

Cities and Buildings

MOHAMMAD AL-ASAD
TAREQ EMTAIRAH



This chapter examines the opportunities and benefits that can be made available to city residents in Arab countries by promoting green buildings and cities. The subject is discussed at both the micro and macro levels, addressing the individual building as well as the city.

The promotion of green practices in cities concentrates primarily on limiting energy and water consumption. Reducing energy consumption through energy efficiency and more sustainable practices should and can be achieved by taking a number of measures aimed at avoiding pollution, enhancing the quality of life, and accommodating and even encouraging economic growth.

Most of a society's energy consumption takes place in the city. Energy use statistics vary from country to country, but energy consumption for the upkeep and running of buildings as well as for urban transportation takes up over half of the total energy consumption in the city (UNEP, 2011a). Another quarter of that energy consumption is taken up by industry (UNEP, 2011a). Any measures that curtail energy consumption, while maintaining productivity levels and controlling costs, will greatly enhance overall economic performance.

Promoting green practices in buildings and cities involves a wide range of activities. These include developing energy-efficient, non-polluting transportation systems as well as energy-efficient building practices, water-conserving open green areas, and renewable energy resources. They also include rethinking the concept of waste management to incorporate extensive recycling and water treatment. Water, transportation, agriculture, energy, and waste management will be discussed in separate chapters in this report.

In addition to instating new technologies and practices, there is a need to formulate appropriate legal and administrative frameworks. These would empower and encourage city residents, as well as municipalities and other public institutions involved in managing urban centers, to adopt and promote green and sustainable buildings and urban systems.

Promoting green practices in buildings and cities does not need to reinvent the wheel, for there is much to learn from practices deeply rooted in the region's heritage. New technologies, processes,

models, and frameworks will certainly have to be devised. However, it should be noted that traditional patterns of urban living and building construction prevalent in the Arab world (and elsewhere) generally have followed what would qualify as green practices. This has continued to be true even into the modern period, as late as the 1970s. Examples are found in urban transportation, energy consumption in buildings, water consumption, and waste generation. People had very limited resources available to them, and they therefore used these resources in the most efficient way possible. Increased wealth in the region has destroyed this ethic of conservation. An illusion of endless abundance of resources prevails; energy today is splurged, and the wasteful consumption of resources has become the norm.

Most of the Arab world, however, has reached a stage where current practices are no longer sustainable. The trend of increasing oil prices over the long term is making it impossible to continue with present rates of energy consumption, at least in countries that do not have significant oil reserves. Moreover, environmental degradation has reached alarming levels. Air, water, and soil pollution and contamination now pose serious health risks and threaten various economically important activities, particularly those related to food production. Valuable and scarce agricultural land is being destroyed by excessive urban sprawl and the uncontrollable building activity it brings with it. Solid and liquid waste is being indiscriminately dumped on land in and around cities and in water bodies. The size of a number of cities in the Arab world has reached unmanageable levels. In addition to suffering from the chaotic land-use patterns as well as the unsafe and shoddily-constructed structures that accompany such unregulated growth, Arab cities have to contend with overwhelming traffic congestion. Movement in cities often comes to a standstill, rendering them dysfunctional.

This chapter identifies the challenges that need to be addressed and the opportunities that are available to promote green and sustainable buildings and cities. It discusses existing conditions, and it projects possible scenarios and solutions. Achieving greener buildings and cities in the Arab world is not only a rational way forward, but it is also a necessity. This chapter explores possibilities for achieving this goal and making it a reality.

SECTION ONE: CITIES AND URBAN PLANNING

I. INTRODUCTION

The Arab world generally has invested considerable resources in construction activities. This was especially the case during the oil boom period of the 1970s and 1980s, as well as that extending from 2003 to 2008. Since many of the projects planned during these periods are large-scale and long-term, construction has continued well beyond the period during which oil prices have gone up. Accordingly, although the construction boom of 2003 to 2008 has somewhat subsided as a result of the 2008 financial crisis, many of the large-scale projects that were initiated then are still under construction, and will continue to be for some time.

Most construction activity takes place in cities. Even large-scale projects taking place outside cities are often intended to serve cities, particularly with infrastructure works such as highways, airports, sewage treatment, and power generation plants. There are currently numerous projects to develop new urban centers, often from scratch. For example, new cities are being constructed in Jordan, Saudi Arabia, and the United Arab Emirates (UAE). These include the King Abdullah City next to Zarqa, Jordan, the King Abdullah Economic City and the Jazan Economic City in Saudi Arabia, and Masdar City in Abu Dhabi. The degree to which green practices are incorporated into such building and urban development activities will have a great impact on the rate at which the greening of Arab economies may be achieved.

II. IMPLICATIONS OF CURRENT URBAN CITY POLICIES

Arab countries, like other developing world countries, have, over the past few decades, experienced extensive growth of their major urban centers, particularly their capital cities. These cities have come to fully dominate the political, cultural, and economic life in their respective countries, usually to the detriment of other urban centers. Many have emerged as mega metropolises, housing a huge number of residents. Exact statistics are often hard to find,

but it is clear that the major cities of the Arab world continue to undergo excessive growth. Conservative statistics place Cairo's population at over 12 million (while many other estimates place it closer to 18 million). The populations of metropolitan centers such as Baghdad, Khartoum, and Riyadh have surpassed the 5 million mark. Others, such as Alexandria, Algiers, Amman, Casablanca, Damascus, and Jeddah, have populations that exceed 3 million inhabitants¹ (ESA, 2008).

The rapid growth of these cities has had numerous negative consequences. They have grown so quickly that their infrastructure systems, whether those related to transportation, water and electricity supply, or waste management, have all become incapable of adequately supporting their populations. For example, many suffer from municipal solid waste management problems. This is most clearly evident in Cairo, where city-wide efforts for solid waste management have become more or less dysfunctional (DNE, 2010). Interestingly enough, a considerable amount of the solid waste generated in Arab cities results from construction and demolition work. Some estimates indicate that such waste accounts for over half of the overall waste generated in countries of the Gulf Cooperation Council (GCC) (Khaleej Times, 2011). Infrastructure problems extend even to oil-rich countries in the region. The rapid construction boom in cities like Dubai, Jeddah, Kuwait City, and Riyadh was not matched by a proportionate growth in infrastructure development, as manifested in raw



sewage sweeping coastal beaches, or rainwater flooding streets (AFED, 2008).

The various infrastructure problems in Arab cities create conditions of considerable inefficiency in energy consumption, particularly relating to urban transportation. Mobility in these large cities is heavily impeded by congestion and poor planning. For many, a good part of the day is wasted in traffic rather than being spent in more productive activities. Air pollution levels have become extremely high in the Arab world's larger cities. Most of that air pollution comes from vehicular emissions. Other sources include emissions from the heating and air-conditioning of buildings and from industrial facilities. Traffic

also contributes significantly to noise pollution in those cities.

Cities suffering from such problems are not able to effectively compete with other world cities where growth is better managed, waste is efficiently and extensively recycled, public transportation is efficient, and other infrastructure systems function properly. Prevalent environmentally destructive practices result in various negative consequences for urban residents, including increased health problems, reduced productivity, the pollution of water resources, and the erosion of infrastructure networks.

Also of relevance is the lack of access to adequate

FORTIMO LED STREET LIGHTING IN EINDHOVEN

Located in the south of the Netherlands, Eindhoven is emerging as an energy-saving city. It has long been known as *Lichtstad*, or the "city of light," due to the presence of Philips headquarters since 1891. The local municipality decided to become an environmental leader by replacing existing lamps with light-emitted diode (LED) technology, without sacrificing cost, functionality, or aesthetics.

The municipality introduced the Fortimo LED light technology to its public streets. Unlike traditional LED lighting suitable only for narrow streets, the Fortimo modules can be used for residential streets up to 10 meters in width.

The pilot project recently kicked off in Eindhoven by replacing five luminaries with Residium luminaries fitted with Fortimo LED light modules. The local authority noticed a considerable difference, as the newly installed luminaries produced soft white lights with perfect color rendering compared to the orange color produced by the old high-pressure sodium lamps. The new LED lights performed better.

With a 30-watt light source, the Fortimo seems to produce just as much light as a 50-watt high-pressure sodium lamp. The old lamp consumed 70 watt when used in combination with ballast. This replacement has generated energy savings up to 57% for the municipality, not counting the longer lifetime of the new LED lighting modules. With a lifetime of 50,000 burning hours, the Fortimo lasts three times longer than its predecessor. In comparison with the PL-L lighting used in several parts



of the town, the Fortimo module achieves about a 20% energy saving.

Reducing carbon dioxide emissions is another target set by Eindhoven's municipality. The municipality will soon install 51 Fortimo modules in the *Ministerlaan*, reducing CO₂ emissions by 3.5 tons. This is equivalent to saving a forest the size of a football pitch.

The pilot project demonstrated that investing in energy-saving lighting technology generates cost savings that will offset the higher initial capital cost, while gaining environmental benefits and improved lighting performance.

http://www.lighting.philips.co.uk/subsites/oem/projects/casestudy_ministerlaan.wpd

housing in cities in the Arab world. Land prices and construction costs have reached levels that make them beyond the financial means of many, even those with long-term gainful employment. This lack of access to decent-quality affordable housing has contributed to the spread of slum areas (usually euphemistically referred to as “informal settlements”), characterized by inadequate - if not absent - basic services and by ambiguous conditions regarding land tenure. Slum areas are environmental blights where systems for solid waste management or sewage treatment are painfully lacking. These problems even exist in the cities of the Arab world’s most affluent countries, where large numbers of migrant workers usually live in poorly planned, built, and served districts (Allen, 2009).

In contrast to the spread of informal settlements that serve the poor of the city, privately managed gated communities and expansive suburban developments are becoming increasingly widespread to serve affluent residents (ElSaiyyad, 2011). These are located at a distance from the city center. In addition to emphasizing conditions of socioeconomic segregation in cities, these low-density developments further contribute to urban sprawl and further expand the geographic limits of the city to unhealthy levels. Such urban sprawl means that various urban services, such as transportation networks, the supply of water and electricity, or waste management systems, need to cover larger low-density geographic areas, resulting in inefficient and poorly-functioning infrastructure systems.

Public green areas, which serve as the city’s breathing spaces and essential places for relaxation and leisure for its inhabitants, are very much lacking in Arab cities. In the United States, for example, most cities feature 20-40 square meters of green areas for each inhabitant (Loukaitou-Sideris, 2006). In Dubai, where there have been serious efforts to develop public green areas, the figure remains at less than 14 square meters (Construction Week, 2010); in Beirut, it is less than one square meter (Slemrod, 2011). In addition, water-conserving landscaping concepts are generally absent from existing public green areas.

Water resources have been considerably mismanaged in urban centers as a result of

uncontrolled urban growth. Rivers, streams, and underground aquifers have been heavily polluted or overused, and wastewater is often left untreated. Even the most affluent cities in the Arab world, such as Dubai and Jeddah, have been facing problems related to sewage disposal and treatment. The lack of efficient sewage disposal networks has meant that sewage is often illegally dumped, usually making its way to city streets or coastal waters (Keyrouz, 2008).

Numerous ecosystems and agricultural land in and around Arab cities have been destroyed as a result of uncontrolled urban growth. Agricultural land, forested areas, grazing areas, and water bodies such as streams have all been viciously decimated because of such growth. This is clearly evident in the loss of agricultural land and green areas around cities such as Amman, Beirut, Cairo, and Damascus.



These agricultural and green areas supplied cities with food, tempered its climate, and provided cities located near arid zones with protection from dust storms. Moreover, the Amman Stream that traditionally used to run through the city became an underground sewer conduit. The famed Barada River of Damascus only has a trickle of water running through it during the dry season, and it often resembles an open-air sewer conduit. In the cities of the GCC countries, desalination plants and the construction of massive human-made islands are having disastrous consequences on existing marine ecosystems in the Gulf waters (Dickie, 2007).

There are also tremendous inefficiencies in energy consumption, which pervade all sectors and city activities, particularly in the oil producing countries of the GCC, which feature some of the highest per capita energy consumption levels in the world (WRI, 2007). This is partly a result of the region's high temperatures and high humidity levels, which are addressed by the extensive use of energy-guzzling air-conditioning systems. Moreover, wealth has created a culture of excess. Private car ownership is very high, and private cars dominate movement in cities of the region. These cities are also marked by an abundance of high-water-consuming landscaped areas. The significant amounts of water required for these landscaped areas are secured through desalination. Imported species of plants are widely used, which require vast amount of water and are not suitable for desert condition. As mentioned above, these cause considerable damage to surrounding ecosystems. The "waste" water resulting from desalination activities, with its high levels of salinity, is dumped

into the sea, thus decimating existing marine life. Moreover, desalination plants consume energy intensively and result in considerable air pollution. Although it is possible to keep up such practices in the Gulf region - though with high environmental costs - as long as oil is abundant, they will come to a crashing halt once oil runs out.

All these challenges bring with them significant economic costs and inefficiencies that place serious pressures on the economies of Arab countries.

III. ENABLING CONDITIONS FOR GREEN CITIES

A new approach is needed for city planning and governance, built on environmentally sustainable urban design principles and community participation. Enabling policies and conditions should be introduced with an eye on protecting agricultural and green areas in and around cities, guarding natural water resources, creating well-functioning public transportation systems, constructing energy-efficient buildings, adopting efficient water use, and putting in place efficient waste management systems. Such practices will guarantee that energy and water resources are managed sustainably, food is produced in proximity to the city or even in the city, clean water is more readily available for various uses, and that services meet inhabitants' needs. These efforts will create healthy and economically competitive urban communities that offer a higher quality of living for their inhabitants.

A. Zoning

One of the most effective urban planning policies for city and municipality administrators is zoning. Fundamentally, zoning consists of regulations that determine what may be built where in and around the city, and how much may be built. It is an essential urban planning tool that can be used to (re-) configure cities in a manner that supports energy efficiency, environmental protection, and greater sustainability. Zoning needs to be coupled with other relevant urban management instruments in order to provide incentives for change. One such instrument is taxation. For example, property taxes or property



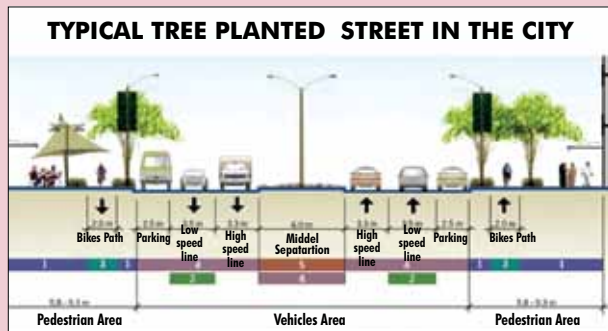
ABU DHABI'S FUTURISTIC STREET DESIGN

The Abu Dhabi Urban Planning Council (UPC) has adopted new street design standards that accord with the guiding principles of the "Vision 2030" which seeks to offer safer, more comfortable, and aesthetic streets throughout the Emirate. "The Urban Street Design Manual" stipulates that all street designs should give priority to satisfying the needs of pedestrians, ensure universal access, and meet the environmental sustainability requirement embraced by the "Estidama" initiative launched by UPC.

