

Building and energy, a key issue in a moving energy market: The example of the Mediterranean region

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ABSTRACT

Building sector is accounting for a significant and increasing part of the worldwide energy consumption and is responsible for important greenhouse gas emissions. This is why rational use of energy and development of renewable energy sources appear as strategic solutions considering the significant resources available. In this context, energy efficiency in the building sector will be more and more considered as a key issue, even for energy exporters or importers. This is also true for Southern and Eastern Mediterranean Countries (SEMC), as this sector represents 18 to 42% of the total national energy consumed. After having emphasised the importance of the building sector in the international and SEMC energy context, we will describe its development and the barriers to overcome in order to implement national and regional building energy efficiency strategies. The need to create or reinforce an urgent proactive regional cooperation on this subject will also be underlined. The topic is not only an energy issue, but the challenge here is to create a collaborative and innovative approach for the implementation of a “Sustainable Mediterranean *Building*”.

1. INTRODUCTION

Considering scenarios either developed by the Mediterranean Action Plan (MAP), the International Energy Agency (IEA) or by the *Observatoire Méditerranéen de l'Énergie* (OME), a significant increase in energy demand and more particularly in electricity coming from Southern and Eastern Mediterranean countries (SEMCs: Algeria, Egypt, Israel, Lebanon, Libya, Mo-

rocco, Palestinian Authority, Syria, Tunisia and Turkey) is clearly expected in the coming years. Becoming more pronounced, this trend will have a significant impact on the region energy situation, for energy producing countries as well as for importing countries. Accounting for a significant part of the total energy consumed, the building sector, both residential and tertiary, is at the core of this increase. This trend should be more pronounced during the next years and, more particularly, air conditioning, heating and domestic hot water needs in urban areas will become a major issue.

Generally speaking, taking into consideration the expected fissile or fossil resources exhaustion, electricity access or energy dependence aspects will more and more become strategic. As an essential component for meeting the needs of a growing population as well as matching the imperatives of economic development, it is advisable to reduce energy demand on one hand, and develop the use of renewable energies on the other hand. The construction sector as a whole represents a concrete example where both approaches can mutually complement and strengthen one another. Moreover, from an energy point of view as well as from other associated impacts, speaking about the construction sector without considering it throughout its whole lifetime would be senseless. This is why it is necessary to reconsider the ways of erecting new buildings or refurbishing old ones with the aim of reducing energy and cooling needs during the whole building lifetime. Finally, in addition to reduce impact on supply networks, this approach will usefully contribute to local development and greenhouse gases emissions reductions.

We will first recall the importance of the construction and building sector in the world energy balance. Then, we will shortly underline the issue of energy supply and demand in the SEMCs and we will see what the relative share of the construction sector is. We will then present this sector's evolution which, while still operating within a booming market, has somewhat differed from the traditional architectural model. We will also emphasise the barriers to overcome to significantly promote an energy-saving building. After having proposed an action plan, we will underline the necessity to imagine new regional partnerships or reinforce existing ones. We will conclude on the importance to admit a regional dynamic to set up the foundations of what could be a "*Sustainable Mediterranean Building*".

2. SOME FIGURES ABOUT THE CONSTRUCTION SECTOR

Worldwide and according to UNEP (United Nations Environment Programme), the construction and building sector generates an annual investment over 3,000 billion dollars (30% in Europe, 22% for North America, 21% in Japan, 4% in other industrialised countries and 23% in developing countries). Over 110 million direct jobs are connected to this sector and distributed for more than 75% over industrialised countries, mainly in firms with less than 10 employees (approximately 90%).

If we consider the construction and building sector over its whole lifetime, it represents 25 to 40% of the total energy consumed (40% in OECD countries). It also contributes to a significant share of the solid waste generated and global greenhouse gases emissions (respectively 30 to 40% and 10 to 20%).

