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meetMED
Mitigation Enabling Energy Transition in the MEDiterranean region
Together We Switch to Clean Energy

CHALLENGES AND METHODS FOR COOLING CITIES AND BUILDINGS

IN SOUTHERN AND EASTERN MEDITERRANEAN COUNTRIES

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MED ENER

RCREEE
Regional Center for Renewable Energy and Energy Efficiency
المركز الإقليمي للطاقة المتجددة وكفاءة الطاقة

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About the project

The Mitigation Enabling Energy Transition in the Mediterranean region “meetMED” is an EU-funded project and developed by the Mediterranean Association of the National Agencies for Energy Management (MEDENER) and the Regional Centre for Renewable Energy and Energy Efficiency (RCREEE).

With the objective of contributing to energy and climate transition Southern Mediterranean Neighbourhood through a multi scale, multi partner inclusive approach, meetMED II activities aim at developing a more stable, efficient, competitive and climate-resilient socioeconomic environments Southern Mediterranean countries, in, by fostering regional cooperation for Energy Efficiency measures and implementing demo actions.

WHY TAKE ACTION TO COOL BUILDINGS AND CITIES?

Mediterranean cities are particularly vulnerable to heat exposure

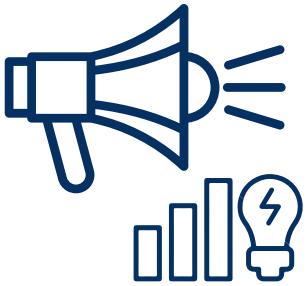
The Mediterranean region, with its dry, hot climate, is particularly vulnerable to increases in atmospheric temperature and is highly susceptible to heatwaves and periods of drought. IPCC scenarios predict that average maximum temperatures could reach around 46°C by 2050 and almost 50°C by the end of the century, and summer rainfall is likely to fall by 10 to 30% in some regions. Furthermore, the concentration of populations and infrastructures in urban areas makes them particularly sensitive to these hazards.

20%

The basin is warming faster than the global average

FOR MORE INFORMATION

Report by MedECC - Mediterranean Experts on Climate and environmental Change -assessing the current situation and future risks related to the impacts of climate change in the Mediterranean basin, with a summary for policymakers (2020).



This context intensifies urban heat island (UHI) and urban overheating effects, which have an impact on the economy (increased energy and water consumption for cooling), the environment (generation of greenhouse gases, depletion of water resources) and the quality of life in the city (reduced thermal comfort, health risks, particularly for vulnerable categories of the population).

To identify appropriate regional solutions, it is essential to carry out diagnostics, which can also be used to raise awareness and mobilise stakeholders (citizens, public and private actors).

WHAT CHALLENGES ARE WE FACING?

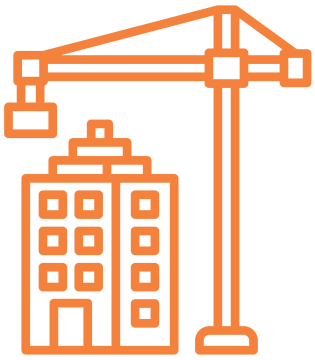
Transformations in Mediterranean cities are exacerbating urban heating effects

Arab cities have a rich heritage of bioclimatic design and construction, which offers an urban and architectural response to heat-related challenges by promoting and optimising coolness in streets and homes.

- Compact but porous cities
- Orientation of the urban fabric and homes to facilitate air circulation
- Fountains
- Narrow streets to reduce heat radiation
- light-coloured buildings that reflect the sunshine
- Covered passageways providing shade

From the **1940s** onwards, the rapid pace of urbanisation resulted in an urban crisis with shortages of housing, uncontrolled expansion of built-up areas to the detriment of agricultural land, and poor quality in new urban areas, with the emergence of "dormitory towns", neighbourhoods with unregulated housing and rudimentary, precarious urban forms of housing. These trends towards accelerated urban sprawl and horizontal and vertical densification of the building fabric, **are influenced by the Western model of the concrete**, motorised city, foster socio-spatial inequalities and the creation of urban structures and types of housing that are poorly suited to the local climate. At the same time the medinas and older housing are deteriorating due to a lack of maintenance.