The Manual complements the Abu Dhabi transit infrastructure components as per the "Vision 2030" which is designed to enhance the quality of life in the Emirate. This approach shall also be applicable to other development projects supervised by UPC, including waterfronts, community and sports facilities, natural environment, cultural heritage, and revitalization strategies.

The Manual has been released for the purpose of reducing individuals' reliance on private cars for commuting by establishing a public transit network that includes high-speed rail, trams, and buses. Moreover, a network of new streets and retrofitted existing ones to accommodate various means of transport shall make Abu Dhabi a safer and more suitable place for pedestrians, bikers, and public transit commuters. The new design standards shall be applicable to all streets of the Emirate except freeways and rural arterial roads.

The Manual supplies designers with the necessary tools for ensuring that all the components of the area between the pavement and the facades of buildings are in the right place and have the right size. Pedestrians shall have unobstructed sidewalks and due care shall be given to the placement of street lights, traffic signs, utility boxes, benches, and trees.



Following the guidelines of the Manual will render the appropriate design of streets in relation with their surroundings. For example, streets lined with shops shall have wide and better shaded sidewalks that are distanced from the traffic lanes. In addition, there shall possibly be sidewalk cafes and some trees.

On the other hand, streets in residential neighborhoods shall be designed for low traffic speed with safe pedestrian crossings to encourage residents to walk to local services, and to provide quiet family environments.

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sales taxes may be increased or decreased in order to influence development patterns and urban activities. Taxation may be used to encourage green growth in certain cities in a given country while slowing growth in other cities where it has reached unmanageable levels.

Before presenting how zoning may achieve this, a few remarks should be made about maximizing the effectiveness of zoning regulations. They need to be carefully developed to suit local realities such

as available lot sizes in the city, topography, and climate. Zoning must give significant consideration to the preservation and protection of structures and neighborhoods that possess a rich cultural heritage. Moreover, for regulations to be effective, available human resources must be involved in urban management. Competent personnel are required to ensure that urban regulations are implemented and enforced. They also need to be up to date regarding developments in the field of urban planning and the urban management tools it offers.

THE ARAB ORGANIZATIONS BUILDING IN KUWAIT: AN EXAMPLE OF MODERN ECO-FRIENDLY ARCHITECTURE

Among glass high-rise buildings that have invaded the Gulf countries stands a unique building in Kuwait: the Arab Organizations Headquarters Building, a model of modern environmentally-friendly construction. The building, which is home to the Arab Fund for Social and Economic Development, adapts the traditional Arab house design which is built around a courtyard. Therefore, all the offices in the building overlook the spacious central courtyard which carries nature inside. The splendor of the interior is not reflected on the exterior of the building which is seen from a few kilometers as a massive cube of gray granite covering 54,000m², and dotted with deep slanting openings on all sides.

As you enter the building, which was completed in 1994, you feel like swimming in the light. You do not feel any draft blowing from air conditioners, nor do you feel any disturbing heat. Special insulation and lighting systems have created, inside the building, a temperate and comfortable environment. This eco-friendly building consumes less than half the quantity of energy used in any other glass building of the same size. In addition to having all these environmental qualities, the building is an embodiment of modern architecture with all its advanced technologies.

Upon entering the building, a visitor is overwhelmed

by its grandeur, extensive dimensions, and lofty heights. One can sit calmly for hours in the waiting room with nothing to hear but the trickle of water from the fountain and nothing to see but stunning scenes around. Attention is immediately drawn to the left side where there is a great waterfall over a Moroccan, light-colored, hand-made mosaic wall.

On climbing the marble stairs that lead from the Moroccan waiting room to the first floor, one would start to hear a melody coming from above mixing the twittering of birds with the gurgling of water. Once on the first floor, your eyes are caught by extended greenery, bright light and ample space. This is the building's main courtyard, an architectural feat manifesting both artistry and power.

Walls and partitions on all floors are made of glass, making it possible for anyone standing at one end of the building to look through to the opposite end easily.

A critical design challenge was to exclude excessive exterior heat while retaining natural light. This was achieved after a careful study of the sun's rays that reflect on the building throughout the year. The windows were designed in directions that do not allow direct sunlight into the building, and artificial lighting was made in a

Municipal staff as well as others involved in urban management should be able to resist pressures from special interest groups who may attempt to manipulate zoning regulations. Zoning interventions are often accompanied by fierce lobbying from entrenched economic interests. Such lobbying may even take the form of corruption. This is not surprising considering that most zoning regulation will have a considerable impact on real estate values. Real estate owners and developers will lobby to ensure that zoning regulations will not adversely affect the value of their properties, and will push for regulations that increase these values. City governance must hence have adequate mechanisms, such as transparency and accountability, put in place to allow municipal staff to resist such pressures and to provide effective controls that keep excessive building activity in check.

It is essential to assess the economic, social, and environmental impacts of proposed zoning regulations. For example, zoning regulations will greatly influence the intensity and distribution of economic activity taking place in various parts of the city, and will direct economic activity to certain localities and away from others. One issue to be taken into consideration under such circumstances is to ensure access to transportation for those who will seek employment in areas of increased economic activity. If such access is not readily available, both the business owners and workers will be adversely affected. Places of work that are not easily accessible from where people live provide somewhat similar conditions to situations where there is a shortage of work opportunities.

Moreover, care should be taken to ensure that zoning regulations will not negatively affect



way that gives daylight effect without shades. The glass wall of the courtyard is unobstructed from the north to allow light in while blocking direct sun rays.

The concept, design and execution of the Arab Organizations Headquarters Building is a striking

proof of the success of employing modern architectural techniques adapted to local environments at an age when imitation and copying prevail.

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<http://www.arabfund.org/aohq/KUWAIT.HTM>

existing social structures. For example, allowing the construction of high-rise buildings within a low-rise neighborhood, or allowing new types of activities that bring in a large number of people into a neighborhood, may have negative social impacts on the neighborhood. Such zoning interventions will bring in much higher population densities and activity than the neighborhood may be able to accommodate.

Zoning regulations can also have very strong environmental implications. In fact, zoning is a basic tool for protecting agricultural land and green areas since it can prohibit any substantial building activity from taking place there. Unfortunately, the area of agricultural land that has been lost to urbanization over the past few decades in Arab countries has reached tragic dimensions. The least that may be done at this stage is to stop this bleeding of agricultural land

and green areas by imposing strict enforcement and compliance procedures.

B. Zoning regulations and urban density

Within built-up areas, the best way through which zoning may help achieve more sustainable cities is by promoting healthy densities and environments. Zoning regulations should allow residential, commercial, office, educational, cultural, public, institutional, and recreational uses to exist in close proximity to each other. Neighborhoods would offer their residents a degree of autonomy by featuring numerous facilities, such as schools, shops, office space, and parks. This would allow inhabitants to satisfy most of their daily needs without having to travel long distances. This should be accompanied by increased pedestrian accessibility. Urban density allows city residents to live within walking distance

ARZ GREEN BUILDING RATING SYSTEM

Samir Traboulsi

The ARZ Building Rating System is the first Lebanese green building initiative of international standard with its certification process being administered by the Lebanon Green Building Council (LGBC). It has been established to support the growth and adoption of sustainable building practices in Lebanon, with a specific focus on the environmental assessment and rating system for commercial buildings. For each credit, the ARZ Green Building Rating System identifies the detailed intent, requirement, technologies or strategies to achieve the credit.

Unlike other international rating systems, the ARZ Green Building Rating System was developed by Lebanese expertise of LGBC in partnership with the International Finance Corporation, (IFC), a member of the World Bank group.

The dramatic continuous electricity shortages, energy prices, and unavailability of other resources like water, prompted the development of the ARZ Building Rating System. Its aim is to maximize the operational efficiency and minimize environmental impacts. It is a certification on the existing building operational performance. Property owners and managers will drive their operational cost down while increasing occupant productivity in an environmentally friendly manner.

Just before the launching of the Rating tool event in June 2011, the Lebanon Green Building Council provided an extensive number of training hours, and candidates who completed the credentials were certified. Assessors are experienced building industry practitioners who have demonstrated their knowledge of the ARZ rating system certification process.

The Order of Engineers in Beirut was the first registrant requesting the ARZ BRS assessment of its headquarters. Two other reputable building owners are now processing

and preparing for the delivery of the documentation requirements to initiate the assessment task. Building owners are convinced that certified and rated buildings will attract higher occupancy rates, higher rents, and an increase in buildings' values. Using this tool enables building teams to focus on sustainability, gives them options when considering capital improvements or implementation of best practices, and allows them to benchmark and rate the benefits of various building attributes and procedures.

The rating process will provide an automatically generated report that can help to evaluate opportunities to benefit from energy savings, reduced environmental impacts, integrated corporate goals and practices, and lower costs for maintenance.

Certified assessors are asked to sign the ARZ BRS Code of Ethics and are requested to adhere to its contents with no allowance for any conflict of interest, whether apparent or not. Owners on the other hand are entitled to file an appeal if certain credits are denied, and ARZ BRS will be responsible to resolve such claims within a defined period.

A board of Trustees formed from key stakeholders in the Building industry in Lebanon will monitor and supervise the operation and performance of the ARZ BRS unit.

Benefits expected from the certifications range from getting solid data that supports the productivity assertions, energy cost and environmental footprint, and to establish baseline data on present energy and water consumption in all buildings in Lebanon. Owners will have open windows for exploring low interest financing and for exploring grants funding and accessing available incentives as provided by the Lebanese banks.

Dr. Samir Traboulsi is President, Lebanon Green Building Council (LGBC)

to many of the services they use regularly, and also to public transportation systems, thus minimizing the dependence on cars.

Urban densities are marked by having a significant number of people occupy buildings in a given area in order to achieve economies of scale. This would allow for a more efficient provision of various

urban services, whether related to transportation, utilities, or waste management. This depends not only on bringing together a significant number of people in a given area, but also on allowing residential, commercial, office, educational, cultural, and recreational centers to co-exist in proximity to each other in order to allow for easy movement between them. In other words,

urban density levels depend on promoting multi-use zoning practices rather than single-use ones. According to single-use zoning practices, complete urban areas would be reserved for one use, such as residential, commercial, or public. Such an arrangement forces people to travel considerable distances from one area to the other, as with the daily travel between places of residence and work. It also creates conditions where these areas are used only during parts of the day or during certain days of the week, rather than on a continuous basis. Single-use zoning therefore, results in a highly inefficient use of the city, where considerable energy and time is wasted on commuting.

In contrast, multi-use zoning allows for a continuous use of a given area in the city and minimizes the need for commuting. One arrangement that well expresses the spirit of multi-use zoned areas is the building that includes retail shops, office space, and residential units. Such an arrangement allows people to live, work, and shop in the same area.

There are many views on what constitutes healthy density levels, and there are no magic numbers. However, building arrangements featuring 100 residents and jobs per 1,000 square meters of land provide an acceptable high-density level² for central urban areas (UNEP, 2011a). Of course, it is imperative that areas with high density include adequate urban services (public transportation, utilities, waste management) and green open spaces. Otherwise, high density merely becomes a case of overcrowding.

Another advantage to high-density arrangements is that they help achieve better levels of energy conservation in buildings. In a high-density urban area, such as one that includes apartment buildings, individual units shield each other and therefore require less energy for heating and cooling. This is because an apartment is bordered by other apartments from the top, bottom, and sides. In contrast, in a low-density area, as with single-family housing, each individual house is open to the outside environment from all sides. High-density zoning regulations that allow buildings to reach a certain height also provide the street with protection from the heat of the sun. Higher buildings allow nearby streets to be more easily shaded, thus easing and encouraging pedestrian activity.

High-density levels already exist in many cities throughout the Arab world. Such density levels, however, need to also satisfy certain requirements. They should exist in multi-zoned areas, where residential, commercial, office, educational, cultural, and recreational activities are allowed to take place in proximity to each other in order to allow for easy movement between them. They also should be provided with adequate infrastructure services, including green public areas and good quality public transportation.

On a related matter, telecommuting and web-based commercial and government services should be actively promoted. As people are increasingly able to carry out different activities and access various services, whether commercial (payment of bills or delivery of goods) or governmental (payment of fees or renewal of documents), via high-speed data exchange networks, they can limit the trips they have to make outside their homes. This brings about numerous benefits similar to those brought about by increased density, including reduced traffic congestion, reduced energy consumption for transportation, and a more productive use of time.

In order to maintain healthy densities, it is imperative that building sprawl is kept in check. Sprawl of course is connected to both natural population growth and to populations migrating into cities. Controlling sprawl partly depends on effective urban management, as with zoning regulations that promote high densities, or the availability of adequate public transportation. It also depends on other public policy interventions that are not directly connected to urban planning, such as promoting family planning measures, and also improving economic opportunities and the quality of life outside major urban centers.

C. Mobility in the city

As mentioned above, high-density urban areas need to be coupled with efficient public transportation systems that facilitate movement between different parts of the city. Although transportation is addressed in a separate chapter in this report, a few remarks still need to be made here about the subject due to its intimate connection to urban density. High urban densities allow for public transportation systems to be more cost effective. High densities create economies of scale and allow public transportation systems to serve a significant



number of people in relatively small areas more easily. In contrast to public transportation vehicles, such as buses and trains, a privately owned car uses up considerable space for parking and movement in comparison to the number of people it accommodates. A private vehicle can take up an area of about 8 square meters, it is empty when parked, which is most of the time, and very often is occupied by only one to two persons. The ubiquity of private automobiles provides for a highly inefficient use of scarce and valuable urban space.

Increased attention has been given to public transportation systems in Arab countries, particularly over the past decade, and in some cases before that. So far, only one Arab city, Cairo, has a subway system. This is not surprising considering the exorbitant costs of building a subway system. The Cairo subway was inaugurated in the 1980s, and is undergoing continuous expansion. Alexandria and Tunis have had light rail metro systems since the colonial period. A metro system has been inaugurated in Mecca in 2010, while a metro network is planned in Abu Dhabi. Rail systems are being planned for other Arab cities including Algiers, Casablanca, Doha, Kuwait,

Manama, Oran, Rabat, and Riyadh. In Amman, a Rapid Bus Transit system that depends on dedicated bus lanes is currently under construction.

The rail metro system that has been receiving the most coverage is that of Dubai. This is partly because of the considerable resources provided for its development, and partly because Dubai, for better or worse, has emerged as an urban model that is being carefully looked at and emulated in the Arab world and beyond. It remains early to judge the effectiveness of the Dubai Metro considering that it was only inaugurated in 2009 and that only two of its lines are operational at this stage. Moreover, private car ownership plays a very central role in the lives of the residents of Dubai, and it is unclear to what extent they will embrace public transportation. Still, it should be noted that the system already serves a number of Dubai's most important destinations. Those who live and work in proximity to a metro line in Dubai can easily live in the city without owning a car.

