meetMED

Mitigation Enabling Energy Transition in the MEDiterranean region

Together We Switch to Clean Energy

Training Package

ENERGY EFFICIENCY AND RENEWABLE ENERGY SOURCES IN BUILDINGS

meetMED is funded by the European Union

This publication was produced with the financial support of the European Union. Its contents are the sole responsibility of MEDENER and RCREEE and do not necessarily reflect the views of the European Union.

Design by REVOLVE

Cover Image: meetMED

The meetMED project is a two-year project funded by the EU and jointly carried out by the Mediterranean Association of the National Agencies for Energy Management (MEDENER) and by the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE). Its main goal is to reinforce regional cooperation aimed at fostering the energy transition in Algeria, Egypt, Jordan, Lebanon, Libya, Morocco, Palestine and Tunisia under the umbrella of the UfM REEE platform.

The meetMED team in Brussels coordinates the project partners and experts in implementing the project activities, in the following areas of work: assessing EE and RES strategies and policies; advancing vocational training and public awareness; attracting sustainable RE and EE investments; supporting the UfM Renewable Energy and Energy Efficiency Platform.

The meetMED activities target and benefit a wide range of stakeholders, including policy makers, public authorities, investors and financial institutions as well as local communities and final customers. meetMED supports regional cooperation by building the technical capacity and raising the public awareness necessary to implement RE and EE projects and solutions, while creating synergies with other initiatives targeting energy transition in the Mediterranean region.

MEDENER is an international non-profit organization gathering agencies from the northern and southern Mediterranean countries in charge of implementing public policies on energy efficiency and the promotion of renewable energy sources, by implementing regional projects facilitating the sharing of know-how and best practices among its members and international partners, as well as accelerating the transfer of skills, methods and technologies in the field of energy efficiency and renewable energy.

RCREEE is an intergovernmental organization aiming at enabling the adoption of renewable energy and energy efficiency practices in the Arab region. RCREEE brings together regional governments and global organizations to initiate and lead clean energy policy dialogues, strategies, technologies and capacity development in order to increase Arab states' share of tomorrow's energy. Its key work areas are capacity development and learning, policies and regulations, research and statistics, and technical assistance.

Foreword

This meetMED publication contains the materials for a professional training aiming to build and strengthen the technical capacity of the public authorities and of the private sector to implement EE and RE measures in the building sector.

Energy efficiency and renewable energy solutions in buildings offer concrete opportunities (both in the planning and in the operation phase) to reduce greenhouse gas emissions as well as for savings in the bill for heating, cooling, ventilation and lighting: energy efficient buildings are less expensive to operate, more comfortable to live in, and more environmentally friendly.

Professional trainings remain a key component to build the technical capacity of the public and private sector to implement EE and RE measures in buildings, possibly translating it into concrete projects. Public authorities have a special responsibility to lead by example with respect to public buildings and to show the way to planners, manufacturers, installers, maintainers and managers in the private sector.

This meetMED training package on EE and RE in buildings was designed by meetMED experts from ANME (Tunisia), CRES (Greece), the Jordanian National Energy and Research Centre (NERC) and the French National Agency for Environment and Energy Management (ADEME).

The modules were developed building on the EU and national experiences in the meetMED countries, as well as development cooperation initiatives, such as MED–ENEC II - Energy Efficiency in Construction, IMPULSE - Integrated Management Support for Energy efficiency in Mediterranean Public Buildings, SHERPA - Shared knowledge for Energy renovation in buildings by Public Administrations, CA-EPBD - Concerted Action Energy Performance of Buildings Directive, SwitchMed, the Global Alliance for Building and Construction.

Special thanks go to the Global Alliance for Building and Construction and to Clima-Med for their support and contribution.

The training materials were first used in a 5-day training organised in Tunisia in February 2020 with the support of the Union for the Mediterranean and hosted by the Tunisian National Agency for Energy Conservation (ANME). The trainers involved were

meetMED experts from ANME (Tunisia), ADEME (France), ADENE (Portugal), ALMEE (Lebanon), CRES (Greece), ENEA (Italy) and RCREEE.

The publication of the meetMED training package makes these materials replicable in future training activities, hence, to make them concretely contribute to strengthening capacity and raising awareness on the implementation of EE measures in buildings in the public and private sector.

All the credit goes to the experts from the national energy agencies and ministries of the 13 meetMED countries, who prepared these training materials - under the restless coordination of CRES (Greece), ANME (Tunisia) and RCREEE. MEDENER and RCREEE together have supported the solid commitment of the meetMED experts and ensured the fruitful delivery of this training activity.

Matteo Barra
meetMED Project Manager

Contents

Foreword 05

About the Training Package 08

TRAINING PACKAGE

0. meetMED Project 10

I. EE & RES in Buildings and Legislative Framework 12

II. Supporting Policy Implementation of EE Measures 14

III. Integration of EE in Buildings 18

IV. Integration of RES in Buildings 23

V. Energy Audits and Energy Management 26

VI. RE Electrical System Considerations 33

VII. Microgrids 35

About the Training Package

Developed in the framework of the meetMED activities on reinforcing public awareness and capacity building, the purpose of this training package is providing the stakeholders of the UfM Member States with theoretical and practical tools to integrate energy efficiency and renewable energy in buildings.

For energy efficiency, this includes information concerning both the structural components of the building and the electromechanical equipment, as well as behavioural aspects; whilst, for renewable energy, this includes information concerning photovoltaic systems and solar thermal systems. Information concerning the use of micro-grids has also been included.

The meetMED training course on EE and RES in buildings took place on 24- 28 February 2020 in Tunis, Tunisia. The event has been organized by the Tunisian National Agency for Energy Conservation (ANME) in cooperation with the Greek Centre for Renewable Energy Sources and Saving (CRES), and the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE).

The training package has been jointly designed by ANME, CRES, the Jordanian National Energy and Research Centre (NERC) and the French National Agency for Environment and Energy Management (ADEME).