Informal construction and self-build have become the main ways in which cities expand, **against a backdrop of a persistent housing crisis fuelled by a shortage of building land and endemic unemployment**. Institutional responses have varied and evolved depending on the country and the period, ranging from laissez-faire and minimal regulation to ad-hoc rehousing programmes and major projects to combat informal housing. Neo-liberal urban models driven by the construction market are poorly offset by public policies that tend to favour modernist mega-projects to the detriment of needs for public facilities and social housing.



These trends have led to an accumulation of factors (morphological, surface and anthropogenic) which, when combined, reinforce UHI effects, in both large and medium-sized cities:

Definitions

"Urban overheating"

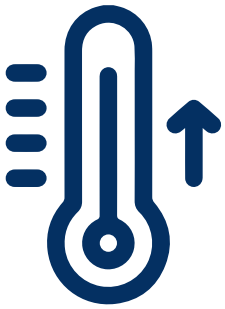
Urban overheating encompasses all the effects associated with the deterioration in the way people feel in cities during periods of intense heat, during the day and night, at both the pedestrian and urban scale. This relates both to the urban heat island effect and to the discomfort experienced by pedestrians in urban spaces (radiation from the sun and mineral surfaces, lack of ventilation, etc.).

"Urban Heat Island"

An urban heat island (UHI) is characterised by higher temperatures in a city compared to the surrounding countryside or the regional average. It is caused by a combination of effects linked to urban morphology, highly mineral surfaces and anthropogenic heat.

1. **The artificialization of land and mineral urbanism**, which reduce the area of green and aquatic spaces that provide coolness through evapotranspiration
2. **A more spread-out urban fabric**, whose orientation does not take into account prevailing winds and reduces their circulation. The shape and height of buildings have a significant influence on microclimates. The proliferation of rows of low-rise buildings means that the density required for protection from the sun is not achieved, and the disappearance of patios in favour of living areas reduces the circulation of indoor air.
3. **Denser, more uniform buildings** that trap the heat from the sun and reduce the circulation and speed of winds.
4. **The increase in anthropogenic heat emissions** such as vehicle traffic, domestic and industrial energy consumption, and the ever-increasing trend for households to be equipped with air-conditioning (ranging from 30% to 70% depending on the country).
5. **The widespread use**, in the context of a housing crisis and the influence of modernist architecture, **architectural models and building materials that that are poorly suited to climate conditions**, such as iron and concrete structures, glass elements, metal joinery, synthetic wood, post-and-beam structures, infilling of facades and partitions with hollow breezeblocks or bricks, reinforced concrete floors, asphalt, large areas of glass windows and doors, lack of insulation on facades, uninsulated floors and roofs, etc.

These various factors **lead to a concentration of heat** in the new dense urban centres and residential suburbs, industrial zones and the fast-growing asphalt and tarmac main roads. Climate studies on an urban scale have shown that temperature differences between urban and rural areas **can exceed 7°C in Beirut, 2 to 3°C in Alexandria, 10°C in Gabès and 4 to 7°C in Sfax during the hottest months.**



Current urban and architectural transformations do not offer a sustainable response to the problems of thermal comfort, from an environmental, economic or social point of view, while at the same time leading to the loss of traditional architectural techniques and expertise and the disruption of local bio- and geo-sourced materials (such as stone and compressed brick), which have been devalued in favour of "modern" techniques and imported materials.

FOR MORE INFORMATION: Diagnostic methods

The **ADEME report "Diagnosis of urban overheating, methods and regional applications" (2017)** presents the diagnostic methods and tools commonly used to determine the issues associated with urban heating, quantify UHIs, map and target vulnerable areas, and assess the thermal comfort conditions of outdoor spaces.

Diagnostics are usually based on a combination of several approaches and tools.

They can be cross-referenced with urban data (vulnerable populations, state of buildings, etc.) to identify areas vulnerable to heatwaves.

There is therefore an urgent need to work on cooling solutions at different scales, from individual buildings to entire cities, with the aim of as much as possible, improving the thermal performance of buildings and installing more efficient cooling equipment in households and public buildings.

