/m^2.

- **Higher Institute of Applied Sciences in Kasserine**

The thermal needs at the institute were around 77 kWh/m^2 in the initial phase, and were reduced to reach 74 kWh/m^2 (class 1).

It was concluded that most of the projects were in conformity with the thermal regulations since the start. However, the General Directorate has been always trying to improve the status of the buildings and reduce the energy consumption.

Problems encountered

Even though the General Directorate for Civil Buildings has achieved successful projects, many of the projects are still below expectations, especially at the regional level and public buildings built outside the context of civil buildings. The shortcomings are mainly caused by a set of factors listed here below:

- Low involvement / lack of support from municipalities;

- Restricted field of thermal regulation application;

- Low legislative weight/power of the TRB (Thermal regulations of the buildings)

- Lack of in situ monitoring of building compliance;

- Lack of skills required for the application of the TRB (Thermal regulations of the buildings);

- Lack of technical working tools;

- Lack of awareness and communication;

Recommendations

It should be noted that people, especially in the regions, are unaware about the thermal regulations in Tunisia. In order to remedy these weaknesses, the following recommendations should be adopted:

-Train the building permit service managers and technicians in the application of the National Thermal Regulations of the buildings;

-Train technical designers/controllers in the application of TRB;

- Improving IT tools for TRB compliance;

- Update and improve the TRB website (www.enerbat.nat.tn);

- Develop a database of the energy characteristics of TRB-eligible construction projects;

- Set up a communication strategy suitable to each target population: general public, building owners/developers, designers, technical controllers, administrative staff, and professionals.

9. History of the process of implementing thermal and energy regulations in buildings in Tunisia

Presented by Mounir Bahri – Energy Efficiency and Renewable Energy expert

Building sector in Tunisia

The building sector is the first consumer of electrical energy and the third consumer of final energy. Hence, it is necessary to take the suitable and effective measures to tackle this issue. The solution is to set up a national strategy for energy management and energy efficiency in the building sector and the first step is to work on active energy efficiency measures, i.e. work on the building envelope, because once the building is technically constructed, it becomes costly and complicated to modify in order to improve its performance. For this reason, implementing the thermal regulation for new buildings is considered as a fundamental step.

Thermal regulation of new buildings – Phase of study

The process started in 1992, when a steering committee was created including actors from different sectors. The preparation of the thermal regulation was a three-phase process. The first phase was financed by the European Commission in 1992 and concerns the 3 Maghreb countries: Algeria, Tunisia and Morocco.

The objective of first phase was to have an idea about the performance of the different types of buildings, to be able to define a scale of performance adapted and to implement also an architectural design adapted to the different climatic zones existing in Tunisia.

During this phase, national operational groups were formed and supervised by European experts to perform the climatic zoning at the level of each country (Tunisia, Algeria and Morocco), and then at the level of the whole region of Maghreb.

Thermal simulations were carried out in the case of residential sector through its various social categories (Social residential, Economic residential and High profile residential) in order to well adapt the energy performances.

In Tunisia, two teams were appointed to work on the elaboration of the thermal regulations. The first team is represented by ENIT, whose solar thermal laboratory is headed by Professor Chiheb Bouden and Professor Nadia Ghrab. The team's mission was to carry out all the thermal simulations and identify what improvements to implement and their relative costs. In fact, the application of the regulation usually depends on the additional generated cost. Thus, it is necessary to assure an acceptable additional cost budget.

The thermal simulations for the tertiary sector were carried out by appointed design offices.

The study carried out included a climatic zoning for the coastal zone, the North-western zone, the central-western zone and south of Tunisia. Following, a more detailed zoning was defined through climatic regions, because at the level of each climatic zone there exist micro climates which were taken into account while carrying out the thermal simulations to be able to adapt the scale of performance to the national context.

ENIT team used the software TRNSYS, which is a very detailed simulation program of transient systems, to be able to reproduce the same conditions of the buildings.

For the tertiary sector, DOE 2 software was used which is a building energy analysis program.

Thermal regulation of new buildings – Phase of demonstration

After accomplishing the study phase and before moving on to the real implementation of the regulation, it was decided to carry out a phase of demonstration of projects: the French Fund for Global environment the (FFEM) through the French Development Agency (AFD) in Tunisia and Funds for Global environment (FEM) through the United Nations Development Program in Tunisia (PNUD). This phase included the following:

- Implementation of demonstration projects for the experimental validation of thermal regulations: 7 Tertiary and 36 Residential;

- Development of simplified tools to control the thermal regulations implemented.

- Development of 7 technical sector guides;

- Carrying out training and communication activities for the various construction actors.

Concerning the results and achievements of the demonstration project, the additional costs generated were evaluated. The following table (Tab.1) summarizes the additional cost ,in % of the housing costs, obtained.

Tab.1: Additional costs generated per sector for the demonstration projects

Category	Additional costs (%)
Tertiary	8% to 9%
Social residential	9% to 10%
Economic residential	4% to 5%
High profile residential	2% to 3%

For the control application, the software CLIP was used to assess the performance of the buildings. The software that was adapted to the local building specifications. Designers were trained to be able to use it as well. The control application of this tool is being currently improved with the supervision of ANME.

The seven technical sector guides developed, concern the following:

1. Equipped housing;
2. Not equipped housing;
3. Office buildings;
4. Educational building;.
5. Commercial buildings;
6. Hotels;
7. Hospitals.

Guides for equipped and non equipped housings were elaborated because Tunisia is characterized by a fairly moderate climate, and so it is possible to design buildings without providing heating and air conditioning equipments, and by just assuring a good architecture of the housing.

Among the other results, there were the communication training activities for the various construction actors. Several technical guides and technical sheets were developed as a support to the controllers and for designers to help them apply the thermal regulations.

Regarding the quality control and the certification of the materials of the construction which are going to be used, a laboratory was established, at the Technical Center for Building Materials, Ceramics and Glass (CTMCCV), to carry out tests on the various techniques regarding the envelope, and thermal insulation of local materials.

In fact, in Tunisia there exist varied and important useful substances that could be put to use to provide technical solutions, for the local envelope, which does not cost much and with interesting performances.

At the CTMCCV center, studies and experiments were carried out on the certification of materials through research and development projects, in close cooperation with various university and industrial teams to provide technical solutions with local materials.

Thermal regulation of new buildings – Phase of regulatory promulgation

The classes of the buildings: the private buildings are at the level of class 5 (Fig.4) but for public sector, it has been suggested that the state should impose a level higher than the existing level adopted for the private sector.

Fig.4: Scale of classification of buildings energy performance

The thermal regulations focused on the climatic zones. For each zone, and according to the rate of glazing, different levels of performance are accorded in order to minimize the glazing rate as much as possible. Increasing the glazing rate requires higher performance in terms of openings and in terms of overall thermal needs.