Without generalisation and considering the regional, European or international evolutions and initiatives, we can however summarize as follows the main current determinants of this sector:

Construction practices are often associated with short-term economic choices. Standards and regulatory texts, when existing, are mainly dealing with technical aspects. Materials, when considered on their own, have certainly improved their performance, but the building industry as a whole is still not considered accu-

ately. Moreover, means for control and assessment are often poor, and, when existing, are not related to a coercive logic favourable to a change in practices. Similarly, lifetime analysis, impacts management and anticipation are still linked to voluntary approaches and a relatively limited number of standards are dealing with the building behaviour profile throughout its operating life (which is even more surprising if we consider that the average building lifetime ranges between 50 and 100 years). In addition, weakness of public policies building sustainable approach support and promotion should be pointed out. Lastly, numerous investors, insurance companies, developers, housing stock managers and owners are still insufficiently aware about the advantages of a building sustainable approach both on global (climate change) and local (economic approach and social advantage) aspects. In addition, the sustainable building concept, according to the country or region, refers to different technical and patrimonial elements. This seems actually obvious however we are obliged to recognize that, for a long time, a systemic approach was promoted, forgetting or minimizing the national or regional heritage.

Construction dynamic has to be part of a more transverse understanding of construction in its environment, taking into account the associated impacts in a local, national or regional development perspective. Beyond the technical solutions and the different expected performance levels for winter or summer comfort, the entire building lifetime has to be considered, from its erection to its use and including also its demolition. In the framework of a transversal analysis on the building close interactions within one territory, the energy issue becomes crucial. It is therefore essential to re-consider as much as possible our vision of what has to be or may be the town and country planning within a dynamic logic taking into account sustainable development criteria. The difficulty of this approach relies on the management of apparently conflicting imperatives between short and long term involving arbitration in terms of cost-benefit ratio that clearly implies an explicit and motivated position of all decision levels.

3. SEMCS CONSTRUCTION SECTOR EXAMPLES

In the Mediterranean area, energy consumption has more than doubled over 30 years. In 2000, it has reached 820 Mtoe and according to the "Plan Bleu" trend scenario, in 2025 energy demand should be in the 1,365 Mtoe range. Concerning the SEMCs and, even if, based on the documents used, the figures are somewhat different, it is generally expected that the region energy demand will show a significant increase (slightly less than 3% per annum by 2030). Most of these needs would be covered by oil and natural gas with an expected strong development in natural gas to favour oil on export markets. Renewable energies will continue to develop but their global share will remain constant in terms of percentage, representing approximately 4%.

The energy consumption profile per inhabitant would increase but would remain extremely fragmented with significant differences between exporting and importing countries. Water and electricity sectors would increasingly be more important compared with the total volume of primary energy consumed (need in seawater desalination and new electricity uses such as air conditioning development).

All the strategic national documents of the SEMCs acknowledge the concern and recognise the importance of energy efficiency for climate change issue as well as for economical efficiency, competitiveness or even energy independence. The share of the building sector in the total national energy consumed ranges from 18 to over 42%!!. This is why, in all cases, building sector is clearly identified as a key sector. Country figures given below are to be considered as examples. They are coming from different sources: National Agencies, MEDENER, IEA, IEPF, Plan Bleu. As a reminder, only Algeria, Egypt, Libya and Syria are net energy exporters.

Algeria is exporting oil and natural gas and over 95% of its revenues come from their trade. In 2003, the construction sector accounted for over 42% of the total energy consumed (22 Mtoe). In the early 1990s, Algeria was involved in the "Reglementation Thermique Maghebine des Bâtiments" (RTMB) project together with Morocco and Tunisia (co-financed by the European Commission). The project ob-

jective was the elaboration and the implementation of a "Maghreb Building Code". It was structured around 3 phases: preparatory studies, experimental validation and implementation of an appropriate regulatory framework. Only the first phase of this project has been entirely carried out by Algeria.

Egypt is hydrocarbons net exporter. The importance of its resources has not helped efficient and rational uses of energy practices implementation. This country's consumed energy ratios per GDP unit is one of the highest in the world. In 2003, approximately 20% of the total energy consumed (36 Mtoe) was linked to the building sector and 45% of the total electricity was consumed by residential and commercial buildings. A Building Code dedicated to Cairo and Alexandria regions has been developed between 2000 and 2005 in the framework of a project supported by the GEF. As of today, no application has been realised.

Jordan, despite few national resources, is heavily dependent on its imports. In 2004, the building sector accounted for 22% of the total energy consumed (4,50 Mtoe) and about 30% of the total electricity consumed. It has to be stressed that from the 1990s, Jordan has implemented a regulatory framework covering buildings thermal insulation. This Code met with obstacles during its implementation and was only very partially applied.

