Energy Smart Mediterranean Schools Network - ESMES

Final Evaluation Report

ENI CBCMED
Cooperating across borders in the Mediterranean

Project funded by the EUROPEAN UNION

REGIONE AUTÒNOMA DE SARDIGNA
REGIONE AUTONOMA DELLA SARDEGNA

ESMES

Gabriele Mugnai

31/10/2023

Evaluation Report

Monitoring reference: ESMES
Date: 31st October 2023
Project Title: Energy Smart Mediterranean Schools Network - ESMES
Reference Number: A_B.4.3_0123
Key project information:

Implementation status	Closed (since 31.08.2023)
Type of monitoring report	External Evaluation
Monitoring phase	Final
Type of project	Multi-country project
Type of contract	Grant
Programme	Cooperation, European Neighbourhood Instrument ENI – Priority B.4.3 Energy efficiency and renewable energy
Donor	EU
Title of the contract	Energy Smart Mediterranean Schools Network
Implementing Agency	Istituto Cooperazione Universitaria (ICU)
Geographical area	Italy, Jordan, Lebanon, Tunisia and Spain
Responsible for the Contractor	Mrs Maria Giovanna Pinna - MA of the ENI MED CBC Programme
Responsible for the Implementing Agency	Mr. Massimo De Angelis – ICU President
Project partners	ICU - Institute for University Cooperation (IT) GJU - German Jordan University (JO) Comune di Alcamo (IT) CRIB - Consorci de la Ribeira (ES) ANME National Agency for Energy Management (TN) LCEC - Lebanese Centre for Energy Conservation (LB)
Start date	01.09.2019
Foreseen end date	31.08.2022
Extended end date	31.08.2023
External evaluator	Gabriele Mugnai
Signature	
Evaluation period	07.07.2023 – 31.10.2023

GRADING

A=high, B= medium, C=low

EQ	Rating
EQ1: Relevance	A
EQ2: Efficiency	A
EQ3: Effectiveness	A
EQ4: Impacts	B
EQ5: Sustainability	B
EQ6: Added Value	B
EQ7: Replicability and scale up	A
EQ8: Capacity to deal with risks	A

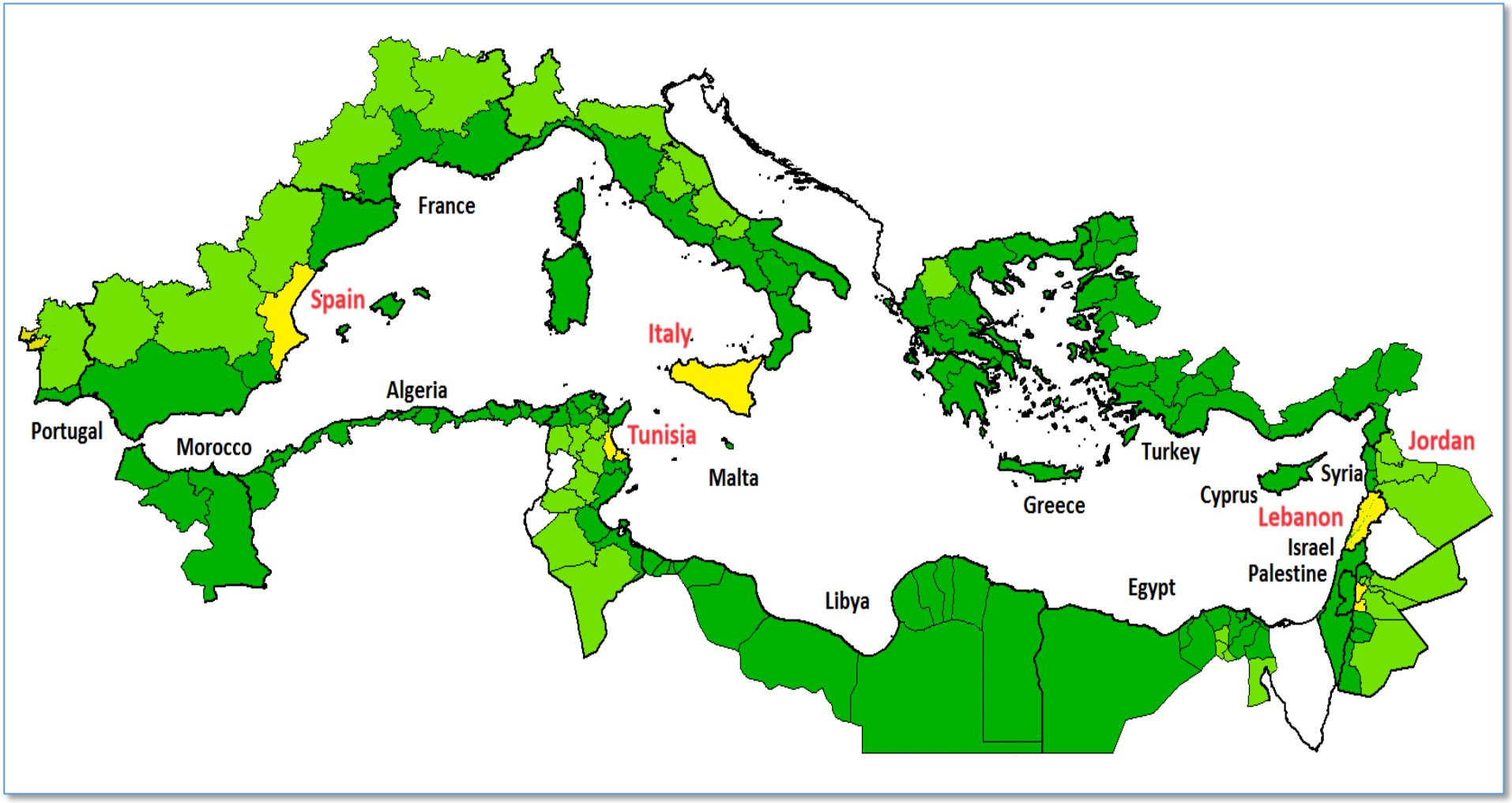
Table of contents

Abbreviations/Acronyms

AFD	French Development Agency
ANME	Agence Nationale pour la Maîtrise de l'Énergie
CERD	Centre for Educational Research and Development
CLS	Centre for Lebanese Studies
CRDP	Centre for Educational Research and Development
CRIB	Consorci de la Ribeira
ECOWAS	Economic Community of West African States
EE	Energy Efficiency
EED	Energy Efficiency Directive
ENI	European Neighbourhood Instrument
EPBD	Energy Performance of Buildings Directive
EPCS	Energy Performance Certificates
EUMC	EU Mediterranean Countries
GEF	Global Environment Facility
GIZ	German Development Agency
GJU	German Jordan University
HVAC	Heating, Ventilation, and Air Conditioning
ICU	Istituto per la Cooperazione Universitaria
ICZM	Integrated Coastal Zone Management
IPCC	Intergovernmental Panel on Climate Change
JOP	Joint Operational Programme
kWh	kilowatt-hour
kWp	kilowatt peak
LCEC	Lebanese Centre for Energy Conservation
LF	Logical Framework
MEHE	Ministry of Education and Higher Education
MIUR	Ministry of Education, University, and Research
MPCs	Mediterranean Partner Countries
Mtoe	Millions of tons of oil equivalent
NDC	Nationally Determined Contribution
NECPs	National Energy and Climate Plans

NEEAP	National Energy Efficiency Action Plan
NEET	Not in Education, Employment, or Training
NEEREA	National Energy Efficiency and Renewable Energy Action
nZEB	Nearly Zero-Energy Buildings Standard
OECD-DAC Committee	Organisation for Economic Co-operation and Development's Development Assistance
PforR	Program-for-Results
PPAs	Renewable Energy Power Purchase Agreements
PROSOL	Programme Solaire
PST	Tunisian Solar Programme
PV	Photovoltaic
RBM	Result Based Management
RED	Renewable Energy Directive
REEE	Renewable Energy, Energy Efficiency
REEEF	Renewable Energy and Energy Efficiency Fund
RES	Renewable Energy Sources
SEACAP 4 SDG	Sustainable Energy Access and Climate Action Plans
SRI	Smart Readiness Indicator
STEG	Tunisian Company of Electricity and Gas
W/m^2	Watt/square meter

Map of the intervention area



Executive summary

CONTEXT OF THE EVALUATION: The report describes the evaluation of the project 'Energy Smart Mediterranean Schools Network - ESMES' funded by the EU through the ENI CBC MED instrument (90%) and implemented by 5 countries partnership led by ICU – Istituto per la Cooperazione Universitaria. The project activities were implemented in Italy, Spain, Tunisia, Lebanon and Jordan from 01.09.2019 to 31.08.2023. This document was drafted following due consultation with the project partners and the stakeholders.

PURPOSE: The objective of the evaluation is to measure project performance based on OECD-DAC criteria (relevance, effectiveness, efficiency, impact and sustainability) to identify eventual weaknesses, risks and propose recommendations for follow-up actions.

METHODOLOGY: The evaluation involved a preliminary review of project documents (logical framework, proposal, financial reports, and donor letters) to assess both expected outcomes and actual implementation trends, as well as key milestones. The process emphasized the project's relevance to national/local policies and the outstanding financial efficiency. Additionally, online meetings with ESMES project partners gathered insights on challenges and outcomes. Online questionnaires were also developed for various stakeholders, including energy experts, school principals, teachers, and students, and were distributed through ESMES coordinators in each country.

RELEVANCE: The project aligns with the policy priorities of partner countries, reflecting their commitment to mitigate climate change. This is achieved by enhancing energy efficiency in schools, installing renewable energy PV systems, and promoting energy-saving practices among students. The Logical Framework offers clear indicators for monitoring in line with the ENI CBC MED Framework, allowing for precise quantification of the project's contribution to the funding line's objectives. ESMES project directly tackles the challenges identified by partners and stakeholders involved in school building energy management. Partners struggle with increasing energy costs burdening public budgets, primarily due to rising energy prices, inefficient thermal performance, and the lack of appropriate behaviors taken by school staff and students. Additionally, many school buildings have inadequate microclimatic conditions and poor thermal efficiency, even if they possess heating or cooling systems. In Lebanon, difficulties faced by education institutes, as insufficient funds, unavailable energy resources and frequent power outages, lead to extended closures.

EFFICIENCY: Despite several challenges, ESMES project exceeded the contractual commitments. While the COVID-19 pandemic disrupted travel, caused products' shortages, and delayed service tenders, other derived global issues like inflation, rising energy costs, and supply chain fails further complicated matters. Although the project implementation period was extended by one year to overcome these challenges, without any additional financial resources, the project achieved more than initially anticipated due to diligent resource management and the commitment to excellence by the project managers.

EFFECTIVENESS: ESMES project excelled in its goals, especially in energy generation from photovoltaic (PV) installations and energy conservation through thermal enhancements in school buildings. By October 2023, the PV systems produced 875,085 kWh annually. Alongside, thermal improvements in school buildings led to significant energy savings. Collectively, these measures reduced the annual carbon footprint, decreasing CO2 emissions by 343.2 metric tons.

IMPACT: ESMES project significantly impacted school communities, enhancing the skills and knowledge of public sector technicians and experts on energy efficiency and photovoltaic systems. It also fostered sustainable behaviors and reduced school management costs. In Tunisia and Lebanon, the project introduced new technologies and standardized tender processes for public schools. Notably, in Lebanon, during the prolonged energy crisis, schools involved in the project remained operational, while others closed. However, the project missed its goal of creating a "Mediterranean community" of individuals working on school efficiency, largely due to travel restrictions and lack of alternative actions to foster personal and institutional connections.

SUSTAINABILITY: The ESMES project consortium prioritized sustainability by choosing the right stakeholders from the outset, promoting best practices, and embedding energy efficiency considerations into local administrative decisions. While the project's sustainability is notably high, the unestablished Mediterranean network will rely on future funded projects for its continuity and collaboration.

ADDED VALUE: ESMES project introduced significant innovation in Tunisia and Lebanon by modeling energy efficiency and photovoltaic installations on school buildings. While the other participating countries might be familiar with the technologies, the creation of processes, manuals, and best practices addressed also their challenges within public school systems. These resources equipped all partners with the right technical and managerial skills for efficient and effective outcomes. The European Union's funding, aligning with national procurement procedures, facilitated the acknowledgement of transparent procedures. However, the rigidity of public bodies' management rules in partner countries sometimes hindered exchanges between participants.

REPLICABILITY AND SCALING UP: Project partners actively participated in ESMES project, consistently with their institutional roles and missions. Concerned local institutions, across different countries, valued the project outcomes and demonstrated engagement in its results. ESMES significantly influenced energy-efficient refurbishment standards for public schools in the five countries, as evident from the best practice manual prepared in Spain for *Generalitat Valenciana*. With substantial funds either allocated or committed for school building improvements, the project's replicability in all partnering countries appears very promising.

PROJECT CAPACITY TO DEAL WITH RISKS/PREVENTION AND ADAPTATION: The COVID-19 pandemic necessitated significant modifications to the action plan: initially allocated funds for international trips were redirected towards enhancing energy efficiency in schools. Due to bureaucratic hurdles, the project consortium shifted funds meant for sub-granting to schools to direct intervention on school building performance enhancement and awareness campaigns. Several challenges faced by project partners were faced and solved with increased technical assistance, to overcome difficulties mainly in procurement and financial reporting. Without additional funds and benefiting only from a one-year extension of the project due to the consequences of the pandemic, the project achieved high performance.

CONCLUSION: ESMES implemented more physical activities than anticipated in the first action-plan, enhancing educational services, classroom comfort, and reducing environmental impacts, including GHG emissions. Nevertheless, the project's value isn't limited to structural improvements: it has fostered increased environmental and energy awareness among educators, students, and families through school contests and educational initiatives and brought the energy efficiency discourse into the public and political debate. The COVID-19 pandemic hindered its international scope, limiting strong and durable ties between partners. ESMES is a pivotal energy efficiency project in the public building sector in Mediterranean, addressing major challenges in energy efficiency initiatives, especially tendering processes. The project has influenced public and political priorities, emphasizing the importance and urgency of such energy efficiency initiatives in the region.

RECOMMENDATIONS: The ESMES project partners, with considerable funds in their countries, can expand their impactful work to more schools. Collaboration with federal entities like Ministries of Education/Culture has set a foundation for widespread adoption of the project's best practices. The regular interactions among technical stakeholders from different Mediterranean countries could boost knowledge transfer and replication of results. It's reasonable to incorporate the project's energy-saving educational tools into regular school curriculums. Despite the pandemic hindered its transnational nature, the opportunity of sharing data on energy productions, school demands, and best adopted solutions among partners could make the partnership meaningful again; the envisioned real-time online data-sharing system, identified for this function, faced compatibility issues; an alternative sharing platform ensuring data sharing among partners should be identified for future collaboration and continuous learning from experience.

1. Introduction

The project “Energy Smart Mediterranean Schools Network” has been implemented in the frame of the Cross Border Cooperation within the European Neighborhood Instrument (ENI). The project responds to the Thematic Priority B.4 “Environmental protection, climate change adaptation and mitigation” and the Priority B.4.3 “Energy efficiency and renewable energy” as for the Joint Operational Programme Document 2014-2020.

The "ENI CBC Mediterranean Sea Basin Programme 2014-2020" is a multinational cross-border cooperation programme funded in part by the European Union through the European Neighbourhood Instrument (ENI). The Programme establishes a framework for the implementation of cross-border cooperation activities within the context of the European Neighbourhood Policy, supplementing efforts made within the framework of the Euro-Mediterranean Partnership, with the ultimate goal of developing a zone of peace, stability, prosperity, and good neighborliness involving EU Mediterranean Countries (EUMC) and Mediterranean Partner Countries (MPCs).

The Joint Monitoring Committee for this call for proposals identified 4 Thematic Objectives and 11 Priorities of the Programme in accordance with the Joint Operational Programme. The thematic objectives and priorities are reported in the matrix below:

Thematic Objectives	*Priorities*
A.1 Business and SMEs development	*A.1.1: Support innovative start-up and recently established enterprises, with a particular focus on young and women entrepreneurs and facilitate the protection of their Intellectual Property Rights and commercialization where applicable*
	A.1.2: Strengthen and support euro-Mediterranean networks, clusters, consortia and value-chains in traditional sectors (agro-food, tourism, textile/clothing, etc.) and non- traditional sectors (innovative ideas solutions for urban development, eco-housing, sustainable water-related and other clean technologies, renewable energy, creative industries, etc.)
	A.1.3: Encourage sustainable tourism initiatives and actions aimed at diversifying into new segments and niches
A.2 Support to education, research, technological development and innovation	*A.2.1: Support technological transfer and commercialisation of research results, strengthening the linkages between research, industry and other private sector actors*
	A.2.2: Support SMEs in accessing research and innovation, also through clustering
A.3 Promotion of social inclusion and the fight against poverty	*A.3.1: Provide young people, especially those belonging to the NEETS, and women, with marketable skills*
	A.3.2: Support social and solidarity economic actors, also in terms of improving capacities and cooperation with public administrations for services provision
	B.4.1: Support sustainable initiatives targeting innovative and technological solutions to increase water efficiency and encourage use of non-conventional water supply

B.4 Environmental protection, climate change adaptation and mitigation	*B.4.2: Reduce municipal waste generation, promote source-separated collection and its optimal exploitation, in particular its organic component*
	B.4.3: Renewable energy and energy efficiency - Support cost-effective and innovative energy rehabilitations relevant to building types and climatic zones, with a focus on public buildings
	B.4.4: Integrated Coastal Zone Management - Incorporate the Ecosystem-Based management approach to ICZM into local development planning, through the improvement of intra-territorial coordination among different stakeholders

Table 1. Thematic Objectives and Priorities of the JOP of ENI CBC MED 2014-2020

ESMES whose goal and activities are in line with the priority 4.3 was funded with Euro 2,999,999.13, equal to the 90% of the overall budget (Euro 3,333,332.37) and equivalent to the 35,43% of Euro 8,466,841.39 which is the available funding for the priority 4.3.