There is also a very pressing need to make Arab cities pedestrian friendly, and even bicycle friendly where appropriate. The dominance of private

MASDAR CITY IN ABU DHABI

Mohammad Al-Asad

Masdar is a new planned city conceived by the Government of Abu Dhabi and is intended as a zero-carbon, zero-waste community. The city project, which is expected to cost under \$20 billion, is currently under construction with completion of the first phase scheduled by 2016, and the final build-out by 2020-2025.

Part of the project plan is to attract clean energy technologists, consultants, entrepreneurs, and investors to make the city “the silicon valley for clean, green, and alternative energy.” The city will host the International Renewable Energy Agency (IRENA). This championing of renewal energy technologies is part of an effort aimed at diversifying Abu Dhabi’s economy away from a heavy dependence on oil exports into one that is industry and knowledge-based.

The new city is located seventeen kilometers to the east of Abu Dhabi City. It will occupy a six square-kilometer site and is intended to accommodate 90,000 people (50,000 inhabitants and 40,000 commuters). As a large-scale settlement designed from scratch, it allows for incorporating ideas that would not be feasible in existing urban settlements. The whole city, for example, is raised 7.5 meters above ground level so that infrastructure services, such as transportation, would be accommodated inside that raised base.

The city’s buildings are placed close to each other to create narrow shaded walkways. These are oriented diagonally from the four cardinal directions to reduce the effects of direct sunlight. Their architecture incorporates traditional passive features such as wind towers and various shading devices. Cars will not be allowed in the city, but will have to be parked at its periphery. Mobility within Masdar will be through mass public transit and personal rapid transport systems or through walking. Its compactness allows for walking distances to be kept to a minimum. Masdar will rely on alternative energy resources including solar, wind, and geothermal, and will include a hydrogen-fired power plant. In addition, its solid and liquid waste will be recycled.

Masdar City has been the subject of considerable controversy. Critics of the planned city have focused on



its exorbitant cost and its full dependence on foreign, rather than local, inputs. It is argued that the high costs of many of the energy saving solutions being developed for Masdar make them uneconomical to implement on a wide scale. Accordingly, it is an unsustainable project that very well may become symbolic.

On the other hand, arguments in support of the project state that it is necessary to devote substantial financial resources to a pioneering project that is intended as a prototype, and that much of these resources are needed for the research and development activities. As the project is realized, developed, and tested, it will be possible to reproduce the solutions incorporated in it on a large scale and in a cost-effective manner, and to widely replicate and adapt them elsewhere.

Mohammad Al-Asad is Chairman, Center of the Study of the Built Environment (CSBE), Amman.



cars has reached excessive levels. In most cases, there is a shortage, if not absence, of functional sidewalks. Pedestrians are often unable to cross streets with heavy or fast traffic, thus making pedestrian accessibility extremely limited, and often nonexistent. This further strengthens the dominance of the automobile in the city. Increased pedestrian access in the city has multiple advantages, including lowering air pollution levels, allowing residents to lead healthier lifestyles, lowering transportation costs, and encouraging higher levels of direct engagement between the public and service centers. Alternative modes of transportation in the city such as cycling should also be actively encouraged. This will greatly depend on making available dedicated bike lanes, as being planned for Abu Dhabi.

D. Urban management systems – at the local, metropolitan, regional, and national levels

These various interventions are partly constrained by existing policies affecting urban management in Arab countries. Different urban centers, and even different neighborhoods, have their own specificities, and there is no “one size that fits all.” Each has its own socioeconomic and geographic characteristics. Residents and users of different areas within the city should have a say in the manner in which they are administered. This requires giving elected city councils significant authority in running the city and promoting mechanisms that ensure that municipal institutions and their staff are responsive to the needs of their residents, and are also accountable to their constituency. Such responsibilities will make it easier for

neighborhoods and districts to function as autonomous, multi use areas that satisfy the various daily needs of their inhabitants.

Gradually, municipal elections are becoming more widespread in Arab countries. Municipal elections have been held in a few countries that have never had municipal elections before, such as Qatar and Saudi Arabia, and ones that have not had them for over half a century, as is the case with Bahrain. It remains to be seen how much authority these elected municipal councils will have, and how responsive they will be to the needs of city residents at the micro neighborhood level.

Many urban decisions should clearly be made at the local, rather than the metropolitan or national levels. However, one cannot ignore the fact that certain aspects of urban management, such as waste management, urban transportation, or the provision of infrastructure services, depend on economies of scale and need to cover metropolitan urban areas as a whole. This requires considerable coordination between various urban districts within a given metropolitan center.

In addition, certain overall urban planning policies and strategies will still need to be developed at the regional and national levels. These include encouraging growth in certain regions, and protecting agricultural or natural areas from being taken over by settlements. In Saudi Arabia, current national urban planning efforts emphasize creating a series of development corridors that run East-West and North-South in the country. These efforts call for further development of existing medium and

CENTRAL BANK OF LEBANON GOES GREEN

Pierre El Khoury

The Central Bank of Lebanon (BDL) is subsidizing green loans, which consumers can apply for at an affordable interest rate of about 2% over the cost of funds. Managed by commercial banks, the loans were initially meant to support eco-friendly industry and agriculture, but have been extended to support green construction, eco-tourism, and even the renovation of existing facilities to preset environmental standards. To broaden the scope of the initiative, BDL and the United Nations Development Program (UNDP) have agreed to establish the National Energy Efficiency and Renewable Energy Action (NEEREA) to finance energy efficiency, renewable energy, and green building projects across Lebanon.

To facilitate collaboration, BDL and UNDP signed a Memorandum of Understanding (MOU) on June 14, 2010. Using the MOU as a framework for cooperation, BDL and UNDP seek to bring in international donors and organizations to support NEEREA. The two bodies will also organize awareness-raising and capacity-building programs targeting Lebanese commercial banks and consumers to promote energy efficiency and renewable energy projects.

To facilitate loan processing, NEEREA will develop a set of criteria to assess the technical eligibility of green loan applications. These criteria will be used to provide technical validation and certification to potential green projects submitted to BDL through the Lebanese Center for Energy Conservation (LCEC), hosted at the Ministry of Energy and Water.

In parallel, the European Union has signed a €15 million grant contract with BDL and the soft loan program Kafalat, geared at providing financing to small and medium size enterprises (SMEs) that want to invest in energy efficiency and renewable energy technologies.

NEEREA is expected to leverage investments in the range of US\$500 million in the coming few years in order to finance projects with interest rates as low as 0% and repayment periods reaching 14 years, with variable grace periods.

Pierre El Khoury is Project Manager, Lebanese Center for Energy Conservation, Lebanon.

small-sized cities along these corridors. The cities located along each corridor are within reasonable distances from each other, and all have suitable infrastructure services related to road, water, sewage, and electricity networks. Such networks allow them to easily accommodate additional growth both as individual cities and as city clusters (Al-Asad and Musa, 2002).

If cities in the Arab world are to become places where natural resources are used efficiently, pollution levels are kept to a minimum, energy consumption is effectively controlled, and water resources are managed sustainably, considerable reconfiguration of how these cities are planned, managed, and governed will need to take place. The enabling conditions for making this transformation possible are available to municipality administrators. Implementing more sustainable patterns of urban planning will have a tremendous positive effect on the quality of life for the urban population as well as positive financial and economic implications for Arab countries³.

SECTION TWO: BUILDINGS

I. INTRODUCTION

A. Scope

The building sector is a key target for greening due to the scale of environmental impacts from buildings and related construction work. This section explores opportunities and implications of pursuing green transformation strategies in the building sector addressing both new construction and existing building stock. The economic, social, and environmental arguments for achieving a sustainable building sector are discussed, as well as the enabling conditions required to make this transformation. The broader goal is to encourage action at various policy levels by Arab governments to capitalize on the opportunities from resource efficiency in buildings. The scope of this review does not enable a comprehensive coverage of all the practical and technical aspects of green buildings. Hence, the analysis provided is socioeconomic in focus and by no means exhaustive of all the

opportunities and strategies for the greening of the building sector. Recognizing the vast experiences and differences in building practices within the Arab countries, the analysis focuses on the common challenges and opportunities driven by the prevailing trends across the region.

B. Definition

In this chapter, the concept of green buildings is used to refer to buildings characterized by increased energy efficiency, reduced water and material consumption, and improved health and environment (UNEP, 2011b). This encompasses a life cycle perspective for costs and benefits. Minimizing energy and water consumption over a building's lifetime is crucial to achieving a sustainable transformation of the building sector. Other related concepts for green buildings include sustainable buildings, passive houses, eco-buildings, and energy efficient buildings. The difference among these concepts is a matter of emphasis on particular environmental and social aspects and methodologies for minimizing the environmental impacts. The greening of the building sector will have a wide range of implications for other related economic activities such as construction materials, transport, waste management, energy, water, and wastewater treatment. Therefore, taking an integrated systemic view of the interactions among these sectors will be crucial for a comprehensive scoping of the opportunities and economics of greening not only of one specific sector, but of the economy as a whole.

C. Overview of the building sector

Trends driving the demand for buildings in the Arab region include high population growth and rapid urbanization. Annual urban population growth rates in Arab countries range between 2-6% with an average for the region of 3.8% (UN-Habitat, 2008). These trends are making the building sector one of the fastest growing sectors in the Arab region. According to a recent report produced by the Global Construction Perspectives and Oxford Economics (2011), a total of \$4.3 trillion is forecast to be spent on construction in the Middle East and North Africa (MENA) region over the next decade, representing a cumulative growth of 80%. The bulk of this construction will be directed towards new building projects, including residential,



commercial, and public buildings such as hospitals and schools. In terms of contribution to economic growth, the building and construction sector accounts for 6-12% of the gross domestic product (GDP) of Arab countries⁴ and employs 9-15% of the domestic labor force, as indicated in Table 1, making it among the top three employment sectors in Arab countries after the public and agricultural sectors. Based on these estimates and International Labor Organization (ILO) statistics on construction sector employment accounting in 10 Arab countries (Bahrain, Egypt, Iraq, Kuwait, Morocco, Palestinian Territories, Qatar, Syria, UAE, and Saudi Arabia), the construction sector employs more than 7 million people in these countries (ILO, 2008).

Driven by these trends, the building sector is a significant contributor to economic growth. At the same time, the current building stock and the projected building sector growth present major environmental and social challenges. Buildings account for 40% of global energy use and close to 35% of global CO₂ emissions (UNEP, 2007). Most of these impacts occur in the occupancy phase of the building lifetime. In Arab countries, buildings account for an average of 35% of all final energy consumption (MED-ENEC, 2006), as indicated in Figure 1. Studies elsewhere in Europe and North America suggest that buildings are responsible for around 45% of CO₂ emissions over their lifetime, in addition to significant use of water and discharge of wastewater (UNEP, 2007).

While we can expect some differences between

ENERGY EFFICIENCY RETROFIT FOR A HOSPITAL

The Centre Hospitalier du Nord (CHN) is a private hospital with 140 beds, located in Zgharta, North Lebanon. Due to frequent power cuts, 75% of the hospital's electrical energy demand has to be produced by generators. The total energy bill was over €270,000 in 2006. The CHN decided to conduct an energy audit that resulted in the following recommendations:

- Improved maintenance of air-conditioning (AC) equipment
- Energy efficient lighting
- Thermal insulation of the roof
- Demand management system (software for peak shaving and control/monitoring)



After implementing the above measures in 2007, the hospital now saves 20% of its overall energy consumption. This corresponds to an annual saving of €55,000 of energy costs and a yearly reduction of 410 tons of CO₂ emissions. The needed investment did not exceed €60,000. The payback time being estimated at slightly above one year, the used technologies are replicable in most hospitals and similar buildings in Lebanon and in other countries in the region, even without any external financial assistance. CHN has already decided to use the positive experiences of this pilot project for a new hospital building in Jounieh, a coastal city north of Beirut.

Energy in Lebanon

Lebanon is extremely dependent on energy imports—about 97% of all energy had to be imported in 2005. Buildings are the second biggest energy consumers with a share of about 30%, with transport coming in

first place and industry in third place. With the sharp increase in world market prices for energy, and with energy prices subsidized in Lebanon, the national electricity company Électricité Du Liban (EDL) alone absorbed 21% of the state budget in January 2008 (L'Orient Le Jour, 11/03/08). Moreover, people suffer from frequent power cuts due to insufficient and obsolete power plants and distribution lines and have to bear significant additional costs for private generators.

At the same time, a large potential for energy efficiency and for the use of renewable energies stays untapped in Lebanon. The building stock and particularly new buildings usually do not integrate technologies such as thermal insulation of the building envelope, energy efficient lighting, or solar water heaters. The project in Lebanon shows that with additional investments of 10–20%, energy consumption can be reduced dramatically by up to 60%.

low-income and high-income Arab countries, a common challenge will be the sector's significant use of resources and CO₂ emissions. For instance, in high-income Arab countries, with significant water and energy subsidies for households, supply is unable to meet soaring demand⁵ for basic services. Green building practices offer a cost effective strategy to reduce electricity consumption and conserve water, compared with, for instance, expansion of supply capacity. Furthermore, improving the energy performance of buildings is among the most cost-effective way of combating climate change, based on projections for greenhouse gas (GHG) abatement costs for key economic sectors (Enkvist et al., 2007).

Rapid urbanization is further resulting in massive informal settlements and slums in both low and high-income Arab countries, as demonstrated in Table 2. In this context, the scale of low-cost housing is vast. Occupants of these informal settlements face major challenges in accessing basic services, let alone affording conventional housing. The case for affordable green buildings for the poor is equally compelling. A number of studies and experiences have shown that the environmental design features do not have to be more expensive than the conventional features for low-income housing (CBSE, 2010). In this context, green buildings can be a complementary strategy to improving access to basic services and living conditions for the poor (UNEP, 2011b).

DISTRICT S: GREEN NEIGHBORHOOD DEVELOPMENT

Nader Al-Nakib

District S is a neighborhood development project located in Beirut, Lebanon, that employs green planning and design principles in architecture, materials, mobility, and energy and water consumption. The development of the neighborhood adopts the premise that environmentally sustainable communities will offer residents and visitors a better quality of life and health. District S qualifies Lebanon as the fifth country worldwide to apply the Leadership in Energy and Environmental Design (LEED) certification system to neighborhood development (ND), endorsing green living on a lifecycle basis. District S will be the first sustainable neighborhood in Lebanon, the Arab world, and the Mediterranean basin, according to LEED-ND.