The objective of the national strategy surpasses the regulatory level. The Tunisian certification ECOBAT aims to promote High Energy Performance buildings in the residential and tertiary sectors. The certification targets the envelope of the building, the building technical equipments, and resources management (energy, water, and waste)

The state is currently adopting the methodology of the obligation of the energy equipments for buildings, to assure a better performance of the buildings which are going to be sold or rented by the state.

For the individual residential, PROMO-ISOL mechanism has been implemented to promote thermal insulation of roofs of existing and new housing. The mechanism offers subsidies and loans to encourage the citizens to design and enhance the performance of their buildings.

10. Research & Development at the National Engineering School of Tunis (ENIT): Towards Thermal regulations for Tunisia

Presented by Chiheb Bouden – Professor at the National Engineering School of Tunis (ENIT)

Why an engineering school? Why a research activity for the implementation of thermal regulation? Why not apply an existing regulation like U-Value which is well known around the world, or coefficient G such adopted in France….

In the case of the thermal performance of buildings and energy efficiency in buildings, several parameters need to be taken into account. The first parameter is the climate. In fact, it is not possible to apply a regulation developed and applied for the case of Europe in Tunisia. The second parameter is occupants. Their intervention consists of the use and management of the building, and of their own behavior inside the building .These parameters are important and should be considered as they will help to conduct research works and develop actions in this field.

Tunisia and the Magheb in general are characterized by a mild climate, so it may be thought that heating and cooling systems are not needed. However, this is not the case, it is essential to heat and cool the buildings in winter and summer respectively. The humidity needs to be managed as well since Tunisia is a coastal country.

Traditional Dwellings

According to the country's historical context, it can be noticed that the ancestors succeeded relatively in managing the buildings and they were able to adapt well to climatic conditions by adopting specific architectures that goes from troglodyte dwellings in the past to the Medina and architectural fabrics etc.

The occupants adapted also by changing their behaviors, and by managing the buildings by themselves. Furthermore, they chose construction techniques that were appropriate for the climate. In fact, the buildings had thick walls and were constructed with materials that have a very high thermal capacity. Furthermore, the architecture was very particular as the buildings were nested (such as the case of Medina) and there were shadows and air circulation and a multitude of architectural features that have made the building appropriate and adapted to the climate. This guaranteed an acceptable thermal comfort in the buildings.

Modern Dwellings

In case of contemporary/ modern buildings, it is noticed that they resemble the European buildings, with glazed facades using new construction materials. However, there are several issues related to the implementation of the construction techniques. Hollow bricks are often not used appropriately, the bricks are poorly made and subsequently the laying of the concrete itself for the lintels is poorly made.

All the aforementioned factors cause thermal bridges (a phenomenon that occurs when there is a gap between materials and structural surfaces) and cause discomfort and overconsumption of energy in the building. Thus, the current situation can be summed up in lack of appropriate comfort.

Besides, the occupants are developing new behaviors. They prefer to be dressed lightly in winter to be efficient and to be able to work at home, which was not possible several years ago. In fact, the occupants used to wear a lot of clothes because the thermal comfort is not appropriate and/or sufficient.

Thermal comfort in the Tunisian context

As the standards of living have improved, occupants started relying on heating and cooling which generated relatively high energy consumption and energy bills.

In case of the European countries, there exist, air-conditioned buildings, with a good quality of envelope, where a heating with a set-point temperature is adopted, and a constant temperature, day and night is provided. This set-point can vary between winter and summer. The level of thermal comfort is good inside the building, and the consumption of energy is quite reasonable. This is thanks to the standards, regulations and building codes that exist.

In case of Tunisia, and for traditional housing, there is a high fluctuation of the temperature outside the building (day–night and summer–winter), and attenuated fluctuations inside the building. This is mainly related to the choice of construction materials. The quality of the comfort is not always guaranteed but the user has known how to adapt by means of certain behavior.

In case of the new buildings in Tunisia, it is recommended to add a set-point temperature, which means a stable temperature inside. However, the large fluctuations outside the building and the very poor quality of the envelope lead to very high energy consumption.

The purpose behind the thermal regulations in Tunisia is to distinguish between two types of buildings: the buildings for tertiary use (administration, hospitals etc) where temperature control should be applied, and the buildings for residential use which is classified into two categories:

- Very high standard buildings: where the heating and air conditioning are systematic.
- Social and economic housing where the use of heating and air conditioning is not entirely systematic, and where it is acceptable to have slight fluctuations in the temperature inside the building because the set-temperature is not used. In this case, it is possible to have a relatively modest energy bill by assuring a properly designed envelope.

Adopted methodology by ENIT

The process started with exploratory and experimental research, which was conducted on an existing solar house at ENIT and allowed to understand various phenomena and carryout numerical studies (numerical modeling), with the aim to master modeling tools as well as thermal monitoring and experimental analysis tools.

Following, the team was able to perform technical and economic analyses to develop know-how on the subject. The gained know-how enabled the team to master not only modeling tools but also monitoring, optimization and technico-economic analyses tools.

As performance indicator , the team opted for the evaluation of the thermal comfort quality, given that it is not possible to have an energy bill always, particularly in housings that are not systematically heated or cooled,.

The model used to achieve the thermal comfort shouldn't follow systematically the one used in Europe where buildings have systematic heating/cooling and so a constant temperature inside and consequently a practically permanent regime.

However, this is not the case in Tunisia since there are large temperature fluctuations and therefore the models used for thermal comfort in this case will be slightly modified compared to the conventional models, such as the well-known "Fanger" models.

The team at ENIT worked in close collaboration with ANME on the implementation of the thermal regulation, and the methodology adopted is the following:

Step 1. **Definition of Climatic Zones and Representative sites**: the first step consists in identifying climatic zones which are essential inputs to conduct the numerical and experimental studies.

This step was accomplished thanks to the close collaboration with the National Institute of Meteorology, ANME, ENIT at the start, and then also the engineering office Season and Moncef Krarti, who is a research professor in the United States.

Step 2. Analysis of the Existing & Data Collection; in a second step, analyses and data collection were carried out, on the existing construction materials used, the local materials, the existing typologies and architectures in Tunisia, the consumers behavior and the uses of the buildings.

Step 3. Thermal, Energy Investigations / Economic Analysis: the next step consisted in carrying out numerical simulation using TRNSYS software. In the majority of the cases, the TRNSYS code was amended in order to reproduce local climatic and occupancy conditions.

The thermal and energy modeling phase has always been accompanied by economic analysis, to identify the most economically viable solutions with a relatively acceptable payback time.

Step 4. Development of Simplified Tools: the fourth step consisted in developing simplified tools.

Step 5. Pilot Projects & Test Phase: The last step is the implementation of pilot project. ENIT was not very dynamic. However, ANME has made huge effort to accomplish this step.