ESMES was kicked off in Amman, Jordan on Wednesday, 27th November 2019 and implemented by a consortium of 6 partners from 5 countries of the Mediterranean shores. The partnership includes:

1. ICU - Institute for University Cooperation (IT)
2. GJU - German Jordan University (JO)
3. Comune di Alcamo (IT)
4. CRIB - Consorci de la Ribeira (ES)
5. ANME, National Agency for Energy Management (TN)
6. LCEC - Lebanese Centre for Energy Conservation (LB)

The Associated Partners are:

1. Generalitat Valenciana
2. Valencian Institute of Business Competitiveness (IVACE)
3. Ministry of Energy and Mineral Resources, Department of Astronautic
4. Eletrical and Energy Engineering of Sapienza University of Rome
5. Universitat Politècnica de València
6. Société de gestion de la Technopole de Borj Cedria
7. University of Sousse
8. Ministry of Education and Higher Education

ESMES intended to contribute to increased awareness and better energy habits in schools, through practical training in REEE delivered to 8,000 students. On the economical level, it is expected to save € 30,000 /year through the return of REEE investments. Finally, the project should save 240 CO2 tons/year, 270,000 kWh/year from RE and 30,000 kWh/year through energy efficiency.

2 Project description and evaluation profile

2.1 Background

Energy demand has been changing steadily in the Mediterranean region. The demand for energy in the Mediterranean in 2018 was 1,022 Mtoe. In 2020, the region was severely affected by the COVID-19 epidemic, which caused energy demand to drop to 937 Mtoe, a 9% fall from 2019. The severity and duration of the lockdowns implemented have been most severe in the North Mediterranean countries. Since the crisis began, low carbon fuels have proven to be the most resilient, and renewable energy has increased at an all-time high. Demand for renewable energy sources has been resilient, whereas

demand for electricity, oil, and coal has been severely affected. However, before the crisis started, some trends anticipated the structural changes in the energy sector for Mediterranean countries:

- The decline in demand for fossil fuels
- The shift in mobility and the use of electricity in final energy consumption
- The need for flexibility in the power sector to facilitate the penetration of intermittent renewables.

The Mediterranean energy trends are characterised by an increase in energy consumption, a reliance on fossil fuels, significant CO2 emissions, all of which have an adverse impact on the environment. Buildings account for 36% of CO2 emissions and a sizeable portion of total energy use.

Mediterranean countries have a large potential for energy efficiency and conservation. According to the Mediterranean Energy Perspective 2050, developed by the *Observatoire Méditerranéen de l'Energie* in 2021, there are 3 possible scenarios which explore different pathways for the Mediterranean energy system and its 26 member countries to 2050, taking into account the impact of the COVID19 health crisis in its prognoses:

- The Reference Scenario (RS) is a Baseline Scenario (BAU), which takes into account past trends, current policies and ongoing projects. It incorporates the Nationally Determined Contributions (NDCs), but it assumes that international financing and other aids will not be forthcoming. Under this scenario, the increased demand for electricity will be met with the traditional primary energy sources and with others that will be available in the future.
- The Proactive Scenario (PS) is based on the implementation of strong energy efficiency programmes and increased diversification in the energy mix based on the NDCs submitted by each country. It assumes an increase in clean fuels and technologies substituting to oil and coal input in electricity generation capacity.
- The ProMED "Near Zero Carbon" Scenario (PM) foresees more ambitious measures for energy efficiency, significant technology development to further curb CO2 emissions, as well as increased diversification in the energy mix, tailored for each country based on the expertise drawn from the extensive works of the three Unions for Mediterranean (UfM) platforms on gas, electricity, renewable energy and energy efficiency. It assumes a substantial increase in renewables, especially in power generation, but also in end-usage with the increase of storage and the introduction of hydrogen. It also assumes a sizeable increase in building efficiency refurbishing, especially for new constructions.

According to the Proactive Scenario, around 26% of primary energy demand in the region can be saved by 2050. The projected savings in 2050 are 366 Mtoe. Savings in the ProMED Scenario might reach 559 Mtoe, with a much different composition. Renewables, particularly non-hydro renewables, are predicted to maintain solid growth trends until 2050, thanks to incentives, forward legislation, and technology breakthroughs. Renewables will grow at a 2.7% annual rate to contribute 19% of energy supply in the Reference case by 2050.

The South Mediterranean's per capita energy demand is currently less than half that of the North. Under the Reference Scenario, as South populations have access to more efficient contemporary energy services, this average should rise significantly by 2050 (+47% compared to current levels).

Overall final energy consumption savings might reach 254 Mtoe in 2050[1], accounting for almost 70% of overall energy savings. The South Mediterranean, as well as the building and transport sectors, account for the majority of end-use energy savings. Compared to the Conservative Scenario (Business-As-Usual), by 2040, the Mediterranean Energy Transition Scenario would lead to[2]:

- 30% reduction in energy demand and 23% reduction in final energy consumption,
- Increased share of renewable energy to 27% of the energy mix in the region, with renewables becoming the primary source of electricity production,
- Avoiding an additional 200 GW of fossil-fuel based electricity production infrastructure,
- Reducing CO2 emissions by 38%.

Given the South Mediterranean's projected population expansion, the buildings sector alone may save 79 Mtoe of energy by 2050. According to the ProMED Scenario, the energy consumption of the buildings sector will be cut by one-third by 2050, and the energy mix will move significantly away from fossil fuels with an enhanced electrification process of end-uses.

Under the Energy Transition Scenario, 30% of primary energy demand and 23% of final energy consumption can be avoided by 2040 in the whole region compared to 2013. The cumulative potential of final energy savings over the next 25 years would amount to nearly 6 billion toe which is equal to nearly six times the current final energy consumption of the whole region.

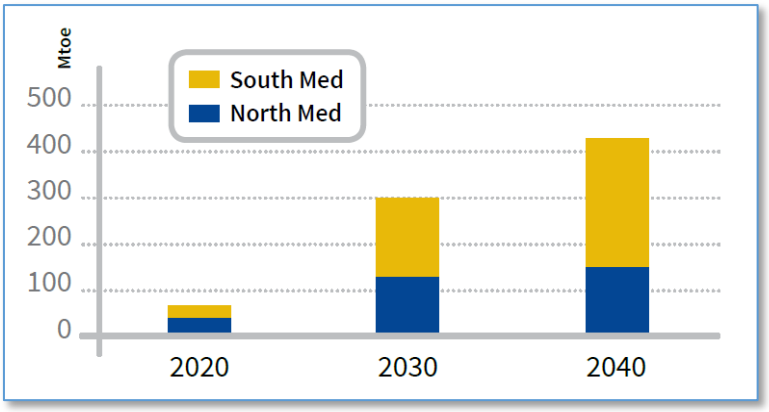


Figure 1. Mediterranean Energy Savings by Region.
Source: MEDENER/OME, 2015.

Substantial energy savings are forecasted in the buildings sector (residential and tertiary sectors), especially in the South Mediterranean where over 50 million new dwellings are expected to be built over the next decades. The Energy Transition Scenario also takes into account efficiency standards for all electrical equipment (including household appliances, cooling and heating of office space). In 2040, buildings consumption would be 22% lower in the Energy Transition Scenario. This represents savings of 72 Mtoe by 2040 of which 47 Mtoe for the residential sector alone. For the South countries energy savings would reach 29% in 2040.

[1] Mediterranean Energy Perspectives to 2050 (2021 edition): OBSERVATOIRE MEDITERRANEEN DE L'ENERGIE. https://www.ome.org/wp-content/uploads/2021/09/MEPto2050-2021-ed-Executive-Summary.pdf

[2] Contribution de l'ADEME à l'élaboration de visions énergétiques 2030-2050 - Document technique complet et Synthèse avec évaluation macro-économique. https://librairie.ademe.fr/institutionnel/3481-contribution-de-l-ademe-a-l-elaboration-de-visions-energetiques-2030-2050.html

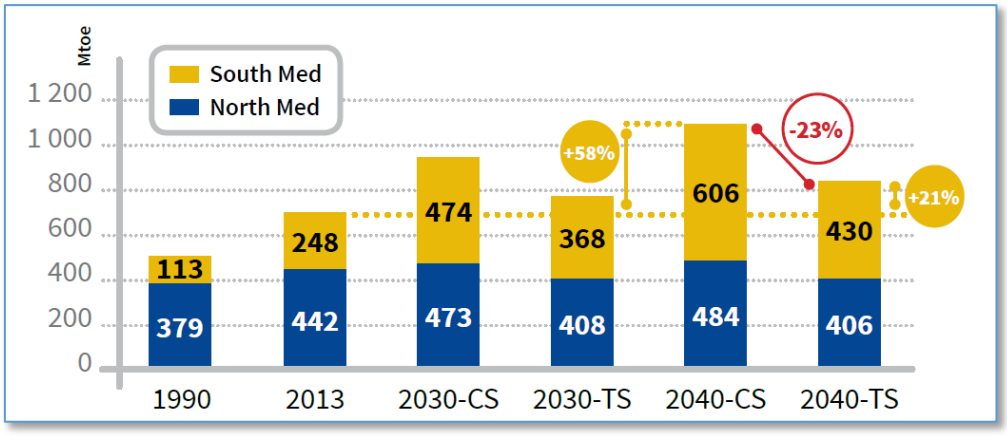


Figure 2. Energy consumption by region. CS=Conservative Scenario; TS Energy Transition Scenario. Source: MEDENER/OME 2015.

For the industry sector, energy savings could reach 25%, especially taking into account substantial efforts on heavy industry, through standards and through cleaner and more efficient technologies. Energy demand in the transportation sector would also fall by approximately 21% taking into account, major efforts in terms of energy and societal policies and measures for private transport (more efficient vehicles), but also in the design of new cities and the organization of public transport. The bulk of the efforts will target the electricity sector the most, especially in the buildings sector. Electricity could account for a third of total savings in final energy consumption with 81 Mtoe electricity savings in 2040.

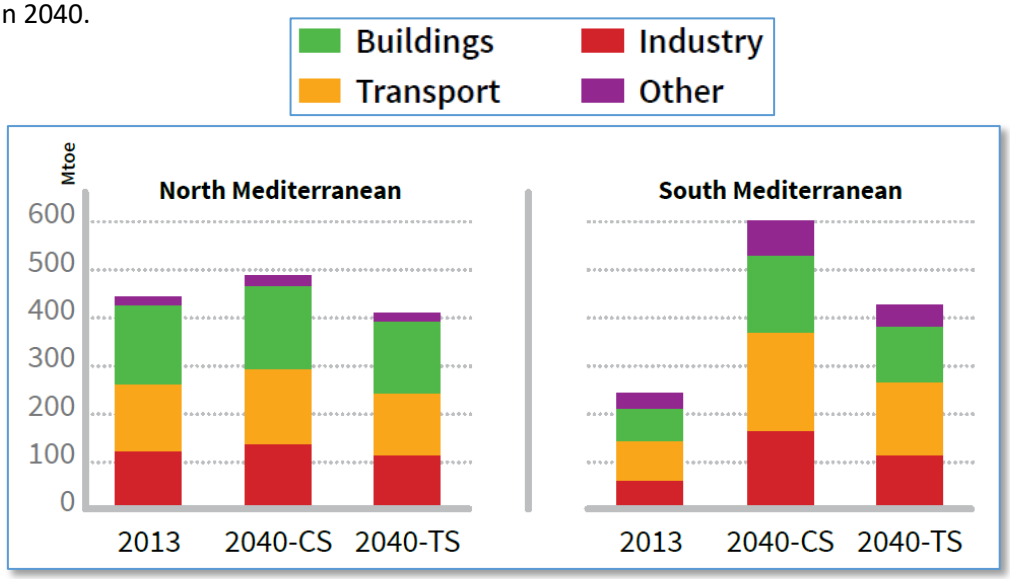


Figure 3. Final Energy Consumption by Region. Source: MEDENER/OME 2015.

2.2 Project description

ESMES intended to contribute to increased awareness and better energy habits in schools, through a set of actions addressed to students, teachers, policy makers and school buildings in 5 Mediterranean Countries.

ESMES beyond its impacts on communities' awareness and students/teachers' behaviours, should have reached a remarkable impact in the financial management of the schools, quantified in a saving

of € 30,000 /year through the return of REEE investments and in the mitigation of climate change, with a reduction of 240 CO2 tons/year and the production of 270,000 kWh/year from RE and 30,000 kWh/year through energy efficiency.

Work Packages, main actions and coordinators are reported in Table 2 below.

Work package Code	Title	Coordinator	Involved partners	Programme expected result
WP0	Preparation	BEN	PP01, PP02, PP03, PP04, PP05	
WP1	Management	BEN	PP01, PP02, PP03, PP04, PP05	
WP2	Communication	BEN	PP01, PP02, PP03, PP04, PP05	
WP3	Institutional capacity building for sustainable energy policy making & rehabilitations management	PP03	BEN, PP01, PP02, PP04, PP05	4.3.1
WP4	Planning of REEE rehabilitations in 10 public schools	PP01	BEN, PP02, PP03, PP04, PP05	4.3.2
WP5	Pilot of REEE innovative solutions in target public schools	PP05	BEN, PP01, PP02, PP03, PP04	4.3.2

Table 2. WPs, key actions, and action plan of ESMES project

ESMES indicators of achievements concerning expected results and outputs are reported in the below matrices (Table 3).

Programme Overarching objective	**Programme Priority**
B.4 - Environmental protection, climate change adaptation and mitigation (Address common challenges in environment)	B.4.3 - Support cost-effective and innovative energy rehabilitations relevant to building types and climatic zones, with a focus on public buildings
ESMES general and specific objectives	
General objective:	**Specific objectives:**
To contribute to environmental protection, climate change adaptation and mitigation through improved energy management of public schools buildings based on REEE solutions	1. Increased civil society awareness and improved energy habits through the cross-border engagement of students in a sustainable use of energy resources in Jordan, Tunisia, Lebanon, Italy and Spain.
	2. Reduced and cleaner energy consumption in 10 public school buildings in Jordan, Tunisia, Lebanon, Italy and Spain through the introduction of cost-effective REEE solutions tailored to buildings energy loads, type&use and climatic zone.

	3. Enhanced capacities of national, regional and local institutions of Jordan, Tunisia, Lebanon, Italy and Spain to plan and realize improved energy rehabilitations for higher energy sustainability of public buildings through cross-border cooperation.