Training Package

0. meetMED Project

About the Author

Matteo Barra – meetMED Project Manager

Mr Barra is currently working as Project Manager for the meetMED Secretariat. His main responsibility is to lead the implementation of the meetMED Project by coordinating the work package leaders and monitoring the organisation of the activities in order to ensure that they will achieve the deliverables of the project. Matteo is also responsible for reporting to the European Commission on the implementation of the project. In his former experiences, Matteo has worked as senior expert on investments at the Energy Charter Secretariat, acting mainly on ECT investment provisions and dispute settlement. Previously, he was associate with the international arbitration team of a large law firm in Geneva, where he acted in investment and commercial disputes concerning among others the electricity, gas and oil industry. Matteo holds a Ph.D. in International Economic Law (Bocconi) and an LL.M. in International Energy Law and Policy (CEPMLP).

Summary of the Presentation

meetMED project is a two-year project funded by the EU and jointly carried out by the Mediterranean Association of the National Agencies for Energy Management (MEDENER) and by the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE).

Its main goal is to reinforce regional cooperation aimed at fostering the energy transition in Algeria, Egypt, Jordan, Lebanon, Libya, Morocco, Palestine and Tunisia under the umbrella of the UfM REEE platform.

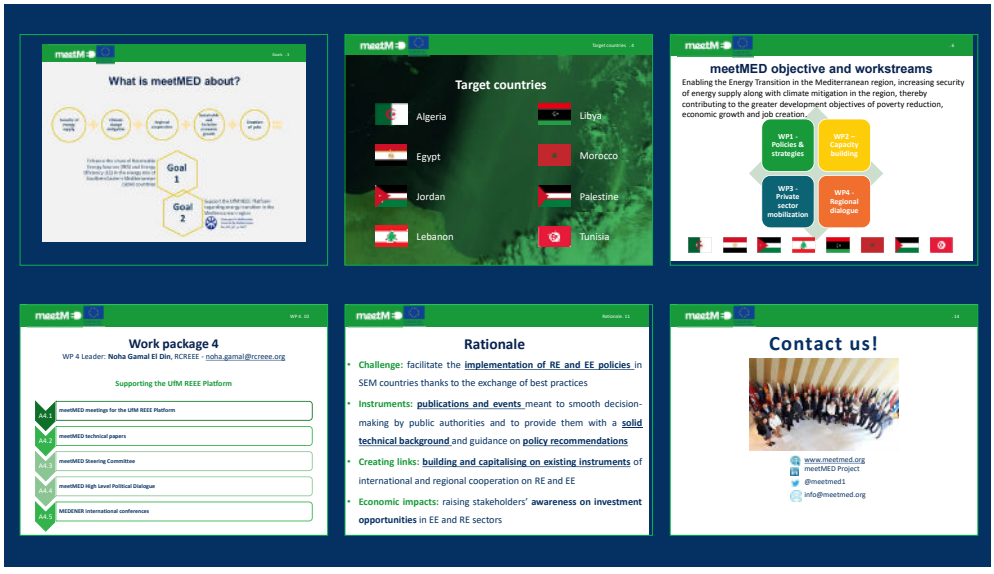
meetMED brings together more than 60 experts from national energy agencies and ministries, whose common goal is to exchange best practices, to train professionals and to raise public awareness on sustainable energy choices and investments. The meetMED activities target and benefit a wide range of stakeholders, including policy makers, public authorities, energy stakeholders, investors and financial institutions as well as local communities and final customers at large.

Due to the importance of the Mediterranean region as the key area where energy transition to clean and sustainable energy is possible in the next following years, meetMED supports regional cooperation in the field of RE and EE not only by facilitating the exchange of best practices between all its partners and by raising capacity building and public awareness, but also by creating synergies with other initiatives targeting the Mediterranean region, such as the ClimaMed, SwitchMed, MedStat and EuroMed Cities.

The meetMED team in Brussels coordinates the project partners in implementing the project activities, which concern mainly the following areas of work: assessing EE and RES strategies and policies; advancing vocational training and public awareness; attracting sustainable RE and EE investments in target countries; supporting the UfM Renewable Energy and Energy Efficiency Platform.

The Module's Contents

- Context
- Goals
- Target Countries
- Structure
- meetMED objective and workstreams
- Work Packages - 1 to 4
- Rationale
- Events 2018 / 2019
- Contacts



Preview of some of the slides. This Module has 14 Slides.

Download the full module **here**

I. EE & RES in Buildings and Legislative Framework

About the Author

Fethi HANCHI – Central Technical Director, ANME

Since 2011, F. Hanchi is the Director of the Division for the Rational Use of Energy at ANME. As such, he has been in charge of the management and coordination of energy efficiency programs and activities in the tertiary, residential, building and transport sectors in Tunisia. His portfolio also includes a national programme for energy efficiency in the public sector, energy efficiency conventions with local authorities, as well as national and Mediterranean cooperation projects. Graduated in mechanical engineering, Mr Hanchi has more than 19 years of experience in energy efficiency. He has been actively involved in the energy sector reform in Tunisia and contributed designing, implementing and evaluating energy efficiency programs in the country. He has a solid track record in the economic and managerial aspects of energy efficiency. Since March 2019, he has been nominated Central Technical Manager at ANME.

Summary of the Presentation

This presentation focuses on Tunisian policy in the field of RE and EE, with special attention to the activities by the Tunisian energy agency ANME – whose experience illustrate the potential of energy conservation in the region.

The existing policy framework for energy efficiency regulates buildings, household appliances, renewable energy sources and behavioural changes across institutions, regulation, technology, finance, tax and communication.

Regulation covers energy efficiency (energy audits, labelling, thermal regulation, ESCo, cogeneration, public lighting) and electricity generation from RES (self-consumption, local consumption and export). The main financial instrument is the Energy Transition Fund (FTE) funded by taxes on cars, household appliances and other energy products.

The programs PROISOL (roof insulation) and the PROSOL (solar waters heaters and roof PV) support measures that are administered by ANME in collaboration with the energy distribution company STEG.