Evaluation of the thermal comfort

For the evaluation of the comfort, a numerical model was developed and coupled to TRNSYS. The model is based on the work of Fanger but also amended by other models developed by researches and scientists who have worked on hot zones such as the model of Gonzalez. This led to the elaboration and evaluation of a "comfort note" or a qualifier of the quality of this comfort.

As mentioned above, the comfort is not only based on the characteristics of the building, but also based on the behavior of the occupant. In fact, in Tunisia, the occupants' behavior differs to adapt to the building by dressing differently, eating and drinking differently in winter and summer. Therefore the Fanger model is not the most suitable model for the Tunisian context. Other models were tested, adopting a different approach to evaluate the thermal comfort which were developed by " Michael A. Humphreys " and which currently has many adherents all over the world e.g. in Australia in the United States etc. The developed model is called **adaptive comfort model.** This model is based on a survey of the occupants in a transient regime (not in permanent regime like in the case of Fanger), i.e. survey the peoples' daily life conditions by inquiring a number of information. Following this, statistical analyses were carried out and which resulted in a comfort temperature which varies according to the ambient temperature outside.

The survey was carried out in five towns in Tunisia and targeted two hundred people; each was visited once a month. Among the results obtained following this survey is a correlation between the ambient temperature and the "comfort" temperature. This finding is very important because the Fanger model considers that a comfort temperature is equal to 19°C and can be 24 or 25°C in summer, while the adaptive temperature varies depending on the ambient temperature which is very important as the temperature is essential in the evaluation of energy consumption. In fact, if the estimated comfort temperature varies by only 1°C (18°C instead of 19 °C), the energy consumption, function of the temperature gradient of the indoor and the ambient, will decrease, and so, gaining a degree in temperature will enable to gain practically 18 to 20 % on the heating or cooling bills. Thus, it was very important to find a correlation which determines the comfort temperature.

Through this survey, the team was able to identify also all the parameters that the occupants adopted to adapt to the climate and the indoor conditions such as clothing, activities etc. A series of correlations was found which enabled to obtain all these findings.

This phase was followed by the investigation process through modeling. The main parameters taken into consideration were: the thermal mass of the building, solar gains, orientations of the buildings, architectural and bioclimatic elements such as trombe wall, bay windows, night natural ventilation, glazing and solar protection. Additional elements were explored such as the Canadian well or cooling or heating.

For simulations, TRNSYS software was used, which is detailed and open source, so it was possible to amend the code, and add models. However, the software was sufficiently compact to be managed with the team at ENIT due to the lack staff.

The simulation results showed that TRNSYS was inconvenient or not totally suitable for the Tunisian context. For example, the TRNSYS algorithm could not evaluate the heat transfer in case of old buildings which have very large wall thicknesses, and so amendments had to be added to the algorithm, in order to obtain the behavior of the heat transfer in the envelope. Therefore the DIFFIN model was developed, which is a finite difference model having a response factor adapted to the one of TRNSYS by adding a number of modifications.

Concerning the architecture, modules for the courtyard were added, which is an architectural mode common in Tunisia. The courtyard can be inside the house or integrated into a grouping of dwellings given the urban fabric currently used in Tunisia. Models, such as the Canadian well (ground heat exchanger), were used as a tool for either heating or cooling in summer.

Besides, a very important model which is ZAER was introduced, which offers the possibility to model the aeraulic flows in the building. In fact, in bioclimatic buildings, there are façades exposed to the sun and others not, and the heat transfer and flows between the climatic zones inside the building were not well evaluated while using TRNSYS. ZAER was also accompanied by a model predicting the solar radiation and identifying how and where the radiation is directed.

Whether the solar radiation hits the ground, the wall or the floor, there will be a different influence given the absorptivity and the thermal mass of each component.

The complete model developed presented in the following graph (Fig.5).

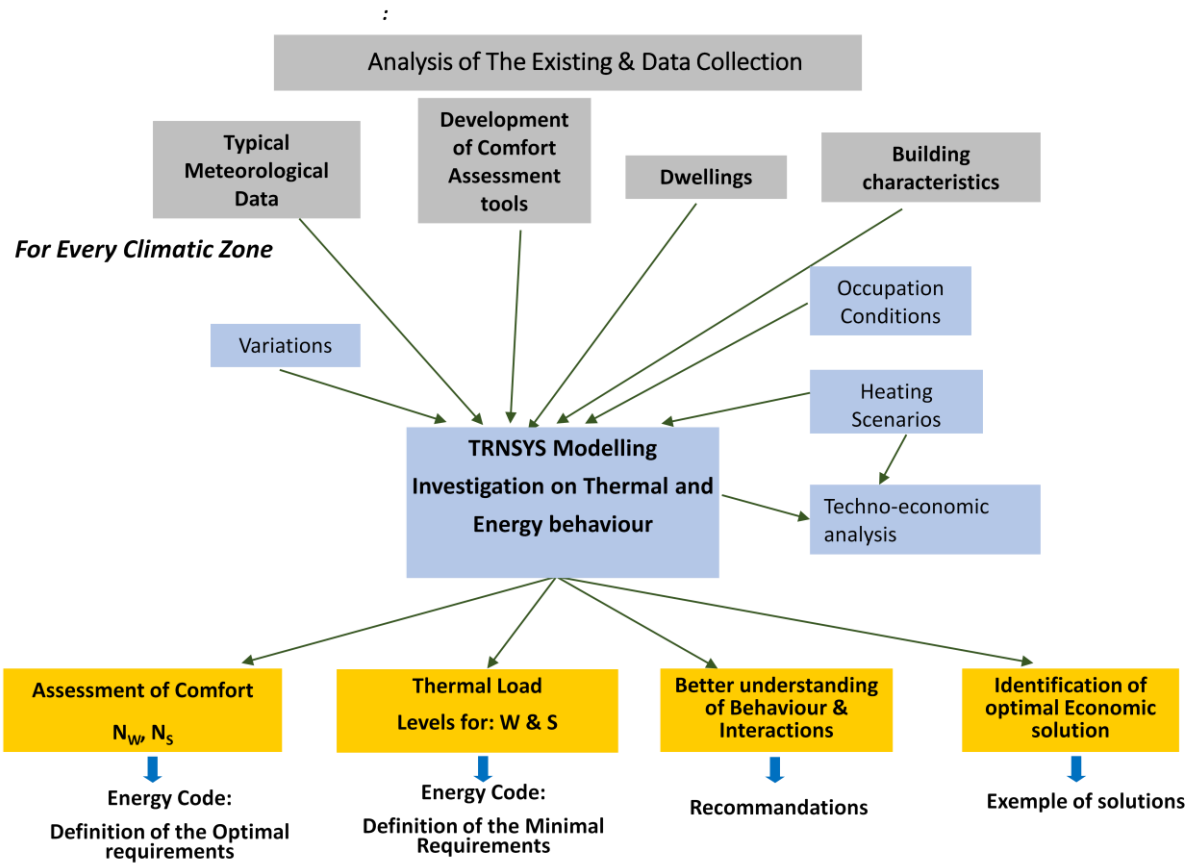


Fig. 5: Detailed simulation model

The inputs of TRNSYS model are the weather data, the comfort model, the typologies of buildings, the characteristics of the buildings, the modes of occupation and the conditions of occupation, the heating and air conditioning scenarios.