EASY-TO-IMPLEMENT, LOW-COST COOLING SOLUTIONS ARE KNOWN AND AVAILABLE

These solutions are based on different principles:

Bioclimatism: an architectural or town planning project that makes the most of local climatic and microclimatic conditions (integration into the surrounding landscape, taking account of prevailing winds and vegetation, etc.), while also taking usage into account.

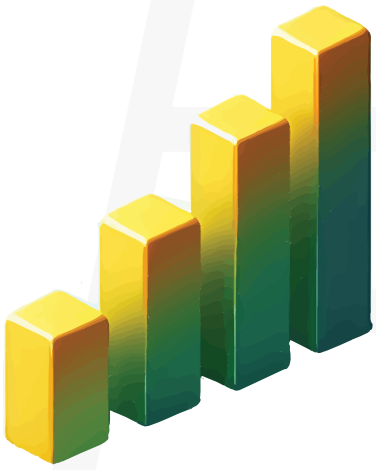
Albedo: heat (energy) reflecting power of road surfaces, roofs, building facades, etc. This depends on the colour and roughness of the surface: a black or dark surface will have a low albedo and will absorb heat, whereas a light surface will have a high albedo with a higher reflecting power.

Thermal inertia: this is the ability of a material to store heat and release it gradually. On a city scale, the more compact and mineral the urban form and the more it is exposed to solar radiation, the more the inertial mass will retain heat. In the case of buildings, good interior inertia helps to keep them cool during the day.

Shading: the ability to block out light, particularly sunlight.

Evaporation and evapotranspiration: transition from liquid to gaseous state requiring energy input. The natural evaporation of water therefore lowers the temperature of the ambient air in the immediate vicinity. More specifically, evapotranspiration is the transfer of water to the atmosphere through evaporation from the soil and transpiration by plants.

Ventilation: air movement that can be natural (wind, sea breeze, thermal lift) or mechanical (fan or electric air blower).



Specialists emphasise that **simultaneous action on urban form, technology and construction systems, as well as on behaviour and greater control over use**, would lead to significant gains in terms of thermal comfort, reduced energy consumption and, more broadly, mitigation and adaptation to climate change.

Furthermore, the potential of "**local**" practices currently appears to be largely under-exploited. By this we mean practices that are "within the reach of local residents", characterised by their ease of implementation, low cost and/or their anchoring in local customs and knowledge.

TYPOLOGIES OF “FORMAL” SOLUTIONS:

The typology proposed by ADEME, based on that of the European Environment Agency (2013), distinguishes between different types of solution:

Grey - technical solutions relating to urban infrastructures: light-coloured roofs and claddings with high albedo, ventilation grids, orientation of the road network, etc.

Grey - design of buildings and urban developments: fixed or mobile shading systems, insulation, systems to allow air to circulate (patios, pilotis, meshrebeeyeh)

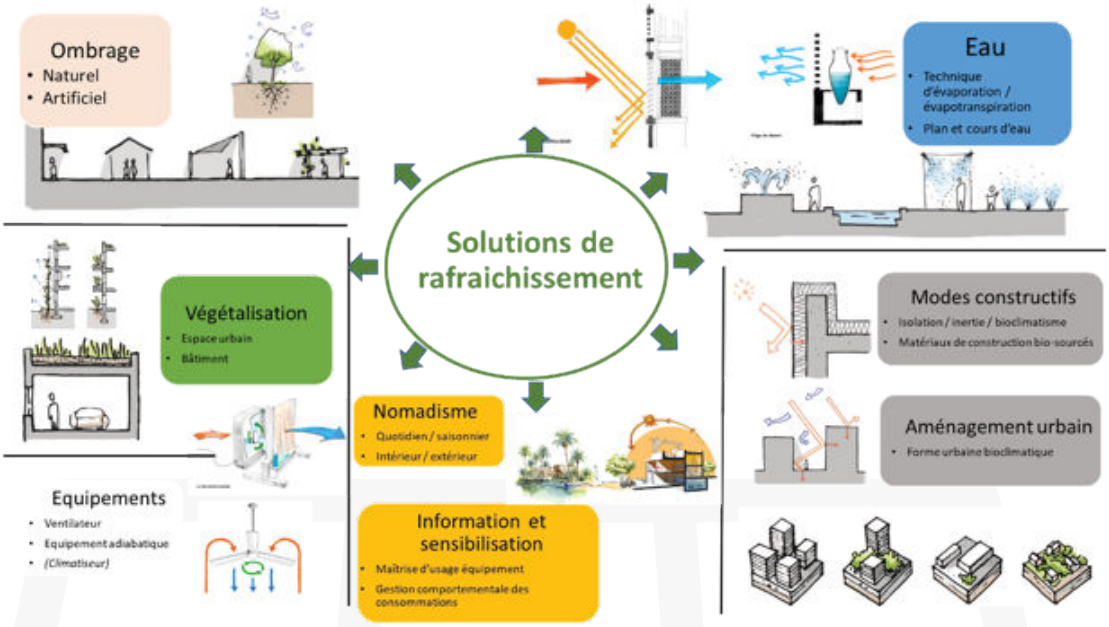
Green and blue - nature-based solutions: green façades and roofs, tree planting, urban agriculture, removal of impermeable surfaces and creation of green spaces, rehabilitation of watercourses, fountains, etc.