Priority, expected results and indicators for the Programme and ESMES

Priority	*Expected results*	*Expected results indicators*	*Programme target*	*ESMES target*
B.4.3 - Support cost-effective and innovative energy rehabilitations relevant to building types and climatic zones, with a focus on public buildings	4.3.1 Enhanced capacity of public institutions to plan and implement sustainable energy policies and measures with regard to public buildings	4.3.1.A Number of public institutions that adopted energy mix efficiency plans/strategies	25 Public institutions	5 Public institutions
	4.3.1 Enhanced capacity of public institutions to plan and implement sustainable energy policies and measures with regard to public buildings	4.3.1.B Number of public institutions cooperating towards strengthened multi-level governance (linking up local, regional and national levels) for delivering integrated sustainable energy action planning and measures	25 Public institutions	5 Public institutions
	4.3.2 Reduced and cleaner energy consumption in public buildings through the	4.3.2.E Total kWh saved (expressed in budget reductions) using renewable	1,800,000 kWh generated from RES	300,000 kWh generated from RES

	use of renewable energy measures and energy saving interventions	energy applied to public buildings		
	4.3.2 Reduced and cleaner energy consumption in public buildings through the use of renewable energy measures and energy saving interventions	4.3.2.C Estimated annual decrease of greenhouse gases as a result of renewable energy and energy efficiency measures implemented in public buildings (adapted ENI CBC nr.23)	771.0 tons of CO2 equivalent/year	240.0 tons of CO2 equivalent/year
	4.3.2 Reduced and cleaner energy consumption in public buildings through the use of renewable energy measures and energy saving interventions	4.3.2.D Total kWh generated using renewable energy applied to public buildings	1,800,000 kWh generated from RES	300,000 kWh generated from RES

Table 3. Indicators of achievement for Results, Outcomes and Outputs

Expected result	**Project outputs**	**WP**	**Output indicator(s)**	**Programme target values* (From Annex 2 of the JOP)**	**ESMES target value**
4.3.1	Approved procedures for smart and sustainable energy management in public school buildings	WP3	4.3.1.1.a Number of new or revised procedures (legal, regulatory, economical,	18 procedures	2 procedures

			etc.) initiated as a result of a transfer of good practices		
	Approved strategies to support efficient and cost-effective energy mix in public schools' buildings	WP3	4.3.1.2.b Number of energy mix efficiency plans/strategies approved	27 approved plans	5 approved plans
	Case studies on REEE project portfolio solutions for enhanced energy rehabilitation of schools' buil	WP3	4.3.1.3.c Number of innovative and affordable renovation solutions and technologies for public buildings that can deliver significant improvements in energy performance while ensuring indoor comfort requirements, and being non-invasive, and reversible	36 renovation solutions	6 renovation solutions
	Tools for implementing REEE project portfolio solutions and SEM measures in schools' buildings	WP3	4.3.1.4.d Number of tools for planning and implementing the renovation of public buildings	12 Tools	3 Tools
4.3.2	Pilot REEE cost-effective project portfolio solutions	WP5	4.3.2.5.e Number of cost-effective technologies for energy efficiency and renewable energy solutions implemented on a pilot basis	12 Technologies	2 Technologies
	REEE rehabilitation plans for 5 selected public schools buildings with non- linear energy loads	WP4	4.3.2.7.h Number of public buildings and/or facilities benefiting from Renewable Energies & Energy	54 public buildings	5 public buildings

			Efficiency (REEE) measures		
	REEE rehabilitation plans for 5 selected public schools	WP4	4.3.2.7.h Number of public buildings and/or facilities benefiting from Renewable Energies & Energy Efficiency (REEE) measures	54.0 public buildings	5.0 public buildings
	Energy performance certificates (EPC) released to rehabilitated schools	WP5	4.3.2.6.g Number of energy audits carried out on public buildings	36 energy audits	6 energy audits

2.3. Scope and objectives of the evaluation

The evaluation of the ESMES project was conducted by an external consultant, appointed by ICU Istituto per la Cooperazione Universitaria (BEN) on 7th July 2023, during the concluding phase of the project's implementation. Given the project's multi-country scope and the technical nature of its primary activities, the evaluation was structured around a comprehensive remote data collection and stakeholder interview methodology. This approach permitted the consultant to engage with a diverse range of stakeholders from all partnering entities. However, it necessitated a less intensive yet protracted evaluation process, which ultimately concluded in October 2023.

The objective of the evaluation is to measure project performance based on OECD-DAC criteria (relevance, effectiveness, efficiency, impact and sustainability), to identify added value, replicability and scale up potential, lessons learned and propose recommendations for follow-up actions.

The methodology used was conceived to assess achieved impacts, identify and understand unexpected impacts and evaluate the long-term sustainability of the project actions.

All the project partners are in the position to take care of the proper management of the RE and EE solutions realized on ground and to promote appropriate behaviors for energy savings in schools and families beyond the project end. The alignment of partners' mandate in their daily duties with the role taken in the implementation of ESMES reassure on their commitment in long term sustainability of the actions and - to some and different extents for each specific country frame – for the replication of the best practices piloted by ESMES for new schools and public buildings.

The evaluation takes in consideration all the activities implemented by ESMES project from 01.09.2019 to 31.08.2023 in Spain, Italy, Jordan, Lebanon and Tunisia.

2.4. Methodology

As indicated in the Indicative Monitoring and Evaluation Plan of the ENI CBC MED PROGRAMME 2014-2020, the MA and the JTS apply the Result Based Management approach (RBM) to the ENI CBC MED funded projects. The advantages of using the RBM in the framework of ENI CBC MED Programme, are:

1. Planning: the RBM offers a systematic approach to select interventions that are most likely to address the targeted problems;
2. Consensus, coordination, and ownership: the RBM provides the opportunity to work with key stakeholders coordinating the implementation approach, agreeing on and verifying the expected results, highlighting and checking the underlying assumptions and specifying needed resources;
3. Management: the RBM offers a tool for guiding corrective adjustments to activities, reallocating resources, and re-evaluating targeted objectives or underlying assumptions;
4. Communication and reporting: the RBM acts as a vehicle for communicating about the resources, activities, and outcomes to Programme staff, Project partners and other relevant stakeholders. It can be an important tool in illustrating to the beneficiaries what a project is meant to achieve;
5. Project Evaluation: the description of each level of Results with associated Indicators, Priorities, Targets and Milestones establishes an effective framework for ongoing monitoring and evaluation. The RBM clearly identifies how progress toward the targeted objectives will be measured and thus provides the basis for the development and use of the monitoring system;
6. Positive and negative lessons learnt: the systematic use of the RBM allows the Programme staff to assess what approaches contribute most effectively to achieving the Thematic Objectives (TOs). The RF helps identify good practices for replication and better manage risks and opportunities.

The Evaluation phases (mid-term and final) is expected to provide valuable information for decision-making and lessons learnt for the future, and the fifth point of the project cycle (evaluation) incorporates outcomes from all the other 5 steps, as reflections on the project results and sustainability. The evaluation steps were:

Preliminary documents and data review: Recreate the project implementation process in order to grasp the key crucial features and define shared knowledge between the evaluator and project partners, which will be useful in establishing the succeeding evaluation phases.

All relevant documents are thoroughly examined in order to perform all analysis above mentioned. While logical framework and the project proposal document represent the baseline/expected results, on the other side mid-term monitoring and evaluation reports, financial reports, main resuming accounting documents, donors' official letters show the real project implementation trend.

The preliminary phase focuses on:

- relevance analysis of the project frame on the basis of LF and National/local policy strategy. A deep examination of the proposal, together with the collection and understanding of the main national laws, strategic plans, and socio-economic rules of the concerned communities.

- financial efficiency analysis, based on the main resuming financial documents. The project documentation should clearly show how the budget has been allocated in the different actions and in specific moments. Accountancy reports versus monitoring reports: will pointed out the extent of financial efficiency.

Project staff meeting and discussion: Several on-line meetings have been organized with reference persons of all ESMES partners, to understand the key difficulties, challenges, results from ESMES in the whole lifespan.

Preparation of questionnaires for different stakeholders and beneficiaries: on-line questionnaires (prepared through Google Drive templates) have been prepared for different stakeholders and beneficiaries of ESMES project specifically:

- Energy experts from local institutions
- Principals of involved schools
- Teachers working in the involved schools
- Students of the involved schools

The questionnaires have been shared with the ESMES coordinators in each country and they took care of delivering them to the appropriate recipients.

2.4.1 Evaluation criteria

The evaluation will measure OECD parameters as they are considered as a standard benchmark in project evaluation framework:

1. RELEVANCE

It indicates the coherence between project objectives, as identified problems addressed by the project, and physical, social and political environment of intervention area. Specific informations were gathered about:

- National, local policy frame, including strategic and sectoral laws in force in the area.
- Logical Framework Analysis, aimed at comparing the project design with the actual operational framework (goals and objectives, risks and assumption, management system set up in the project document, target group identification in the respect of gender issues and capacity, in other words, the rationale and completeness of project design process and internal logic and coherence of the intervention itself).
- Beneficiaries' analysis: comparing the needs and priorities of beneficiaries with planned actions and sector achievements. Measuring the appropriateness of the deployed strategy with beneficiaries' engagement, the consistency of project actions with needs of people, disaggregated for sex and age. The extent of involvement of local groups in the project phases (since identification of strategy).

2. EFFICIENCY

The costs, the timely, and the wise project resources management, that translated financial and human resources into concrete results with proper objectively verifiable quality. Detailed assessment will be addressed to following elements:

- Daily budget management (appropriateness budget value for each action) and project personnel employed, with specific organisational and management structure.
- Relations and coordination with local authorities, institutions, beneficiaries and other donors.
- The adherence to deadlines.
- Costs and value-for-money of implemented actions: by a cost-benefit analysis project costs have to be compared with benefits. The assessment should contain as much as possible monetised values, although not all benefit could be easily internalised through a scientific approach. The results should be further compared with results expected and mentioned in the project document.
- Contributions from counterparts: partners, local institutions, beneficiaries and government. Evaluation of expected versus performed contribution, and communication with counterparts.
- Level of technical assistance.
- Quality of monitoring.

3. EFFECTIVENESS

The level of achievement of project objective, by the realisation of concrete results, in the specific implementation context. It is composed by:

- Indicators analysis, based on Logical Framework and value of indicators at baseline data collection.
- Stakeholders' vision on project impacts, intended as all those changes recorded by them in their daily life.
- The contingency strategy adopted by the project to minimise those risks considered at project design phase or those unexpectedly occurred during the project implementation: flexibility of management team, shared process with counterparts.
- General ability of project staff to deal with complex and unexpected changes within implementation frame.

Based on such analysis the evaluation will then formulate recommendations for future long-term vision exercises:

I. **Institutional arrangements:** what are the optimal institutional arrangements for preparation of long-term visions? When is it most appropriate to engage the regional implementation team to lead the exercise versus an independent third party or some other arrangement?
II. **Relevance**: how can long-term visions be made more relevant to the needs and interests of stakeholders in each hotspot?
III. **Ownership**: how can the ownership of long-term visions by key stakeholders be enhanced, both during and after their preparation?
IV. **Timing**: at what point(s) during the five-year investment cycle is it most appropriate to prepare long-term visions?
V. **Value for money**: How can long-term visions be prepared in a cost-effective manner? Are current plans to combine these with mid-term assessments appropriate?

The above considerations will be formulated with the aim to increase the future impact and sustainability of the actions.

4. IMPACT

The changes that the project brought to the social, cultural, political and physical environment, and its contribution to sectoral aim indicated in the LF as Overall Objective. The impact is also defined by OECD (Organisation for Economic Co-operation and Development) as "**the positive and negative, intended and unintended, direct and indirect, primary and secondary effects produced by an intervention**".

Additionally, the impact can be assessed based on its relative effects on the anticipated results of the call for proposals, providing a quantitative analysis of the project's achievements compared to the expected outcomes of the ENI CBC MED programme.

5. SUSTAINABILITY

It indicates the probability that positive output and outcome of the project will last in the long run. To be sustainable the project should:

- Be consistent with national and local policy to ensure a proper attention of policy makers toward the project outputs and outcomes
- Financial and economic sustainability: resources can be public, private or mixed, but appropriate availability of funds must be ensured. While the financial analysis is a mere evaluation of cash flows, the economic analysis is a wider evaluation of monetised costs and benefits recorded at social level, useful element to know the social value of the plants for all the communities. It has to evaluate environmental benefits, ecological services, improved health better sanitation condition and, as far as it makes sense, assign to each unit, a monetary value.
- integrated in the socio-cultural environment. A key issue is the participation of relevant stakeholders in the project. The project must be congruous with local power management systems, and operate in abidance with those laws. Behaviours of project staff are further important to ensure proper ownership of beneficiaries, and pushing an effective hand-over of infrastructures, from project board to beneficiaries' committees.
- Foresee the deploy of appropriate technologies based on available human resources (knowledge, skills, people) to manage assets, and services.
- In line with institutional capacity: managerial, technical, political ability of policy makers and civil servants to follow up and support institutions in the proper use and maintenance data collection, offices, data processing units for REEE.

6. ADDED VALUE

It investigates how ESMES ensures complementarities and generate synergies with other programmes and stakeholders at local, national and European level. It is conceptually in line with sustainability but it focuses more on the potential network that the consortium was able to stimulate with the aim of reinforcing its action and amplify its results.

7. REPLICABILITY AND SCALING UP

This is a very important aspect of the sustainability, particularly focused on the locally available funds to sustain the project efforts, replicating the pilot project and strengthening the policy and private sector ecosystem to enhance REEE initiatives at country level.

8. PROJECT CAPACITY TO DEAL WITH RISK/PREVENTION AND ADAPTATION

The capacity of the project to deal with risk refers to its ability to identify, assess, mitigate, and manage potential risks that may arise during the project lifecycle. Building a robust risk management capacity

is crucial to minimize the negative impacts of uncertainties and increase the likelihood of project success. The assessment measures:

- What kind of risks the project implementation faced and how they were treated;
- To what extent the workplan was adapted to unforeseen conditions that has put at risk the proper project implementation;
- How the key risks were properly identified in the project document in the ex-ante phase. The identified risks were: Risks: A) staff insecurity; B) political situation worsening; C) delays caused by partners/suppliers Probability: low Possible effects: hindering activities Corrective measures: A) Relying on: national embassies warnings, local staff constant monitoring of the situation, B) On field monitoring, involvement of PPs institutions that ensure the prosecution of the action if the situation worsens; C) Population is involved and informed on the positive impact on public budget and environment (WP2). External conditions: Stability of economy/inflation/exchange rates: conditions quite firm in target countries. Mitigation: adaptation of pilots/equipment/budget to modified conditions, ensuring an advantageous cost/benefit ratio. - Solid political situation: current political stability in target areas; involvement of institutional PPs ensures government support. Mitigation: target areas changed in case of problems, on-field staff ensure constant monitoring to act early and avoid delay.

2.4.2 Evaluation Questions

The evaluation is structured around 8 groups of Evaluation Questions (EQ) covering different dimensions of ESMES. The questions have been defined during the identification of the terms of references for the evaluation and have been confirmed during the first phase of documents' desk review and analysis with ICU.

The Evaluation Questions related to the 8 evaluation dimensions are:

1) **Key questions on relevance:** "Is ESMES aligned with the goals and priorities of key stakeholders and beneficiaries? To what extent ESMES responds to the strategic policies of involved countries and EU?"
2) **Key questions on efficiency:** "Are the activities implemented in line with the plans? Are they implemented and the outputs delivered in a cost-efficient manner?"
3) **Key question on effectiveness:** "What are the major factors influencing the achievement or non-achievement of the objectives of ESMES project?"
4) **Key questions on impact:** What is ESMES project's likely contribution to the overall objective? To what extent the project benefited the target beneficiaries, directly or indirectly and a larger number of people in the sector and/or region?"
5) **Key question on sustainability:** "What was put in place by the project to ensure the sustainability of the expected project outcomes?"
6) **Key questions on added values:** "How did the implementation of ESMES ensure complementarities and generate synergies with other programmes and stakeholders at local, national and European level"; "What are the strengths and weaknesses of having the EU implement the project?"
7) **Key questions on project potential replicability and scaling up:** "Do you have funding available at the national level to ensure the continuity of this project's activities? How would you consolidate the activities in phase 2?"

8) **Key questions on project partnership capacity to deal with risks and prevention and adaptation measures adopted to ensure the best performances: "**How did you modify the action plan to address unforeseen risks? What solutions did you implement to navigate challenges during the project's execution?"

2.4.3 Evaluation time line

According to the ToR the evaluation was carried out in three different stages: (i) desk evaluation, (ii) on-line consultation with project partners, stakeholders and beneficiaries and (iii) report writing.

The desk evaluation started on 07th July 2023. The list of analyzed documents is included in Annex 1.

The consultation phase took place from 14th July 2023 to 01 September 2023.

The final report-writing phase started soon after the end of the consultation phase and led to the first draft of the final report on 30th October 2023. Review by the project manager and inputs collections from partners, was integrated into the final document.

3. Evaluation findings

3.1 EQ1: Relevance

Is ESMES aligned with the goals and priorities of key stakeholders and beneficiaries? To what extent ESMES responds to the strategic policies of involved countries and EU?

POLICY FRAMEWORK STRATEGIC ALIGNMENT

ESMES is totally in line with the policies on energy transition and decarbonization issued by all the partnering countries. EU member states as **Spain** and **Italy** have acknowledged the EU directives and laws promulgated to enhance energy efficiency and renewable energy supply in the building sectors as:

1. Energy Performance of Buildings Directive (EPBD): The EPBD is a cornerstone directive that sets out the framework for improving the energy performance of buildings within the EU. It establishes requirements for energy performance certificates, minimum energy performance standards, and the nearly zero-energy building concept. Member states are required to transpose the directive into national law and implement its provisions.
2. Renewable Energy Directive (RED 2018/2001): The RED, along with its recast version (RED II), sets binding renewable energy targets for EU member states. It encourages the use of renewable energy sources in heating, cooling, and electricity generation in buildings and other sectors. The directive also supports the development of renewable energy communities and self-consumption of renewable energy.
3. Energy Efficiency Directive (EED 2012 and its updates in 2018 and 2023): The EED aims to improve energy efficiency across various sectors, including buildings. It sets energy savings targets and requires member states to develop national energy efficiency plans. The directive

promotes measures to enhance the energy performance of buildings and encourages the renovation of existing building stock.

4. Governance Regulation: The Governance Regulation sets out the governance framework for the Energy Union and the Climate Action Regulation. It requires member states to establish national energy and climate plans (NECPs) that include strategies and measures to promote energy efficiency and renewable energy in buildings and other sectors.
5. Nearly Zero-Energy Buildings (nZEB) Standard: The EPBD establishes the concept of nZEBs, which are buildings that have a very high energy performance and meet their energy needs primarily from renewable sources. Member states are required to establish definitions and national plans for nZEBs and ensure that new buildings are nearly zero-energy by a certain deadline.
6. Smart Readiness Indicator (SRI): The SRI is introduced to assess the level of smart readiness of buildings. It aims to promote the use of advanced technologies and digital solutions for optimizing energy use and enhancing comfort in buildings.