The technco-economic analysis was obtained while having the TRNSYS model and heating scenarios as input.

The outputs of the model are:

- The assessment of the comfort: enables to evaluate the buildings that are not systematically heated and cooled. The evaluation is carried out using a winter comfort rate and a summer comfort rate that will allow drawing the necessary conclusions regarding the design.

- Calculation of thermal loads: summer and winter thermal loads are calculated for heated and cooled buildings. Often, the architectural measures that minimise the winter load may not minimize the summer load, so a compromise had to be found between winter and summer and optimization tools were used to find the right configuration.

- Better understanding of behavior and interactions: the simulations carried out enabled to better understand the behavior of buildings and therefore to define a list of recommendations addressed to building users who will implement control techniques and monitor the building, such as the case of window openings, ventilation… as well as recommendations targeting the users' behavior themselves.

- The identification of optimal economic tools: allows identifying the most relevant solutions from an economic perspective. An example of an obtained result is the parametric study of the walls of buildings to investigate the impact of thermal capacity, thermal insulation, solar gains…, to evaluate the energy consumption in winter and in summer, and finally identify the optimal scenarios.

These studies were conducted on buildings having a fluctuating temperature, which means that they are not systematically heated or cooled. In this case, the results and the recommendations are not the same as in the case of buildings heated and cooled systematically (with a set point temperature).

Simulations of different configurations were carried out (building type, equipment type, modes…) and models based on genetic algorithms were developed in order to identify the optimal solution

Following, we simplified tools were developed such as a manual tool that deals with non heated and cooled buildings in a systematic way. In fact, not all buildings are equipped with computers, so it is not possible to use a tool such CLIP. That is why the team developed a manual calculation approach and charts which identified the qualities of comfort. The team worked also on computerized tools, such as Cheops which is a tool using the TRNSYS solver and the simplified interface of TRNESD, which is a TRNSYS tool that enables to have standard menus or charts with boxes to fill in. As a result, TRNSYS solver gives a fairly detailed calculation and therefore very detailed evaluation.

In conclusion, it is not a possible to adopt and implement a foreign regulation in Tunisia because it is characterised with a very specific climate, a specific behavior, uses and customs. Hence, a specific approach that is applicable in the Tunisian context is needed. Appropriate tools for stimulation were developed in order to assess the performance of the different types of buildings in Tunisia, and that is why TRNSYS models were amended and enriched with additional modules. This work enabled to improve the local knowledge in terms of building control and understanding the physics and behavior of the buildings and couple it with the complex behavior of the occupants, and to develop simplified tools.

Future perspectives

Further research work on the models developed is needed because the objectives set have not been reached yet. Currently, the team, at ENIT, is going to use ZAER tool which deals with aeraulic flows inside the building. The focus will be directed on the pollutant diffusion inside the building, which is very important, and it has an impact on the quality of comfort. Studies on the thermal capacity will be carried out as well.

Furthermore, cooled buildings and buildings with fluctuating temperatures were studied and analysed. However, this remains an area of exploration because there are still improvements to add such as the monitoring, measurement, and definition of experimental protocols particularly for existing buildings, to determine their energy footprints and assess their quality. This includes developing experimental accompanying protocols and characterisation tools for these buildings. Inverse methods/algorithms are foreseen to be adopted in order to identify the parameters of the buildings.

Concerning the comfort, the adaptive comfort part needs to be further developed because the survey conducted explored certain parameters, and the relevant results obtained were only in terms of temperature. However, if other parameters will be integrated, such as humidity for example, the model will be more refined and more important results will be obtained.

11. Recommendations for promoting energy managers' mission within universities and the implementation of necessary capacity building programs

Presented by Mounir Bahri – Energy Efficiency and Renewable Energy Expert

The energy consumption has become a crucial issue in the building sector in Tunisia. A suitable strategy for the Tunisian context should be applied to avoid the rapid increase in energy consumption in this sector which will become soon the first energy consumer in Tunisia.

The state is currently working to establish the national strategy of energy control. Hence, it is important to act promptly and implement the required measures to avoid the over energy consumption.

In this context some stumbling blocks have been identified:

The first inadequacy concerns the human resources of ANME that must intervene in the different activities concerning the buildings.

Another issue is that sometimes the ANME cannot find contact persons within the public institutions to follow up its activities.

In this context, a circular was issued by the Prime Minister in 2001 for the establishment of an energy manager in each institution. In addition other circulars were issued to tackle the same issue because the establishment of an energy manager in each institution didn't really solve the problem of then absence of counterparts/contact persons in public institutions. As a result, coordinators within the ministries were appointed, to facilitate the intervention. It was much easier to coordinate with twenty ministries than with a large number of establishments.

There have been several circulars from 2001 to 2019 to facilitate the implementation of the decisions which concerns appointing energy managers in each establishment. The last circular, number 11 of April 17, 2019 was issued with more details compared to the former circulars. Earlier, the concerned institutions didn't know how to implement the decree and what their responsibilities were. ANME started working on this issue through the creation of the expert auditor position, whose mission is to intervene in certain diagnostic aspects of existing or new buildings. Following, "Expert Relais" were recruited, who work for ANME and who are responsible for providing information, advice and assistance, necessary for the correct application of the regulations. Besides, these experts monitor all energy managers in their working places.

All these measures were taken to facilitate the implementation of the regulations and to help achieve the action program successfully and reach the objectives set.

The role of the Energy Manager

The energy managers will assess the situation of the building. It is recommended that the energy managers work in close collaboration with the decision-makers so that they can follow up and make the necessary decisions. The energy audits are carried out through funds, such as the National Energy Management Fund or the Energy Transition Fund (FTE). The financial support for the energy audit mission is provided by the fund at a rate of 70% of the cost of the audit,

It is recommended also to create an energy team. The energy managers are the coordinators of the team composed of a financial manager to assess the energy consumption, a park manager and a maintenance manager (Fig.6).