The results 1990-2018 are cumulative savings amounting to 43 Million toe (including 2 Mtoe generated by renewable electricity) for actual primary energy use of 9,5 Mtoe.

The Module's Contents

- **Energy management in Tunisia: Concept and legislative framework**
- **Programs and mechanisms**
- **Market indicators**

Preview of some of the slides. This Module has 26 Slides.

Download the full module **here**

(French Only)

II. Supporting Policy Implementation of EE Measures

About the Author

Romain RIOLLET – Project Manager, ADEME

Currently working for ADEME's Department of Europe and International Affairs, R. Riollet is an international project manager trained in political science and strategic analysis, with a decade of experience in the field of climate/energy policy design, implementation and evaluation at French, EU and international level (banking and power sector analyst, independent consultant, public agency project manager, NGO advocacy officer...). He mostly worked on carbon markets, energy efficiency in buildings and appliances, as well as green public procurement and the circular economy. In the Mediterranean, he has worked mostly with Turkey and Morocco.

Summary of the Presentation

This training module aims at discussing the barriers to energy efficiency policy implementation in buildings and the issues faced by the target group of public authorities and private actors. Indeed, the work carried by the Regional Experts Network of the MeetMED project identifies implementation as a major weakness of energy efficiency policies in the building sector, while it should be a key driver of the energy transition and climate change mitigation. Participants were invited to share their experience and expectations in this field.

ADEME has a long experience with energy efficiency in buildings policy implementation, not only at the national level but also in the framework of several bilateral and regional Mediterranean cooperation. First, in the implementation of EE measures through professional training (PRAXIBAT program, RGE certification, FAIRE mobilisation, PACTE network); second, in the dissemination of demonstration projects of energy-positive houses and in the communication to households and civil society in general.

Concrete examples were presented and discussed with training participants, in order to identify appropriate support measures and possible strategies for further cooper-

ation on efficient buildings with Mediterranean partners. The fundamental drivers for energy efficiency in buildings (private sector, public authorities, energy agencies) and the experience of the French energy agency, ADEME, were illustrated. The French experience with policy implementation illustrates a combination of mandatory measures (minimum performance standards in building codes to push market actors) and incentives (ambitious performance labels that drive innovation and demonstrate the technical and economic feasibility of more ambitious legislative measures over time). The white certificate scheme is another example of a combination of mandatory energy savings targets imposed on energy suppliers with a flexible market system to support implementation. Energy agencies, such as the members of the MEDENER network, play a key role in supporting policy implementation since they work at the intersection of policy and social targets groups in the society. They are able to identify real life obstacles that are not identified at the legislative and regulatory level to suggest and implement appropriate support measures. Further regional cooperation at the Mediterranean level is recommended to help address common challenges, such as the rise of energy consumption from air conditioning and sharing lessons learnt from practical experiences to devise effective and appropriate policy support measures.

The groupwork on possible demonstrative projects for efficient cooling in buildings resulted on the proposal described in the table below:

Subtopic	Legis. Framework (countries)	Target Groups	Demonstration Action	Monitoring Method	Stakeholders to Involve
AC and cooling appliances	No legislative obstacle (JO, AL, TN)	Housing with energy intensive AC units and large energy bill	Assess number and energy consumption of AC units, identify alternative cooling appliances/systems (e.g. ventilation); use of energy labelling also crucial, scrapping and recycling of old inefficient AC units	Compare energy consumption and bill	Individual citizens, Ministries, energy companies/ suppliers
Behaviour of AC users	No legislative framework (MA, AL)	Individual users of all ages	Good practices: stop AC when window open, manual temperature setting in summer (26°C) and winter (20°C). Issue of AC being considered a "comfort/ affordable luxury" item	Compare energy bill with different types of use	State stakeholders, individual citizens

Subtopic	Legis. Framework (countries)	Target Groups	Demonstration Action	Monitoring Method	Stakeholders to Involve
Passive building design	Not mentioned (LY, EG)	Individual home owners, builders; architects	Modern housing design could replicate efficient traditional methods (windows and doors orientation, building envelope insulation, environmental friendly building white outside painting to reflect heat)	Compare electricity bills, winter/summer inside temperatures of “modern” and passive homes, lifetime of AC units (increased in passive homes), measure impact on national energy consumption	Government, building materials manufacturers
Cool urban planning	No legislative framework on urban planning and management of outside temperature (LB, TN)	Municipalities, individual citizens	Municipalities especially expanding ones (limited potential for planting trees in dense urban centers), individual citizens (vegetal roofs and facades in dense urban areas), vegetal sidewalks and bushes to absorb heat reflected by streets/roads	Pedestrian traffic as a proxy of perceived comfort, comparing inside temperatures of buildings in normal vs. “green” street	Municipalities, individual citizens

The Module's Contents

- EE in buildings: importance and implementation
- The French buildings sector
- Research, development and demonstration projects
- Communication and awareness raising for households
- Perspectives for regional cooperation on support to EE buildings policy implementation
- Conclusions

Preview of some of the slides. This Module has 37 Slides.

Download the full module **here**

III. Integration of EE in Buildings – Part 1-2

About the Author

Miguel SANTIAGO – Energy Expert of the National Energy Performance Certification System, ADENE

Miguel Santiago holds a master's degree in mechanical engineering, in the Climatization and Energy area, from the Superior Institute of Engineering of Lisbon. Currently, he is working at ADENE as an Energy Expert of the National Energy Performance Certification System providing technical advisory to other Experts of the National Energy Performance Certification System. Previously, he has been working in ADENE for the European Local Energy Assistance program, thus assisting public entities with energy audits and energy efficiency planning. Before he has worked as energy auditor and as HVAC design engineering of commercial and residential buildings.

Summary of the Presentation

This module aims at presenting the benefits of integrating EE solutions in buildings.