Jordan has invested in the development of a strong legal and regulatory framework to promote energy efficiency and renewable energy in the building sector, promulgating several laws and specific measures:

1. Renewable Energy and Energy Efficiency Law (No. 13 of 2012): This law aims to promote and regulate renewable energy projects and energy efficiency measures in Jordan. It establishes the legal framework for feed-in tariffs, net metering, and other incentives for renewable energy projects.
2. National Energy Efficiency Action Plan (NEEAP): The Jordanian government developed the NEEAP to outline specific measures and strategies for improving energy efficiency in various sectors, including buildings. This plan sets energy efficiency targets and provides guidelines for implementation.
3. Net Metering Regulations: The Jordanian government introduced net metering regulations to encourage the installation of solar PV systems on rooftops and buildings. This allows consumers to generate their electricity and sell excess energy back to the grid.
4. Green Building Codes and Standards: Jordan has been working on developing green building codes and standards to improve the energy performance of buildings. These codes include requirements for energy-efficient insulation, lighting, HVAC systems, and renewable energy integration.
5. Renewable Energy and Energy Efficiency Fund (REEEF): The REEEF was established to provide financial incentives and support for renewable energy and energy efficiency projects, including those in the building sector. It offers grants, loans, and technical assistance to promote sustainable energy practices.
6. Energy Efficiency Labeling: Jordan implemented an energy efficiency labeling program for various appliances and equipment to inform consumers about the energy efficiency of products and promote the use of energy-efficient technologies in buildings.
7. Energy Performance Certificates (EPCs): The government has introduced EPCs for buildings, which provide information on a building's energy performance. This helps buyers and renters make informed decisions about the energy efficiency of properties.

8. Renewable Energy Power Purchase Agreements (PPAs): Jordan has established a legal framework for PPAs to encourage private sector investments in renewable energy projects, including those for on-site power generation in buildings.

Lebanon, despite the strong need in diversification of energy sources and difficulties to satisfy the internal energy demand, has a less strong legal frame in this sector, with the following laws:

1. National Energy Efficiency and Renewable Energy Action (NEEREA) Program: NEEREA is a financial incentive program in Lebanon that provides subsidized loans and grants for energy efficiency and renewable energy projects in various sectors, including buildings.
2. Energy Performance Certificates (EPCs): Lebanon has introduced EPCs for buildings to assess and disclose their energy performance. EPCs provide information to property buyers and renters about the energy efficiency of buildings.
3. Building Codes and Standards: Lebanon has been working on developing and updating building codes and standards to incorporate energy efficiency measures. These codes cover aspects such as insulation, lighting, HVAC systems, and renewable energy integration.
4. Renewable Energy Feed-in Tariffs: Lebanon has introduced feed-in tariffs to incentivize the deployment of renewable energy systems, including solar photovoltaic (PV) installations on buildings. These tariffs offer favorable rates for electricity generated from renewable sources.

Tunisia had implemented several laws and measures to promote energy efficiency and renewable energy in the building sector:

1. National Energy Efficiency Action Plan (NEEAP): The Tunisian government has developed a NEEAP that outlines strategies and actions for improving energy efficiency in various sectors, including buildings. The plan sets energy efficiency targets and includes measures to enhance building insulation, lighting, and heating/cooling systems.
2. Renewable Energy Law (Law No. 2015-12): This law promotes the development of renewable energy sources, including solar and wind power. It includes provisions for incentives and regulatory frameworks for renewable energy projects, which can be integrated into buildings.
3. Energy Performance Certificates (EPCs): Tunisia has introduced EPCs for buildings to assess and disclose their energy performance. EPCs provide information to property buyers and renters about the energy efficiency of buildings.
4. Building Codes and Standards: Tunisia has established building codes and standards that incorporate energy efficiency requirements for new construction and renovations. These standards cover aspects such as insulation, lighting, HVAC systems, and renewable energy integration.
5. Solar Water Heating Mandate: The Tunisian government has mandated the use of solar water heaters in certain types of buildings, including hotels and swimming pools, to reduce energy consumption for water heating.
6. Renewable Energy Feed-in Tariffs: Tunisia has implemented feed-in tariffs to promote the production of electricity from renewable sources, which can include solar PV installations on building.

According to the factors already mentioned, the broad and developed legal and regulatory framework, on the one hand, makes ESMES relevant to the political priorities and needs of partner countries and,

on the other hand, offers the regulatory framework the opportunity to adopt best practices ESMES and use the positive results of the projects as leverage for further replication through public funding.

BENEFICIARIES AND STAKEHOLDERS' PRIORITIES AND NEEDS

The need to improve the energy efficiency of school buildings and the provision of clean energy through photovoltaic systems identified during the project design, was made more urgent by the COVID-19 pandemic and the subsequent Ukrainian crisis, with a gigantic impact on costs of goods and raw materials first, and then of energy, causing exceptional inflation which has made the cost of living unsustainable for many.

In all partnering countries the costs for heating schools in winter time for municipalities and/or other concerned management public authorities, it is now a major expense in the public budgets of the organisations that administer schools.

Heating schools in winter time is a significant challenge for municipalities and other public authorities, especially in countries where temperatures can drop significantly. To highlight the different situations for each partnering countries we report a brief analysis below.

1) **Italy**
   - Old Infrastructure: Many schools in Italy, especially in historic towns, are housed in old buildings. This makes it challenging to retrofit them with modern heating systems without compromising the structural integrity or cultural significance of the buildings.
   - Variability in Winters: While northern regions like Lombardy or Veneto experience harsh winters, southern regions like Sicily have milder winters. This leads to varied heating requirements across the country.
   - Budget Constraints: Municipalities, especially in less affluent areas, may struggle to allocate sufficient funds for efficient heating systems.
2) **Spain**
   - Diverse Climates: Spain's climate varies from oceanic in the north to desert in the southeast. Thus, heating requirements can differ significantly between regions.
   - Energy Costs: The price of energy can be high, making it expensive for public authorities to heat schools throughout the winter months.
   - Efficiency Concerns: Older buildings, especially in historic areas, may lack proper insulation, making them less energy efficient.
3) **Jordan:**
   - Resource Scarcity: Jordan is one of the world's most water-scarce countries, and energy resources are also limited. This impacts the availability and cost of heating solutions.
   - Refugee Populations: Like Lebanon, Jordan has a significant number of Syrian refugees. The increased number of students can strain the infrastructure and make it challenging to provide consistent heating.
   - Varied Geography: While areas like Amman can get quite cold in winters, regions like Aqaba are milder. This results in diverse heating needs.
4) **Tunisia:**
   - Budget Limitations: Being a developing nation, Tunisia has to allocate resources judiciously, and sometimes, school heating might not be at the top of the list.

- Lack of Infrastructure: Not all schools, especially in rural areas, are equipped with central heating systems.
- Reliance on Traditional Methods: In some areas, traditional methods of heating, like stoves, might still be in use, which may not be as efficient or safe as modern heating systems.

5) Lebanon:

- Political and Economic Instability: Ongoing political challenges and economic issues in Lebanon can make consistent funding for school heating a lower priority.
- Refugee Crisis: The influx of Syrian refugees has added strain to the already overwhelmed public services, including schools. With overcrowded classrooms, ensuring proper heating for everyone becomes a bigger challenge.
- Electricity Shortages: Lebanon often faces electricity cuts, making it difficult to rely on electric heating systems consistently.

Common Challenges Across These Countries

Energy Efficiency: As a measure to combat climate change, there's a push towards energy-efficient solutions. Finding and implementing such solutions in schools can be both a priority and a challenge.

Safety Concerns: Old heating systems or poorly maintained ones can be fire hazards or cause health issues due to poor air quality.

Budgetary Constraints: Public funds are often limited, and prioritizing between various essential services can be a challenging task for municipalities and public authorities.

ANSWER TO EQ1

Is ESMES is aligned with the goals and priorities of key stakeholders and beneficiaries?

ESMES project fully addresses the priorities and needs identified by the project partners and stakeholders who participated in the activities.

All the partners who actively worked on the implementation of the project face challenges in managing school buildings from an energy perspective. These difficulties can be grouped into 3 main categories:

1) The costs due to the energy demand of the buildings is increasingly significant on the public budgets of the municipalities or entities that administratively manage the buildings. This is due to the rising cost of energy, low thermal efficiency, and also the behaviors of teachers, students, and administrative staff who rarely make efforts to reduce consumption.
2) The microclimatic conditions of the buildings, despite having heating systems and, rarely, cooling systems, are not good because of the poor thermal efficiency of the buildings.
3) The country's conditions are such that school buildings are forced not to use the available systems adequately due to a lack of funds, lack of available energy sources, or continuous power outages. This last type of difficulty is the cause of widespread and prolonged school closures in Lebanon.

To what extent ESMES responds to the strategic policies of involved countries and EU?

The rationale for the project aligns perfectly with the policy priorities of the countries where the partners are located. The planned actions are in sync with the commitment of all five governments to

combat climate change. They aim to implement mitigation measures by reducing greenhouse gas emissions through:

1) Enhancing energy efficiency in school buildings,
2) Generating renewable energy from PV systems installed in these buildings, and
3) Educating and raising awareness among students about energy-saving practices in their daily lives.

The primary beneficiaries of the project are indeed those equipped to actualize change, assimilate best practices, and replicate them in forthcoming school building construction or retrofitting endeavors. Furthermore, initiatives targeting students and teachers foster profound behavioral shifts within the citizenry, permeating through students and extending to their families.

The Logical Framework includes detailed indicators for project implementation monitoring that are related to the Specific Objective and each Expected Result. These indicators respond to the ENI CBC MED Framework and are all in line with the overall impact of the call for proposal. It is feasible to clearly quantify the project ESMES and how they contribute to the achievement of the call for proposal using this word.

3.2 EQ2: Efficiency

Are the activities implemented in line with the plans? Are they implemented and the outputs delivered in a cost-efficient manner?

The consortium partners for the project execution have a rather long history of collaboration that stems from initiatives that closely fit with the aims and methodology of ESMES.

The project commenced on September 1st, 2019. Just two months later, the COVID-19 pandemic was declared globally, profoundly altering consortium's working methods for several months, eliminating the possibility of travel, particularly among countries, and shifting the focus of local authorities to this new and vast global challenge. The pandemic also affected international markets, reducing the availability of goods and equipment that the project intended to use for the retrofitting interventions and for the installation of photovoltaic systems.

Some actions had limited efficacy, particularly those that should have been based on meetings, exchanges, and building of lasting relationships, especially among administrators, principals, teachers, and students active in the various ESMES project countries. The initial impossibility, followed by huge challenges, in organizing and conducting international travel in 2019, 2020, and 2021 effectively minimized the establishment of a coordinated project consortium, especially for those from civil society, for whom the exchange would have had experiential and human value even before a technical one. This was not the case for the project's technical experts, among whom exchanges solutions to overcome barriers in implementing technical actions, especially between Jordan, Lebanon, and Tunisia. Despite the serious challenges that ESMES faced and the necessary changes in the action plan imposed by travel restrictions enforced by all governments to control the spread of COVID-19, ESMES achieved significant results concerning project efficiency.

The following indicators demonstrate achieved versus planned outputs.

Project outputs	WP	Output indicator	Programme target values	ESMES target value	ESMES Achiev.	%
Approved procedures for smart and sustainable energy management in public school buildings	WP3	4.3.1.1.a	12.0	2.0	**2.0**	**100**
Approved strategies to support efficient and cost-effective energy mix in public schools' buildings	WP3	4.3.1.2.b	18.0	5.0	**5**	**100**
Case studies on REEE project portfolio solutions for enhanced energy rehabilitation of schools' building	WP3	4.3.1.3.c	24.0	6.0	**6**	**100**
Tools for implementing REEE project portfolio solutions and SEM measures in schools' buildings	WP3	4.3.1.4.d	8.0	3.0	**3**	**100**
REEE rehabilitation plans for 5 selected public schools' buildings with non-linear energy loads	WP4	4.3.2.7.h	36.0	5.0	**6**	**120**
REEE rehabilitation plans for 5 selected public schools funded by project sub-grants	WP4	4.3.2.7.h	36.0	5.0	**7**	**140**
Pilot REEE cost-effective project portfolio solutions	WP5	4.3.2.5.e	8.0	2.0	**2**	**100**
Energy performance certificates (EPC) released to rehabilitated schools	WP5	4.3.2.6.g	24.0	10.0	**6**	**60**

Table 4 Output indicators: planned versus achieved

The school buildings, retrofitted through renewable energy (PV) schemes installation and energy efficiency solutions are reported in the table below (n.5) and following maps.

Country/School	Latitude	Longitude
LEBANON		
Amir Shakib Erslan	33,888664	35,481775
Majadel Public School	33,229553	35,365054
Barouk Public School	33,707089	35,685613
Ecole Officielle Hosh El Omara	33,831074	35,901856
Ain Jarfa Intermediate Public School	33,383087	35,688711
Ecole des Arts et Métiers	33,879921	35,545459
Bir Hasan Technical Institute	33,866950	35,489725
George Sarraf Public School	34,416168	35,839247
Abi Samraa Public School	34,416168	35,839247
SPAIN		
IES Bernat Guinovart	39,195361	-0,424859
CEE Miguel Burguera	39,207096	-0,301140
JORDAN		
Bait Yafa School for Girls	32,528591	35,776578
Jrainah Technical School for Boys	31,702408	35,768076

Madaba Technical School for Boys	31,707389	35,793096
TUNISIA		
ISSAT SOUSSE University	35,812397	10,638709
High School Sahloul 4	35,830719	10,598381
High school Erriadh Bouficha	36,296458	10,455564
High school Abou Kacem Echebi Kalaa Kébira	35,902120	10,529370
High school Khawarezmi Msaken	35,719305	10,561980
High school Farhat Hached Msaken	35,722893	10,585454
High school Zaouia Ksiba Thrayet	35,776889	10,624646
College Jamel Abdejlil Akouda	35,802708	10,655991
College Yasmine Enfidha	36,137292	10,381047
Colege Erriadh Sousse	35,808037	10,610632
High school Hammem Sousse 2	35,846675	10,589459
High school Ibn Kholdoun Msaken	35,738084	10,587343
ITALY		
Istituto Comprensivo S. Bagolino - Alcamo	37,976038	12,961346