District S integrates the principles of new urbanism, green building, and smart growth. It is carefully sited to be in close proximity to basic community services such as schools, convenience stores, places of worship, recreational facilities, and public transportation. These destinations are reachable by foot or bike, hence reducing the carbon footprint of transportation. The neighborhood infrastructure will be green. Street lighting will use energy efficient fixtures, the sewage system will use recycled content, inner roads will be shaded with trees, and a portion of rain water will be harvested. Pedestrian areas will be lined by trees, bushes, and greenery, allowing residents and visitors to walk or ride their bikes to the café, gym, school, or community center. Biking racks will be available for residents, visitors, employees, and shoppers. Hybrid and all-electric cars will have preferred parking spots. All roofs will be green. In summary, District S will exemplify green city development in Beirut.

The developers of District S are collaborating closely with their sustainability consultants to integrate environmentally friendly components in all phases of the project. All buildings will have green roofs that will



decrease the heat island effect caused by the absorption and retention of heat by city building roofs and asphalt. Wood used in construction will be sustainably harvested. Most building materials will have recycled content. Highly efficient heating, ventilation, and air-conditioning systems (HVAC), proper insulation, and building orientation will cut energy usage by around 30% compared with a similar, conventionally-developed neighborhood. Air conditioners will use environmentally friendly gases. Sophisticated air filters and paints with low volatile organic compounds (VOCs) will ensure improved indoor air quality for building occupants. Daylight views are integrated into building design to maximize productivity and reduce the use of artificial lighting. State-of-the-art water conserving fittings and fixtures will decrease water consumption by around 40%. The introduction of waste segregation at source will divert approximately 70% of generated waste from landfills.

District S cannot fight climate change alone, but it can contribute to protecting Beirut's heritage and environment, hoping that many others will follow and undertake similar initiatives to preserve the environment (or what's left of it.)

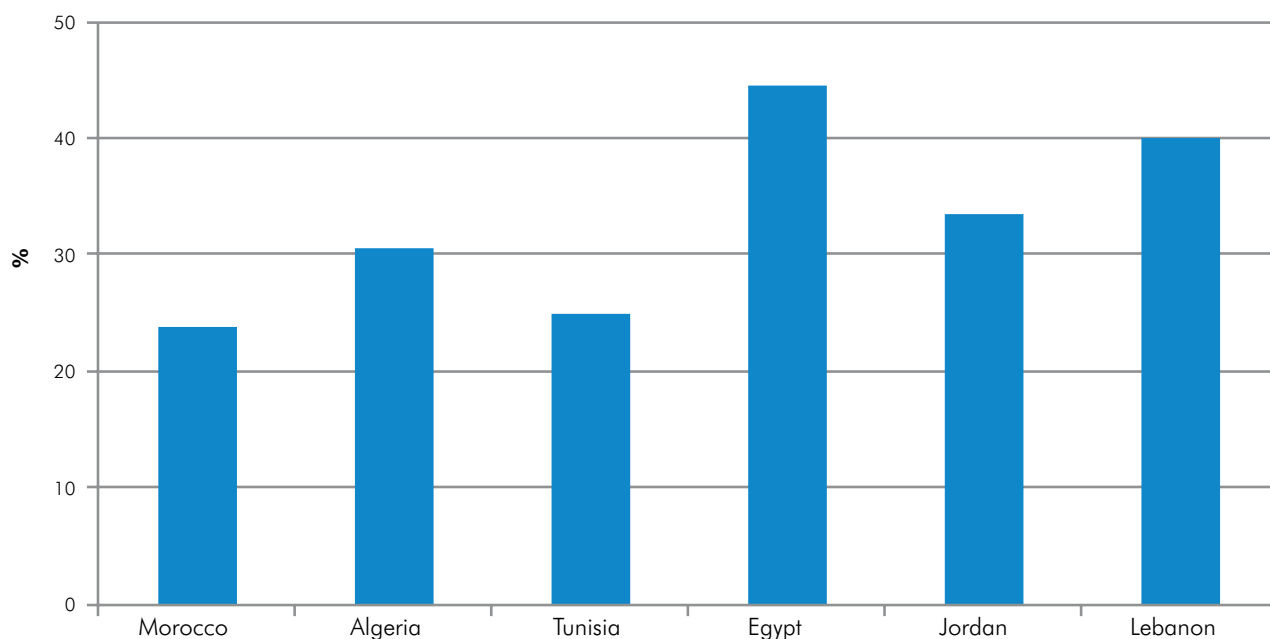
Nader Al-Nakib, is Co-founder, G Lebanon.

II. CURRENT PRACTICES AND THEIR IMPLICATIONS

A. Existing stock of buildings

Assessing the performance characteristics of the existing building stock in Arab countries requires collecting data on annual energy end use per square

meter for the different categories of buildings (e.g., apartment blocks, detached homes, commercial buildings). Consistent and comprehensive data on the performance characteristics of the existing building stock in Arab countries do not exist. Anecdotal and case study data point to alarming inefficiencies in the energy and water use in the existing building stock across the region, and in

FIGURE 1 SHARE OF BUILDING SECTOR IN THE FINAL ENERGY CONSUMPTION IN SELECTED ARAB COUNTRIES


Source: MED-ENEC, 2006

particular in commercial and public buildings. According to a study undertaken in 2007, five star hotels in Dubai on average use between 650 and 1,250 liters of water per guest and consume 275-325 kilowatt-hours (kWh) of power per square meter. In stark contrast, similar hotels in Germany use only 350 liters and 100 kWh per square meter, a difference of 225% (Gulf News, 2007). As a result, Dubai has instated higher tariffs for electricity and water as well as a fuel surcharge in 2011 with the expectation that such measures will create incentives for consumers to improve efficiency measures (Gulf News, 2010).

In the residential sector, the costs of heating and cooling in inefficiently designed and constructed buildings are putting an increasing financial burden on occupants, especially in those countries where fuel and electricity subsidies are gradually being removed. A study conducted in 2007 in the city of Aqaba, south of Jordan, showed that the average household pays up to 30% of monthly income on air-conditioning during the summer months (Biggs, 2005). On the other hand, a considerable percentage of the building stock in Arab cities is without adequate access to basic services in terms of water and sanitation,

especially for informal settlements in and around cities like Cairo and Jeddah. Large income differences also affect energy use intensity at the household level. Because of the uneven access and distribution of basic services for households in Arab cities, the average performance will most likely be a misleading baseline indicator

TABLE 1
EMPLOYMENT IN CONSTRUCTION* AS A PERCENTAGE OF TOTAL EMPLOYMENT IN SELECTED ARAB COUNTRIES (2008)

Country	%
Egypt	10.08
Iraq	10.83
Kuwait**	14.21
Morocco	8.87
Saudi Arabia	11.09
Syria***	14.88
United Arab Emirates (UAE)	12.35
West Bank and Gaza	10.97

* Defined according to the United Nations (UN) International Standards Industrial Classification (ISIC) of all economic activities, and includes construction of buildings, civil engineering, and specialized construction activities

** statistics from 2005

*** statistics from 2007

Source: Data derived from ILO, 2008

TABLE 3 INTERVENTION AREAS FOR GREENING OF BUILDINGS

Intervention Level	Selected examples
Design & engineering	<ul style="list-style-type: none"> • Climatic design taking into consideration, for instance, location, building orientation, sizing of windows and shading. • Design influencing material choices, behavior, and use patterns. • Integrated energy design and performance modeling of buildings.
Construction and materials	<ul style="list-style-type: none"> • Wall and roof systems and materials. • Glazing choices. • Procurement criteria for materials and their origin, e.g., local sourcing, ban on certain chemicals, and manufacturing conditions. • Water efficiency in landscaping.
Installations	<ul style="list-style-type: none"> • Sound choices with regards to energy using devices such as lighting systems, appliances, and use patterns • Water using devices, such as water saving shower taps and faucets. • Energy efficient heating and cooling systems. • Active systems for zero emissions and renewable energy production.
Systems for the provision of basic services	<ul style="list-style-type: none"> • Delivered energy. • Delivered water & wastewater services. • Mobility services.

for setting national performance targets for the building sector.

The prevailing pattern in the region is of a building sector that has evolved without taking the environmental and social considerations into

account. Old and new buildings are without adequate insulations for walls, windows, or roofs (FFEM and ANME, 2010). In commercial buildings, the currently installed systems for heating, ventilation, and air-conditioning (HVAC) have the lowest energy efficiency performance among available options, because of preferences for low cost systems over more efficient ones, aided by the prevalence of large subsidies for electricity in most countries of the region. With many countries in the region heavily dependent on air-conditioning systems, up to 70% of the peak power load is consumed by cooling systems (MENA Infrastructure, 2011).

B. New buildings

Early design stages offer the greatest opportunities for influencing the environmental performance of new buildings at low costs (WBCSD, 2009; UNEP, 2011b). Traditional design approaches in Arab architecture were much

TABLE 2 POPULATION IN SLUMS IN SELECTED ARAB COUNTRIES (2005)

Country	(% of urban population)
Egypt	17.1
Iraq	52.8
Jordan	15.7
Lebanon	53.1
Morocco	13.1
Saudi Arabia	17.9
Syria	10.5
Yemen	67.2

Source: UN-Habitat, 2008

ESTIDAMA AND THE PEARL RATING SYSTEM

The Abu Dhabi Urban Planning Council (UPC) is recognized internationally for large-scale sustainable urban planning and for rapid growth. Plan Abu Dhabi 2030 urban master plan addresses sustainability as a core principle. Estidama, which is the Arabic word for sustainability, is an initiative developed and promoted by the UPC. Estidama is the intellectual legacy of the late Sheikh Zayed bin Sultan Al Nahyan and a manifestation of visionary governance promoting thoughtful and responsible development while creating a balanced society on four equal pillars of sustainability: environmental, economic, social, and cultural. The goal of Estidama is to preserve and enrich Abu Dhabi's physical and cultural identity, while creating a better quality of life for its residents.

The early foundations and aspirations of Estidama are incorporated into Plan 2030 and other UPC policies such as the Development Code. Estidama is the first program of its kind that is tailored to the Middle East region. In the immediate term, Estidama is focused on the rapidly changing built environment. It is in this area that the UPC is making significant strides to influence projects under design, development or construction within the Emirate of Abu Dhabi. An essential tool to advance Estidama is the Pearl Rating System.

The Pearl Rating System for Estidama is a framework for sustainable design, construction and operation of communities, buildings and villas. The Pearl Rating System is unique in the world and is specifically tailored to the hot climate and arid environment of Abu Dhabi. The extreme summer temperatures of Abu Dhabi reach 48°C and humidity levels can be near 100%. Air conditioning consumes large amounts of energy. Water is a precious resource due to its scarcity, high evaporation rates, infrequent rainfall averaging less than 100mm/year and the environmental impacts of potable water production through desalination techniques.

The Pearl Rating System is part of the government wide collaborative initiative to improve the lives of all citizens living in the Abu Dhabi Emirate, by supporting the social and cultural traditions and values of Abu Dhabi. It reinforces what this unique place has been in the past and hopes to be long into the future.

All new projects must achieve a minimum 1 Pearl rating to receive approval from the planning and permitting authorities. Government funded buildings must achieve a minimum 2 Pearl rating.

Source: Estidama <http://www.estidama.org/estidama-and-pearl-rating-system.aspx?lang=en-US>

more responsive to environmental elements. These approaches incorporate much of today's knowledge about climatic design - as a process of identifying, understanding, and controlling climatic influences at the building site - for achieving comfortable and healthy environment for inhabitants (see Traditional Architecture supplement). However the adoption of internationalized and formalized approaches to architecture and construction engineering in educational curriculums across the Arab world has relegated much of this traditional knowledge forgotten or ignored by mainstream architects (Elgendy, 2010). Traditional design approaches in Arab architecture remains consigned to niche practices. Today, there are few Arab architects who can work with the full potential of climatic design and fewer construction engineers who can work with thermal performance modeling of buildings. As a result, the dominant design approaches are insufficiently tuned to the climatic conditions of the region.

In terms of construction work and building materials, building codes and standards are the main institutional levers for influencing construction practices and material selection. Most Arab countries have, or are in the process of introducing, energy efficiency requirements for new construction (Gelil, 2009). According to recent observations⁶, the current initiatives and measures have yet to create a noticeable shift in construction practices. Reform in building regulations and codes to incorporate environmental aspects are still in the early stages of development in most Arab countries. Even in countries such as Egypt and Jordan, where energy efficiency requirements have been in place for a while, enforcement of those aspects of the building code has not been taken up (Gelil, 2009). Among the challenges facing these initiatives are the lack of a sufficient knowledge base within the industry, weak innovative capacity within local building supply chains to meet the demand for better materials and

ECO-FRIENDLY STADIUMS IN QATAR

Qatar won its bid to host the 2022 World Cup Finals, but will players and spectators be able to endure the scorching Doha summer? And who will later, in this tiny country, make use of stadiums built to accommodate tens of thousands of spectators? And what will the magnitude of this tournament's ecological footprint be? Qatar pledged to have a carbon-free tournament but the question is whether it will be able to fulfill its promise.

Qatar undertook to use and develop eco-friendly technologies that could later be adopted by other countries. After the end of the finals, the stadiums will be contracted by dismantling some parts and shipping them to, and reassembling them in, other Asian countries. This will help keep the spirit of Qatar 2022 alive across the continent. Visitors from all over the world will enjoy Arabian hospitality and leave Qatar with a new understanding of the region.

The main challenge facing the organizers is to overcome the extreme desert heat in summer when the finals are taking place. Providing a comfortable environment inside the stadiums requires too much energy, especially for cooling. Two solar energy technologies shall be applied simultaneously to guarantee a convenient and carbon-neutral environment for all players, fans, administrators, and the media. The first technology is the photovoltaic system that converts sunlight into electricity. The second is the solar thermal system that uses heat captured from the

sunrays. The system's collectors transmit and store energy to be used on the days of the matches to cool the water which, in turn, cools the air down to 27° C. Cold air shall be carried, through tubes, to the ground of playing fields and under seats to cool players and watchers alike. Though these two systems are not new, it is the first time they are used in combination with each other.

The roofs of the stadiums shall be retractable to comply with the FIFA regulations which might require matches to be played in open air. Roofs shall be closed during the days before the matches to keep the temperature in the stadiums at 27° C. When there are no matches in the stadiums, the solar equipment shall transmit electricity to Qatar's main grid, and receive its power from the same grid during matches, making the stadiums carbon neutral.

These cooling technologies shall be made available to other countries that have hot weather, so that they may also host major sports events.

Engineers at Qatar University's Mechanical and Industrial Engineering Department produced a design for an artificial cloud that is remotely controlled, so that its location may be changed depending on the position of the sun. Such a cloud shall hover above the stadium and overshadow all fans sitting to watch the game. The cloud consists of a mixture of light carbon and helium, and the

components, and weak institutional capacity within public agencies for the monitoring and enforcement of environmental requirements.