Soft - behavioural solutions and urban policies that act on uses and practices in cities, on an individual and collective scale: reduction of car traffic in favour of alternative modes of transport, development and accessibility of public spaces, particularly green spaces, etc.

- Using the principle of evaporation to cool, like the "**desert fridge**" - two pots, one inside the other, with the gap between them filled with sand that is moistened. The evaporation of water under the effect of heat cools the inner pot, thereby helping to preserve food. These solutions have their limits in wetter climates.
- Creation of shade: installation of sunshade fabric and other forms of removable sun protection.
- Daily or seasonal nomadism: relocation of activities or even moving during the hot season to cooler locations, either within the home (underground rooms) or outdoors or in other locations (oasis, seaside, etc.)

Combining these various solutions at different scales (city, street, building, residents' practices) provides a more effective response, provided that the choice is made in line with the urban morphology and meets the implementation challenges specific to the Mediterranean area.

Water resources are a key factor in the implementation of solutions based on urban greening. In Mediterranean and arid climates, it is therefore important to estimate water availability during dry spells and carefully choose species adapted to the local climate (e.g. Virginia creeper, jasmine).



There are many advantages to incorporating these measures into regulations, strategies and policies, and projects for town planning, building and home renovation. The main advantages are:

Economic (rationalisation of energy consumption for all parties, reduced additional costs in the medium term due to better adaptation to present and future climatic conditions, better quality of structures and equipment and less dependence on fluctuations in energy prices, creation of jobs that cannot be relocated);

Environmental (reduction in CO_2 emissions, better adaptation to the effects of present and future climate change, reduced pressure on natural resources);

Health and social (better taking-up of issues by the population, improved well-being and thermal comfort, reduced health risks, improved quality of life in the city);

Socio-cultural (better knowledge, enhancement and modernisation of traditional skills and heritage).

FOR MORE INFORMATION

Cooling cities: a variety of solutions - ADEME (2021), a report on international initiatives

Feedback from the City of Marseille (France) - AGAM

“Plus fraiche ma ville” (“Cool my city”) website

HYPERLINK "https://www.enviroboite.net/la-lutte-contre-l-effet-d-ilot-de-chaleur-urbain" EnviroBoîte - a selection of resources relating to urban heat islands

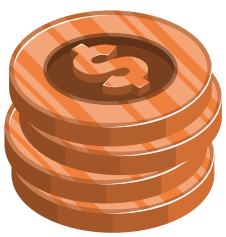
Cooling issues are still not taken into account sufficiently in national and local strategies, policies and actions

Faced with pressure on household budgets due to the growing need for air-conditioning, the various actors involved are gradually becoming more aware of cooling issues. Strategies have been developed at a number of levels, from the individual to the state, and cover several areas: energy efficiency of buildings, town planning and architecture, equipment, individual practices, etc.