Table 5. Geographic locations of the schools involved by ESMES

Figure 4. Overall distribution of schools taking part in ESMES

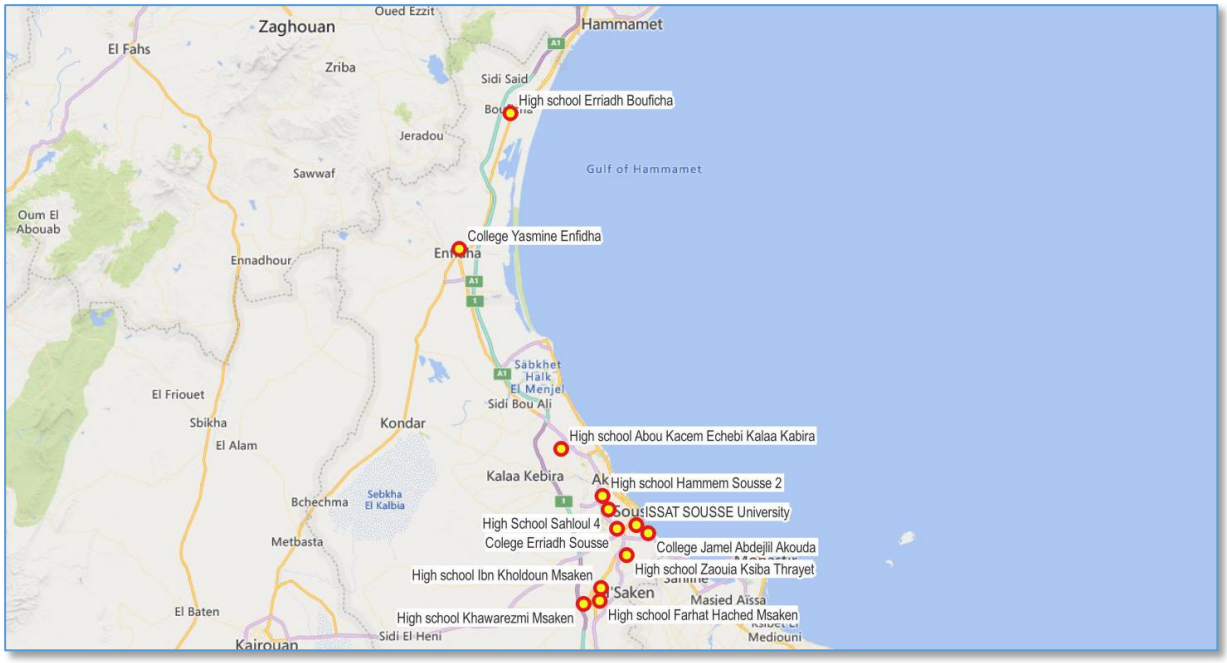


Figure 5. Schools in Tunisia

Figure 6: Schools in Lebanon

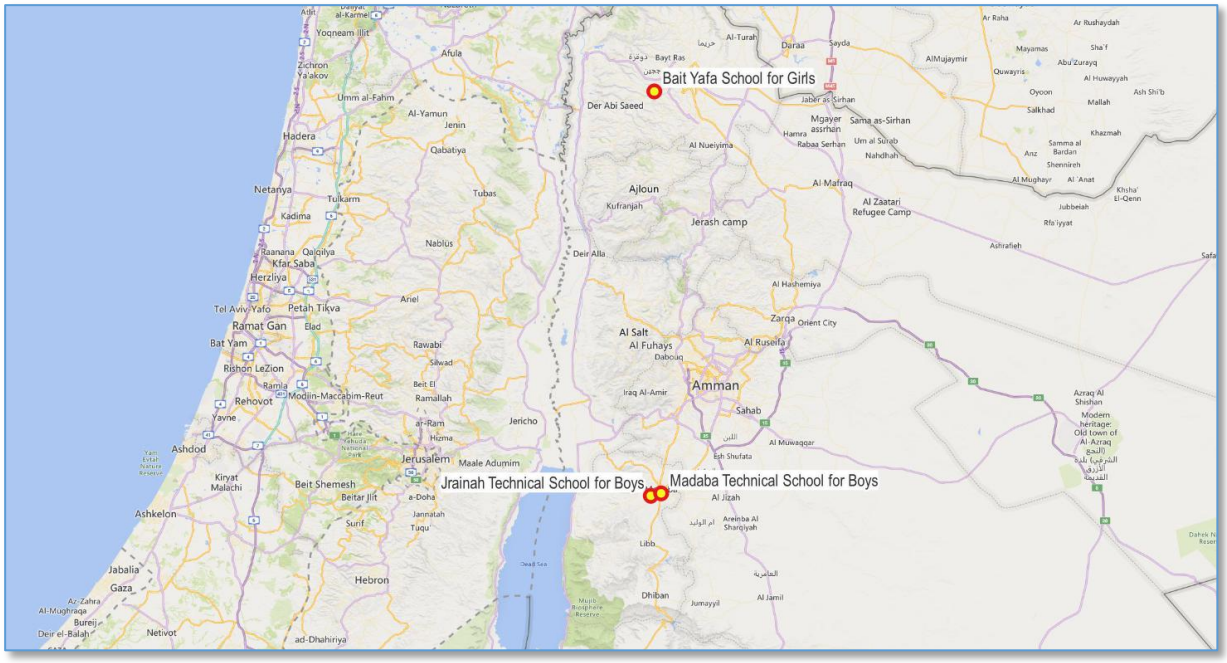


Figure 7: Schools in Jordan

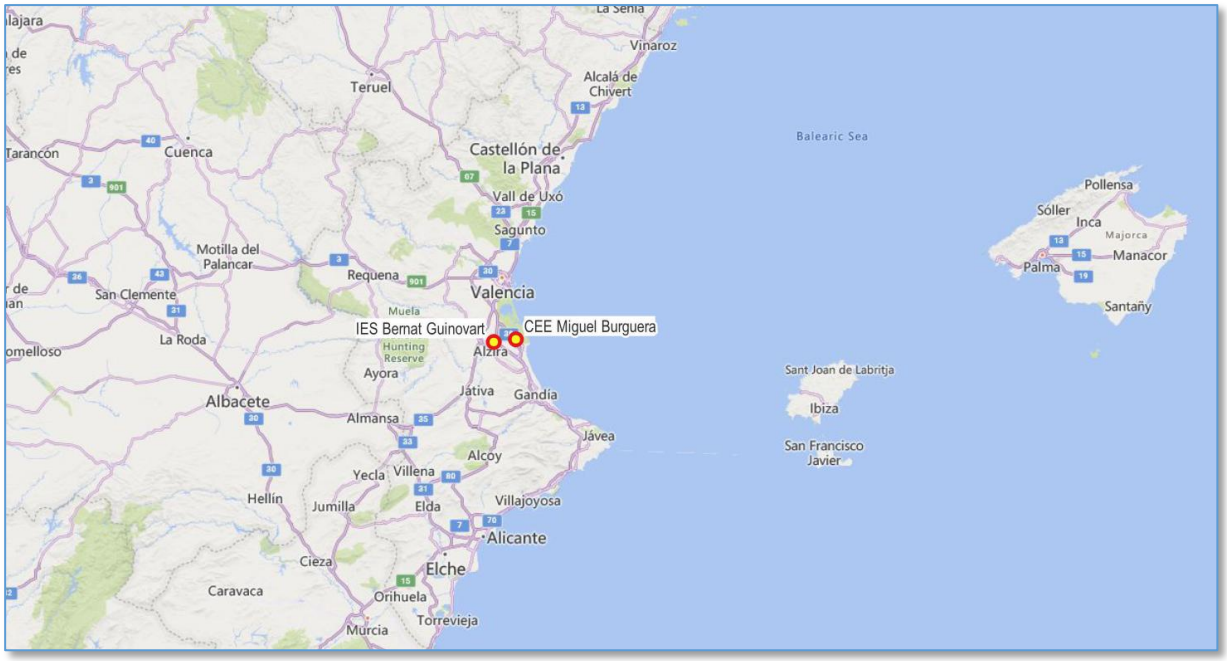


Figure 8: Schools in Spain

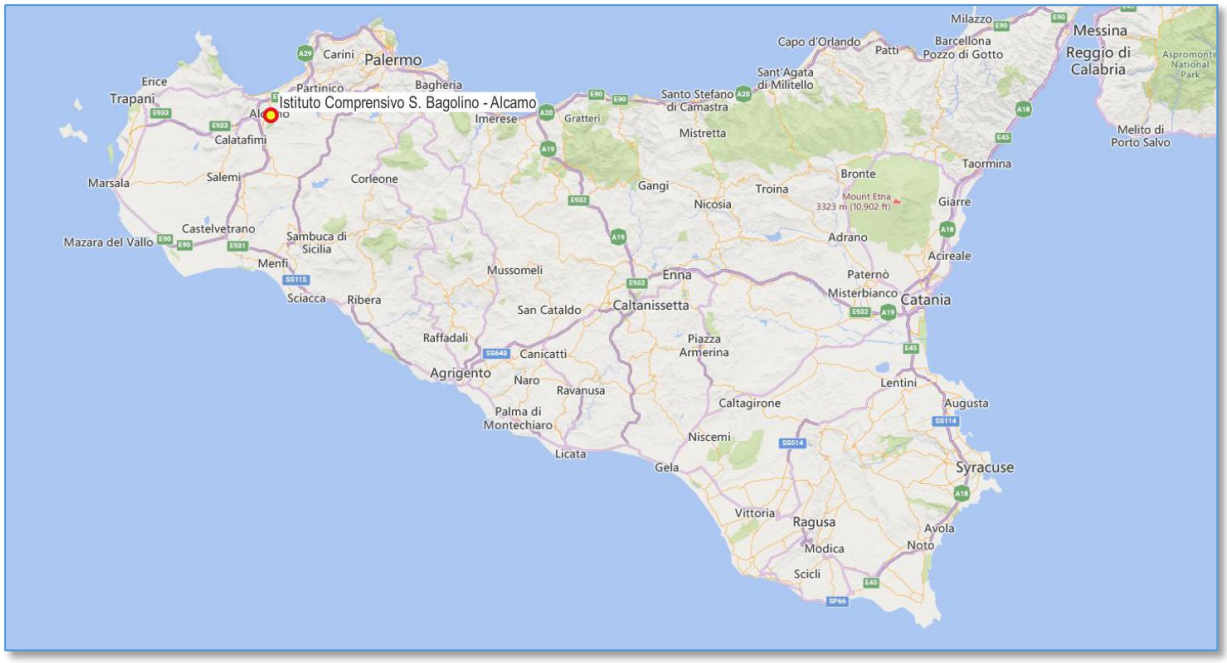


Figure 9. School in Italy

Project partnership has been able to implement the project timely and with due flexibility to adapt the plan to the real needs and in-depth analysis conducted by qualified professionals and institutions.

The good coordination and goal-oriented approach brought the project consortium to align daily commitment to final goal, mobilizing private companies through national tenders, public bodies and schools to achieve the planned results.

ANSWER TO EQ2

Are the activities implemented in line with the plans?

ESMES project successfully met its planned objectives in terms of outputs. Concrete actions were executed in alignment with or even surpassing the commitments made by the consortium upon signing the ESMES project contract.

The COVID-19 pandemic had a significant impact on the implementation of ESMES: i) it made travel and meeting planning impossible; ii) it actually contributed to the shortage of products needed for building infrastructure and solar power plants on the market; and iii) it slowed down the processes involved in issuing service tenders because public administrations were dealing with a significant challenge.

For these reasons the project's deadline was extended by one year above the original plan (from 31.08.2022 to 31.08.2023).

Have the activities been implemented and the outputs delivered in a cost-efficient manner?

During the project implementation period, several challenges arose: inflation, unmet demand for products on the market leading to global price increases, halting of production due to prolonged lockdowns in many countries worldwide, rising energy costs and speculative processes that triggered a spiral of increasing costs for raw materials and finished products.

Despite these challenges, ESMES consortium utilized the available funds - without any additional financial resources - to achieve more results than initially anticipated in the project document. This demonstrates the project's exceptionally high efficiency, attributed to the meticulous attention of each project coordinator, ensuring expenditure optimization while delivering excellent results.

3.3 EQ3: Effectiveness

What are the major factors influencing the achievement or non-achievement of the objectives of ESMES project?

The project approach was designed in order to promote EE and RE solutions in school building through the demonstration of the benefits in terms of:

1) Reduction of electric bills due to the self-production of electricity by PV systems
2) Reduced needs of energy to achieve good indoor comfort thanks to EE measures
3) Transparent measurement of different EE solutions in increasing energy saving in school buildings
4) Identification of best mix of EE and RE solutions for each typology of school building
5) Reduction of CO_2 emissions for retrofitted buildings
6) Educate teachers, students and diverse school staff about the importance to adopt energy saving behaviors at school and at home

The scientific approach of the project in testing, piloting and measuring the good performances of EE and RE in school buildings should have been a key tool to establish a shared awareness among the consortium partners and to have evidence to advocate for replication of ESMES experiences toward further schools in the 5 partnering countries.

The awareness creation campaign for students, with contests and gathering happenings allowed the project partnership to put the energy saving and energy efficiency at the core of the debate for the school involved in the project and for all those families whose children attend those schools. The project rationale is reported in the Table 3.

Type of action	Outputs	Outcomes	Impacts
Better energy performances for schools	Thermal insulation reduces the need of air conditioning and heating in buildings	Higher indoor comfort Decreased energy consumption for similar indoor conditions	Improved working/living environment Released budget for further investments
Clean energy production	PV plants produce electricity reducing the use of energy from fossil fuels/energy from grid	Decreased cost for electric bill and/or reduced use of fossil fuel for school heating	Further budget released from excess power selling Greenhouse gas emission reduction for the clean energy produced

Energy Performance Certificates	Standardized procedure to measure energy efficiency for school building are a key tool for systemic improvement of the sector	Wide adoption of the certificates as a benchmarking of building efficiency for schools	Policy uptake of the certificates and higher motivation to invest in the sector
Knowledge of the state of the art on EE and RE by policy makers, and building sector actors	The skills of civil servants, policy makers, students on EE and RE improved due to the knowledge transfer	The capacity to manage RE systems increased the ownership of the plants The full understanding of the benefits coming from EE solutions facilitate the further use of such technologies in future retrofitting	Expected impact relate to the capacity of trained people to influence the decision-making process of public building manager and private citizens when they decide to undertake a retrofitting of their buildings

Table 6. Rational of ESMES from outputs to long terms impacts.

ESMES GOAL AND OBJECTIVES

The project goal is:

- *To contribute to environmental protection, climate change adaptation and mitigation through improved energy management of public schools' buildings based on REEE solutions.*

While the 3 specific objectives are:

1. *Increased civil society awareness and improved energy habits through the cross-border engagement of students in a sustainable use of energy resources in Jordan, Tunisia, Lebanon, Italy and Spain.*
2. *Reduced and cleaner energy consumption in 10 public school buildings in Jordan, Tunisia, Lebanon, Italy and Spain through the introduction of cost-effective REEE solutions tailored to buildings energy loads, type and use and climatic zone.*
3. *Enhanced capacities of national, regional and local institutions of Jordan, Tunisia, Lebanon, Italy and Spain to plan and realize improved energy rehabilitations for higher energy sustainability of public buildings through cross-border cooperation.*

ESMES RESULTS

The expected project results, as for the initial project document were:

Priority	*Expected results*	*Expected results indicators*	*Programme target*	*ESMES target*

B.4.3 - Support cost-effective and innovative energy rehabilitations relevant to building types and climatic zones, with a focus on public buildings	4.3.1 Enhanced capacity of public institutions to plan and implement sustainable energy policies and measures with regard to public buildings	4.3.1.A Number of public institutions that adopted energy mix efficiency plans/strategies	25 Public institutions	5 Public institutions
	4.3.1 Enhanced capacity of public institutions to plan and implement sustainable energy policies and measures with regard to public buildings	4.3.1.B Number of public institutions cooperating towards strengthened multi-level governance (linking up local, regional and national levels) for delivering integrated sustainable energy action planning and measures	25 Public institutions	5 Public institutions
	4.3.2 Reduced and cleaner energy consumption in public buildings through the use of renewable energy measures and energy saving interventions	4.3.2.E Total kWh saved (expressed in budget reductions) using renewable energy applied to public buildings	1,800,000 kWh generated from RES	300,000 kWh generated from RES
	4.3.2 Reduced and cleaner energy consumption in public buildings through the use of renewable energy measures and energy saving interventions	4.3.2.C Estimated annual decrease of greenhouse gases as a result of renewable energy and energy efficiency measures implemented in public buildings (adapted ENI CBC nr.23)	771.0 CO2T equivalent/year	240.0 tons of CO2 equivalent/year
	4.3.2 Reduced and cleaner energy consumption in public buildings through the use of renewable energy measures	4.3.2.D Total kWh generated using renewable energy applied to public buildings	1,800,000 kWh generated from RES	300,000 kWh generated from RES

	and energy saving interventions			

Table 7. Priorities, results and indicators for the Programme and ESMES project

ENERGY SAVING AND CO2 EMISSION REDUCTION

All most recent data about school buildings retrofitting activities were collected by the project manager of ICU is reported in the table below (8).

The project installed photovoltaic system for a total **nominal power of 533,6 kWp**.

The nominal power of a photovoltaic (PV) system, often referred to as the peak power or installed capacity, represents the maximum power output the system can produce under specific standardized conditions. This standardized condition is typically referred to as Standard Test Conditions (STC). Under STC: i) the solar irradiance (sunlight intensity) is 1,000 watts per square meter (W/m^2); ii) the cell temperature is 25°C (77°F); iii) the air mass (AM) coefficient is 1.5. The actual power output of a PV system is less than its nominal power due to various factors such as shading, soiling, temperature variations, and system inefficiencies. The nominal power provides a benchmark to compare the performance of different PV panels or systems.

To calculate the total produced kWh for each PV system, we used the performance rate reported on the website https://globalsolaratlas.info/. In total ESMES is able to produce **875,085 kWh per year**.

Calculating the combined impacts from PV systems and improved building performances, the total tCO2 equivalent saved by the project are **343,2 tCO2.**

School	Built on	Type of school	N. of pupils	Energy demand (kWh/year)	Construction surface (m2)	KWp (PV)	KWH produced	tCO2 saved
SPAIN								
IES Bernat Guinovart	1981	Vocational school & secondary	700	10,2613	3,000	20	41,768	4.98
CEE Josep Burguera	2003	Physical disability school	200	100,254	2,500	51	90,827	10.71
JORDAN								
Bait Yafa School for Girls	2000	Main vocational school for several villages	853	47,592	7,076	60	97,040	40.76
Jrainah Technical School for Boys	1954	Agricultural and veterinary technical school	312	23,416	2,500	20	18,757	7.88
Madaba Technical School for Boys	1981	Secondary technical school	400	41,709	10,000	48	76,224	32.01

The 10th school for girl Aqaba						-		
TUNISIA								
ISSAT SOUSSE University						60	97,584	40.99
High school Sahloul 4	2013	Secondary High School	895	14,883	1,200	10	16,264	6.83
High school Erriadh Bouficha	2003	Secondary High School	895	35,802	2,175	23	37,407	15.71
High school Abou Kacem Echebi Kalaa Kébira	2003	Secondary High School	868	23,965	3,700	16	26,022	10.93
High school Khawarezmi Msaken	2016	Secondary High School	1004	19,129	3,327	13	21,143	8.88
High school Farhat Hached Msaken	1980	Secondary High School	652	22,266	1,500	14	22,769	9.56
High school Zaouia Ksiba Thrayet	2008	Secondary High School	891	27,749	3,600	17	27,648	11.61
College Jamel Abdejlil Akouda	2002	Preparatory School	1401	22,525	1,600	15	24,396	10.25
College Yasmine Enfidha	1997	Preparatory School	930	7,667	1,500	6	9,758	4.10
Colege Erriadh Sousse	1994	Preparatory School	866	24,045	2,300	16	26,022	10.93
High school Hammem Sousse 2	2006	Secondary High School	1014	39,645	6,000	22	35,780	15.03
High school Ibn Kholdoun Msaken	1986	Secondary High School	1327	23,800	1,915	12	19,516	8.20
LEBANON								
Ecole des Arts et Métiers	1970	Technical and Vocational school	581	120,688	4,960	-		-
Bir Hasan Vocational and technical complex	1980	Technical and Vocational school	800	135,000	5,000	43	73,090	30.70
Al Amir Shakib Arslan Public School	2003	Primary and Secondary School	1246	4,5	10 floors	-		-
Ayn Jarfa Public School	2004	Primary and Intermediate School	341	670	420	-		-

Barouk Public School	1970	Primary School	108	950	800	15	27,370	11.50
Hoch EL Omara Public School		Primary and Secondary School	288	3,335		-		-
Majadel Public School	1995	Primary and Secondary School	728	1,291	1,125	12	20,720	8.70
George Sarraf Public School, Tripoli, North Lebanon						12	20,092	8.44
Abi Samraa AlOula for Girls School, Tripoli, North Lebanon						12	20,092	8.44
ITALY								
S.Bagolino school	1962	Secondary level	/	/	3,050	15	24,788	10.41
						TOTAL	**875,085**	**343.2**

Table 8. Combined environmental impacts of ESMES

ANSWER TO EQ3

What are the major factors influencing the achievement or non-achievement of the objectives of ESMES project?