In addition to design and construction technology, buildings' environmental performance can be improved through the choice of installations and components such as heating and cooling systems, lighting, appliances, and water fixtures. The potential savings from promoting energy saving appliances and light fixtures in buildings in the Arab world is substantial. According to some estimates, economically feasible potential savings run in the range of 60% of current consumption (ESMAP, 2009). Similar water saving potentials can be realized by switching to water efficient taps and faucets. The chapters on energy and water in this report give a more detailed review of current green practices in Arab countries.

The overall assessment is that the scope and effect of current measures for promoting energy and water efficient installations, or renewable energy ones, fall short of the economically and technically feasible potential. One primary barrier cited by a recent World Bank assessment report is related to subsidies for conventional energy resources prevalent in most Arab countries (ESMAP, 2009). Energy subsidies exceeded 7.1% of the region's GDP in 2006, according to the same report. One exception has been the wide scale adoption of solar water heating systems (SHW) in several Arab countries, notably Algeria, Egypt, Jordan, Palestine, and Tunisia. This success is the result of an extended period of technical and institutional support for the industry and favorable market conditions for SHW technologies for the low to medium income housing markets (Kordab, 2009). Even in those markets, diffusion of solar thermal



solar energy will keep it floating in the air.

Qatar's pledge to adopt the green building standard was part of its national 2020 vision, and not solely to support its World Cup bid. If the Green Building Council and construction companies succeed in implementing

environmental principles during the next few years, Qatar might witness, by 2022, the development of highly-advanced building technologies. Yet the great challenge will be to shift these technologies from sports spectacles to everyday life.

Al-Bia wal-Tamnia (Environment & Development) magazine

technology for heating at favorable economic returns for users could have been higher (Kordab, 2009).

iii. Policies and initiatives

Encouraging signs are in the horizon. Regionally based trade and professional publications in construction, architecture, building materials, and engineering are increasingly profiling and making the case for greener solutions in buildings (The Big Project, 2010). In parallel, going green has been a focus theme within the leading construction markets of the Arab world, mainly in the UAE and Qatar (Deloitte, 2010). On January 1, 2010, Abu Dhabi enforced a new building code that makes sustainability compulsory in all new buildings and major retrofits of existing buildings. The code addresses energy efficiency, water use, and the

wider environmental impacts of construction. In Qatar, a new assessment system for buildings, the Qatar Sustainable Assessment System (QSAS), was devised and launched in April, 2009 (Deloitte, 2010). The QSAS stipulates new compulsory standards to be incorporated into the Qatar building code. Thermal standards and/or energy efficiency building codes are enforced in Algeria, Egypt, Jordan, and Tunisia (Mourtada, 2008). Other Arab countries, namely Lebanon, Morocco, Palestine, and Syria, are in the process of revising their building codes to include thermal standards or have introduced voluntary standards. However, the scope can be expanded, for instance, by consideration of simple measures such as solar shading and thermal bridges. Furthermore, the implementation and control of the application of the thermal standards need to be improved (Mourtada, 2008).

GREENING CAMPUSES AND CURRICULA

Université Saint-Esprit De Kaslik (USEK) has launched the Carbon Neutral Challenge Project, aspiring to achieve a net zero carbon footprint or emissions on its 67,000 m² campus by the year 2025.

Located in Kaslik, to the north of Beirut, USEK estimated its own production of carbon emissions in 2010 at more than 8,911,000 kg of CO₂ (8,911 metric tons) divided as follows: 800 Kg/day from the consumption of 60,000 kWh of public electricity, 615 Kg/day from the consumption of 40,000 kWh of electricity provided by private diesel generators, and 16,000 Kg/day generated by approximately 2700 cars entering its premises, in addition to other sources of lower carbon emissions generated by other activities on campus.

The project adopted a master plan with a priority on new construction satisfying green building certification by the Leadership in Energy and Environmental Design (LEED) rating system. The estimated total cost of construction is US\$81.3 million, excluding the renovation of existing buildings, transportation, renewable energy production, and landscaping.

USEK is planning to adopt other major initiatives by 2012 to push the campus closer to becoming carbon neutral. The university plans to switch to Energy Star certified efficient appliances or their equivalent, encourage car pooling, and begin a shift to generate renewable power on site using solar and wind power.

Between 2012-2018, USEK plans to move towards a car-free campus, roll out a green fleet hybrid shuttle bus system, and apply water treatment and recycling technologies on campus. François Bassil Medical Building will be constructed with the goal of qualifying for a Platinum LEED certification. An environmentally friendly sport complex is also planned. Furthermore, an underground multi-story car park will be built that will provide 17,000 m² of green roof park space accessible to students and community residents. Landscaping on campus will be recreated using water efficient Xeriscaping principles, including soil amendments, appropriate plant selection, efficient irrigation, use of mulches, and proper maintenance.

USEK's plan over the 2017-2025 period involves the green retrofitting of existing buildings to meet the carbon neutrality goal. A designated task force will evaluate the progress achieved.

The physical green transformations of the USEK campus will be accompanied by new educational and research programs that reflect the goals and means for achieving sustainable development. Innovative learning experiences will be offered to students, including planning sustainability campaigns, creating an organic garden on-campus, and choosing sustainability-related themes to focus on for a semester or on a yearly basis. Moreover, new environmental sustainability courses will be introduced, and related research programs initiated. USEK is seeking to expand the university's efforts beyond its own campus and reach out to local communities in order to raise public awareness about actions we can take to promote green city living.

At the Lebanese American University (LAU), a commitment to green the curricula as well as the campus has been incorporated as an integral part of the university's strategic plan for the period 2011-2015. LAU will continue to integrate energy efficiency, conservation, and the use of renewable materials in new construction and renovation projects on campus. The university's purchasing guidelines will be revised to promote the purchase of products that have minimal environmental impact over their entire lifecycle. LAU has also decided to conduct a campus sustainability audit to identify relevant environmental sustainability initiatives prioritized according to their return on investment. The audit results will be used to select three sustainability pilot projects for implementation by 2016. To create a smoke-free campus, the university will implement programs and activities, such as offering smoking cessation classes and creating designated smoking areas.

In addition, the following action steps will be taken to develop green content in the university's academic educational and research programs:

- Promote enrollment in classes that satisfy the new Environmental Science Minor.
- Study the feasibility of offering undergraduate and graduate courses of study (majors) in environmental sustainability (e.g., Environmental Sciences, Environmental Engineering, and Environmental Design), and develop new program offerings based on the results of the feasibility study.
- Introduce green sustainability topics and courses into existing curricula in the School of Engineering, School of Architecture and Design, the Business School, and the Department of Natural Sciences.



- Create internships related to environment sustainability at LAU facilities, local non-governmental organizations, area industries, and municipalities.
- Identify, target, and build relationships with funding agencies, foundations, and prospective donors who are committed to environmental sustainability, to secure financial support for student scholarships/fellowships, development of new programs, and sustainability research
- Conduct seminars, workshops, training programs, exhibitions, and service learning to increase awareness of environmental sustainability-related education for LAU's students, alumni, and the local communities.

AQABA RESIDENCE ENERGY EFFICIENCY (AREE)

Florentine Visser

The initiative to build a pilot scale energy efficient residence in Aqaba aimed to demonstrate the advantages of sustainable building in Jordan. The Aqaba Residence Energy Efficiency (AREE) design was selected to inspire improvements in the environmental performance of buildings. The building design addresses the efficient use of resources in building construction and in water and energy consumption.

AREE is a three-floor, 420 m² building that includes a living room, a kitchen, a study room, a family room, six bedrooms, three bathrooms, a car garage, and a basement.

The summer temperatures in Aqaba rise above 40° C, and with hardly a need for heating during the winter, the design was focused on adopting passive cooling strategies. By design, heat accumulation is prevented in the summer and heat gain is optimized in winter. The architectural concept was formed by sun angle analysis, wind conditions, Red Sea views, and Jordan's common construction practices (plastered block work and stone cladding).

The architectural design is the first step to get to efficient use of energy, water, and materials. The orientation and layout of AREE optimize passive cooling. Spaces that are generally used for short periods (bathrooms, garage, corridors) are located on the southwest side, the hottest side of the house, creating a buffer that helps keep the main spaces cooler. To minimize the internal cooling load, the bedrooms face northeast. The main part of



the building is finished in regular plasterwork mixed with straw to decrease heat transfer and reduce the use of cement. The use of plasterwork provides a nice texture that improves with ageing.

Natural ventilation is improved by carefully positioning the windows, doors, and ventilation openings below the ceiling and the main staircase, designed to work as a 'wind tower'. Movable shades prevent solar warming in the summer time, but allow for solar heat to enter during the winter to minimize the need for heating.

Exterior and interior space is connected by a zone with recessed glass doors for optimal day lighting. This zone, housing the kitchen and dining area, connects both building volumes. The lower volume is clad with recycled stone procured from local stone companies. The roof

On the regional scale, the Arab League issued in December 2010 the first Pan Arab energy efficiency guidelines. These guidelines stipulate the development of national energy efficiency action plans (NEEAP) and provide recommendations for energy conservation in buildings (Arab League, 2010). Voluntary green building standards and labels offer another way of encouraging green building practices through market incentives. In 2009, Abu Dhabi launched PEARL, the first voluntary regional standards for green buildings. At the same time, the Egyptian Green Building Council has developed a national building rating system called the Green Pyramid Rating System (GPRS) (EGBC, 2009).

Lebanon Green Building Council has developed a green building rating system called ARZ. Other international labeling systems such as the Leadership in Energy and Environmental Design (LEED) and the Building Research Establishment Environmental Assessment Method (BREEAM) have gained an increasing number of promoters within the professional community through local and regional green building councils in Egypt, Jordan, Qatar, Saudi Arabia, and the UAE. While these standards do help raise the environmental benchmark for large-scale building projects, their relevance and applicability to the largest segment of the housing market, low to medium income, is still unclear. In fact, the use of international

garden on top of the lower volume contributes also to a lower internal cooling load achieved by the heat accumulation capacity of the 40-cm garden soil. This roof garden provides shading and has a beautiful view of the Red Sea.

The building envelope is the second step for environmental design and passive cooling strategy. Interior spaces are protected from solar heat through the use of improved insulation. The blocks of the cavity walls have a better insulation value because of the volcanic and perlite aggregates. The cavity is filled with insulation material. The most exposed building surface is the roof, and therefore it is also insulated, which is not a common practice in Jordan. Another new practice introduced is the insulation of the 'heat bridges' at the floor-wall connections. The sand filling of the north cavity wall and natural stonewall finishing increase the heat accumulation capacity of the building.

The building design and construction save 30% on the cooling load, compared to a conventional building. To ensure significant savings on electricity bills, efficient lighting systems have been installed as well.

The 'solar cooling' concept is based on hot water from solar panels providing thermal energy to the adsorption chiller, which provides chilled water to cool the interior. This is the first application of solar cooling in Jordan, and therefore there are challenges in achieving optimal performance. The local supplier is working on a second prototype. In the meantime, an imported adsorption chiller has been installed and is currently being tested.

The solar cooling system brings the total potential savings

of electricity costs to 72%, compared to a conventional design. Taking in consideration additional investment costs, the expected payback time is less than nine years. To make AREE almost self-sufficient in energy supply, the option of photovoltaic (PV) panels for electricity generation was considered. However, the long payback time of around 14 years rendered this option uneconomical.

Reducing water consumption is essential for Jordan, a country with a very low annual per capita share of freshwater. AREE is the first project in Aqaba equipped with a dual plumbing system, separating grey and black wastewater. The grey water from showers and sinks is filtered by a constructed wetland and used for garden irrigation. Water-efficient plants and trees that are well adapted to Aqaba's climate were selected, minimizing the need for irrigation. Together with water-saving taps, toilets, and showerheads, the total estimated water saving is 51%.

All design and construction elements were easy to plan on the drawing board, but required a lot of discussion with the engineers and contractors on site. The biggest challenge for sustainable building in Jordan is the use of materials and the reduction of construction waste. Environmentally friendly materials are scarce and local suppliers are often unfamiliar with material specifications. Moreover, Jordanian contractors were not familiar with passive cooling strategies. The opportunities for learning have been immense, which bodes well for the dissemination of more sustainable building practices in Jordan.

Florentine Visser is Dutch architect and sustainable building consultant, was AREE Project Architect

labeling schemes has so far been limited to a few upper end luxury buildings, and often used as a public relations tactic. Instead, efforts should be directed toward developing national and regional green building standards adapted to local climatic and cultural conditions. The Regional Center for Renewable Energy and Energy Efficiency (RCREEE) is one actor working at the regional level spearheading a process of harmonizing energy efficiency standards across the Arab World.

These efforts are moving in parallel with increased interest in institutional reforms to promote and create incentives for renewable energy and energy efficiency in buildings (Gelil, 2009). Several Arab

countries have or in the process of completing their national renewable energy strategies (RCREEE, 2010). These will have wider implications on the environmental performance of the building sector.

III. OPPORTUNITIES FOR GREEN TRANSFORMATION IN THE BUILDING SECTOR

Broadly speaking there are four levels where green transformation in buildings takes place: 1) design and engineering choices, 2) construction processes and materials, 3) installations, and 4) systems for the provision of basic services such as

THE DUTCH EMBASSY IN AMMAN: FIRST LEED CERTIFIED BUILDING IN JORDAN

Florentine Visser

Sustainable building is high on the agenda of the Dutch government and has been exemplified in the design and operation of the country's embassy in Amman, Jordan. The embassy, which was officially inaugurated in December 2010, was awarded the Silver Certification of the Leadership in Energy and Environmental Design (LEED).

Beside featuring high environmental performance standards, a challenging assignment for architect Rudy Uytenhaak, a Dutch Sustainability Award winner, and the Jordanian counterpart, Consolidated Consultants, was to incorporate in the new design an existing villa, earthquake risk protection, high insulation standards, shading, and operational security features.

The environmental measures of the design have included high standards of energy efficiency, water conservation and recycling, and material selection. All products and materials of construction used had to be locally sourced to the extent possible. The architectural design had to minimize the heating and cooling loads. Daylight had to be the main source of illumination in the office space. However, reducing thermal bridges turned out to be quite difficult to achieve during construction.

The first sustainable aspect in the development process was the preservation of the existing villa on the new embassy site. To provide enough space for the embassy's needs, the existing villa was 'topped' with an additional floor. This new upper floor is larger than the existing ground floor and thus provides shading for the existing southern façade.

Structural analysis revealed that, according to building seismic regulations in Jordan, the existing villa was at an unacceptable risk due to the attachment of a new upper floor. Therefore, additional columns were needed to add structural strength, which resulted in an impressive front elevation in the form of a modern stone-clad colonnade. This reflects the rich architectural history of Jordan, which bears traces left by the Greeks, Romans, and Nabataeans. The colonnade is also an elegant representation of hospitality, an important element of Jordanian society. In addition, the colonnade provides a pleasantly shaded space in front of the building.