Lebanon is almost 98% dependent for energy. In order to face this critical situation and reduce as much as possible the energy bill, Lebanon has worked on various energy conservation programmes. The building sector was and still remains at the core of concerns. It accounts for 38% of the total electricity consumed and 19% of the total energy imported (9 TWh and about 6 Mtoe in 2003 respectively). Lebanon is also one of the rare countries to display rational use of energy in the building sector through its National communication of the United Nations Framework Convention for Climate Change. Early 2000, ALMEE (The Lebanese association for energy and environment management) in partnership with ADEME, the FFEM (Fonds Français pour l'Environnement Mondial) and the AFD (French Development Agency) has lead a pilot project for the promotion of energy efficiency in the construction sector. In the first phase, 3

demonstration buildings (3,700 m²) were completed at Zouk-Mosbeh near Beirut and, simultaneously, an investment refund mechanism dedicated to collective solar hot water production with fuel boiler support has been implemented. A one year telemonitoring campaign has been realised in some accommodations. In the second phase, 4 buildings were erected, bringing the demonstration total to 20,000 m²: 2 orphanages in the southern suburb of Beirut (refurbishing) and in Bekaa (5,000 m² in new built), a family building at an altitude of 800 m and 3 buildings of 10 accommodations supported by cooperative funding at Maghdouché near Saïda.

A regional project implemented with the Palestinian Authority and supported by the Global Environment Fund (GEF) has enabled drawing up between 2001 and 2004 a simplified and theoretical regulatory document on the buildings thermal envelope. No application has yet been realised.

Morocco is heavily dependent on its imports. In this country made up of a significant rural population using mainly biomass for its daily needs, the building sector however accounts for 25% of the total energy consumed or 11 Mtoe. Morocco has participated in the RTMB Project but, as Algeria, only the first phase has been completed. Morocco has just asked for GEF support to develop a Building Code in the residential, commercial and hospital sectors.

The Palestinian Authority is purchasing most of its energy from neighbouring countries (except a 140 MW facility recently commissioned in the Gaza Strip). In 2004, the total energy consumed represented 870 Mtoe with a share of 40% for the construction sector. Total electricity consumption stood at 356 ktoe of which 60% was dedicated to residential sector needs. Despite the regional project implemented with Lebanon and supported by the GEF between 2001 and 2004 as of today, no application has been realised.

In Syria, in 2005, 18% of the total energy consumed (approximately 18,5 Mtoe) was designed for the building sector (20% in residential and approximately 4% in commercial and public buildings) and almost 60% of the total electricity production (35 TWh) was meant for the building sector.

Over the last decade, Tunisia went from an exporter status to a net importer one. The share of the building sector in the total energy consumed has significantly increased. Between 1989 and 1999, residential sector energy demand has increased by over 20%. In 2004, the building sector accounted for more than 27% of the total energy consumed. To date, it accounts for the third consumption item and should become the second in 2010 to be the first one in 2020! A national energy management strategy has been promulgated and concrete results are under way or will soon be visible. Tunisia has participated in the RTMB Project but similarly to Algeria and Morocco, only the first phase has been brought to completion. Tunisia is implementing the second phase in the framework of an ongoing project (2000-2006) lead by the National Agency for Energy Management (ANME) and with the support of the GEF, FFEM and the AFD. This programme is aimed at promoting the design and realisation of buildings suiting Tunisian climate while saving energy through the use of high performance materials and favouring the use of renewable energies (passive and active solar energy). It also consists in experiencing a buildings thermal regulation project and favouring its adoption.

In the SEMCs, energy saving potential in the building sector is more than significant when compared to a scenario that simply continues the current trends over time. Provided an appropriate Building Code application, this potential can be estimated at approximately 20-25%, which is far from insignificant when considering the figures above mentioned.

In parallel, considering equipment, the use of energy efficiency labellisation, based on the model implemented within the EU-25, is about to be generalised. There is a real dynamic, and from now on the concerned partner countries are beginning to recommend a regional approach to bring more coherence in their own national markets. However, it is necessary to emphasise that the pay back period (a maximum of a few years for equipment that will last at least about ten years) and the financial volumes mobilised cannot be compared with those of the building sector.

In conclusion, as shown by the examples given above and even if all the Southern and Eastern Mediterranean countries have commit-

ted themselves in a regulatory approach focusing on an energy saving building, to date none of these countries has completed the whole process and no Code or Standard is really applied. This situation forces us to see with realism the barriers to overcome and that we will study in the following paragraphs.