ESMES project has successfully met its established project achievement at the **outcomes/results** level, demonstrating exemplary performance in key areas. The primary focus has been on the generation of energy from photovoltaic (PV) installations and energy conservation, attributed to the thermal enhancement measures implemented across educational building infrastructures. The PV systems have demonstrated high efficiency and reliability in energy production, contributing to the project's overarching goal of sustainable and environmentally friendly energy. As of October 2023, recorded data indicates an annual energy production from PV systems, amounts to **875,085 kWh**, affirming the project's significant impact in this domain. Complementing the PV installations, the project implemented several interventions aimed at enhancing the thermal properties of school buildings. These interventions, which included various forms of insulation and energy-efficient design practices, have led to substantial energy savings. The energy conserved as a result of these improvements contributes directly to the project's goals, underlining the initiative's multifaceted approach to energy sustainability. The initiatives undertaken have led to a significant decrease in the annual carbon footprint of the operations involved. Specifically, the improvements and installations have resulted in an annual reduction of CO2 emissions by **343.2 metric tons (tCO2).**

The factors that allowed the proper achievement of ESMES results are:

i) the sincere engagement of project partner and key stakeholders,
ii) the outstanding technical capacity of the experts deployed by the project partners in the supervision and coordination of the activities,
iii) the common project vision of ESMES partners, enabling them to overcome serious constraints faced during the project implementation, even when country context was particularly challenging, as in Lebanon

iv) the aptitude of prioritizing expectations from ESMES implementation and to focus on those realistically achievable.

Concerning the achievements at **project goal** and **project objectives**, it is not easy to quantify the actual project effectiveness because of the following reasons:

1) Measurable systemic changes in the policy and governance spheres require a much longer period than the 4 years of ESMES project lifespan. The expected **project goal** "*To contribute to environmental protection, climate change adaptation and mitigation through improved energy management of public schools' buildings based on REEE solutions*" should be measured on a decade base. However, the project has put on ground solutions to showcase, concerned local authorities and made awareness among the appropriate target citizens in order to gradually move forward in achieving the shift from low-efficient/high energy demanding school building to high efficiency, solar energy powered buildings.
2) The **specific objectives 1**: *"Increased civil society awareness and improved energy habits through the cross-border engagement of students in a sustainable use of energy resources in Jordan, Tunisia, Lebanon, Italy and Spain".* To evaluate the success of the objective n.1 presents certain challenges. Firstly, changes in awareness and habits, especially in diverse cultural contexts, evolve over extended periods and may not be immediately observable. Moreover, given the cross-border nature of the initiative, consistent and standardized measurement techniques are essential yet challenging to implement. Finally, a timeframe of four years might not be sufficient to witness and gauge deep-seated behavioural shifts in the targeted regions. Thus, deriving a clear and definitive analysis shortly after project completion proves to be complex. Notwithstanding, ESMES has put in place the seeds for changes in young generation's behaviours promoting more responsible daily habits for energy saving and thoroughly understanding of best technologies to achieve energy self-sufficiency, through clean solutions.
3) The **specific objective 2**: *"Reduced and cleaner energy consumption in 10 public school buildings in Jordan, Tunisia, Lebanon, Italy and Spain through the introduction of cost-effective REEE solutions tailored to buildings energy loads, type and use and climatic zone".* The project's second objective was not only fully realized but also surpassed to a significant extent. The strategic choice to allocate additional budgetary resources for school retrofitting emerged as a beneficial decision, directly translating to heightened efficiency. This success was further enhanced by the rigorous efforts expended on the meticulous design of an optimal blend of energy efficiency and renewable energy-based solutions, tailored to the unique needs of each context. Such rigorous design efforts culminated in enhancing the competency of various stakeholders involved, including policymakers, specialists affiliated with the pertinent local authorities, and firms presenting their technical and financial proposals. As a result, the collective capabilities of all involved entities have been robustly fortified, fostering efficient collaborative ties amongst them.
4) The **specific objective 3**: *"Enhanced capacities of national, regional and local institutions of Jordan, Tunisia, Lebanon, Italy and Spain to plan and realize improved energy rehabilitations for higher energy sustainability of public buildings through cross-border cooperation".* Local authorities, across all partner countries, actively collaborated with the managing entities of school buildings. Their joint efforts encompassed the assessment of needs, the initiation of tendering processes, the execution of required work, and the subsequent analysis of accrued

benefits. This collective endeavour prominently positioned the critical discourse on school investments within various ministries and/or institutions responsible for such outlays. It emphasized the importance of directing funds towards structural improvements in schools, rather than continuously grappling with escalating heating and energy costs. Consequently, this has advocated for a heightened prioritization of such initiatives within the public expenditure decisions of these entities.

3.4 EQ4: Impacts

What is ESMES project's likely contribution to the overall objective?

To what extent the project benefited the target beneficiaries, directly or indirectly and a larger number of people in the sector and/or region?

ESMES project addressed the Priority 4.3 of the Call for Proposal for Standard Project under ENCI CBC MED Mediterranean Sea Basin Program 2014-2020, whose target is "Support cost-effective and innovative energy rehabilitations relevant to building types and climatic zones, with a focus on public buildings".

Based on sector-specific studies, countries collaborated to focus on improving energy efficiency and making upgrades, especially in public buildings.

Research indicates that the building industry uses about one third of all energy in MPCs and 40% in the European Union. In response, Europe introduced a directive about building energy performance. Countries like Algeria, Egypt, Turkey, Tunisia, Jordan, Palestine, Syria, and Lebanon have set energy guidelines for new buildings and started test projects.

Participating nations share geographical and climatic features. Therefore, they find value in sharing knowledge and new methods to reduce heating needs and lower peak cooling demands. It's important to help industry experts find affordable ways to renovate buildings suitable for their climate. There's also strong support for a system that involves public agencies, industry experts, and other key groups. One goal is for public organizations to better design and use sustainable energy practices.

Along with energy-saving updates, a main goal is to use more renewable energy, especially in public structures. The Overarching Objective B, Thematic Objective B.4 and Priority B4.3 of the call for proposal is reported in the table below.

Overarching Objective B: **ADDRESS COMMON CHALLENGES IN ENVIRONMENT**			
Thematic Objective B.4: **ENVIRONMENTAL PROTECTION, CLIMATE CHANGE ADAPTATION AND MITIGATION**			
Priority B.4.3: **Renewable energy and energy efficiency - Support cost-effective and innovative energy rehabilitations relevant to building types and climatic zones, with a focus on public buildings**			
Expected Results	**Result Indicators**	**Indicative list of Output**	**Output Indicators**

Enhanced capacity of public institutions to plan and implement sustainable energy policies and measures with regard to public buildings.	Number of public institutions that adopted energy-mix efficiency plans/strategies. Number of public institutions cooperating towards strengthened multi-level governance (linking up local, regional and national levels) for delivering integrated sustainable energy action planning and measures.	Administrative and legal provisions for sustainable urban design through innovative approaches regarding sustainable building and energy efficiency. Energy-mix efficiency plans/strategies developed to stimulate cost-effective deep renovations of buildings. Cross-border case studies that demonstrate potential replication of proposed measures and solutions (including technologies, methodologies, systems or tools). Twinning and knowledge sharing activities involving public authorities.	Number of new or revised procedures (legal, regulatory, economical, etc.) initiated as a result of a transfer of good practices. Number of energy-mix efficiency plans/strategies approved. Number of innovative and affordable renovation solutions and technologies for public buildings that can deliver significant improvements in energy performance while ensuring indoor comfort requirements, and being non-invasive and reversible. Number of tools for planning and implementing the renovation of public buildings.
Reduced and cleaner energy consumption in public buildings through the use of renewable energy measures and energy-saving interventions.	Estimated annual decrease of greenhouse gases as a result of renewable energy and energy efficiency measures implemented in public buildings (ENI CBC 23). Total kWh generated (expressed in budget reductions) using renewable energy applied to public buildings. Total kWh saved (expressed in budget reductions) using renewable energy applied to public buildings.	Implementation of pilot cost-effective technologies for energy efficiency and renewable energy. Energy performance certificates. Renewable energy systems (solar, etc) application to public buildings.	Number of cost-effective technologies for energy efficiency and renewable energy solutions implemented on a pilot basis. Additional capacity of renewable energy production (ENI CBC 22). Number of energy audits carried out on public buildings. Number of public buildings and/or facilities benefiting from REEE measures.

Table 9. Overarching and Thematic Objective (B and B.4) and Priority pursued by ESMES.

ESMES CONTRIBUTION TO THEMATIC OBJECTIVE B.4: ENVIRONMENTAL PROTECTION, CLIMATE CHANGE ADAPTATION AND MITIGATION

ESMES project has made a significant contribution to thematic objective B.4. First and foremost, it has ignited public discussion on the importance of energy conservation as a widely practiced and critical

measure for environmental protection. This pertains to the broader perspective of conserving our planet's natural resources, which are often depleted due to energy production processes.

To provide some context, global energy consumption has been on the rise, and with it, the demand on our planet's natural resources. As of recent years, buildings account for nearly 40% of global energy-related carbon dioxide emissions when considering their entire lifecycle, from construction to operation. This makes initiatives targeting energy conservation in buildings, especially public ones, paramount.

ESMES took this challenge head-on, delivering tangible results. Specifically, the project has directly resulted in a measurable reduction of greenhouse gas emissions by approximately 320 metric tons of carbon-equivalent per year. This was achieved through the harnessing of renewable energy sources, primarily solar, and by enhancing the energy efficiency of school buildings.

To shed light on the significance of this achievement, the energy sector globally accounts for over 70% of total greenhouse gas emissions. Among these emissions, carbon dioxide plays a pivotal role, with renewable energy sources like solar energy showing great potential in mitigating these emissions.

The impact of ESMES's contribution becomes even more salient when considering the potential replication of this project. Once the experiences and strategies developed by ESMES are adopted by local partners and implemented in more school complexes, the reduction in emissions could be exponentially higher. Such replication efforts could serve as a blueprint for other institutions, leading to a more sustainable and environmentally conscious energy landscape.

ESMES CONTRIBUTION TO THE PRIORITY B.4.3: RENEWABLE ENERGY AND ENERGY EFFICIENCY - SUPPORT COST-EFFECTIVE AND INNOVATIVE ENERGY REHABILITATIONS RELEVANT TO BUILDING TYPES AND CLIMATIC ZONES, WITH A FOCUS ON PUBLIC BUILDINGS

Regarding Priority 4.3, ESMES has indeed achieved its goals. Its primary accomplishment was to lay the foundation for a wider adoption of state-of-the-art technologies and methodologies related to energy-efficient renovations of school buildings.

First, ESMES equipped experts in the public sector with the knowledge and understanding necessary for effective tender processes. This is pivotal because, in project partner countries, such renovations can be perceived as extremely innovative and “pilot”. Given this context, there is often a learning curve in understanding how the private sector can meet these new needs and how to structure tenders that are in line with the standards of local companies - which by legislation are the only ones eligible to apply - guaranteeing at the same time the best available quality.

Globally, the push for energy efficiency in buildings is well-understood. Buildings, including schools, account for a significant portion of global energy use, highlighting the importance of such innovative renovation projects.

Secondly, ESMES enabled knowledge-sharing on cutting-edge technologies. This included discussions on photovoltaic systems, advanced thermal-acoustic insulation techniques, and strategies for integrating various energy sources. This collective understanding aims to boost the overall energy self-

reliance of schools. Real-world applications of this shared knowledge were evident in tenders initiated by the partnering countries.

Furthermore, ESMES's legacy isn't just about introducing new technologies. It's also about establishing standards for materials, construction techniques, and integrating monitoring software for energy management. This initiative empowers public sector technicians/experts with advanced tools, cultivates a culture of energy awareness in schools, and sets the stage for future projects of this nature.

The active participation of Ministries and key local institutions at federal level underscores the commitment to this cause. Their involvement bodes well for the future replication of the project's strategies. With enhanced technical know-how and support from administrative bodies, there's optimism for a growing number of energy-efficient schools, capable of self-generating energy, primarily from solar sources.

How ESMES is aligned to Expected Result n.1 Enhanced capacity of public institutions to plan and implement sustainable energy policies and measures with regard to public buildings

ESMES project significantly advanced the understanding of the benefits of investing in schools to enhance energy efficiency and self-generate energy from renewable sources. In practical terms, only the Consorci de La Ribeira and the Agence Nationale pour la Maîtrise de l'Énergie of Tunisia, have developed specific guidelines for use in their country, focusing on energy renovation initiatives and solar energy production.

However, in all participating countries, policymakers have engaged with the project's activities and gained essential insights. This knowledge ensures that such initiatives rise in priority on the political agendas of the involved entities, strengthening their commitment to reducing emissions and decreasing energy demand.

How ESMES is aligned to Expected Result n.2 Reduced and cleaner energy consumption in public buildings through the use of renewable energy measures and energy-saving interventions

The project is fully aligned with outcome No. 2, as all activities focused on school buildings, enhancing their structures, and engaging students, teachers, support staff, and management. This has fostered a growing awareness that starts with students, extends to their families, and impacts the entire community. The direct benefits of the structural works, such as improved comfort and livability of spaces, the ability to monitor energy consumption reductions, and the response of photovoltaic systems to energy demand, all strengthen this awareness. They encourage replication and facilitate the transfer of this knowledge from students to their families, positioning schools as centers of quality and innovation, from which practical solutions can be learned and replicated. ESMES's contribution is also evident in its genuine engagement with local communities and in stimulating long-term reflection on the importance of planning improvements and energy efficiency in public buildings, starting with schools.

Impacts measured through consultation with project stakeholders

Project partners

Through an online survey conducted using Google Drive tools, feedback was collected from project partners. Following this, online interviews were carried out, diving deep into the successes, challenges, and results of the project. It was evident - from the feedback - that the project successfully achieved its objectives, even amidst the disruptions caused by the COVID-19 pandemic which affected interactions between students, teachers, and technicians. Interestingly, the local impacts of the project varied across countries. In Spain, Italy, and Jordan, the promoted solutions and technologies had already an established and recognized role in the building design but not yet widely adopted in new school building design and retrofitting interventions. ESMES demonstrated the importance of joining efforts of different stakeholders to reach results in reducing environmental impacts, school management costs and quality of life in schools. Moreover, the project had a key impact in the educational advancements for students and teachers. Meanwhile, in Tunisia and Lebanon, the project played a pivotal role in ensuring continuous services to schools and maintaining educational standards. Notably, in Lebanon, the initiative even ensured some schools remained operational when they otherwise lacked the necessary energy to operate.

Teachers and principals

The teachers enthusiastically embraced the actions proposed by ESMES. They recognized the value in combining tangible improvements to school infrastructures with an educational and awareness-raising program for students. By using hands-on interventions to showcase the potential of solar energy, reduced consumption, and enhanced comfort in school settings, the project was able to convey its messages to students in a highly effective manner. Furthermore, these messages were passed on by the students to their families, amplifying the impact. School principals also expressed strong appreciation of the project. They appreciated its educational aspect and its role in aiding school management through reduced operational costs. The principals highlighted that with the availability of more reliable and clean electric energy, they are now committed to adapting the best/most suitable heating systems to these renewed energy sources. However, the teachers noted that one of the ESMES project's objectives, fostering exchanges between countries—specifically among students and teachers—was not fully achieved. The planned travel and delegation meetings between countries had to be canceled due to the COVID-19 pandemic restrictions. No alternative actions were introduced to offset this shortfall, resulting in a missed opportunity for personal and institutional connections between countries.

Students

Students have expressed a strong appreciation for ESMES's activities, indicating a deeper understanding than before about the significance of using the right technologies combined with mindful behaviors for environmental sustainability. The use of educational kits was especially illuminating in showcasing how solar energy is utilized in the school environment, supporting its functioning even in areas without alternative energy sources, as observed in Lebanon recently. Nevertheless, students pointed out the minimal international interactions, feeling that their activities were largely confined to their immediate school surroundings.