Over the last twenty years or so, southern and eastern Mediterranean countries have shown growing interest in the issues of energy efficiency and thermal comfort in buildings, and this interest has been translated into objectives in terms of national commitments to climate initiatives and the energy transition: Nationally Determined Contributions, national energy efficiency action plans, etc. Several countries have introduced legal frameworks through insulation standards, building codes incorporating thermal regulations and the creation of labelling systems for buildings and/or equipment. At the same time, governments:

are becoming aware of the exacerbation of heat in urban areas, made worse by climate change, and are considering adaptation measures to improve urban resilience and thermal comfort. Eco-district and "green city" projects are being developed alongside the formulation of sustainable development strategies, tools and standards.

Regional authorities are also key players in implementing urban and housing strategies and projects, and in meeting national targets for energy efficiency in buildings. Morocco and Tunisia have developed support programmes for energy efficiency in buildings specifically for local authorities; Tunisia, Algeria and Palestine offer



Financing mechanisms to promote investment in renewable energy and energy efficiency, for which local authorities are eligible. Local authorities can also formulate their own mitigation and adaptation objectives. They can form networks to facilitate access to a range of resources: information, training, technical support and funding. More than a hundred local authorities have drawn up Sustainable Energy and Climate Action Plans (SEACAPs) identifying concrete pilot actions, particularly in the areas of public lighting, the construction or renovation of efficient public buildings, and creating green spaces. Local authorities are investing in energy and climate awareness-raising, training and consultancy initiatives to disseminate best practices to all stakeholders, for example through the development of Energy and Climate Information Services.

A kit to support contracting authorities and project managers

ADEME has developed a number of tools to support regional authorities. A COMPLETER

FOR MORE INFORMATION

Covenant of Mayors for the Mediterranean (CdM Med)

ClimaMed projects and publications support government and local authorities as well as non-state actors in Algeria, Egypt, Israel, Jordan, Lebanon, Morocco, Palestine and Tunisia in the transition to sustainable, low-carbon and climate-resilient development.

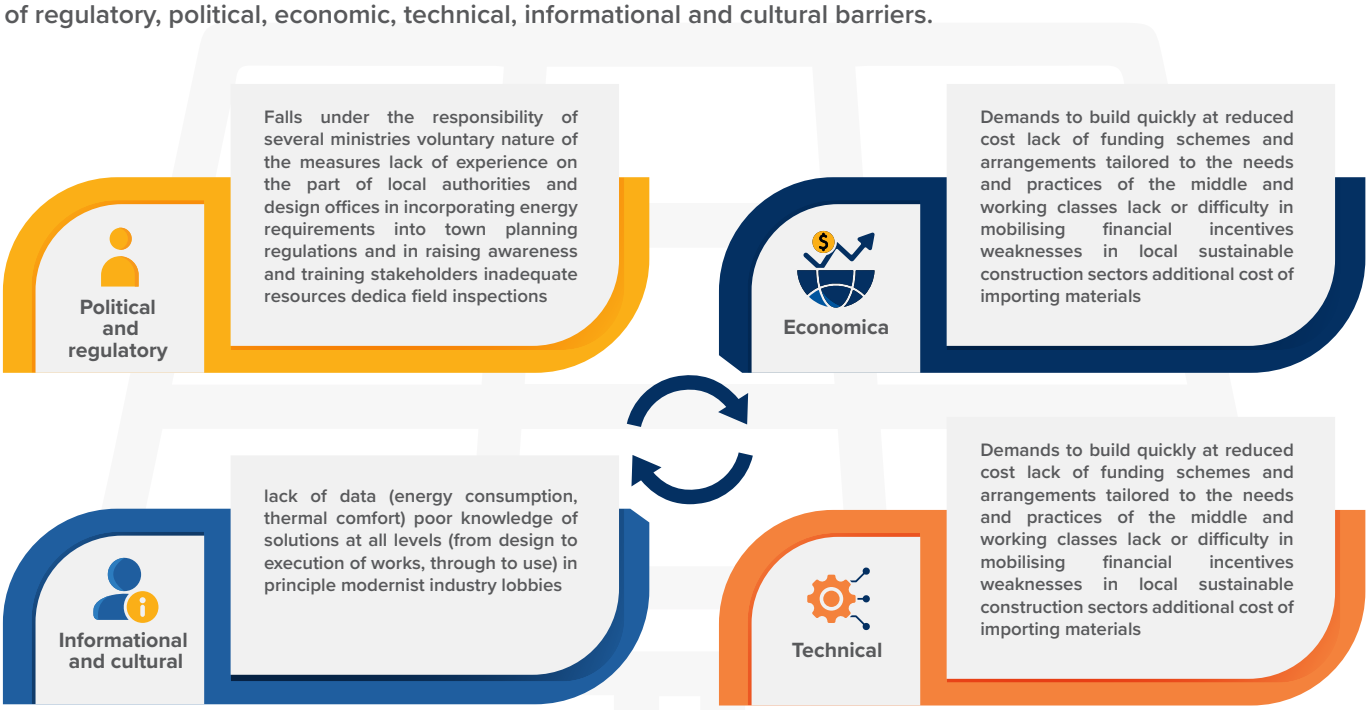
HYPERLINK "http://www.siec-med.org"Toolkit for Energy-Climate information services (SIEC) in the Mediterranean proposed by GERES (2023)