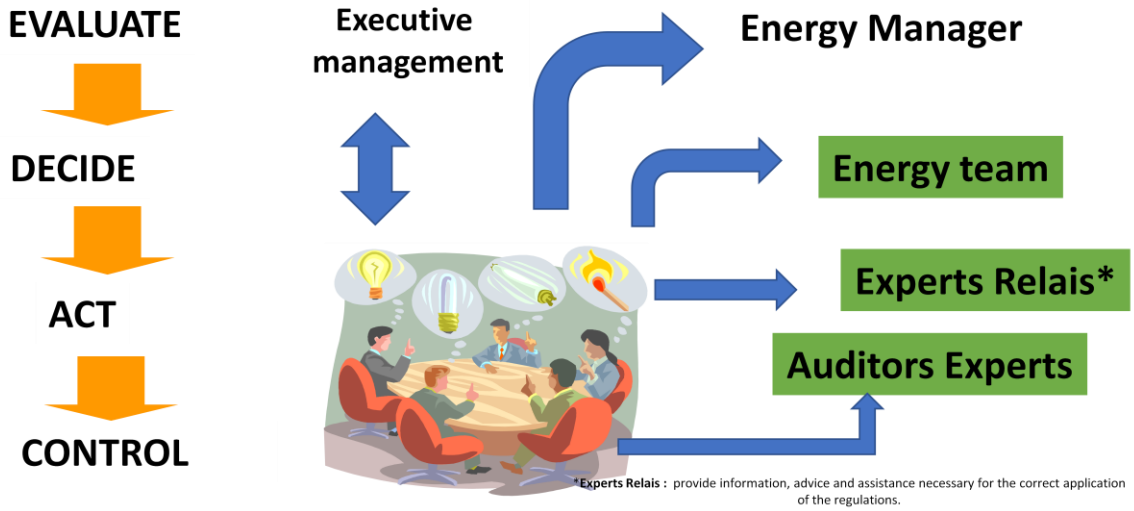


Fig.6: Schematic of the role of the energy manager

The energy manager can also assess the current situation of buildings through the contribution of the expert auditor to be able to decide which measures to implement. The energy audit report can be checked by the first person in charge, to give updates on the current situation and decide on the right action programs to reduce energy consumption.

Through the energy transition fund (FTE), the head of establishment can benefit from a subsidy of 30 % of the investment cost with a ceiling of 200.000,00 DT at the implementation phase. The aim of the energy transition fund (FTE) was to provide the institutions/establishments with an almost complete mechanism to finalize their action plans and to be able to monitor the outputs/results.

The "Experts Relais" main task is to support the appointed energy managers in the implementation of their activities. The expert's contribution is financed by the State at a rate of 70% with a ceiling of 70.000,00 DT, to provide support and technical assistance to the energy manager in performing the energy audit.

Training actions have also been implemented for the team in charge of energy, monitoring and control. Thus, the energy mangers are provided with all the human and material resources they need to succeed in their missions.

The coordinating energy manager at the ministries should work closely with the energy managers at the regional establishment and those of additional services, and they must report the building energy consumption to the management board. Besides, ANME should always stay in touch with the coordinators at the ministries to follow up and evaluate the projects progress, to identify the issues, and to put into practice the action plan that guarantees the optimal results.

Action plan for energy management in higher education buildings

An agreement has been signed between ANME and the Ministry of Higher Education for the establishment and implementation of an action plan for energy management in higher education buildings. The agreement includes the following recommendations:

- Appointing an Energy Manager-coordinator from the Ministry of Higher Education.

- Appointing Energy managers from higher education institutions.

- The recruitment of an "Expert Relais" for the technical support of the energy manger-coordinator for the implementation of the energy control action plan in higher education institutions.

- The organisation of training sessions to improve the technical capacities of the energy manager-coordinator and the energy mangers of higher education institutions.

- The selection of a demonstration project to improve the thermal performance of higher education buildings which could be carried out in the framework of Med-EcoSuRe project.

-The elaboration of a practical energy management guide specific to higher education institutions which could be carried out in the framework of Med-EcoSuRe project. The study carried out by ANME in 2005 can be considered as a basis to elaborate the practical guide. This will help the managers put into practice their action plans.

- Performing an energy audit of the demonstration project by an auditor approved by ANME, which may be carried in the framework of Med-EcoSuRe project.

- The development of a program for the implementation of the energy management action plan following the energy audit.

-The implementation of the program

- The evaluation and the dissemination of the results

-Expanding the program to include all higher education institutions.

12. Questions and answers

a) Question of Ms Ben Ayed Alia: "How could we contribute in Med-EcoSuRe project actions?"
b) Question of Skander Moknessi: "Have you used the technology of "smart meter" or "demand response" in Tunisia?

Answers by Prof Chiheb Bouden –Professor at ENIT

a)

There is always room to cooperate in the framework of Med-EcoSuRe. In fact, Pilot actions are foreseen which includes the proposal and implementation of Renewable energies and energy efficiency technologies. Thus, the intervention of the architects in these pilot actions is very important. ENIT have been in contact with the director of the National School of Architecture and Urbanism to try to find a way to involve the students in Med-EcosuRe project in order to work on the architectural design and the improvement of some buildings .Unfortunately the covid19 outbreak prevented the project team from progressing on these activities for the past few months. Now it is the time to restart working on the defined plans and the cooperation with the students architects will be definitely successful.

b)

Actually, the smart meter" or "demand response" technologies have not been used yet. However, two types of energy monitoring systems have been developed so far. The first one is a detailed monitoring program which is a small house, implemented at ENIT, equipped with 70 sensors that measure the heat, solar radiation and the heat inside the walls. Various parameters have been measured for years, and the measured data are registered every 15 minutes. The objective is to understand the phenomena and calibrate the models as well. In case of TRNSYS, the calibration of the model is performed in order to check if it reproduces the real working conditions.

The second measuring method, adopted for the pilot actions implemented by ANME, was simpler than the method aforementioned since it dealt with existing buildings (housing for families) and it was difficult to use wires and measuring devices everywhere in the buildings. However, the team at ENIT succeeded in measuring very accurate parameters such as the global electricity and gas consumption, rooms' temperature and household appliances electricity consumption. The measuring systems used were advanced since they used wireless techniques.