The roof is covered by sunshades, made of cloth in a

reference to the local tradition of Bedouin tents. 'Sails in the wind' would be another legitimate metaphor, a poetic integration of cultures in a highly functional and energy saving element. The lightness of the sunshades provides a counterbalance to the heavy stone. The shading of the front and side elevation and on the roof significantly reduce direct solar heat gain in the hot Amman summer. In addition, the shades are designed in such a way that in the colder winters, when the sun is at a lower angle, the sun warms the building's interior. This generates remarkable savings in heating energy consumption. Thanks to the shading, the façade of the new first floor is translucent. The offices behind the curtain walls enjoy transparent views and daylight, which further reduces the energy demand for artificial illumination.

To provide daylight in the core of the building, the centre of the existing villa has been hollowed out. The resulting central hall connects the old and new floors with abundant daylight from the skylight. The skylight can open on hot days to release excess heat and contributes to the natural ventilation in the building. This courtyard is not a new concept but can be found in traditional Arab houses. The architect of the Dutch Embassy succeeded in combining a traditional concept with contemporary design and functionality.

The construction approach adopted is similar to common Jordanian building methods. The façades are clad in Jerusalem stone to produce unity between the existing and new building. The elegant stone detailing is based on the craftsmanship of making a building, a trademark of Rudy Uytenhaak's architecture. The mechanical fixtures allow the stone to be reused once the building is no longer needed. This was a new concept for the Jordanian contractor.

To accommodate the ductwork and fan coils of the heating, ventilation, and air-conditioning (HVAC) system, space was created between the existing structure and the new 'floating' first floor, providing the opportunity to use night ventilation. The elevation of this 'intermediary' space was furnished with grills that allow the cool night breeze to pass through, releasing the heat gain of the day and, in the process, reducing the cooling load.

The detailed design of the HVAC system is the last step in reducing the energy demand of the building.



Front elevation with colonnade and shading. Solar hot water panels on the carport (left).

Photo: Pieter Kers

Solar hot-water panels are integrated into the carport to provide hot water for heating the building in the wintertime. The swimming pool of the existing villa was covered and reused as an underground 'heat-sink' to store the heating or cooling energy. The heat pump of the former embassy building was transferred to the new building and used to generate cold water at night. This water is stored in the underground pool for daytime use. During the day a ventilation system is used with energy recovery to minimize the energy requirements for a comfortable indoor climate.

The photovoltaic (PV) panels on the roof generate power to meet about 12% of all electricity needs, which is enough energy to power computer use in the building. Moreover, the PV panels provide shade for the roof. Sustainability goals have been pursued right down to the choice of furniture. The Dutch firm Gispem supplied furniture certified by the Eco-Management and Audit Scheme (EMAS), an environmental standard developed

by the European Commission. The desk illumination is designed to meet local lighting levels.

As one of the water-poorest countries in the world, Jordan places great importance on saving water. Compared with a conventionally designed building, potable water consumption has been reduced by 32% using water-saving fixtures. Garden irrigation hardly uses any potable water (4% of baseline). Rainwater is harvested on site at a rate of 48%, and used in irrigation. Native plants that are well adapted to a scarce water environment have been selected. Existing trees were retained wherever possible.

The overall result is an impressive new embassy building with comfortable office space and sophisticated architecture. The balanced sustainability measures have created Jordan's first LEED-certified building.

Florentine Visser is Dutch architect and sustainable building consultant.

energy, water, and mobility. The latter dimension concerns more the urban or district scale but in some cases can be tightly linked to or influenced by project developers. Examples of each intervention type are provided in Table 3. Environmental performance improvements can be achieved at every level. However, the greatest opportunities with the lowest costs can be found at the early stages of design and engineering. A holistic design approach, incorporating environmental principles in the various design stages including building form, orientation, components, and other architectural aspects, yields the highest results (WBCSD, 2009).

Various demonstration projects in selected Arab countries have demonstrated the economic feasibility of integrated energy efficiency in design and construction of new buildings. In Tunisia for instance, the Project for Energy Efficiency in Buildings, which started in 1999, has demonstrated energy savings of 33% on average through the use of simple and locally manageable techniques in 43 demonstration buildings with additional investment costs that are considered acceptable at about 4% for 'affordable' housing and 2% for high-end housing (FFEM and ANME, 2010).

Similarly, an analysis from the European Union (EU) funded project MED-ENEC, which implemented pilot energy efficiency building projects in eight Arab countries, found that the cost to benefit ratio of passive design elements were much more rewarding than the 'active' approach that uses newer technology such as solar heating and cooling, photovoltaic (PV) solar systems, and other devices found in state-of-the-art high technology buildings. Using the cost of primary energy saved compared to international market price indicates that measures introduced in the Jordanian pilot project were profitable at a price of \$40 per barrel of crude oil. For the pilot project in Morocco, the energy efficiency measures were profitable to the country at a price of \$80 per barrel of crude oil (Missaoui, 2009).

Major opportunities can also be found in the maintenance and retrofitting of existing buildings. In Jordan, for example, potential energy savings of 20% have been estimated through cost-effective retrofitting of existing commercial buildings, with a payback of less than 1.6 years on required investments (Shahin,

2006). In the residential sector, simple measures such as the upgrading of lighting and water fixtures and energy and water leakage inspections can yield on average 30% savings.

Finally, adapting behavioral patterns constitute a key element of achieving the full potential of green buildings at nearly no cost. User behavior can make a substantial difference in a building's consumption of energy and water. A recent World Business Council for Sustainable Development (WBCSD, 2009) analysis concluded that wasteful behavior can add one-third to a building's energy performance, while conservation behavior can save a third.

IV. ENABLING CONDITIONS AND POLICIES

While the environmental and socioeconomic case of greening the building sector is strong, recent international and regional studies of the sector point to industry and market barriers for the widespread adoption of green building practices (El Andaloussi et al., 2010; UNEP, 2007; UNEP, 2011b; WBCSD, 2009). These include barriers related to the structure of industry, financial constraints, and misplaced incentives among others (UNEP, 2007; UNEP, 2011b). Overcoming these constraints in the Arab world will require a proactive green building policy at national and regional levels. Recent global assessment studies of the sector have identified a variety of administrative, regulatory, and financing tools (El Andaloussi et al., 2010; UNEP, 2007; UNEP, 2011b; WBCSD, 2009). Governments can create policies for procurement, contract specifications, building performance, and building codes regulating municipal standards. Municipalities can also enact regulations and develop training and education programs that focus attention on sustainable design in building.

A. Regulatory and administrative tools

Mandatory energy efficiency requirements through building codes have been acknowledged for their effectiveness in many countries (Liu et al., 2010). However, the success of implementation was subject to the institutional capacity within implementing agencies at municipal and national

SHARJAH FUTURE ARCHITECTS FOR “GREEN” MOSQUES

Ahmed Hanafi Mokhtar

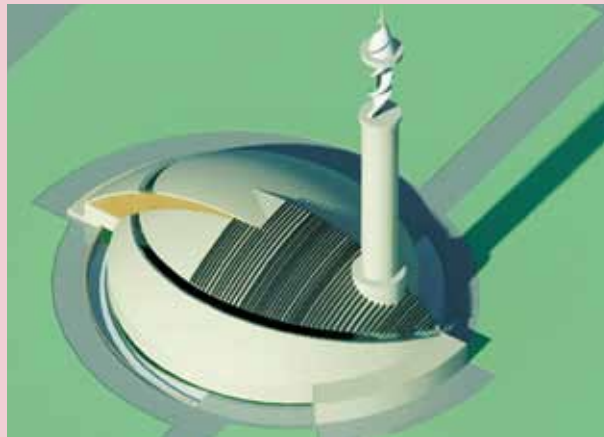
There are verses in the Holy Qoran that forbid extravagance in eating and drinking. So if man is required to be moderate in consuming such life necessities, this should also hold true for the consumption of energy in buildings, with mosques at the top of the list.

Unfortunately this is not the case in the countries of the Gulf Cooperation Council (GCC), where mosques generally tend to be liberal in the use of electricity, since air-conditioning is a necessity. Having their electricity supply free of charge, usually, mosques have little or no motive to use it efficiently, whether in design or operation. It is therefore not uncommon to find a mosque with full internal lights on at midday with the air-conditioning units fully operating almost round-the-clock to have excessively low temperatures inside, despite the presence of a few people off prayer times.

Mosque patrons are partly to blame for this extravagance, in spite of the fact that most of them are unaware of the impact of over-consumption. Yet, the responsibility falls heavily on mosque designers who can address this lack of awareness, because the design of the existing mosques does not respond even to the intentions of those who are willing to conserve energy.

During a course I taught to architecture students at the American University of Sharjah, I urged future architects to consider seriously saving energy through a standard design as a first step towards controlling extravagant consumption of energy in mosques. I asked them to apply the principles of environment-friendly design which they had learned in order to come up with an architectural design adapted to the weather of Abu Dhabi city, which was chosen due to the availability of weather data all-year-round.

The students conducted an analytical review of Abu Dhabi's weather using computer software of the capital's meteorological data. Consequently they defined the ecological strategies to address this weather which has two seasons: temperate climate during the months of November through April, and the hot and humid climate the rest of the year. Accordingly, it was decided to apply the natural aeration strategy during temperate months, whereas the use of air conditioners was found inevitable during the hot and humid season. This should be guided by two principles: First, minimizing thermal



loads by choosing adequate architectural designs, and hence minimizing the size and power requirement of air-conditioning units. Second, whenever possible, using the natural energy on-site derived from sunlight to power these units.

To achieve this it was decided to use absorption chillers that basically need heat (not electricity) to cool the air. Such heat can be absorbed from the sun rays that fall on the roof of the building through evacuated tubes or other water heating methods. The resulting hot water is to be used to operate the absorption chillers.

The main challenge facing the students was how to develop an architectural design for a mosque to reflect these strategic decisions that were based on environmental requirements. I instructed the students to discard, in their designs, traditional architectural features such as domes and arches, except for the minaret which is essential for the building's orientation.

Students variably rose up to the challenge. The efficient concepts they developed included using the minaret as an air duct during the temperate climate. The design strategies also involved making large vents in the mosque that help natural aeration during the winter season and work also – like the minaret – for wind capture. Moreover, the students developed the shape and orientation of the mosques' roofing to make optimum use of natural lighting and enable the absorption of solar energy through collectors that power absorption chillers during the summer.

Dr. Ahmed Hanafi Mokhtar, Associate Professor of Architecture, American University of Sharjah –Al-Bia wal-Tanmia.

DESIGN AND CONSTRUCTION OF ENERGY EFFICIENT RURAL HOUSE PILOT PROJECT, ALGERIA

Hamid Afra
Abdelkarim Chenak

As part of the Energy Efficiency in the Construction Sector in the Mediterranean (MED-ENEC), a European Union funded project, pilot projects were established to demonstrate the best practices and integrative approaches for efficient energy use and the use of renewable energy in the building sector.

The pilot project in Algeria is a rural low-energy house with 80 m² floor space; 3 bedrooms, 1 kitchen, 1 bathroom, and lavatories, all on ground level. Energy efficiency measures include the use of local building materials and solar energy.

The main purpose of this pilot project is to build a residential rural house suitable for replication within the framework of Algeria's rural housing program. The program entails the construction of 500,000 rural houses during the period 2010-2014 in order to minimize rural-to-urban migration and to encourage the return of rural populations from urban areas and centers.

The energy concept used in this project is based on optimal insulation of the envelope, the use of solar energy, and the utilization of earth stabilized bricks. The objective is to reduce energy consumption during the entire lifetime of the house including the construction phase. Therefore, local building materials, e.g. adobe bricks (compressed earth with a low content of cement),



were used. This reduces building costs as well as energy consumption for the production and transport of the construction materials. In addition, the bricks have good insulation and acoustic and bio-climatic properties.

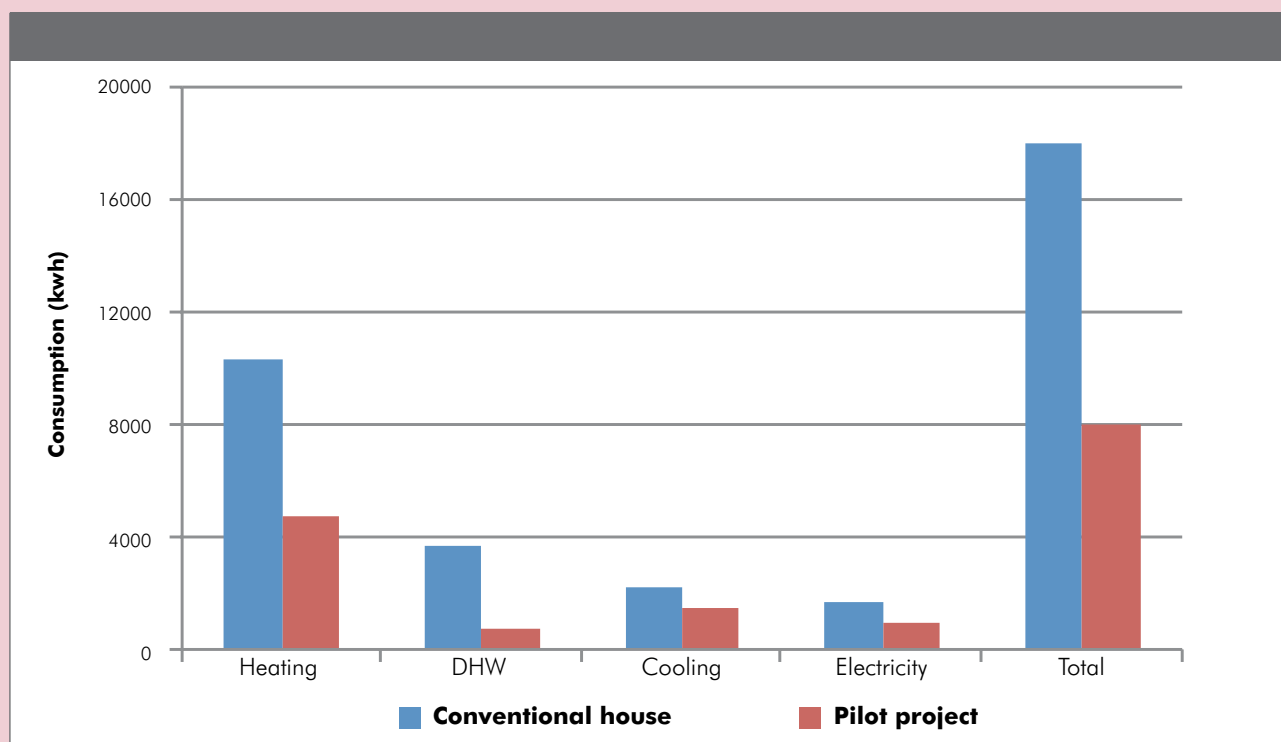
The following measures have been adopted to improve the environmental performance of the house:

- Optimal orientation.
- Thermal insulation of the envelope.
- Use of earth stabilized bricks (adobe).
- Double glazed windows.
- Use of natural light.
- Summer shading.
- Natural ventilation in summer.

levels, and technological capacity within the national building supply chain to meet the requirements without considerable increase in costs. The general consensus from past experiences is that the process of transforming a country's building supply chain takes time and requires continuous government intervention as well as uniformly enforced and regularly updated building energy efficiency codes (Liu et al., 2010).