ANSWER TO EQ4

What is ESMES project's likely contribution to the overall objective?

To what extent the project benefited the target beneficiaries, directly or indirectly and a larger number of people in the sector and/or region?

ESMES had a significant impact when measured against its expected medium-term objectives and in the tangible changes made to the lives of school communities, specifically students, teachers, principals, and the students' families. The changes affecting these beneficiaries include: i) the improvement of skills and knowledge of technicians and experts employed in the public sector on best practices and procedures for implementing the best energy efficiency interventions and increasing energy production from photovoltaic systems; ii) a deeper understanding and adoption of appropriate behaviors to optimize energy use and generally pursue more sustainable lifestyles; iii) a reduction in management costs for school administration bodies. For 2 countries, Tunisia and Lebanon, the project has added value in introducing new technologies and standardized tender procedures to implement these interventions in public schools. Finally, for Lebanon, an additional benefit is that, due to the current crisis in the country, the schools involved in the project have been able to ensure their operation, unlike many others that had to close due to a lack of energy service. A missed project impact, significant for its Mediterranean and multi-country dimension, is the creation of a "Mediterranean community" of students, teachers, and technicians working on school efficiency. This result was not achieved mainly due to the inability to complete the planned trips of delegations from different countries, which would have surely created personal ties, thus overcoming distance barriers.

3.5 EQ5: Sustainability

What was put in place by the project to ensure the sustainability

of the expected project outcomes?"

From a physical and structural perspective, the project exhibits robust sustainability based on the following criteria:

Technical Sustainability: All the schools that have benefited from the energy efficiency measures and the installation of photovoltaic systems are overseen by management entities. These entities bear the full responsibility for the optimal operation of the institutions and the installed equipment. Furthermore, these schools either have in-house experts and technicians or access to specialists from oversight bodies, ensuring immediate assistance in case of operational or maintenance issues.

Financial Sustainability: The managing entities consistently allocate financial resources for both routine and extraordinary maintenance of the equipment and infrastructures. Despite challenges in securing the required investments for public schools, savings generated by the photovoltaic installations will be earmarked by public entities for future extraordinary maintenance or equipment part replacements. Furthermore, with the ongoing shift towards energy transition and the likely rising energy costs, the significance and relevance of these installations are bound to increase.

Political-Institutional Sustainability: ESMES has devised an engagement strategy that involves local authorities at all levels, from local to central. This engagement has elevated the visibility of the project and validated its interventions as being fully in line with other planned public undertakings in the education sector. The vested interest and ownership demonstrated by local authorities concerning the

achievements of ESMES will play a pivotal role. This role is twofold: ensuring optimal management of the installations and involved schools and promoting similar solutions in different settings.

Regarding the **network** established by ESMES, its sustainability is not as assured. As previously described, the inability to complete trips and missions involving experts, students, and teachers has hindered the consolidation of interpersonal relationships, which are fundamental to the survival of international networks. Some exchanges and systematic contacts did occur among experts from different countries, but they were sporadic and voluntary, making it not enough to ensure that the network can remain active in the future. Relationships might only be revamped if new funded projects provide a motivation to revive the network for shared objectives.

ANSWER TO EQ5

What was put in place by the project to ensure the sustainability of the expected project outcomes?

ESMES project consortium implemented the best strategy to ensure the project's sustainability: selecting the most appropriate stakeholders, since the project partnership design, to ensure proper management and maintenance of facilities and systems, promoting the adoption of best practices from a procedural and regulatory standpoint, and fostering the mainstreaming of energy efficiency and investments for the energy transition of public buildings into the administrative decisions of local authorities. For these reasons, the overall sustainability of the project is high. The only point to highlight is the missed establishment of the Mediterranean network, whose continuity and collaboration will solely depend on additional funded projects to be implemente in the future.

3.6 EQ6: Added Value

How did the implementation of ESMES ensure complementarities and generate synergies with other programs and stakeholders at local, national and European level?

What are the strengths and weaknesses of having the EU implement the project?

ESMES has carried out activities that align fully with the needs of the partner countries to reduce greenhouse gas emissions, in keeping with international obligations such as the Paris Agreement and sources from the Intergovernmental Panel on Climate Change (IPCC).

Italy: Italy, as a member of the European Union, adheres to the EU's broader climate goals under the European Green Deal. The country has been working towards enhancing the energy efficiency of public buildings. According to Italy's National Energy Strategy, there is an emphasis on renovating existing buildings to comply with energy-efficient standards. For school buildings, specific regulations and funding opportunities have been introduced to ensure renovations lead to significant energy savings.

Spain: Spain, under its National Energy and Climate Plan (NECP), focuses on reducing energy consumption and increasing the renewable energy share in public infrastructures, including schools. The country aims to refurbish a considerable percentage of its existing buildings per year to make them more energy-efficient.

Lebanon: With no significant oil or gas reserves, Lebanon depends heavily on imports, leading to a push towards renewable energy sources. The country's National Renewable Energy Action Plan 2016-

2020 has emphasized the importance of energy efficiency, especially in public buildings. Schools, being a focal point in communities, stand to benefit from such improvements, reducing operational costs and setting an example for sustainable practices.

Tunisia: Tunisia's Solar Plan aims to produce 30% of its electricity from renewable sources by 2030. As part of its energy strategy, the emphasis has been on retrofitting public buildings, including schools, to be more energy-efficient. The government recognizes the dual benefit of not only saving costs in the long run but also reducing carbon emissions.

Jordan: Lacking in fossil fuel resources, Jordan has an urgent need to diversify its energy sources. The country's National Energy Strategy outlines a significant role for renewables. Given the sunny climate, solar energy, particularly for public buildings like schools, has been a focus area. Energy efficiency measures are seen as critical in managing the growing energy demand, with schools being pivotal public structures that can set a benchmark.

In terms of the legislation for improving the school building stock, there are variations across these countries, yet they all prioritize aligning structures with stringent regulations concerning energy demand reduction, efficiency enhancement, and energy self-production. The initiatives taken by state actors resonate with and complement the ESMES project's objectives. In this context, ESMES stands as a significant benchmark in refining procurement procedures, monitoring the quality of interventions, and generally supplying valuable information. Such inputs offer robust motivation ensuring the continued commitment of national and local governments to this sector.

ANSWER TO EQ6

How did the implementation of ESMES ensure complementarities and generate synergies with other programs and stakeholders at local, national and European level?

What are the strengths and weaknesses of having the EU implement the project?

ESMES project boasts a very high degree of innovation for Tunisia and Lebanon, serving as a model for energy efficiency and the installation of photovoltaic systems on school buildings. For all participating countries, even though the technologies and solutions might be partially or fully known, the establishment of procedures, templates, manuals, and best practices to achieve the best results in this area has addressed some challenges faced by the public-school administrative bodies. It has allowed them to tackle such challenges armed with the appropriate technical and managerial experiences, ensuring the best outcomes within a reasonable timeframe. The involvement of the European Union as the funder of the initiative has aided in overcoming the difficulties of public entities, given that the procedures indicated by the Donor often align with national procurement procedures. This alignment enabled the partnership to develop technically agreeable solutions. The only constraint has been the rigidity of public entity management mechanisms, which, for the partner countries, has limited the possibility of exchanges between partners.

3.7 EQ7: Replicability and Scaling Up

How would you consolidate the activities in phase 2?

Do you have funding available at the national level to ensure the continuity of this project's activities?

Replicability and scaling up is a key evaluation parameter to appreciate the long-term impact of the project. Therefore, a thoroughly analysis is reported below for each partnering country.

Italy

Replication and scaling up perspectives

Italy has nearly 60,000 school buildings, with around 40% built in the late 1970s. Refurbishing these is essential not just for energy efficiency and environmental goals but also for modernization and safety, including earthquake resistance. Considering over 10 million people, from students to staff, use these buildings daily, indoor quality is crucial. Refurbishments should ensure suitable temperatures, efficient energy systems, proper ventilation, and reduced energy consumption. Moreover, the pandemic underscored the importance of monitoring indoor air quality.

In Italy, certain structural aspects pose significant constraints to the swift replication of project activities in the Sicilian Region and throughout the country. For many years, there has been notable legislative instability, leading to frequent changes in environmental authorization regimes and energy regulatory frameworks. Another critical factor is the lack of coordination between various sectoral intervention tools at the national, regional, and local levels, resulting in a confusing and uncertain operational landscape. The absence of a clear operational framework, at least in the medium term, strongly hinders investments by school managing bodies in energy efficiency measures and the installation of PV energy production systems. For this reason, despite the subpar comfort conditions of many schools, their low energy efficiency, often non-compliance with earthquake safety standards, and the rapid and significant increase in energy bills impacting school budgets, institutions tend to address the situation annually rather than investing for the future.

On the other hand, Italy boasts a rich ecosystem of businesses and expertise in both the private sector and applied research. This spans from building solutions for energy efficiency, advanced solar systems, cutting-edge technologies, and software to enhance optimization of production facilities, energy storage systems, and household appliances that require energy to operate. Given clarity in the regulatory-institutional framework, motivation from the political and administrative components, and the allocation of adequate funds, the wealth of the private sector could undoubtedly ensure the swift and effective implementation of these initiatives.

Available funding for further consistent investments

The MIUR (Ministry of Education, University, and Research) allocated €5.2 billion on November 30, 2020, for the refurbishment, energy efficiency, and safety of school buildings, divided into five distinct directions:

- € 3 billion are designated for the Plan for Nursery Schools and Kindergartens. The aim is to enhance facilities for early childhood education nationwide. This amount is part of a larger tranche set to fund 1,800 school building projects.
- € 800 million are reserved for the construction plan of 195 new schools, which will replace outdated buildings. The approach to these school structures is innovative, incorporating more digital technologies, building automation, advanced materials, and primarily focusing on energy efficiency goals. Once suitable sites are identified, MIUR will initiate a design competition.

- € 400 million are dedicated to strengthening school canteens either by constructing new spaces or refurbishing existing ones, affecting at least 1,000 facilities.
- € 300 million target the enhancement of sports offerings, thereby involving the building and upgrading of dedicated gymnasiums, covering a total area of 230,400 square meters.
- Lastly, € 710 million are assigned to the Safety and Refurbishment Plan for schools. Each Region will determine the entities eligible for funding to ensure the safety and modernization of current school structures. Priority will be given to earthquake retrofitting and energy efficiency improvements. Of the total funds, 40% will be allocated to the southern part of the country.

Despite the bureaucratic and administrative challenges in the allocation of funds, these financial resources are indeed allocated and/or committed (in the process of being assigned) to the implementing entities. The experience of ESMES, in this context, holds significant importance, as it represents a best practice both from a technological and innovative standpoint, and in terms of overcoming challenges related to allocating funds to companies for project execution (procurement).

Spain

Replication and scaling up perspectives

According to the report 'Data and Figures - Academic Year 2019/2020', published by the Ministry of Education and Vocational Training in 2020 there were a total of 28,816 educational centres in Spain, of which 19,184 were public education centres and 9,632 were subsidized and private.

In the Valencian Community, there are a total of 2,770 school buildings for all levels of education: from early childhood to high school diploma, to vocational training or special education such as music. The most numerous centres are the Primary Schools, which throughout the autonomous territory number up to 1,381. Of these, 1,013 are public, 66 are private, and 331 are subsidized.

Most of the school buildings were constructed before 2009, the year in which Spain adopted the European directive 'Energy Performance of Buildings (2002)', by implementing the 'Energy Saving of the Technical Building Code (CTE-DB-HE 2009)'. For this reason, the energy adaptation to the directive has been applied to only a small portion of the buildings constructed after that year.

However, *Generalitat Valenciana* has been proactive in enhancing the energy efficiency of public buildings, particularly focusing on public schools. In particular we mention:

Audit and Retrofitting: by the end of 2021, they had conducted energy audits on 60% of public buildings, leading to retrofitting projects in over 500 school buildings to meet contemporary energy standards.

Renewable Energy Installations: They invested in solar energy by installing photovoltaic panels on 250 schools, aiming to generate 20% of these schools' total energy consumption using solar energy by 2025.

Training Programs: Over 2,000 school staff members have been trained in energy efficiency practices as of 2022. Moreover, an educational program has been integrated into the curriculum of 300 schools, educating students on the importance of energy conservation.

Monitoring Systems: They've installed energy management systems in 400 schools to monitor real-time energy consumption, aiming to reduce energy use by 15% across these institutions by 2024.

Collaborations: They've partnered with local energy agencies and European green initiatives, bringing in an additional €30 million in funding and support for energy efficiency projects. *Generalitat*

Valenciana, is also partner of a further ENI CBC MED funded project, SEACAP 4 SDG, https://www.enicbcmed.eu/projects/seacap-4-sdg, whose objective is to o reduce energy consumption in public buildings through cost-effective approaches to energy refurbishment, integrating Sustainable Energy Access and Climate Action Plans and innovative financial mechanisms. The project end is planned for on September 2023, and we expect to have synergies between SEACAP 4 SDG and ESMES.

Available funding for further consistent investments

Generalitat Valenciana, recognizing the importance of energy efficiency and its long-term benefits both environmentally and economically, has made significant financial commitments to promote such initiatives within the educational sector. From the regional budget, they earmarked € 50 million specifically for energy efficiency projects in schools over a two-year span from 2021 to 2023. This funding indicates a robust and strategic approach towards ensuring that educational institutions not only function effectively but also sustainably. The Generalitat dedication extends beyond just funding, introducing an incentive scheme to encourage innovative thinking within schools.

An additional fund of €10 million has been designated solely for those institutions that go beyond conventional measures and come forward with creative, innovative energy-saving solutions. This not only encourages schools to think critically about their energy consumption patterns and potential areas of improvement but also empowers them to become active participants in the broader movement towards energy conservation.

As ESMES results, a code of best practices has been developed and made available for all the schools of the *Generalitat*. Such financial incentives, combined with the empowerment of schools, and the sharing of manuals, best practices and consolidated procedures for service purchasing, have the potential to lead to changes. Schools, given their influential role in communities, can set a precedent, inspiring other sectors and even other regions to take similar energy-efficient measures. Furthermore, by placing schools at the forefront of this green movement, the Generalitat ensures that the next generation of Valencians grows up with a keen awareness of the importance of sustainability, thus sowing the seeds for a greener future for the entire region. Definitely ESMES has a huge potential of replication and scaling up, especially in synergies with other initiatives conceived to fix a benchmark to pursue in public school building energy performances.

Lebanon

Replication and scaling up perspectives

Lebanon has 2,796 schools, of which According to CRDP, 44% are public schools and 56% are private schools (Centre for Educational Research and Development - CRDP). In 2020-2021 academic year, Lebanon registered 1,053,856 Lebanese and foreign students in schools, of which 36% are in public schools and 64% are in private schools.

Lebanon has long struggled with energy issues, including frequent power outages, ageing infrastructure, and a significant reliance on foreign fuels. These issues apply to public buildings, including schools. Many of the public school buildings in Lebanon, approximately 60% by some estimates, date back to the mid-20th century or earlier. Constructed in an era prior to the advent of modern energy-efficient standards, these buildings often lack the features we associate with green construction today. Research has indicated that outdated insulation methods used in such older structures can result in up to 25% more heat transfer compared to buildings with modern insulation, leading to increased energy consumption for heating during the winter and cooling in the summer.

Moreover, many of these schools are equipped with HVAC (Heating, Ventilation, and Air Conditioning) systems that are more than 20 years old. Such aging systems can be up to 40% less efficient than contemporary models, meaning they consume significantly more energy to achieve the same temperature regulation.

Lighting is another concern. A survey of selected older schools revealed that over 70% still use traditional incandescent bulbs, which consume up to 80% more electricity than modern LED alternatives. Over the course of a year, this difference in lighting alone can result in hundreds to thousands of kilowatt-hours of unnecessary energy consumption per school.

However, Lebanon is positioned to achieve substantial strides in energy efficiency in public buildings in the future, driven by growing awareness, policy support, and technological advancements. The implementation of more stringent energy efficiency laws and requirements for public buildings by the Lebanese government, reinforces the country policy framework. This includes incentives for energy-efficient retrofits and new construction, as well as required energy audits and building performance certificates. Accountability and compliance are guaranteed by explicit policies and procedures for enforcement. Continuous monitoring and evaluation of energy performance has become normal practise in public buildings. Real-time energy monitoring technologies give insights into energy usage trends, suggest opportunities for improvement, and enable informed decision-making. Building occupants and administrators have access to user-friendly interfaces that display energy use and offer energy-saving advice.

Finally, energy efficiency education and awareness initiatives foster an energy-conscious culture among building tenants, administrators, and the general public. Workshops, training sessions, and community engagement programmes encourage sustainable habits while also encouraging energy-saving practises and instilling a feeling of responsibility for environmental stewardship.