The benefits of the building envelope and its performance requirements were illustrated in the first place. The building envelope is an assembly of components and materials that separate the conditioned indoor environment from the outdoor environment. The envelope typically includes the foundation, walls, windows, doors, and roof. In particular, the heat transfer mechanism, infiltration issues and the heating load and cooling load for a building, which is the heating and cooling energy required for building to maintain interior air temperature, were explained, together with radiation, fenestration and windows as well as the roofing options.

With respect to thermal insulation, the concepts of thermal conductivity and resistance were initially introduced. The thermal conductivity of a material is the rate at which heat passes through a specified material, expressed as the amount of heat that flows per unit time through a unit area with a temperature gradient of one degree per unit distance;

whilst the thermal resistance is a heat property and a measurement of a temperature difference by which an object or material resists a heat flow. The main effects of introducing thermal insulation measures is, on the one hand, that energy saving is achieved due to reducing of heating and cooling flows so that the level of thermal comfort of the building is increased; on the other hand, to protect the building from external environment conditions and thermal stresses, as well as from internal condensation and damps.

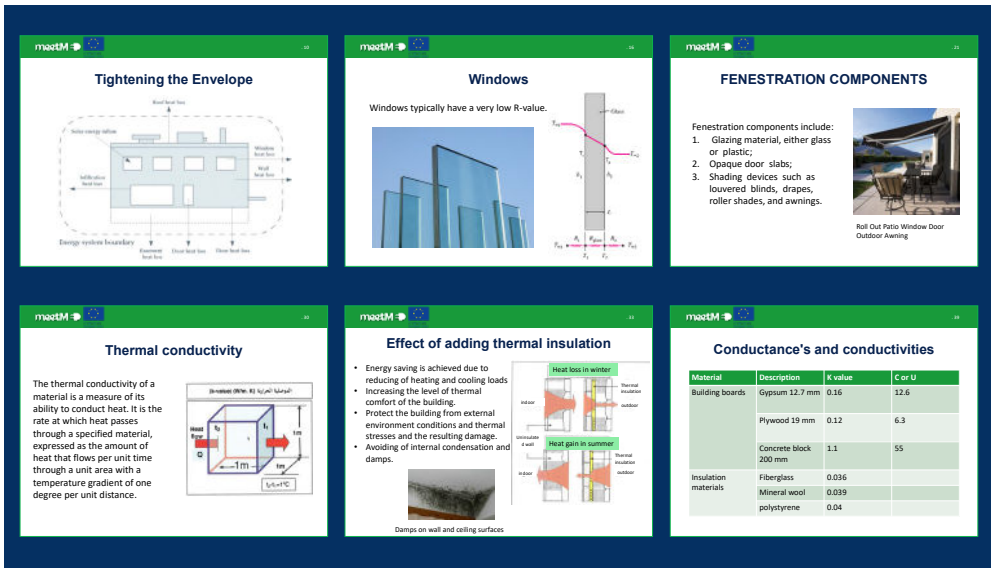
Sources of thermal discomfort are multiple and affect the thermal comfort of a building. Overheating for instance is one of typical cases of thermal discomfort. Passive measures to be undertaken include the use of external shading devices or natural ventilated facades, improving urban planning and reducing internal gains through energy efficient equipment. Comfort conditions are evaluated according to both basic (Temperature – Humidity - Air velocity - Air quality – Radiation) and human-related (Activity - Clothing - Health status – Acclimation) parameters.

The Module's Contents

PART I: BUILDING ENVELOPE

- Buildings envelope
- Thermal insulation

PART II: THERMAL COMFORT



Preview of some of the slides. This Module has 48 Slides.

Download the full module **here**

Integration of EE in Buildings – Part 3-4

About the Author

Miriam BENEDETTI – Researcher, ENEA

M. Benedetti is a researcher at ENEA, the Italian National Agency for New Technologies, Energy and Sustainable Economic Development. Her current work focuses on the identification of solutions to overcome technological, economic, organisational and information barriers to the uptake of Best Available Technologies and Best Practices for Energy Efficiency in industry. She is project manager for the project "Energy efficiency of industrial products and processes" (8.6 M€ funded by the Italian Ministry for Economic Development) and her research activities particularly focus on the creation of support tools to help industrial companies identify and implement waste heat recovery opportunities. She was previously Senior Researcher at EURAC (Italy) and Research Associate at the University of Cambridge (UK). She holds a PhD in Industrial Engineering and an MSc in Energy Engineering from the University of Rome Tor Vergata.

Summary of the Presentation

Heating, Ventilation and Air Conditioning (HVAC) as well as lighting systems are vital to the smooth functioning of a building and to the thermal and visual comfort of its occupants, and yet most people are reminded of their existence only when it happens to them to feel too hot or too cold in a room or when the light is not sufficient for them to read or write. However, having a thorough knowledge of HVAC systems and lighting systems, of the principles at the basis of their functioning and of the best practices and best available technologies that apply, can consistently help organisations to reduce the energy consumption of their buildings and therefore to reduce their energy costs.

In the light of these considerations, the training programme includes a detailed overview of HVAC systems, lighting systems and their main components, with particular focus on heat generation systems, such as boilers and chillers and on different lamp typologies, as well as a review of the main technical and operational energy efficiency opportunities.

In order to facilitate the identification of energy efficiency opportunities and to select the most appropriate efficiency intervention for each case, it is nowadays a well-known (but not always implemented) best practice to monitor and control energy data, and to extract meaningful information, and therefore value, from them.

One of the key messages of the training is therefore the importance of measuring energy consumption as well as other factors influencing energy performances, related for example to weather conditions, in order to control main energy uses and to be able to identify needs for energy efficiency measures implementation. The key message is conveyed by the means of meaningful case studies and group discussions where real data gathered are discussed together with participants as well as different typologies of data representation. The importance of energy data monitoring for operational efficiency purposes (such as maintenance optimisation), a hot topic in operational and energy management research, is also highlighted.