Mandatory procurement regulations at the city level were found to be quite effective in emerging economies, e.g., Ghana, Kenya, Mexico, and South Africa (UNEP, 2011b). In the Arab world, only the government of Abu Dhabi seems to be moving in this direction, where all publicly commissioned

buildings are required to achieve at least a 2 Pearl rating. Other types of regulatory measures that can be used in the building sector include mandatory energy audits for commercial or large development projects and issuance of mandatory energy certificates upon a sale or a lease transaction of a building. Mandatory audits and performance certificates, however, can be difficult to implement in countries with limited qualified personnel and accredited facilities to perform such audits. The case of Egypt illustrates how long it can take to put these elements in place if policies are not conceived in a comprehensive manner. In 1998, Egypt developed the energy efficiency criteria for room air-conditioners and refrigerators. The Ministry of Industry, then issued a regulatory decree to enforce



- Solar thermal with gas back-up boiler for domestic hot water.
- Solar thermal system also supports space heating.

The project allows annual reduction in energy consumption by 54%, compared with the baseline scenario. The project negates the annual generation of 3-4 tons of greenhouse gas emissions.

The investment required for the pilot project exceeds

the costs of the conventional baseline case by 10%. The payback period is 12 years. The payback period will be reduced with greater economies of scale and increased learning, and by incorporating the real rather than the subsidized cost of energy.

Hamid Afra is Director of the Centre National d'Études et de Recherche Intégrées du Bâtiment (CNERIB)

Abdelkarim Chenak is Head of Solar Thermal & Geothermal Division, Centre de Développement des Energies Renouvelables (CDER)

the program, but enforcement in practice was undermined by the absence of a testing laboratory for appliances (RCREEE, 2010).

Negotiated performance agreements are another type of administrative tool available for municipalities to advance green building targets for selected urban zones or districts. However, these agreements are difficult to institutionalize and protect against powerful interests in the absence of decision making powers for urban planning and zoning at the local and municipal levels. There is a great potential for these agreements in the newly created development zones and districts in, for example, countries of the Gulf Cooperation Council (GCC), Egypt, and Jordan. Although

these countries have declared their commitment to the environment, developers have scaled down their commitments, particularly after the financial crisis of 2008. In such cases, negotiated agreements will have provided an effective governance framework for the implementation of these environmental commitments within the mega development zones.

B. Market Enabling Initiatives

Regulations need to be complemented with market enabling measures in order to foster the emergence of a sustainable market for green buildings. These include economic, fiscal, and public awareness tools (RCREEE, 2010; Iwaro and Mwasha, 2010).

Efficiency certificate schemes and energy performance contracting are two examples of measures that have been used in developed countries. There is a good potential for energy performance contracting in Arab countries within the commercial buildings sector, and especially in countries where energy prices reflect real cost, e.g., Jordan, Morocco, Palestine, and Tunisia.

Examples of fiscal and economic instruments and incentives include tax exemptions, subsidies, soft loans, and grants. Tax exemptions are efficient in stimulating initial sales of clean technologies, e.g., solar heating systems, solar electric, insulation materials, energy and water efficient appliances, and electricity-saving lighting fixtures. Grants and subsidies are well suited to low-income households, which according to UNEP (2011b) “tend not to make investments in energy efficiency even if they have access to capital.” In Tunisia, for example, the Technical Center for Building, a specialized agency under the Ministry of Industry and Technology, introduced a PRO-SOL program offering financial incentives for the use of solar hot water (SHW) systems and a PRO-ISOL program offering financial incentives for thermal insulations of existing roofs and dwellings. These programs have had a remarkable effect on the uptake and spread of SHW systems in the country, the development of a competitive supply market of SHW, and a significant 40-50% drop in the costs of insulation products (RCREEE, 2010).

Soft loans work well in combination with performance standards to encourage households to carry out energy-efficiency improvements. These can be granted through a third party, in which government agencies or donors provide financial incentives to banks, which in turn establish low interest rates for their customers (UNEP, 2011b). In Lebanon, for example, with support from the Central Bank, commercial banks are offering soft loans to individuals and developers for the implementation of renewable and energy efficiency measures in both existing and new buildings.

Public awareness encompasses a broad range of measures for creating spontaneous demand through targeted communication campaigns. For example, capacity building and training programs can be offered for designers and engineers to foster the development of a local, responsive supply

chain. Other initiatives in this area may include public recognition for voluntary labeling schemes and public leadership programs and awards.

Focusing on voluntary labeling schemes, the potential is rather promising in the Arab region. Increasingly locally adapted schemes are emerging in several Arab countries such as the Istdama Pearl system in Abu Dhabi, and the ARZ standard in Lebanon. The experience from the internationally known LEED and BREEAM certification schemes, have shown increased compliance with these schemes in their respective markets, inducing healthy competition among leading construction companies, to use green building strategies for winning large scale projects such as hospitals and schools. On the other hand, the use of green requirements in the commissioning of public buildings should not only target high profile projects, but also low income housing projects, with conditions for cost control. These initiatives typically spur the kind of innovations that are needed to enhance the knowledge base within local construction supply chains, including architects, engineers, material suppliers, and builders.

C. Addressing structural barriers

Buildings seen purely in a narrow end-product perspective are often perceived as low technology products, but in practice they are the outcome of complex product systems (Gann and Salter, 2000), involving diverse knowledge areas, a wide range of physical resources, and a disparate network of actors. The network of actors is dissolved after the completion of a building project and a new network is created with the initiation of a new project (Manseau and Seaden, 2001), not often with the same constellation of actors. The project-based form of organization and the fragmented nature of the construction industry have been widely cited as presenting challenges and barriers for the green transformation of the sector. In this context, addressing the structural barriers will be essential for the success of greening efforts.

There are important differences in the structure and knowledge pool of the construction industry across the Arab region with potential implications for green building strategies. For instance, the considerable construction activities and large-scale projects of some of the GCC countries

have attracted top firms from all over the world with considerable architectural and engineering expertise. It will not be difficult for these firms to pool in the necessary knowledge and expertise to implement high profile green building initiatives, although it will most likely be at considerable additional costs. In low to medium income Arab countries, on the other hand, the industry remains localized, fragmented, and based on small scale contractors and entrepreneurs. Promoting transformation in the practices of the sector within those countries will require considerable efforts in capacity building among builders, architects, engineers, and private developers.

With regard to the knowledge base sector, introducing changes to the curriculums in colleges of architecture and engineering and to vocational training institutions have been cited as key transformational measures of the building sector in the Nordic experiences (Emtairah, 2008). Changes in the academic curriculum included methodologies for incorporating environmental design considerations in all aspects of building design and construction work. There are promising developments in this area with the recent introduction of higher education programs in selected Arab universities in the area of renewable energy and energy efficiency⁷ in the built environment. These however need to be complemented with further changes to core curriculums at the basic level of professional training in all phases of the building supply chain.

V. IMPLICATIONS FOR TRANSFORMATION TO GREEN BUILDINGS

A comprehensive macro analysis of the costs and benefits of green buildings would investigate the effects of implementing the range of measures discussed earlier based on a life cycle analysis. Greening of the building sector in the Arab world will require investments in design and engineering, sustainable materials, and clean technologies. According to some estimates this will increase the upfront capital cost of building construction relative to the 'business-as-usual' scenario (UNEP 2011b). However, for a correct evaluation of the benefits the total cost of ownership over the lifetime of a building needs to be incorporated. There will also be the transition costs associated

with the implementation of the above enabling measures, including governmental support schemes and market incentives to stimulate these transformative changes in the building sector. Furthermore, in countries with limited public resources, the analysis must highlight the case for redirecting investment into green buildings that would have otherwise been invested elsewhere in the economy. On the other hand, the benefits of investing in green buildings go beyond achieving improved environmental performance to bringing about positive social and economic changes.

A. Economic implications

The primary economic benefits from green buildings occur at the household level in terms of realized savings in energy and water bills. While there are contrasting views on the upfront costs, construction costs need not increase substantially as a result of added improvements in the building's energy and water efficiency. Experience from elsewhere suggests that typically construction costs increase by 3-5% due to the introduction of energy efficient solutions, although this figure may vary according to the type of construction. Lowering the overall energy and water consumption has a direct positive impact on life cycle costs. Analytical studies from the United States (US) report that a minimal upfront investment of about 2% of construction costs typically yields life-cycle savings of over ten times the initial investment. The cost data used in the study include energy, water, waste, emissions, operations and maintenance, and productivity and health (Kats, 2003).

Other important benefits of pursuing green building practices include the creation of new jobs and new industries⁸. In terms of retrofitting of the existing building stock, in one estimate, 10-14 direct jobs and 3-4 indirect jobs would be created for every US\$1 million invested in building-efficiency retrofits (UNEP, 2011b). While these figures are based on US housing market, we can expect doubling or tripling of this rate of job creation, considering the average labor productivity and cost factors in the sector in the Arab region. Using a value of 40 direct and indirect jobs per US\$1 million invested in retrofitting activities, close to two million jobs would be created over the next 10 years by investing an average of US\$5,000 per building

for energy and water efficiency retrofitting of the prime 10 million buildings (20% of building stock) in the Arab world.

B. Social implications

Arab countries are urbanizing at a fast rate, resulting in massive informal settlements and slums. In the majority of those countries, the scale of informal and low-cost housing is vast. In this context, providing affordable green housing for the poor is a considerable challenge when so many already face major economic barriers to afford conventional housing. Analysis for social housing, however, does not lead to clear results whether green social housing is more expensive at the point of construction; environmental design features may be, but do not have to be, more expensive than conventional housing (UNEP, 2011b). For example, the results from a recent design competition for social housing organized by the Center for the Study of the Built Environment (CBSE) in Jordan produced consistent cost estimates for upfront construction costs of greener buildings that were comparable to conventional ones (CBSE, 2010). Incorporating life cycle costing into the analysis of greener buildings clearly demonstrates a reduction in monthly ownership and maintenance costs by up to 30% (CBSE, 2010), making them an even more attractive option in social housing schemes.

C. Environmental sustainability

Greening of buildings will have major positive implications in response to the key environmental challenges facing the region such as water scarcity, climate change, land use, waste, and sanitation. Focusing specifically on the water challenge, water efficiency measures for households can result in significant water savings, with fraction of the investments required on the supply side.

VI. CONCLUSION AND RECOMMENDATIONS

The rapid growth in construction work and the significant environmental impacts associated with current and future growth in building stocks make a strong case for promoting green building practices in Arab countries. First, current building practices are still promoting inefficient

building stock characterized by poorly designed and insulated building envelopes and inefficient installations for heating, cooling, and appliances. Green building practices are expected to reduce electricity consumption and conserve water at a time of soaring power demand and limited water resources in most Arab countries. Furthermore, improving the energy performance of buildings is among the most cost-effective ways of reducing climate change emissions.

Second, the case for green transformation of the building sector is also an economic and social one. A key benefit of pursuing green building practices includes increased value creation in terms of new jobs and new industries⁸. Removing water and energy subsidies and directing a portion of these savings towards green social housing will help reduce the cost burden on low income households for basic services (through efficiency gains). At the same time this shift in subsidies removes one of the key market distortions and provides an economic justification for green buildings in the housing market. Consequently, promoting green building practices will have far reaching implications for sustainable urban transformation and for economic growth in a region experiencing rapid urbanization and high unemployment rates.

Meanwhile, current initiatives and policy efforts are fragmented; they target selected parts of the value chain without considering the interactions within the building industry, and they have had limited success in creating real and effective transformation of the construction sector towards building resource efficient buildings. Greening of buildings and achieving sustainable urban transformation in Arab cities will require comprehensive, long-term strategies taking into consideration the particular urban context, the structure of the construction industry, and the target segment in buildings markets. For effective transformation of the building sector, these strategies need to be developed in coordination with other green actions and interventions at the urban scale and in other sectors, namely transport, energy, water, and waste management. Finally, an effective intervention strategy necessitates the identification of current performance levels and setting of clear and realistic targets in terms of energy and water performance for different types and uses of buildings.

SPECIAL SUPPLEMENT SECTION
WAEEL AL-MASRI

ENVIRONMENTAL SUSTAINABILITY IN TRADITIONAL ARAB ARCHITECTURE

Traditional architecture is place-specific, and strongly influenced and shaped by environmental forces in addition to socioeconomic factors. It has evolved through the interaction of man with a particular environment over time, using the available building technologies. Architectural typologies, forms, and details reflect the outcome of this interaction. An adequate understanding of the evolution and logic behind such elements should inform a more rational approach to their adoption and interpretation today as elements of sustainable design, rather than the present reference to such elements in general as iconic or attractive and romantic visual devices.

For example, the courtyard house type was adopted as a “green” device to provide a favorable microclimate in the harsh heat of the desert and represented a true environment-friendly building. The size of the courtyard and its proportions varied considerably from one region to another, reflecting the specific environmental conditions in each region as well as the social, economic, and urban factors. The courtyards of the old houses in Cairo were compact and dense with minimum or no ground floor arcades, acting as cooling wells, while courtyards in the Gulf region were generally spacious with shading arcades, with proportions that helped in the protection from sand storms. Where land was not restricted, multiple courtyards were adopted in houses to accommodate the various family needs. Other examples include a two courtyard arrangement allowing the creation of cross ventilation between the adjacent courtyards. Different levels in dwellings were used interchangeably as living and sleeping quarters at different times of the day and night, and throughout the different seasons. The old houses of Baghdad utilize this creative vertical use of the house around the central courtyard.

Arcades, pergolas, and screens or mashrabiyyas were among several devices used in buildings to shade living areas, or to filter the strong sunlight into these spaces. Wind catchers or towers were utilized in various forms in many places throughout the region to overcome humidity resulting from stagnation of air in living spaces. For example, the wind towers in old Dubai, which were brought in from Iran, became the subject of recent scientific studies and lab tests to evaluate their environmental performance. The wind catchers of

the houses of Cairo were carefully studied in the mid-twentieth century by Hassan Fathi, who illustrated their valuable contribution to environmental comfort in the famous Cairene Qa’a.

Water cascades and fountains, as well as vegetation, were introduced in private and public spaces to lower the temperature and to modify the microclimate in these spaces. The use of vegetation served both aesthetic, symbolic, and entertainment purposes in the elaborate and intricate layouts of courtyard gardens from Iran to Arab Spain. Inspired by a landscape culture that draws its symbolism from the Quranic depictions of paradise gardens, the nature of such gardens is also a reflection of the delicate harsh environmental conditions in the region and the scarcity of water – the essential ingredient for such gardens.