Available funding for further consistent investments

According to the Centre for Lebanese Studies CLS, over recent years, the MEHE benefited from substantial loans and grants, with a portion dedicated to public school renovation. The World Bank and other Institutional Donors are significantly funding actions for the improvement of Lebanese education sectors, including the quality of buildings and energy performance. The World Bank's funded RACE 2 (S2R2) programme was designed with the Ministry of Education and Higher Education (MEHE), the Centre for Educational Research and Development (CERD) and other national and international actors and allocated 2.1 billion USD in the period 2016-2021 to improve the education sector including education facilities and school building quality. Considerable parts of the already allocated budget are not yet disbursed, hence making MEHE capable to replicate and scale up the experiences acquired in ESMES.

Tunisia

Replication and scaling up perspectives

In Tunisia, there are 7,135 educational institutions across all levels, of which the majority are primary schools (4,969) and secondary schools (1,882). On September 10th 2020, a nationwide workshop took place in collaboration with the German Development Agency GIZ and the UN's ECOWAS to unveil the conclusive findings of a research assessing the fundamental energy performances of Tunisian structures. This research delved deep into distinct energy consumption elements such as heating, cooling, illumination, cooling systems, and office machinery in both private and governmental residential and workspaces. From the amassed data, an electricity consumption chart for Tunisia's governmental structures was established. In 2017, the overall electricity usage for the housing sector

was determined to be 5,176.2 GWh (equating to 13.07 KWh per m² annually), marking a 27% growth since 2014. Cooling systems accounted for the most (30.3% in total), succeeded by cooling (rising from 3.4% in 2004 to 22.2%) and televisions (declining from 21.16% in 2004 to 17.2%). The energy efficiency potential spanning the studied public buildings from the project totals 39,667 TEP, constituting 21% of the public domain's usage and 2.4% of the service domain's consumption.

The updated Tunisian Nationally Determined Contribution (NDC) pledges to reduce its carbon intensity by 45% by 2030. Mitigation efforts typically focus on the energy sector, which accounts for 75% of the proposed emissions reductions. The building sector, one of the country's main polluters, accounts for 27% of its total energy consumption. Population growth and rising living standards are estimated to increase the share to 35% by 2030.

Schools, among the public buildings in Tunisia, significantly contribute to the energy demand and are characterized by poor energy efficiency. However, the government has taken various measures to raise awareness of the importance of energy saving and to enhance the energy performance of public buildings, including educational ones.

National Solar Plan (PROSOL): Initiated in 2005, this programme primarily targets the residential sector but also extends to public buildings, aiming to replace conventional water heaters with solar thermal installations.

Tunisian Solar Programme (PST): This is a long-term program aimed at promoting renewable energy in various sectors, including public buildings. The program has specific targets for solar and wind energy installations.

Energy Transition Fund: Established in 2016, this fund aims to support renewable energy and energy efficiency projects, including those in the public sector.

Tunisian Company of Electricity and Gas (STEG): STEG has implemented several initiatives aimed at increasing the integration of renewable energy in the public sector, offering incentives and technical support for the integration of renewable technologies in public buildings.

Building regulations: Tunisia has implemented building regulations that mandate energy efficiency measures in new public buildings. These regulations prescribe the use of energy-efficient materials and technologies in construction.

In the frame of such a rich scenario of initiatives, ESMES results will be likely valued, transferred and adopted, whenever the retrofitting actions will target schools of Tunisia. A further key success factor in the replication and scale-up of ESME is the full involvement - as local project partner - of ANME: the agency is responsible for the implementation of the government's energy policies, and it has rolled out several programs and initiatives targeting energy efficiency and renewable energy integration in public buildings.

Available funding for further consistent investments

Tunisia is a recipient of several international and global funding mechanism aimed at improving energy efficiency in public buildings as well as residential ones, supporting the ongoing local funding schemes demonstrating a certain effectiveness in the medium/long run. The funds right now regularly disbursed to fund similar initiatives are:

National Sources:

- Energy Transition Fund: Established in 2016, this Tunisian national fund allocates resources to projects enhancing energy efficiency, including the retrofitting of public school buildings.

International Financial Institutions:

- World Bank: Through collaborations with Tunisia, the World Bank extends financial opportunities to boost energy efficiency and incorporate renewable energy in public infrastructure.
- African Development Bank (AfDB): This institution has historically granted Tunisia funds aimed at infrastructure enhancement, including energy-efficient projects.

Bilateral Partnerships:

- German Development Agency (GIZ): Actively involved in Tunisia, GIZ provides both financial and technical backing for energy efficiency and renewable energy projects.
- French Development Agency (AFD): Offering financial aid and expertise, the AFD assists Tunisia in various sectors, notably energy.

Global Environmental Platforms:

- Global Environment Facility (GEF): Tunisia benefits from GEF's financial support, particularly for projects ensuring environmental improvements, which encompasses energy efficiency initiatives.

Private Sector:

- Private Investments: A rising influx of both domestic and international private investors is evident in Tunisia's energy sector. Using the Public-Private Partnership (PPP) model, there's potential

This confirms the great probability that the work carried out during the implementation of ESMES will soon have important repercussions in Tunisia, favouring the rapid implementation of structural activities and also replicating the awareness and information programs for students, teachers and entire families of the local communities.

Jordan

Replication and scaling up perspectives

Jordan has today 2,787 government schools, 1,493 private schools, 48 community colleges, and 19 universities, and ambitious plans foresee to expand the accessibility to education and the quality of buildings in the country. Previously, the Jordanian government had to heavily subsidise energy costs in order to safeguard people from the price instability of fossil fuels. Jordan imports all fossil energy carriers, putting a significant strain on the economy as a whole, giving political traction to energy efficiency (EE) and renewable energy sources (RES). As a result, laws such as the Renewable Energy and Efficiency Act of 2012 and the National Energy Efficiency Action Plans were implemented. In addition, international organisations and state programmes such as the Jordan Renewable Energy & Energy Efficiency Fund provided support for EE and RES. Jordan's INDC aims for a 14% decrease in GHG emissions by 2030 compared to a baseline scenario. At the moment, per capita emissions of 2.9 tCO2eq are still modest. The Jordanian government has developed building rules (for example, on insulation, EE, and solar energy) as well as a Green Building Manual through the National Building Council. These codes are necessary and must be followed during the construction process, however they are rarely followed in practise. Jordan's government has also recently approved and released licencing guidelines and processes for ESCOs.

Although there isn't a dedicated financing source for energy efficiency (EE) in buildings, the industry may nevertheless profit from funds provided by the Jordan Renewable Energy & Energy Efficiency Fund (JREEEF) for windows. Furthermore, tax incentives are offered for the installation of solar water heaters and other highly energy-efficient products like air conditioning and lighting, even though it is currently required in Jordan but is not strictly enforced in all municipalities.

Available funding for further consistent investments

The Jordan Renewable Energy & Energy Efficiency Fund (JREEEF) is a significant initiative in Jordan that aims to promote and develop the use of renewable energy and improve energy efficiency in the country. The primary objective of JREEF is to finance and invest in renewable energy and energy efficiency projects, thereby aiding Jordan in its efforts to reduce its reliance on imported energy, mitigate the impact of rising energy costs, and address environmental concerns. Beside this, Jordan has sought both domestic and international funding mechanisms to achieve these objectives:

National Energy Efficiency Fund: Established by the Jordanian government, this fund aims to support energy efficiency and renewable energy projects, which would include retrofits for public buildings, including schools, to make them more energy-efficient.

International grants and aids: Jordan receives financial assistance from international donors for various development projects. This includes energy efficiency improvements in public infrastructures. Donor countries, as well as international organizations, have frequently partnered with Jordan on energy projects.

Public-Private Partnerships (PPP): Jordan has explored the possibility of engaging private sector investments for public projects through PPP models. This model allows private investors to finance energy efficiency upgrades in return for a share of the savings or other benefits.

Development Bank Loans: International development banks, such as the World Bank and the Asian Development Bank, offer loans and technical assistance for energy projects, including improving energy efficiency in public buildings.

Bilateral Cooperation: Countries with advanced energy solutions, like Germany, the United States, and others, have bilateral agreements with Jordan. Through these agreements, they often provide funding, technology, and expertise to enhance energy efficiency in the country.

Energy Service Companies (ESCOs): ESCOs are commercial entities that offer energy solutions, including energy efficiency upgrades. They invest their capital to implement energy-saving measures and, in return, they get a share of the energy savings achieved.

In Jordan there is a promising scenario for the scaling up of ESMES project to further school buildings.

Considerations at consortium level and Mediterranean dimension

The sustainability of the project consortium, considered as the likelihood of future collaborations and exchanges on the same sectors of the project, is entirely dependent on the availability of further funding obtained through the development and submission of project proposals involving the same partners. Along the implementation of ESMES; the exchanges between technicians, experts, policy makers, teachers, and students from the 5 partnering countries, due to the restrictions imposed by the COVID-19 pandemic, were sporadic, time-limited, and not enough to establish structural and lasting collaborative relationships.

ANSWER TO EQ7

How would you consolidate the activities in phase 2?

Do you have funding available at the national level to ensure the continuity of this project's activities?

All project partners have actively contributed to the project implementation, in line with their institutional mandate, consistent with the project logic. The outcomes of the project have been valued by local institutions, which at various levels in the different countries, have taken part in executing the activities. The development of application codes and best practice manuals attests to the impact that ESMES activities have made in defining the state-of-the-art in energy-efficient refurbishment of public schools in the 5 countries. Furthermore, the replicability of the project seems likely given the substantial availability of funds allocated for the improvement of school buildings in partnering countries. These funds have either already been allocated and made available, or have been earmarked through political agreements and commitments.

3.8 EQ8: Project capacity to deal with risks/prevention and adaptation

How did you modify the action plan to address unforeseen risks?

What solutions did you implement to navigate challenges during the project's execution?

The ESMES project consortium, just in the initial months of implementation, faced the COVID-19 pandemic, one of the most disruptive events of the past century. The outbreak of the pandemic firstly compelled all public authorities, including project partners, to prioritize the safety of the population and to implement all the emergency measures that followed. In the subsequent period, for several months, there were significant difficulties in the free movement of goods. As a result, most tenders requiring the purchase of products and materials from abroad experienced massive delays at global level. Thirdly, the availability of many different raw materials became extremely scarce, inhibiting some production chains and causing further delays in service delivery. This, in turn, led to an increase in the costs of products used in the technical-building field, disrupting the planning of funded projects. Lastly, the movement of people, restrictions in traveling, and even internal country movements or simply commuting added another layer of difficulty in managing ESMES.

Given all these challenges, the project consortium has managed to address unexpected hurdles effectively. Even though it required an additional year, secured through a no-cost extension granted by the ENI CBC MED authority, the project achieved its main outcomes. It delivered more outputs, deemed as interventions to improve the energy efficiency of school buildings, and reached the agreed number of people for awareness-raising activities in the local communities of partner countries.

The difficulties posed by the pandemic, however, prevented the establishment of an "active Mediterranean community" aimed at reducing the environmental impacts of public schools. Achieving this result would have essentially required initiating exchanges, face-to-face meetings, trips, to gradually build mutual trust and understanding that is very challenging to attain solely through remote digital communication tools. The inability to facilitate travel for students, teachers, and technicians from one shore of the Mediterranean to the other, due to restrictions and challenges posed by COVID-19, rendered this goal effectively unmet.

Regarding the challenges faced during the project's implementation, the consortium was able to address the delays of some partners, providing specific technical assistance during the more

challenging phases for each partner. Specifically, ICU deployed its support staff to those partners who, from time to time, reported difficulties in progressing with the work plan. The most challenging stages, according to the partners, were related to the preparation and publication of tender notices for the implementation of energy improvement measures in schools, the installation of photovoltaic systems and auxiliary systems, and all the expense reporting as required by the financial management procedures by the EU.

ANSWER TO EQ8

How did you modify the action plan to address unforeseen risks?

The action plan was substantially modified to address the implementation challenges posed by the COVID-19 pandemic. The financial resources initially allocated for knowledge and exchange trips between countries for technicians, teachers, and student delegations were shifted to enhance the benefits arising from the energy efficiency measures for schools. Similarly, the difficulty of providing sub-granting to schools due to bureaucratic procedural reasons convinced the project consortium to use those resources to further increase the project's tangible actions on school buildings, and partly for awareness-raising and information campaigns. In general, risks were timely identified, and appropriate measures were taken to mitigate their negative impacts on the project.

What solutions did you implement to navigate challenges during the project's execution?

The measures adopted by the project consortium to address the challenges that emerged over time were: i) increased technical assistance to partners in difficulty, particularly during the phases of launching service tenders and reporting activities; ii) reallocation of the budget from the sub-granting activities, initially designed for management by the schools but later deemed unfeasible due to bureaucratic procedural limits of the public entities that were project partners: the issue was resolved by using those resources directly by the project consortium, thereby increasing structural and educational interventions; iii) a request for a 1-year extension of the project to carry out activities significantly and reasonably slowed down by the effects of the pandemic on the global economy.

4. Conclusions

ESMES project achieved its primary expected outcomes, carrying out a greater number of structural interventions than planned and achieving greater impacts measured in terms of services provided by the educational institutions, comfort of the teaching environments, and environmental impacts related to the management of educational institutions, starting with the emission of GHGs.

The shortcomings of the project, measurable in terms of its international dimension with the creation of a Mediterranean community active in energy savings and the reduction of environmental impacts in the school context, can be attributed to the onset of the COVID-19 pandemic in the early months of activity implementation. This forced a revision of the activities, the cancellation of exchange and mutual knowledge programs, which inevitably reduced the building of strong and lasting relationships between partners and project beneficiaries.

The significant impacts of the project, however, are not only related to the environmental, operational, and managerial benefits resulting from the realization of structural interventions and installations. The social impacts, such as increased awareness among teachers, students, and their families regarding the sustainable management of natural resources, energy, and production from renewable sources, are also important. These results were achieved through school contests and targeted educational

activities, and, even if on a local or sometimes national scale rather than a Mediterranean one (as was expected from the project), they have yielded significant outcomes.

Overall, ESMES stands out as a highly significant pilot project in the field of energy efficiency within the Mediterranean school environment. It has enabled overcoming some of the most substantial obstacles in the realization of school energy efficiency interventions in the area: the procedures for the preparation and launch of tenders, which require knowledge of the state-of-the-art technical solutions and their effective mix for defining the terms of reference for the tenders to be launched. The public and political debate on these topics ultimately attracted the attention of policymakers to the benefits and urgency of allocating funds for such interventions. The return-on-investment timeframe, based on the rapidly increasing cost of energy and the uncertain public service (for Lebanon), indicates that these measures are both cost-effective and a priority.

5. Recommendations

As analyzed in the "replication and scaling-up perspectives" section, the ESMES project partners, given the significant funds available in the countries, have a great opportunity to capitalize on the work done during the project in favor of other schools in country. The involvement of federal levels (Ministries of Education/Culture) carried out during the execution of the activities envisaged by ESMES, should have laid the groundwork for the "institutionalization" of the documents and best practices developed by the partners, making their dissemination natural for the interests of local public entities. Scheduling brief meeting and exchange sessions in each country among peers, however, could further facilitate the transfer of skills and knowledge acquired by ESMES partners to benefit similar stakeholders, to replicate and disseminate the results achieved.

Regarding the information and awareness programs conducted in the involved schools, it is advisable to integrate these programs in the schools' curricula. The use of educational kits and ad hoc teaching programs made learning extremely direct and effective for the various levels of study involved. Given that this does not imply significant costs, sharing the training programs and the avalaible data with other schools would allow for an expansion in the number of students educated on the topics of energy saving and the efficiency of structures, in addition to the appropriate behaviors to ensure judicious energy use.

The limitations imposed by the pandemic have effectively reduced the transnational value of the ESMES project. One way to maintain its Mediterranean dimension is to ensure the exchange of data related to the energy production of photovoltaic systems, the energy demands and production of schools, and the methods and the adaptation systems to address the unique needs of each. The online system that would have effectively allowed real-time visualization of this information for all project partners for all implemented systems did not become commonly used because the system's interoperability requirements conflicted with the internal security procedures adopted by the partners' IT responsible. It would be desirable for this functionality to be guaranteed, even in different ways if it is not possible to ensure access and sharing for everyone of the same software, but at the very least to enable for the production of quarterly reports to be transferred between partners. These reports would also be beneficial for a prospective collaborative publication on the advantages of the systems in various schools after 2 or 3 years of operation.

Annexes

Annex 1. List of reviewed documents

Accelerating zero-emission building sector ambitions in the MENA region (BUILD_ME) - Navigant Energy Germany GmbH.

Call for proposals for standard projects - ENI CBC Mediterranean Sea Basin Programme 2014-2020

Education Strategic Plan 2018 – 2022 – Ministry of Education of Jordan, Amman.

ESMES project proposal documents and progress reports

Indicative monitoring and evaluation plan - ENI CBC Mediterranean Sea Basin Programme 2014-2020 – Annex 2

Joint Operating Programme (JOP) - ENI Mediterranean Sea Basin CBC Programme 2014-2020

Mediterranean Energy Transition: 2040 Scenario - The French Environment and Energy Management Agency (ADEME)

Mediterranean Energy Perspectives to 2050 - OBSERVATOIRE MEDITERRANEEN DE L'ENERGIE

SOLE, High-Energy Efficiency for the public stock building in the Mediterranean – WP 6 Capitalisation report

Strategic Environmental Assessment - screening procedure - Mediterranean Sea Basin Programme, 2014 - 2020