The Module's Contents

PART III: HVAC SYSTEMS

- Heating & Ventilation and Air Conditioning (HVAC)
- HVAC case studies
- Secondary HVAC equipment
- Secondary HVAC equipment case study
- Main energy conservation measures

PART IV: LIGHTING SYSTEMS

- Lighting systems
- Main energy conservation measures
- Lighting case study

Preview of some of the slides. This Module has 26 Slides.

Download the full module **here**

IV. Integration of RES in Buildings

About the Author

Adnan JOUNI – EE and RE Expert, ALMEE

A. Jouni is a Doctor Engineer specialised in Energy and Industrial fields, with a long experience as engineer in research, development and technology transfer at HEI- Energy Center (LILLE France). His expertise involves many energy sectors, including renewable energy, energy conservation, heat transfer and recovery, cogeneration, water distribution, HVAC for building, energy efficiency enhancement and innovative technical solutions. In 2001, he became advisor to the Lebanese Minister of energy and water and, in 2002, he was the LCECP project manager launching the first national project for energy conservation and planning in Lebanon. In 2005, he was appointed advisor to the minister of energy and water for the second time and became responsible for the implementation of a national action plan to promote energy conservation issues in Lebanon. In 2007, UNDP recruited him as Local Back Stopper in order to boost the EE and RE activities and to secure the creation of the National Energy Conservation Center. Since 2009, Dr Jouni has been an EE & RE Expert in the frame of several projects and programs at the European and international level, such as RESSOL-MEDBUILD, EE Indicators for Mediterranean Countries Project, Tunisian Environment and Energy Program (PEE), the Lebanese Component of MENA Star Program, and the meetMED Project.

Summary of the Presentation

This module aims at exploring the different forms of Renewable Energy and their applications in the building sector. Among these different forms, Photovoltaic and thermal solar energy, the basic principles, the different elements and applications with some concrete examples were presented.

Renewable energies represent today an alternative means of clean energy production, the share of this production is keeping increasing from one year to another. However, in order to have a better result, we still need to support RE projects and programs and integrate them in a coherent and achievable national energy strategy, without forgetting the importance of energy efficiency and demand side management measures.

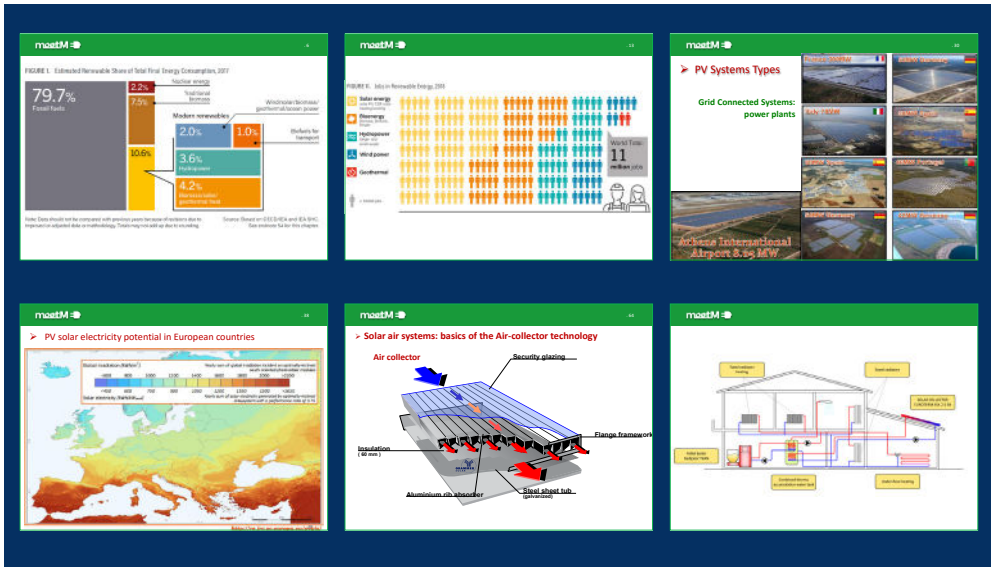
The first objective of the presentation is to describe the physical principles of the various forms of renewable energy, to have a look about the current state and the evolution of RE systems at global and countries level, to explain the important parameters to be taken into account to successfully carry out a RE project.

Another objective is to explore the possibility and the potential of applying these different forms of production to the building sector in our MEDENER countries, to initiate discussions among the group members about strengths and weaknesses of these different forms of RE in each country.

Finally, the RE Lebanon case is illustrated, by presenting some key figures from the Lebanese energy and renewable energy sectors, some analyses and comments about EE indicators, the global energy situation and the RE deployment.

The Module's Contents

- Advantages and disadvantages of RES towards zero or nearly zero energy buildings
- Solar energy systems integration in buildings: Solar Thermal Systems & PVs
  - PV
  - Solar Thermal Systems
  - Case study: Lebanon
- Biomass systems
- Small Wind Turbines
- Ground Source Heat Pumps (GSHP) – energy from the earth
- Geothermal energy



Preview of some of the slides. This Module has 225 slides.

Download the full module **here**

V. Energy Audits and Energy Management – part 1-2

About the Author

Harilaos ANDREOSATOS – Mechanical Engineer, CRES

H. Andreosatos holds a master's degree in Energy, Economics and Environment from the University of Westminster and a bachelor's degree in Mechanical Engineering from the Abertay University in Dundee, Scotland. During his professional career at CRES, he has over 18 years of experience in conducting energy audits and on-site energy measurements in various industries and public/ private buildings, studies regarding energy policy measures at national and European level, feasibility studies for the use of RES/RUE/ES, issuing of energy certificates as well as energy management studies. He was also involved in various European and national projects regarding energy efficiency and RES. Finally, he was evaluator of Energy Investment Proposals/ Studies for RES (PVs) as well as energy auditor/inspector for energy efficiency interventions in the tertiary sector.

Summary of the Presentation

Buildings' energy inspection and asset rating – EU Policy context

This session lays down the key quantitative policy targets, set by EU, as well as the climate and energy objectives for the period up to the year 2030. An example is given for the Southern & Eastern Mediterranean countries. In addition, the most common methods of buildings' asset rating with respect to certain energy performance requirements are also examined.