4. THE MEDITERRANEAN BUILDING

Identified as an “eco-region”, the Mediterranean climate is characterised by a cool relatively mild season and a dry and hot summer. As a result of appropriate compromises, the traditional building has been adapted to this environment. The numerous South-South and also North-South exchanges have created an architectural response based on common principles such as strong inertia materials, the use of a patio, the recourse to a suitable insulation.

The modern Mediterranean building has departed from this model and found inspiration in a “world architecture” that has for a long time recommended and still recommends resorting to equipment rather than building envelope to obtain optimum comfort conditions (summer and winter comforts). In this context, the energy efficiency consideration, besides the explicit reference to the increasing greenhouse effect issue and its impact on energy markets, provides us with the opportunity to look back in order to recapture the not so far-off basis of the Mediterranean architecture.

Besides the loss of knowledge in the construction methods, materials used have also changed. For instance, concrete, a not very costly material, easy to use and with low maintenance, has replaced perpend and the perforated brick. Without predicting the building whole dynamic behaviour, this has actually led to a reduction in walls thickness and to an undeniable incidence on thermal comfort.

In some cases, the design itself has also been modified. The modern house is not turned inwards anymore. It is no more organised around an inner patio accessible by a kind of zigzag. From now on the house is increasingly opened towards the outside, with access to the villa through a large veranda inspired by the European pattern. Openings are larger, walls thinner, floors and slabs are made of concrete and, generally speaking, the housing thermal comfort

does not suit with the traditional construction anymore.

At urban level, in the traditional pattern, houses and buildings used to crowd one against the others, in concentric circles, providing mutual protection against wind and solar radiation. In the modern pattern, the development density is much lower with 6 to 7 m streets and houses height of 7 m and even more in stretched urban area. From now on, facades orientation follows a random pattern with far less party walls. We can underline that, in this model, the collective management of climate uncertainties (each house contributing to the external and internal comfort of the others) has disappeared to be replaced by personal management.

In the framework of a modern construction thermal improvement and, for each of the 3 region climate typologies (coast, relief and desert), we have evaluated the thermal balance component-by-component. We have, among others, envisaged insulation of opaque walls according to their positioning and orientation, openings change from single to double glazing, installation of a south protection wall (Mur trombe), double flow air renewal with exchanger and implementation of a Canadian shaft type ventilation system. Results are not as predictable and what suits one zone does not satisfy the other. For instance, in the coastal area of Beirut type, the north wall insulation should not be systematic while it is suitable whatever the season in a relief zone such as Marrakech. It is interesting to underline that options sometimes complement each other, while from one area to another they can become antagonistic. The importance of night ventilation has been reminded and should be the subject of specific care.

5. BARRIERS TO OVERCOME

Beyond the development and implementation of compulsory regulatory tools, the barriers to overcome are not always technical ones. Their exact identification and their mechanisms and networks knowledge will allow establishing jointly with the concerned players strategies likely to remove them. The objective is clearly to go beyond exemplary operations through the implementation of an appropriate framework in view of a significant market change. Barriers can be classified together under 4 large families.

5.1 Technical barrier

Designing a regulatory framework such as a Building Code requires a transverse and complete approach of the building. It requires in particular having the country complete climate zoning, good knowledge of bioclimatic building rules, construction techniques and available technologies. It is also necessary to have simple simulation and modelling tools including an iterative approach able to evolve according to the technologies progressively available on the national or international market. Modelling need is important as it will allow establishing a building "geographic" map in a given environment but also according to its use. Lastly, it is important not to overlook the "cost" component since it is a significant criterion. Being able to diagnose a building complete cost over its lifetime is one thing. Emphasizing the financial advantage expected in the long term meets the same logic, but managing to satisfy short or medium term investors' concerns is quite another story.

5.2 Institutional barrier

Generally speaking, and this remains true worldwide, construction and building sector refers to a huge number of regulatory texts depending on several decision levels (ministries, municipalities, professional associations, ...). This specifically transverse situation is undoubtedly the source of the difficulties faced by the SEMCs in the implementation of an institutional framework favourable to building consideration through all its components. We must also check if these documents, when existing, take into consideration the different building aspects and if recommendations or obligations are effectively implemented. Actually, once the design stage completed, this is during the construction phase that the observance of regulatory texts has to be controlled and, that is the reason why we need to look at the means available for the bodies in charge of their application.