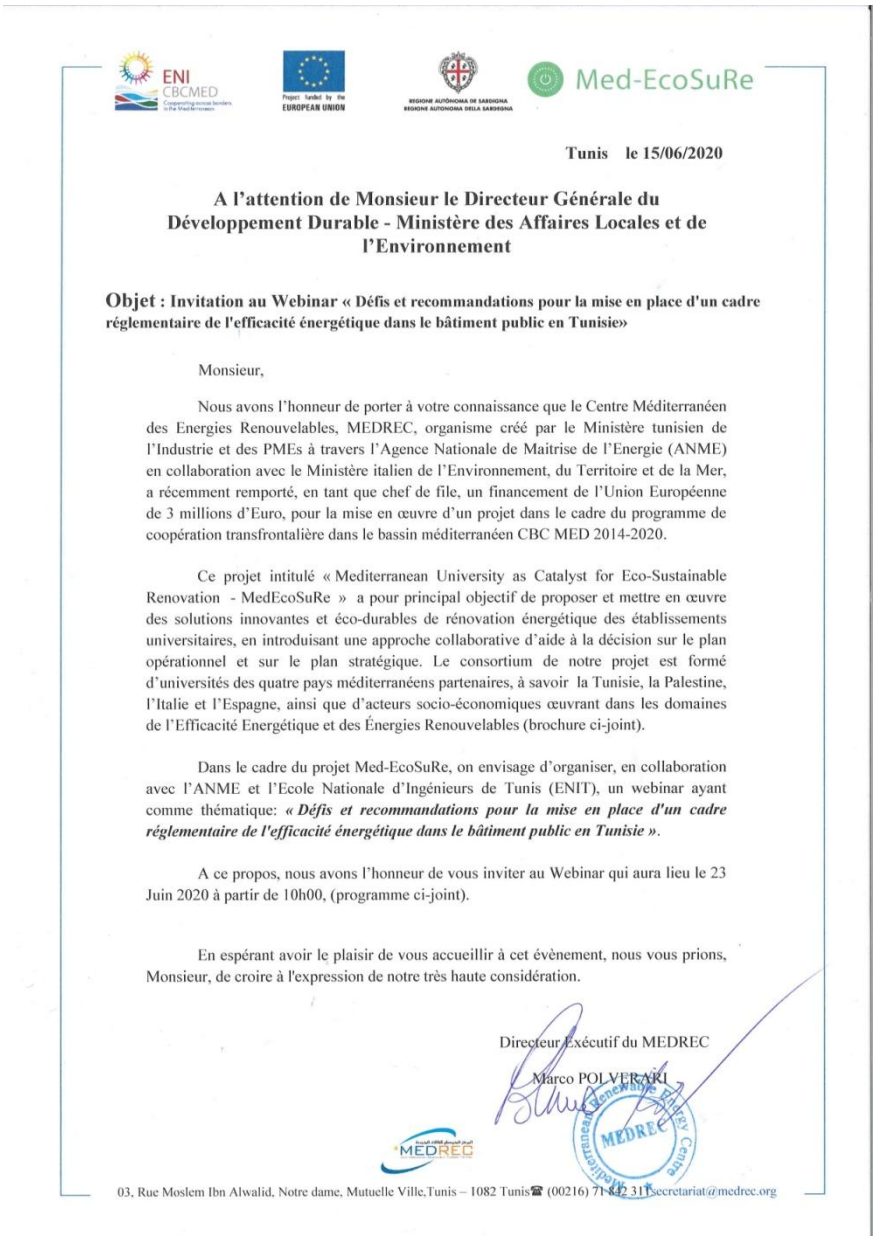
Currently developing a measuring and acquisition system is being developed to be implemented in the university buildings and a protocol is being established to enable the energy managers to make use of a dashboard to visualise and monitor the energy consumption inside the buildings in order to detect failures and anomalies.

A number of smart actions is foreseen as well such as the start and shutdown of certain equipments e.g. to shut down the air conditioners after a pre-defined hour to avoid the overconsumption of electricity.

Another smart idea is implementing twilight switches coupled to presence detection switches to monitor the lighting.

ANNEXES

1. Invitation



Med-EcoSuRe

Tunis le 15/06/2020

A l'attention de Monsieur le Directeur Générale du Développement Durable - Ministère des Affaires Locales et de l'Environnement

Objet : Invitation au Webinar « Défis et recommandations pour la mise en place d'un cadre réglementaire de l'efficacité énergétique dans le bâtiment public en Tunisie»

Monsieur,

Nous avons l'honneur de porter à votre connaissance que le Centre Méditerranéen des Energies Renouvelables, MEDREC, organisme créé par le Ministère tunisien de l'Industrie et des PMEs à travers l'Agence Nationale de Maitrise de l'Energie (ANME) en collaboration avec le Ministère italien de l'Environnement, du Territoire et de la Mer, a récemment remporté, en tant que chef de file, un financement de l'Union Européenne de 3 millions d'Euro, pour la mise en œuvre d'un projet dans le cadre du programme de coopération transfrontalière dans le bassin méditerranéen CBC MED 2014-2020.

Ce projet intitulé « Mediterranean University as Catalyst for Eco-Sustainable Renovation - MedEcoSuRe » a pour principal objectif de proposer et mettre en œuvre des solutions innovantes et éco-durables de rénovation énergétique des établissements universitaires, en introduisant une approche collaborative d'aide à la décision sur le plan opérationnel et sur le plan stratégique. Le consortium de notre projet est formé d'universités des quatre pays méditerranéens partenaires, à savoir la Tunisie, la Palestine, l'Italie et l'Espagne, ainsi que d'acteurs socio-économiques œuvrant dans les domaines de l'Efficacité Energétique et des Énergies Renouvelables (brochure ci-joint).

Dans le cadre du projet Med-EcoSuRe, on envisage d'organiser, en collaboration avec l'ANME et l'Ecole Nationale d'Ingénieurs de Tunis (ENIT), un webinar ayant comme thématique: ***« Défis et recommandations pour la mise en place d'un cadre réglementaire de l'efficacité énergétique dans le bâtiment public en Tunisie »***.

A ce propos, nous avons l'honneur de vous inviter au Webinar qui aura lieu le 23 Juin 2020 à partir de 10h00, (programme ci-joint).

En espérant avoir le plaisir de vous accueillir à cet évènement, nous vous prions, Monsieur, de croire à l'expression de notre très haute considération.

Directeur Exécutif du MEDREC

Marco POLVERARI

MEDREC

03, Rue Moslem Ibn Alwalid, Notre dame, Mutuelle Ville,Tunis – 1082 Tunis☎ (00216) 71 842 311 secretariat@medrec.org