Building energy inspection - Collection and processing of required data

The necessity for data collection is a pre-condition for effective data processing towards estimation of buildings' energy performance. Critical indices (with specific examples) for calculating buildings' energy performance and therefore buildings' energy classification are also presented. As an example of asset rating calculation method, the Greek case was presented.

Practicing asset rating in energy-upgrading recommendations

Asset rating energy calculations based on key performance indicators (KPI) were illustrated as well as examples of energy upgrading based on retrofit scenarios.

Advanced building energy assessments through dynamic simulations

Quasi-steady simulation tool has been compared with a dynamic simulation software. Specific example of a case study is presented.

Advancements in building energy efficiency planning

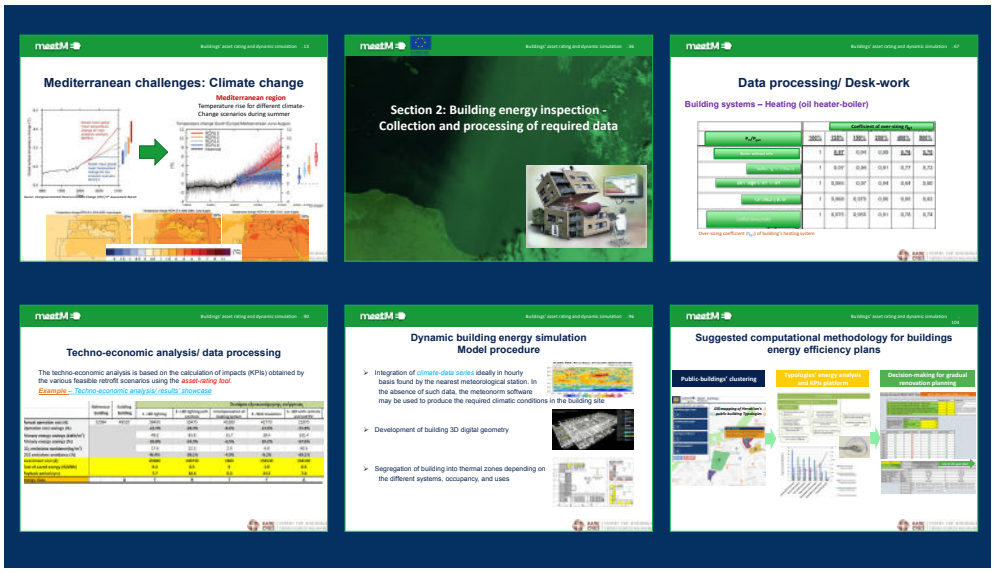
Specific computational methodology (example) for buildings' renovation planning was illustred.

Financial Instruments for energy efficiency interventions - buildings

In order to achieve the targets set by the EU, significant investment funds and/or specialized financial mechanisms should be mobilized from both the public and private sector.

The Module's Contents

- Buildings' energy inspection and asset rating – EU Policy context
- Building energy inspection - Collection and processing of required data
- Practicing asset rating in energy upgrading recommendations
- Advanced building energy assessments through dynamic simulations
- Advancements in building energy efficiency planning
- Financial Instruments for energy efficiency interventions – buildings



Preview of some of the slides. This Module has 115 slides.

Download the full module **here**

Energy Audits and Energy Management – part 3-4

About the Author

Foteini KARAMANI – Senior Expert, CRES

F. Karamani holds a Degree in Chemical Engineering from the Aristotle University of Thessaloniki (AUTH), and a Master in Energy Management Systems and Environmental Protection from the National Technical University of Athens (NTUA) and University of Piraeus. Since 2006, she has been working at the Centre of Renewable Energy Sources and Saving (CRES), where she has participated as energy expert in many European and National projects related to Energy Efficiency (EE) and Renewable Energy Sources (RES). Currently, she is working on the development of methodology and tools for the assessment of the economic viability for EE investments. This assessment is based, among others, on: national legislation; the implementation of a Cost-Benefit Analysis for the potential of EE measures; the Life Cycle Cost Analysis for different EE technologies; energy audits; measurement and verification of energy savings of applied measures; data analysis for EE and RES investments; energy indicators; energy statistics; energy billing; Combined Heat and Power (CHP) Systems; District heating and cooling; Energy Performance Contracting (EnPC). Maria has been responsible also for the preparation of the 2nd , 3rd and 4th National Energy Efficiency Action Plans as well as for the implementation of a Comprehensive Assessment of the Potential for Efficient District Heating and Cooling (DHC) and for High-Efficient Cogeneration (HE-CHP) at the national level (article 14 of EED 2012/27/EE). She is one of the administrators of the measurement, monitoring, control and verification mechanisms within the framework of the Energy Efficiency Obligation Scheme. Since 2006, she is a member of the National Team of the Concerted Action for Energy Efficiency Directive (EED, 2012/27/EC) and the previous Energy Service Directive (ESD, 2006/32/EC).

Summary of the Presentation

Energy audits

Introduction to Energy Audits

The first section consists of the demonstration of the basic principles of energy audits. The definition, the meaning, as well as the common types of energy audits were presented. An energy audit is a systematic inspection and analysis of energy use and energy consumption of a site, building, system or organization with the objective of identifying energy flows and the potential for energy efficiency improvements and reporting them. As a result, an energy audit is carried out for improving the energy performance and minimizing the environmental impacts of the organization's operations, as well as for providing clear financial information regarding energy savings opportunities in order to prioritize these items for the organization's decision-making process.