Throughout history and across the Arab/Islamic region, water devices were creatively used in houses, and can particularly be seen in Cairo, Damascus, Iranian cities, and the cities of Morocco and Andalusia. The fountain is more effective than a still pool of the same size and has the additional advantage that it does not only cool the air, but also “cleanse” it. In some old Arab houses the fountain is replaced by the *salsabil* which flows from one side hall (*iwan*) into a pool in the center of the court. The *salsabil* is constructed of a slab of marble carved with a wave pattern, with water trickling down from it, thus producing evaporative cooling. The fountains and water channels that have survived in the gardens of Al-Hambra Palaces are testimony to the advanced engineering knowledge and technologies developed and adopted by Arab architects and engineers. In the Generalife, water channels still bring in crystal clear chilled water from the far away Sierra Nevada Mountains. The aesthetic of the trickling water fountains in the courtyard gardens of Al-Hambra and the region is a reflection of a sensitive environmental awareness, and is expressive of the value of water in this part of the world.

Water has more direct functional use in some courtyards; in the *Sahn* of many old mosques in Fez and Istanbul for example, water fountains are still being used for ablution and drinking as can also be observed in Al-Qarawieen Mosque in Fez. At a smaller scale, drinking water pots were placed inside the typical *mashrabiyyah* in Cairene

houses to humidify air as it passes through, and to cool air in the drinking pot – hence the name *mashrabiya*. At the urban scale, drinking water fountains, *asbilah* (pl. of *Sabil*), used to be the subject of much architectural and urban celebration in old Cairo, often associated with a school for teaching Quran to young students (*kuttab*). A typical example of this association between water and culture is represented by the famous *Sabil Kuttab Katkhuda* in old Cairo. Drinking water fountains also have important functional, aesthetic, and social features in the urban landscape of Moroccan cities and villages. Great efforts were made to harness, conserve, and channel this precious natural resource in the cities and in the countryside, for domestic consumption, irrigation, and manufacturing. The use of water in these buildings, cities, and farmlands is a product of a culture that respects and values this precious national resource.

Traditional architecture was not only influenced by environmental, but also by socio-cultural and religious practices. For example, the general inward orientation of Arab/Islamic architecture worked well, not just from the climatic points of view, but also in the way it satisfied the conservative nature of Arab Muslim societies. Privacy, emphasis on community and neighborhood solidarity, and respect for neighbors, called for by the teachings of Islam, all found their formal expression in the close knit clusters of traditional Arab urbanization, with their narrow alleys, courtyards, and clear distinction between the public and private realms. The social structure and extended family relationships and growth promoted the general organic character of such urban clusters, while the nature of the relationship between the individual and the community influenced the form of public and private space in the city, and shaped the human aspects of the public experience in the urban context, exemplified by the concept of *fireej*, or *hara* (neighborhood), for example. Cultural values, combined with environmental considerations strongly shaped the character of these cities with emphasis on the strong relationship between nature and the built form, human scale, tight urban grain, inward orientation, and focus on living spaces rather than objects or individual buildings. For example, the dense urbanization resulted in narrow alleys between clusters of buildings, which helped keep pedestrian movement networks in Arab cities largely shaded and protected from the harsh sun. An example of such environments can still be seen in many historic living Arab cities such as the Moroccan cities of Fez and Marrakech. The dense urbanization of these cities also means that circulation and transportation networks are minimized, and that people can live, work,



shop, and perform congregational prayers within walking distance, thus reducing the consumption of energy needed for transportation, minimizing the need for mechanical systems, and saving on valuable time, stress, and effort in communicating between these places. It is worth mentioning that the city of Marrakech, for example, has attracted people to move into the city to live there, not just to visit as tourists, and promoted the real estate market in this ancient city to thrive in the twenty-first century, helping towards its sustainability and economic viability, when other old similar cities are suffering from decay and general neglect, and from the escalating threats and pressures of modern urbanization.

Traditional architectural forms evolved through trials and experimentation with materials and structural systems and technologies. Logic and the economy of materials and technologies influenced the development of roofing and support systems and the associated formal aesthetics. Throughout Islamic history, the interaction with other cultures through conquest and trade resulted in the borrowing of technologies and the importation of materials and builders, and led to the emergence of hybrid architectural styles and forms, which gave diversity and vitality to traditional architecture in different geographic locations.

Control of temperature is achieved in traditional architecture by careful selection of materials. Juxtaposition of materials with different reflective capacities generates

heat gradients which cause enhanced convection. The first line of heat control lies at the surface. The surface temperature of a sunlit material will be higher than that of the air. Air movement over an exposed surface will therefore reduce the impact of external heat. Corrugated uneven surfaces, such as the domed roofs of old Jerusalem, or the alternating recessed brick layers, or elaborate stone carving, or even decorative stucco will also simultaneously increase the rate of convection heat transfer and hence create a cooling effect.

The selective absorption and emission characteristics of materials are also very effective defenses against radiation impacts and are especially important in overheated conditions. Materials which reflect rather than absorb radiation, and which more readily release the absorbed quantity as thermal radiation, will cause lower temperatures within the building. The ceramic lining of the walls of the courtyards as seen in the houses of Iran, Iraq, North Africa, and Spain as well as the marble paving found in most of the sophisticated town houses of the region, are directly related to the absorption and emissive qualities of these "cool" materials.

Symbolism evolved in traditional architecture due to the close interaction between man, culture, and nature. Such symbolism has helped create a strong bond between societies and their physical environment, resulting in a sense of belonging and identity. The expressions of this symbolism in Islamic architecture is manifest in the use of geometry in structural forms and in decorative surface applications, the use of Arabic calligraphy, and in the use of muqarnas, for example, the symbolic aspects of colors and surface textures, as well as the use of water and gardens inspired by quranic description of paradise. Due to the nature of fast changing and moving contemporary cultures, such symbolism has largely disappeared from the contemporary dwelling and city. Understanding of the symbolic aspects of traditional architecture, and their effect on the wellbeing of individuals and the identity of communities, can inform the current practices of architecture and add valuable layers of richness and purpose to these practices.

Conclusion

The environmental lessons to be learned from traditional architecture can be of significant value and relevance. Devices such as wind towers, the use of courtyards, and the various means of dealing with passive energy in traditional architecture, are appropriate and typical examples of green design. The rich architectural heritage of the region should

be carefully analyzed and understood in its own historic and physical context. Its human, cultural, and environmental values should be considered, adapted, and applied where relevant and appropriate in the context of contemporary conditions and technologies. It must be understood, however, that this is not a call for the adoption of traditional solutions to solve more complex and contemporary problems of different nature. Rather it is about the use of such concepts and devices in similar situations where the reintroduction and reinforcement of traditional values can contribute to the general environmental and cultural sustainability in a particular locality. It is also about the critical questioning of the appropriateness of those current modern practices in planning, urbanism, and architecture that have contributed to the deterioration of the quality of living environment in the Arab region and its general alienation.

Although this typology does not offer solutions to the general problem of housing in congested urban centers in the Arab region, it nevertheless can offer a higher density, and a more environmentally and culturally appropriate approach to current planning practices for similar dwelling units. The project has generated interest in the courtyard as a viable practical alternative to the villa type in Kuwait. It is hoped that, as more people learn about the courtyard house, this interest will lead to further research into its affordable adaptation, supported by adjustments to building regulations, and a will to change patterns of living.

Wael Al-Masri is Chief Architect, Wael Al-Masri Planners & Architects, Amman.

Further reading

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CASE 1: BEIT AL-SUHAYMI, CAIRO

Beit Al-Suhaymi, a historic merchant's (1648-1796) house, is located in old (Fatimid) Cairo, and is approached through a narrow street off the main spine of Al-Mu'iz Street. The complex planning of the house and its compact design reflect its gradual growth over time. It includes a rectangular courtyard at its center, with a backyard garden to the north side. The main central courtyard is approached through the typical "bent" entrance leading to this lush bright space, which is preserved in its original outline.

The two-courtyard arrangement increases the available range of thermal zones so that people can select the microclimate most suited to their needs. Seasonal and daily thermal variations generate patterns of movement within the house, which became habitual and ultimately form part of a culture. Beit Al-Suhaymi includes several places around the central courtyard with thermal comfort qualities such as the various qa'as, the takhtabosh, al-maq'ad, and the built-in seats inside the masharabiyyas.

The courtyard acts as a well into which the cooler air from the roof sinks, and so the downstairs rooms cool more rapidly during the night. This cool air is preserved as long as possible and the "bent" entrance leading to the courtyard from the street not only protects its privacy, but also helps preserve this cool air of the well. The thermal forces acting on the courtyard's walls and floor consist of solar radiation and radiant heat exchange. The use of high walls around the courtyard, together with vegetation and water, helps to cut down solar heat through shading, and hence contributes to the preservation of this cool air well. The high walls define the courtyard limits and concentrate the sense of its coolness.

Cool breeze generated by differential pressures between the courtyard and the surrounding rooms, flows at intervals, while the positioning of ventilators and wind catchers in the various halls – qa'as – assists this flow within the house. This breeze is also assisted by the two courtyard arrangement in this house. Opposite the main entrance to the courtyard is a covered terrace - takhtabosh with its fine transparent screen which gives an additional dimension to the courtyard by extending views into the back garden. This is a favorable sitting place because of the breeze generated between the two courts. Air flows from the shaded courtyard garden, over evaporative coolers such as porous pots, to the larger warm courtyard. There is a special sense of comfort being experienced through the alternating warmth and coolness



of this "courtyard breeze," which is very different from the constant temperature and humidity in a mechanically air-conditioned environment.

Al-Ma'ad is one of the "socio-thermal" spaces in this type of houses, which overlooks the main courtyard on the first floor. It is always cool and refreshing and enjoys the best view and breeze of the courtyard and a favorite place for the family to socialize. The mashrabiyya, which is employed here in abundance, is a complex environmental, cultural, and architectural device. This elaborate window usually has a small compartment where a water-filled porous pot is placed. Air from outside is cooled by evaporation as it passes over the surface of the pot. Water inside the pot is eventually cooled and is used for drinking, thus the Arabic name mashrabiyya (a drinking place). This window type reduces solar and light penetration into the room but still allows the cool air of the courtyard to filter through. The deep recesses of these windows were used as favorite sitting sofas, enjoying cool breezes, filtered light and views to outside without encroaching on privacy.

This building is an example of the environmental success of the courtyard house concept and remains today as a testimony to the ingenious sustainable approaches adopted by this traditional society. It has in the past few years been restored to its former glory, and remains an important example of traditional building ingenuity offering timeless lessons for a green sustainable architecture.

CASE 2: AD-DALALIAH, KUWAIT

Ad-Dalaliah houses sit on four adjacent plots, adopting the courtyard house type. The size of each house and the functional program are relatively modest compared to similar houses in Kuwait, with a total built up area of about 600 square meters. The size of the courtyard seems ideal for a family of a small or medium size—around 6 x 6 meters—big enough to have a small family and guest gathering as an extension of the inside living rooms.

The character of this project is in sharp contrast with the mainstream architecture in Kuwait today, where housing types such as the villa and the apartment represent values and socio-cultural behavioral patterns that differ from those represented by the traditional courtyard house.

During the 1950s, the Municipality of Kuwait adopted new building regulations based on Western models, the appropriation of which has resulted in a proliferation of architectural forms that seem to be incompatible with local environmental and regional heritage. At the environmental level, the adoption of the villa house type increased the external surfaces and the size of windows, and the resulting heat penetration, and hence increased the reliance on mechanical cooling systems.

On the other hand, the setbacks around the villa house would not allow freedom of movement between indoor and outdoor spaces, unless the boundary walls are high enough to prevent visual intrusion. Balconies in apartment buildings do not work well for similar reasons, and due to the harsh weather conditions in Kuwait. The application of such regulations, together with the adoption of western design ideas and the use of advanced mechanical technology to provide the desired environmental comfort, have all led to the near disappearance of the courtyard house from the architectural vocabulary of modern Kuwait.

In this project, setbacks between the four units were cancelled to have them completely attached to one another, which allowed for the creation of a central courtyard, so that the two-story high walls of one house form the fourth wall of the courtyard of the neighboring house. This was made possible through negotiation with the municipality to obtain exemptions from the local regulations. At the functional level, the courtyards had to satisfy contemporary living patterns for Kuwaiti families who have become accustomed to the comforts



of mechanical cooling and ventilation systems within indoor settings. These houses provide for the option of moving from one part of the house to the other within a completely enclosed circulation system centered round the courtyard. Nevertheless, the courtyard allows for its extended use to enjoy the temperate microclimate it creates and may also be viewed as a functional spatial element; an additional outdoor room that is protected and contained.

The courtyard includes a fountain and a water channel, potted plants, and is surrounded by an arcade at ground level, first floor loggia, 'maq'ad' and a screen 'mashrabiyya' window. Such elements further enhance the favorable microclimate created by shading and the 'cool well' effect, allowing the courtyard's extended use and helping to conserve energy consumption and reduce reliance on mechanical systems. The courtyard also serves as a "light well," bringing subdued, filtered light into the inner parts of the house, which helps cut down electricity consumption.

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NOTES

1. For preliminary information on the population of those cities, see the web site of the United Nations Department of Economic and Social Affairs Population Division.
2. Some expert opinions even accept much higher density levels, reaching 300 persons per 1,000 square meters.
3. For a more detailed discussion of the themes presented in this section, see the Urban Crossroads articles written for the Jordan Times by Mohammad al-Asad (2004 – present). The articles are available on the web site of the Center for the Study of the Built Environment (CSBE), Amman: http://csbe.org/urban_crossroads/introduction.htm
4. Drawn from statistics for the following countries: 12% Jordan (2010), 12% Lebanon (2008), 6% Palestine (2009), 5.7% Qatar (2005), 10% Saudi Arabia - non-oil GDP (2010).
5. Riyadh and Jeddah (2009) both experienced an electric power blackout due to increased demand for air-conditioning.
6. Even in this area, there is a lack of policy evaluation studies, highlighting

the need for proper evaluation studies with regards to the MENA building and construction sector.

7. Masdar Institute in Abu Dhabi is leading with a technology focused Master program in renewable energy and energy efficiency. Other universities in Jordan, Egypt, Lebanon and Palestine have participated in curriculum development projects with European partners in the area of energy efficiency in buildings and renewable energy.
8. For instance, between 50,000 to 80,000 new jobs will be created from 2010 to 2020 in Nordic countries as a result of the drive to meet national targets for energy efficiency in new buildings and retrofitting of old ones. For more details, see: Andresen, I., Engelund Thomson, K., and Wahlstrøm, A. (2010). Nordic Analysis of Climate Friendly Buildings: summary report. Nordic Council of Ministers (NORDEN), Copenhagen.