The growing number of initiatives reflects a trend towards taking sustainable urban development into account in SEMCs, and a change in practices. They can be supported by qualified professionals who are aware of the challenges of thermal comfort. Nevertheless, the effects of heat and how these are evolving in the context of climate change are still poorly understood by the various stakeholders involved in the city and the construction of buildings. Regulations and public policies are still too rarely translated into practical applications. Pilot projects are still on a one-off basis and dependent on the willingness of local actors and the availability of external and/or private funding, so they are struggling to consolidate and spread. Support mechanisms remain under-exploited by local authorities, and in the absence of dedicated institutional, regulatory and financial frameworks, they lack the skills and resources to implement or promote energy and climate projects at local level.

Barriers to integrating energy management and cooling solutions

Considerations relating to sustainable cities and the challenges of cooling in buildings often remain compartmentalised between disciplines and between scales of intervention (buildings, regional planning).

The sustainability and wider roll-out of these initiatives is hampered on the one hand by the complexity of mobilising a large number of very different parties, which makes it difficult to adopt a comprehensive, integrated approach at the individual building level, and even more so in terms of coherent urban planning, and on the other by a multiplicity of regulatory, political, economic, technical, informational and cultural barriers.



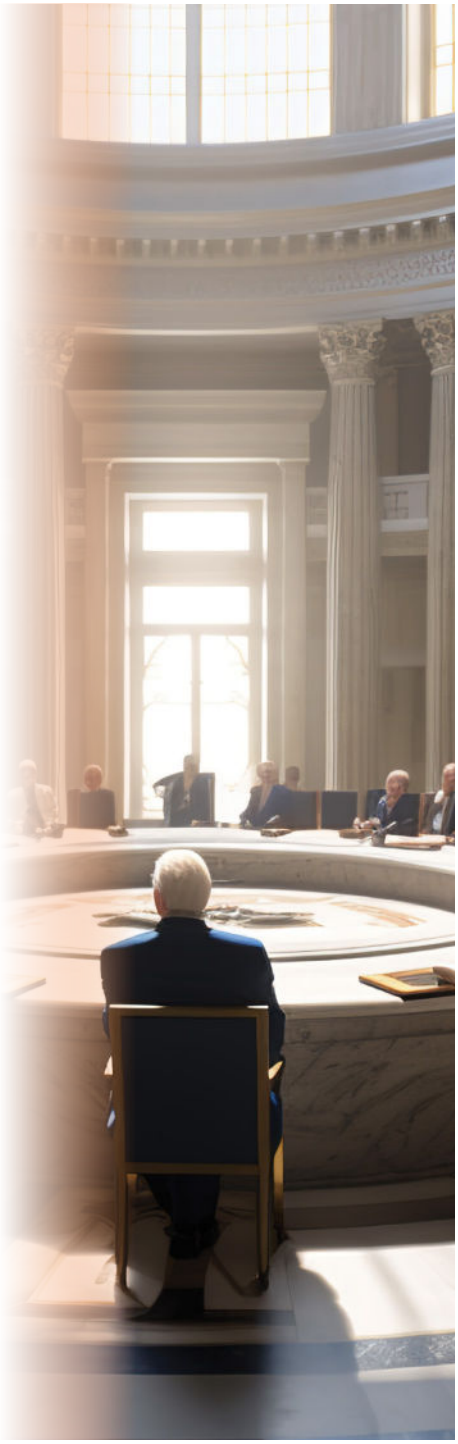
Removing these various barriers requires significant resources, in particular to enable the necessary support measures to be put in place in a short space of time.