Procedure for Energy Auditing

The procedure for performing an energy audit based on case studies was analysed. All stages of the procedure from the preliminary contact of the beneficiaries to the drawing-up of an energy saving action-plan were presented in detail. The preliminary contact is necessary for setting the context for the energy audit, confirming its scope, identifying all relevant organization personnel in the audit process and requesting specific energy information from the organization. This information includes historical energy consumption records of utility data, fuel types, building geometry, specific operation conditions, and all relevant information for performing the building and utility data analysis. The walk-through inspection of the building is a procedure for checking the operating and maintenance conditions and procedures, determining the capacity of all installed energy consumed equipment of the building and conducting all necessary measurements for buildings' baseline energy consumption. The analysis of all collecting data is used for drawing-up of an energy saving action-plan.

Energy Efficiency improvements

Energy efficiency improvement measures have been identified based on the existing energy performance situation of the audited object. The impact of each energy efficiency improvement measure on the existing energy and economic performance situation has been evaluated. The financial analysis of identified measures for energy efficiency improvements is a key step in the audit process. Identified measures have been prioritized based on the organizations' economic and energy needs.

Typical tools and time frames for energy audits

Factors that affects the implementation of an energy audit. The time taken to perform an energy audit depends on the availability of energy data, the size of the site and the complexity of the systems.

Energy Management

Energy Management Systems

General principles of Energy Management Systems (EnMS) for a continual improvement in energy performance: Organizations that target behavioural and organizational barriers, as well as technological, can achieve continual improvement in energy performance. Key Requirements of Energy Management Systems is the establishment, implementation and maintenance of an energy policy with commitment for achieving energy performance. The main objective of the EnMS is to identify the main factors that have an influence on energy consumption, to establish the relationships between energy consumption and energy factors and to build a periodic forecast of energy consumption and identify opportunities of energy savings.

Monitoring and Verification of Energy Savings

Monitoring and verification of energy saving opportunities identified from the energy audits, is part of the implementation of an energy management system for the implementation and maintenance of an energy policy committed to achieving energy performance. Common practices for the International Performance Measurement and Verification Protocol (IPMVP), measuring, computing and reporting savings achieved by energy efficiency projects, which can produce verifiable savings results, were also presented.

Energy Performance Contracting

The Energy Performance Contracting (EPC) was introduced as a mechanism for organizing the energy efficiency financing. EPC is a contractual arrangement between the beneficiary and the provider of an energy efficiency improvement measure/action plan, where investments in that measure are paid for in relation to a contractually agreed level of energy efficiency improvement (EU Energy Services Directive).

The Module's Contents

- Introduction to Energy Audits
- Procedure for Energy Auditing
- Energy Efficiency improvements
- Typical tools and time frames for energy audits
- Energy Management Systems
- Monitoring and Verification of Energy Savings

Preview of some of the slides. This Module has 61 slides.

Download the full module **here**

VI. RE Electrical System Considerations

About the Author

Ali HABIB – Sustainable Energy Projects Analyst, RCREEE

A. Habib has more than 10 years of working experience in distributed power, co-generation, waste heat utilization, and renewable energy. He holds a master's degree in renewable energy engineering, which entailed studying all kinds of conventional energy, renewable energy, and energy storage. Two summer university programs in renewable energy and energy storage - held respectively in Germany and Switzerland - strengthened his knowledge. Ali holds also a Master of Business Administration (MBA), major management, from ESMT Berlin. His minor, instead, was in sustainable energy future, thank to which he had the opportunity to learn about some of the latest energy technologies and applications, such as the block chain in energy application and energy efficiency using the Internet of Things (IoT). Currently, Ali is working at the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE), where he is engaged in several projects, such as the long-term energy planning for multiple countries, developing national renewable energy action plans (NREAPs) and national energy efficiency action plans (NEEAPs), developing suitability maps, as well as a project in Iraq to catalyse small-scale PV systems.

Summary of the Presentation

Grid operators face huge challenge to match supply and demand and make electricity grid stable. These challenges have been increased with the advent of renewable energy. Take an example, the recent power outage in England that is caused by one conventional and one wind turbine plant malfunctioning and stopped operating.

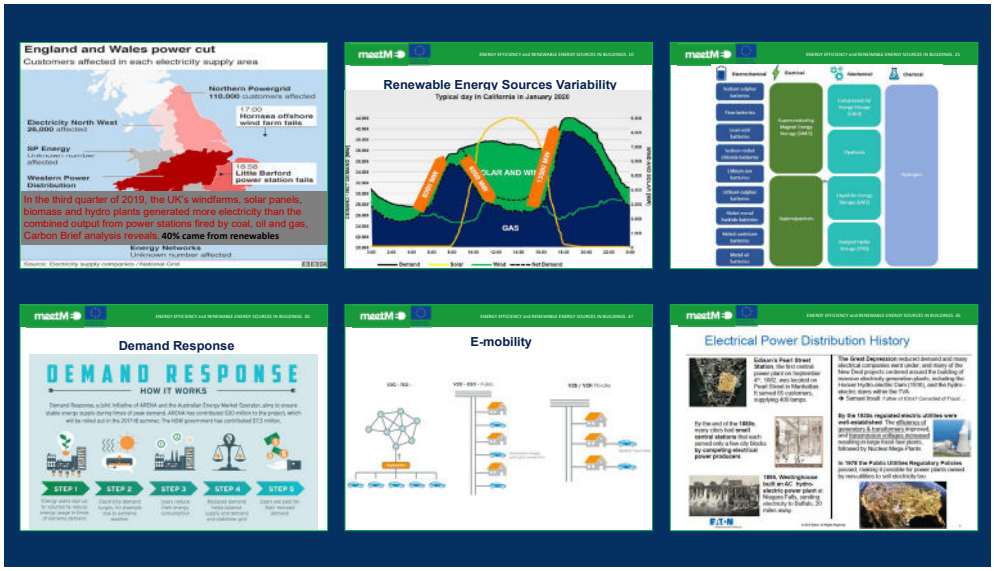
In case of calamity or grid instability, the grid operators have three type of reserves they can use. Primary reserve, secondary reserve, and tertiary reserve. Utilizing those reserves helped the grid to be stable and functioning well.