2. Agenda


ENI CBCMED
Cooperating across borders in the Mediterranean
Project funded by the EUROPEAN UNION
REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA
Med-EcoSuRe
Invited Projects:
GreenBuilding
ESMES
MED beX live
Mediterranean Cross Border Living Lab
live the experience of university building environment
Mediterranean University as Catalyst for Eco-Sustainable Renovation
WEBINAR
How to implement sustainable policies with a cost-effective approach for construction and building renovation?
Tuesday, 23 June 2020 11:00 - 13:00 AM CEST
link to connect: https://meet.google.com/vyn-poci-hsb
Organized by: MEDREC (Mediterranean Renewable Energy Centre)
in collaboration with: ENIT (National Engineering School of Tunis) - ANME (National Agency for Energy Management)
h. 11:00-11:10 | I. KHALIFA / Project Coordinator Med-EcoSuRe
Mediterranean Renewable Energy Centre (MEDREC)
Presentation of the Project, its objectives and findings
h. 11:10-11:20 | M. KOUTA / Green Building Project
University of Patras
Supporting sustainable energy-policies in public buildings
h. 11:20-11:35 | S. AMARA / Esmes Project
National Agency for Energy Management (ANME)
- Presentation of ESMES project
- Current situation of the building sector in Tunisia
- Projects aiming at implementing thermal and energy regulations in public buildings in Tunisia
h. 11:35-11:45 | A. BEN OTHMAN
Ministry of Equipment, Housing and Territorial Development - General Directorate of Civil Buildings - Tunisia
-Role of the Ministry of Equipment in the implementation of thermal and energy regulations in buildings in Tunisia
- Energy savings in public buildings
- Challenges / Difficulties encountered while implementing the thermal regulations in public buildings
h. 11:45-12:05 | M. BAHRI
Energy Efficiency & Renewable Energy expert
History of the process of implementing thermal and energy regulations in buildings in Tunisia
h. 12:05-12:15 | C. BOUDEN /Med-EcoSuRe partner
National Engineering School of Tunis (ENIT)
Contribution of ENIT in the elaboration of thermal regulations in university buildings in Tunisia
h. 12:15-12:35 | M. BAHRI
Energy Efficiency & Renewable Energy expert
Recommendations for promoting energy managers' mission within universities and the implementation of necessary capacity building programs
h. 12:35-13:00 | Debate and conclusion

3. Webinar news

http://www.enicbcmed.eu/med-ecosure-oragnises-series-webinars-launch-its-bexlive-ll

http://www.enicbcmed.eu/medecosure-kicks-its-series-webinars-topic-sustainable-policies-construction-and-building

4. Registered Participants

Full Name	Organisation	Position within the organisation	Country
Fehri Aida	MEDREC	Financial expert	Tunisia
Ben Smida	MEDREC	Assistante à la coordination du projet Med-EcoSuRe	Tunisia
Rym NAFTI	GIZ	Coordinatrice nationale de la composante Tunisie du programme global d'Efficacité Energétique dans le secteur du bâtiment	Tunisia
Adnen ben hassine	GEEC	Efficacite Energetique	Tunisia
Syrine djebbi	GEEC	Efficacite Energetique	Tunisia
Souissi Amel	ARCHIBAT	CEO	Tunisia
Hamza BATTIKH	GEEC	Project Manager	Tunisia
Chraief Nassim	ATEC	Ingénieur	Tunisia
Touaiti bilel	Ensit	Ingénieur principal	Tunisia
Mahjoubi Soufiane	FSEGT	PhD student	Tunisia
Ahmed Foued ZAYATI	ENSIT / La Soie SARL	Doctorant / HSE & RSE	Tunisia
Hassane Essid	MEHAT	ENGINEER	Tunisia
Sara zaabi	Faculté de droit et de science politiques	Étudiante	Tunisia
Anissa Ghomrassi	Université privée de Sousse	Directrice des études et des stages	Tunisia

EL FEKIH Henda	ENIT	Professeur	Tunisia
Gharbi Mohamed Salah	Golden Sun Energy	Gérant	Tunisia
Ghada Boumaiza	Atelier .EXE (Bureau d'architecture)	Architecte chef de projet	Tunisia
Jaïdane Mériem	ENIT	Enseignante	Tunisia
Moez Zouaoui	MEDREC	Assistant en coordination de projet	Tunisia
Soudani Chaima	CDC	Chargée de projets	Tunisia
hammami fathi	STEG	ched département métrologie qualité et homologation	Tunisia
Darghouth Asli Aaida	JTS / ENI CBC Med	Junior Officer	Tunisia
Ghrayri Mayssa	Inat		Tunisia
Salma chamkhi	Iqspot/ GreenYellow	Chef de projet de déploiement/ cheffe de groupe efficacité ENR	Tunisia
Chaker Rym	SGTBC	Chargée de la formation	Tunisia
SELLAMI BEN AYED Alia	Ecole Nationale d'Architecture et d'Urbanisme Tunis	Enseignant-chercheur	Tunisia
Bouattay Ibtissem	Consultant	SC2A	Tunisia
Fadi Karam	JTS ENICBC-MED	Senior Expert - Environment & Climate change	Tunisia
samira rafrafi	MDICI	Directrice	Tunisia
Afef Bennani	University of Carthage/ University of Tunis El Manar	Enseignant chercheur	Tunisia
LAYEB Sana	Université de Carthage/ENAU/ERA	Architecte/Docteure en architecture/Enseignante à l'ENAU	Tunisia
GUELLOUZ, Mohamed Sadok	ENIB	Enseignant-chercheur	Tunisia
Ismail Dorra	ENAU & qartbunDESIGN, sarl	MC & Directrice 4C-ENAU, associée qDESIGN	Tunisia
ahmed BEN OTHMAN	DGBC (MEHAT)	Ingenieur en chef	Tunisia

SAID Rachid	université de Monastir	vice - président	Tunisia
Hamdi Ben Romdhane	Consultant CVC		Tunisia
ameni trigui	ENIM	DOCTORANT	Tunisia
Fadi Karam	JTS	Senior Expert Environment	Tunisia
Akkari Sabrine	ENIM	étudiante	Tunisia
IBRAHIM MEDINI	FIPA TUNISIA	DIRECTEUR POUR L'ESPAGNE ET LE PORTUGAL	Tunisia
Leila Youssef	Greater Irbid Municipality	Assistant Director of the International Projects and Programs Unit.	Tunisia
Sami imen	Institution		Tunisia
Hany S. Mansour	Private Company (Mansour Scale)	Head Mansger	EGYPT
Marina Kouta	University of Patras	Project Manager	Greece
Yorgos Stephanedes	University of Patras	Emeritus Professor	Greece
Aggeliki Danopoulou	University of Patras		Greece
Skander Moknessi	Medrec	intern	Tunisia