The situation is now urgent: demographic trends and projections and increased urbanisation highlight a strong, imminent demand for new housing, as well as the need to take action on existing buildings.

4 KEY RECOMMENDATIONS

There is therefore an urgent need to rethink the building sector as a whole, within its environment and in its urban context, favouring an approach involving all the actors at different levels:

- **Convince actors (public and private)** who influence urban construction of the harmful effects of the dominant trends and practices, and encourage them to promote other models, in particular those inspired by historical expertise. This involves awareness-raising, capacity-building and advocacy actions. These actions must be based on a better understanding of the issues (diagnostics, surveys) via studies highlighting the results of pilot projects, in particular the cost-benefit of the various cooling measures. The development of professional networks for sharing experience, training and information is essential to encourage the promotion and deployment of good practices.
- **Encourage a change in mentality**, particularly with regard to "local" and vernacular practices from rural environments and local materials, by adapting them to the requirements of modern urban contexts. To achieve this, it is essential to involve those carrying out research and training of city and building professionals, as well as to strengthen the control of use in households and in public buildings, among other things.
- **Encourage cross-sectoral thinking and policies** (energy, construction, urban planning, education, social affairs, health, etc.) at different levels (buildings, neighbourhoods, cities, policies, behaviour), through dedicated forums for dialogue and consultation involving, in particular, representatives from the professional and private sectors. At sub-national level: support the integration of cooling principles into urban planning (strategic and operational) and strengthen resources (human and financial, as well as regulatory and organisational) of local authorities to steer sustainable urban planning and housing approaches and projects based in particular on community initiatives. Intervention at neighbourhood level requires skills in leadership and social engineering that can be mobilised internally by local authorities or through collaboration in particular with associations.
- **To finance and support the organisation** of a sustainable construction industry by providing appropriate institutional support, access to international financing, an improved regulatory framework, the introduction of incentive tools, the development of public-private partnerships, quality control of equipment and construction, and training for professionals. Setting up local construction channels is a vital link, thereby helping to structure a competitive supply of skills (tradespeople) and materials. Workshops, pilot schemes, professional groups and inter-professional networks are also part of the possible solutions.



IF YOU WANT TO IMPLEMENT URBAN COOLING SOLUTIONS IN YOUR REGION:

1

Ask yourself the right questions
A diagnosis of urban overheating can identify specific vulnerabilities in your region.

2

Get help Contact the Energy Agency in your country or region and they will give you information on certified consultancies, existing regulations, good practices, etc.

3

Use the right tools...

The levers for action differ according to the type of building and different urban forms:

With regard to new and formal buildings, the main aim is to give practitioners in the field the means to ensure existing regulations are applied.

Develop methods of intervention and financing adapted to the construction and improvement of existing self-built, self-promoted and/or informal buildings, which represent the majority of buildings and the main development trend in SEMC cities, based on feedback from pilot projects

A strong lever for action therefore lies in supporting the implementation, documentation and sharing of pilot projects as demonstrators in an integrated approach, making it possible to raise awareness and convince the various actors through proof.

Consult the summary sheets for different types of urban morphology: Medina / Colonial-type central districts / Garden cities and suburban districts / Self-development districts / Planned residential districts / Eco-districts

Credits

Technical coordination

Alicia Tsitsikalis (ADEME)

Authors

Clémentine Laratte (GERES)

Marc Glass (GERES)

Marie-Maud Gerard (GERES)

Design lead

Asmaa Ahmed (RCREEE)

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For further information: www.meetmed.org

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