Renewable energy source variability is one of the challenges that is addressed by grid operators. Renewable energy can suddenly produce high energy or no energy at all. This variability will cause grid instability and cannot be mitigated with usual measures. Four newly measures can help to stable the grid. Demand Response, Energy Storage, Interconnection, Flexible generation.

E-mobility is a technology will emerge transportation sector with electricity sector. It can help to integrate renewable energy on large and small scale. It can help also in integrating RES in buildings. New concept, your car as power plant, can make dramatic change on how electricity is generated and transferred all over the world.

The Module's Contents

- Examples of Grid Extremes
- Renewable Energy Sources Variability
- Basics of Grid operation to match supply and demand
- Flexibility sources
- Energy Storage
- Demand Response
- Interconnection
- Flexible Generation
- Future outlook



Preview of some of the slides. This Module has 80 slides.

Download the full module **here**

VII. Microgrids

About the Author

Ali HABIB – Sustainable Energy Projects Analyst, RCREEE

A. Habib has more than 10 years of working experience in distributed power, co-generation, waste heat utilization, and renewable energy. He holds a master's degree in renewable energy engineering, which entailed studying all kinds of conventional energy, renewable energy, and energy storage. Two summer university programs in renewable energy and energy storage - held respectively in Germany and Switzerland - strengthened his knowledge. Ali holds also a Master of Business Administration (MBA), major management, from ESMT Berlin. His minor, instead, was in sustainable energy future, thank to which he had the opportunity to learn about some of the latest energy technologies and applications, such as the block chain in energy application and energy efficiency using the Internet of Things (IoT). Currently, Ali is working at the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE), where he is engaged in several projects, such as the long-term energy planning for multiple countries, developing national renewable energy action plans (NREAPs) and national energy efficiency action plans (NEEAPs), developing suitability maps, as well as a project in Iraq to catalyse small-scale PV systems.

Summary of the Presentation

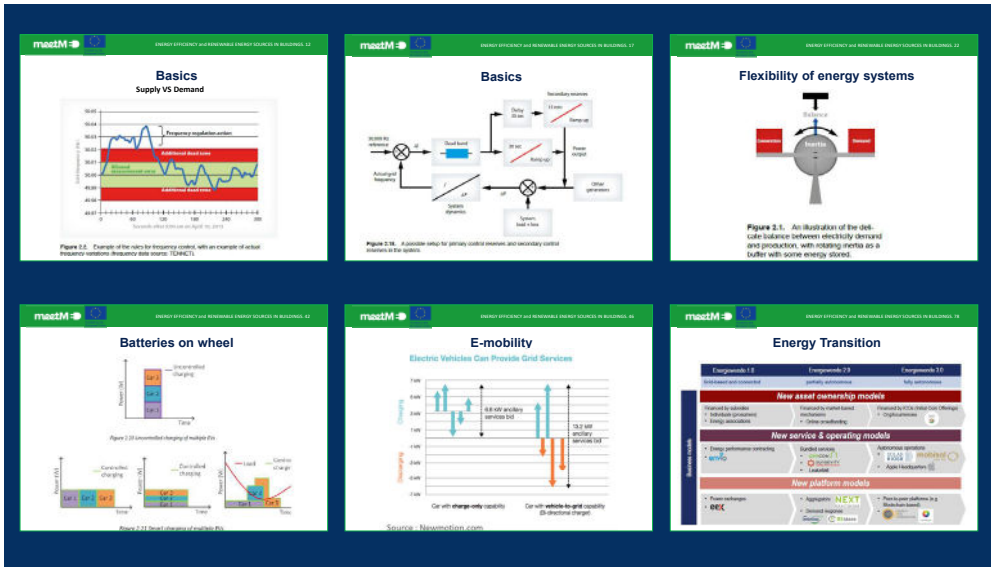
Distributed generation is spreading nowadays. From biogas plants, roof top solar plant, small wind turbines, and small battery storage. Combining different distributed generation sources can add up to form Microgrid.

Microgrid consists of distributed generation, loads, storage, controller, and point of common coupling. Microgrid can result in substantial savings and emissions cuts and in the same time provide high quality and reliable energy supply to critical loads.

Microgrids have two operating modes, grid connected mode and Island mode. Although the Microgrids have several advantages, it has also several disadvantages. For example, interconnection standards need to be developed to ensure consistency.

The Module's Contents

- Distributed Generation
- Microgrid Definitions
- Microgrid Components
- The Need of Microgrids
- Microgrid Operating Modes
- Advantages Vs Disadvantages
- Brooklyn Microgrid



Preview of some of the slides. This Module has 80 slides.

Download the full module **here**

This publication is a product of the meetMED (Mitigation Enabling Energy Transition in the Mediterranean region) project which is funded by the European Union and jointly implemented by the Mediterranean Association of the National Agencies for Energy Management (MEDENER) and the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE). The conclusions of this report result from the analysis of the Country Policy Papers prepared by the meetMED Regional Expert Network (REN) – a network composed by experts coming from 13 Mediterranean countries – the aim of which is to support national governments in the implementation of EE and RE policies enhancing national programmes and frameworks in the region. Since 2012, the eight target countries (Algeria, Egypt, Jordan, Lebanon, Libya, Morocco, Palestine and Tunisia) have improved their energy efficiency and renewable energy sectors, having put in place long-term national energy strategies that set ambitious targets for energy savings and renewable energy penetration. Nevertheless, several challenges still hinder the development of EE and RE, particularly related to governmental, technical or information aspects. This report identifies a set of recommendations that can be implemented to promote the development of both sectors. Awareness of the population for EE and RE benefits should be one of the main objectives of the countries since the lack of knowledge is a clear barrier to the dissemination of good practices. Regional cooperation should be encouraged to facilitate the energy transition in the Southern and Eastern Mediterranean Countries (SEMCs) – cooperation will accelerate the implementation of common measures and help overcome shared barriers.

www.meetmed.org

info@meetmed.org @meetmed1

meetMED Secretariat - c/o MEDENER
Rue de Namur 72, 1000 Bruxelles