5. Presentations

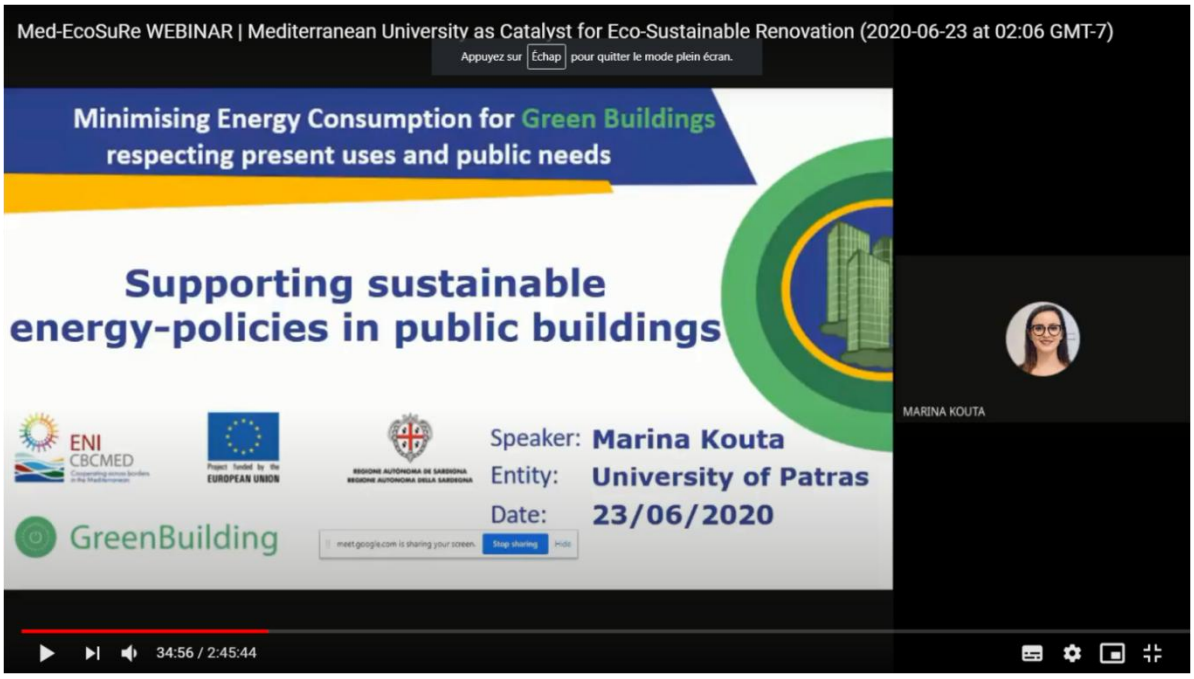
https://drive.google.com/drive/folders/1FZqD8Sv6LaBHM5WB3xhNXQ-Nwxji-zf4?usp=sharing

6. Recording of the webinar

https://drive.google.com/file/d/1CW1gM6KN7_ncSpxp2rAI9Gr319IuZ6cH/view?usp=sharing

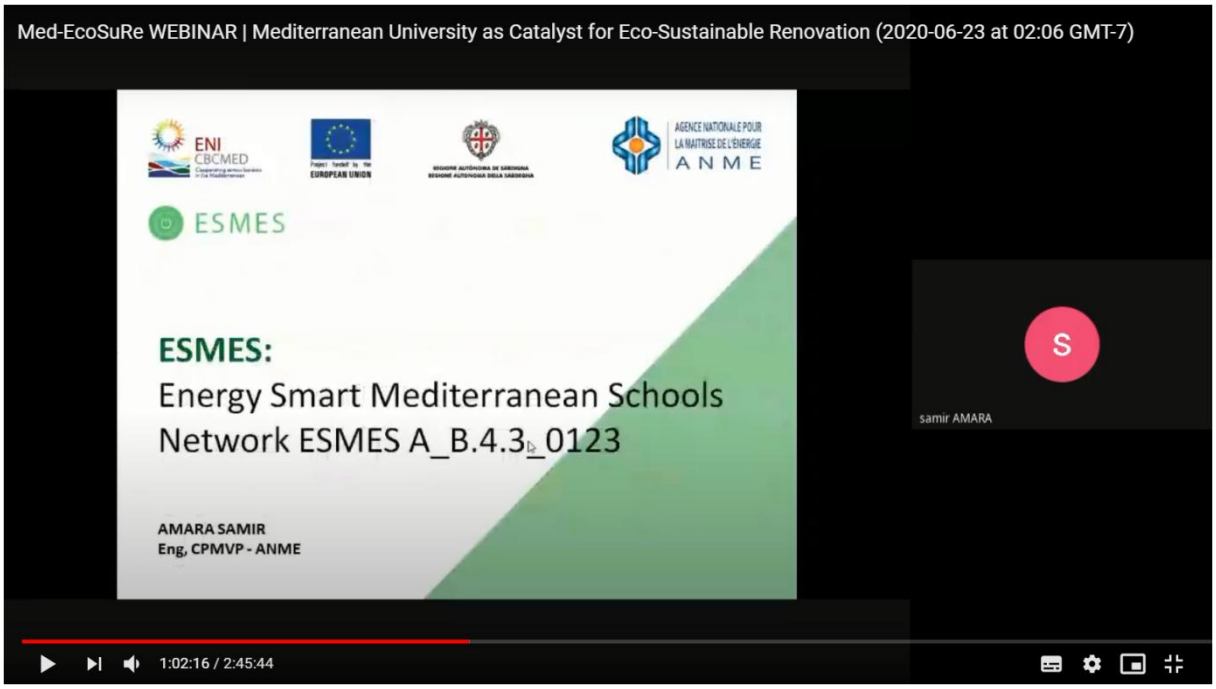
7. Photos


Med-EcoSuRe WEBINAR | Mediterranean University as Catalyst for Eco-Sustainable Renovation (2020-06-23 at 02:06 GMT-7)
Appuyez sur Échap pour quitter le mode plein écran.
12:50 / 2:45:44


Med-EcoSuRe WEBINAR | Mediterranean University as Catalyst for Eco-Sustainable Renovation (2020-06-23 at 02:06 GMT-7)
Appuyez sur Échap pour quitter le mode plein écran.
Minimising Energy Consumption for Green Buildings
respecting present uses and public needs
Supporting sustainable
energy-policies in public buildings
ENI CBCMED
Project funded by the EUROPEAN UNION
GreenBuilding
Speaker: Marina Kouta
Entity: University of Patras
Date: 23/06/2020
MARINA KOUTA
34:56 / 2:45:44

Med-EcoSuRe


Med-EcoSuRe WEBINAR | Mediterranean University as Catalyst for Eco-Sustainable Renovation (2020-06-23 at 02:06 GMT-7)
Med-EcoSuRe
MED beX live
Mediterranean Cross Border Living Lab
live the experience of university building environment
WEBINAR
How to implement sustainable policies with a cost-effective approach for construction and building renovation?
Med-EcoSuRe project Overview
Ines Khalifa – Coordinator of Med-EcoSuRe
23 / 06 / 2020
Inès KHALIFA
19:53 / 2:45:44


Med-EcoSuRe WEBINAR | Mediterranean University as Catalyst for Eco-Sustainable Renovation (2020-06-23 at 02:06 GMT-7)
ESMES
ESMES:
Energy Smart Mediterranean Schools Network ESMES A_B.4.3_0123
AMARA SAMIR
Eng, CPMVP - ANME
S
samir AMARA
1:02:16 / 2:45:44