5.3 Existence of a market

This is a central issue not to under-estimate. Once technical and regulatory requirements have been expressed, we have to find out whether a market exists or not. Sustainable construction requires sustainable materials. Materi-

als should be available locally, in sufficient quantity and at costs suiting the sector to reach beyond the simple niche market. For example, a regulation requiring, under certain conditions, the recourse to triple glazing with no offer existing on its own market will be meaningless. Equipment must equally be subject to standardisation and labelling process and that announced performance can be checked on the basis of a shared protocol.

One more time, the regional approach makes sense in order to encourage the South-South and also North-South export opportunities. In addition, for producers, the national markets are often too small to justify heavy investments. Let's also stress that a local production should allow developing new economic activity fields with associated new jobs.

5.4 Lack of knowledge

Generally speaking, the energy efficiency issues in the SEMCs, are not the result of an old and shared culture. Due to the region important existing resources, this point was never subjected to heavy communication. The energy sector and the sale prices on domestic market calculation structure (social rates, complex brackets tariffs...) did not favour raising awareness. To date, almost all countries are concerned by these issues, either for energy security reasons, for climate adaptation motives or for simple economic reasons. There is a real need for communication, information and training at all levels as regards public area, universities, architects, or industry or building users sector.

6. CONCLUSION

We have noted the great importance of the building sector in Southern and Eastern Mediterranean countries and the significant increase expected. Whether we are considering new or older building and even if actions to be implemented are very different, these actions have to be implemented today in order for this sector to be able to contribute positively to tomorrow's new energy and environmental stakes. In an important population growth and new energy uses context, the building as a whole has to be reconsidered. Several work axes should be favoured:

- Inform and increase awareness of public in-

- stitutions (relevant ministries), companies and private sector operators (architects associations, developers and banks);
- Contribute to the development of suitable policies (regulations and decision-making tools) in financial and fiscal fields, on technical aspects with, among others, the development of specifications and the implementation of approval/certification procedures and of construction minimal energy recommendations or even for adapted Building Code;
 - Identify and support pilot operations/initiatives carried out in strong demonstration potential areas;
 - Implement pilot operations and also existing buildings monitoring and carry out comparative assessments on each approach advantages;
 - Draw up and implement specific training programmes. As much as possible, existing training programmes will be used, supplemented and/or adapted favouring as much as possible a regional approach allowing multiplying their effects and gaining expertise;
 - Favour North-South and also South-South know-how transfer, from building design to the choice of technologies to be used and encourage professionals networking work (exchanges in technical fields and also in marketing, maintenance and after-sales services fields).

In addition to the promotion of a sustainable building, this Action Plan should allow reducing this sector's impacts on environment and, more particularly, the coastal area with heavy concentration.

Architectural heritage knowledge should be enhanced. And, even if new data is required, the stake for now on is to imagine a modern building that could benefit from the expertise and the know-how gained by the ancients while using technologies and efficient and simple processes to multiply the projects number while also working towards unit costs reduction.

Even if, at first stage, new building seems easier to deal with through an appropriate regulatory context, the low housing stock turnover rate and the building's lifetime also lead us to take a look at the existing park and at older building refurbishing.

Beyond national approaches to reinforce, re-

gional one remains an excellent sharing and capacities strengthening place. New projects created synergies and expected results will be determinant to focus next actions programmes that will be implemented by funders. To achieve this purpose, the quality of the existing partnership arrangements or the ones to be elaborate will be crucial. These actions must allow going beyond the demonstration project stage, as it used to be in the past. Each decision level, political, technical or financial, will have its part to play. National agencies in charge of energy management in Southern and Eastern Mediterranean countries as well as neighbouring countries have a crucial role to play in collaboration with their national and international usual partners (Ministries in charge of infrastructures, national and regional planning authorities, tourism and finance, architects and engineers orders, professionals associations from the building industry, developers, engineering offices, financial institutions, training organisations, ...).

Lastly, it is essential to implement a definitively innovative approach. Changes in political options through an appropriate regulatory framework associated with control means and effectively implemented. Changes in technical options to encourage via an adapted aids system and finally, changes in the way of understanding building from its design to its completion without overlooking its operation impact during its lifetime. On the basis of this common thinking, we need to lay the foundations for an ambitious policy and a building, which could be called "*Sustainable Mediterranean Building*".

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