“Public Green Buildings in Jordan”

Magdy Tewfik* and Mena M. Ali**

Abstract
Jordan imports 96.5% of its need for energy. Escalating price of imported fossil energy amounts to JDs 4.6 billion = US$ 6.48 billion/year. However, trends driving the demand for building include high rates of population growth, rapid urbanization and recurring forced in-migration from neighboring countries. Greening of the building sector has a wide range implication on other relevant economic activities, such as: construction materials, transport, waste management, energy, fresh water and wastewater treatment. This paper attempts to answer some valid questions like: why going green? and, does greening cost more?. Applicable measures of green buildings, with regard to Jordan have been discussed in this article, while an account on the financial and social constraints and opportunities have also been dealt with. Two selected pioneering examples of green public projects in Jordan have been highlighted and some concluding remarks were given.

Keywords: green building; energy; environment; sustainable; Jordan; water.

The quest:
The concept of “green building” is used to refer to buildings characterized with increased energy efficiency, reduced water and material consumption, and improvement of health and environment. However, this includes a life-cycle perspective for costs and benefits, minimizing energy and water consumption over building’s life time which is regarded crucial to achieving a sustainable transformation of the building sector. Other pertinent concepts encompass sustainable building, eco-building and energy efficient building. The difference among these terms is a matter of emphasis on particular social and environmental aspects, as well as methods of minimizing negative environmental impacts. A sustainable building should also be economically viable and socially equitable achieving some vital factors, such as: environment, economy and equity.

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Ecology, green architecture and sustainability are terms sometimes used mistakenly in literature to express the same thing. They could be easily defined and categorized in terms of the aspects they mainly deal with. “Ecology” deals with ecological design including eco-village, and eco-city. It concerns only protection of natural environment. “Green architecture” includes green building and green construction. It concerns both natural environment and human comfort. “Sustainability”, however, encompasses much more. In addition to natural environment protection and human comfort, it concerns economic development. This article focuses mainly on building as the main challenge for adoption of green architecture.

Greening of the building sector also has a wide range implication on other relevant economic activities, such as: construction, materials, transport, waste management, energy, fresh water and wastewater treatment. Therefore, dealing with an integrated systematic approach at the interaction of these sectors would help in exploring some opportunities for greening not only one specific factor but also the overall economy.

*Why going green?*

Jordan imports 96.5% of its need for energy. Escalating price of imported fossil energy (crude oil and natural gas) amounts to JDs 4.6 billion = US$ 6.48 billion per annum (Ministry of Energy and Mineral Resources, 2012) which swallows a considerable portion of the state’s annual budget, thus counts up to 83% of the total export gains. Jordan enjoys unique climate and microclimate conditions. Despite the relatively moderate climate adorned with an average of 300 days/year at rate of brightness up to 8 hours and strong daily solar radiation rating between 5.5 and 6.5 kWh/sq. m., Jordan is already too late in applying renewable energy. The building sector in Jordan is a key target for greening due to the magnitude burden it shoulders on the environment. There is no concrete action yet taken towards greening such sector. At best, it remains at the embryo stage.

Trends driving the demand for building in Jordan include high rate population growth and rapid urbanization, coupled with waves of recurring forced in-migration from neighboring countries over the past 66 years. Urban population exceeds 80% of the total bulk, of which urban poor living in slums rates over 15.7% (UN-Habitat, 2008). However, these trends are making the building sector the fastest growing in the country. In Jordan, the share of the building sector in the final energy consumption accounts more than 33% (UNEP, 2007). Buildings are also responsible for high rate of CO2 emissions over their lifetime, in addition to significant use of water in a country which is one of the world four poorest in water resources.

Green building practice offers a cost-effective strategy to reduce solid waste, electricity consumption and conserve water, compared with for instance, expansion of supply capacity. Further more, improving energy performance of building is among the most cost-effective ways of combating climate change, based on projection for greenhouse gas (GHG) abatement costs for key economic sectors (Enkvist et al. 2007).

The case of affordable green building for the poor is equally compelling. A number of studies and experiences have indicated that the environmental design features do not have to be more expensive than the conventional ones for low-income housing (CSBE, 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). In Jordan, on the other hand, informal settlements and rural areas currently suffer from shortage of adequate access to basic services in terms of water and sanitation.
In the residential sector, household expenditure on heating and cooling in inefficiently designed and constructed buildings are forming an increasing financial burden on the occupants, especially in Jordan where fuel and electricity subsidies are gradually being removed. A study conducted in 2004 at the city of Aqaba revealed that the average household pays up to 30% of its monthly income on air-conditioning during the summer period (Biggs, 2005).

In most commercial and other public buildings in Amman, Zarqa and Irbid (highest populated cities in Jordan) the currently installed systems of heating, ventilation and air-conditioning have the lowest energy efficiency performance among available options. This is mainly due to the preference of applying cheaper systems over the more efficient ones.

Distinguished discrepancy in income, however, affects the use intensity of energy at the household level. It can be said with some confidence that a large portion of the building sector in Jordan has evolved without taking the environmental and social considerations into account. Old and new buildings are without adequate insulation for walls, windows and roofs (FFEM and ANME, 2010). Not all the building codes are yet enforced, let alone being adequately practiced, particularly those for green buildings.

**Applicable measures of green buildings:**

It goes without saying, that the first step in the construction of a green building is the initial integrated design. Proper analysis of factors such as climate, topography, site location, available natural resources and municipal building legislations is essential to yield a comprehensive approach to the design process. Design also should include examining the most environmentally friendly and least ecologically obtrusive structure. The design process should take into consideration the interaction of the whole building structure and its systems. For example, a building that uses extensive day-lighting techniques would reduce the amount of heat giving off by lighting fixtures, thus allowing a smaller air-conditioning system to be used (Crosbie, 2000).

Another important aspect of green building design is the life cycle impact which should be taken into consideration. This includes short and long term effects of building materials, maintenance and operation on the environment and occupants. Effective green buildings should be seen as more than a collection of environmentally friendly ideals and/or latest technology models. In the meantime, green designs can reduce resource demand and enhance the quality of life. Another significant aspect of green building is the use of rational building materials. This starts by choosing low or high impact local materials. A low impact material, for example, is less toxic or carcinogenic. A good example would be applying insulation made from low VOC (volatile organic compounds) emitting materials. Another example is water based lead free paints.

A product may be considered green for more than one reason. Recycled plastic lumber is an example of multiple reasons for being considered green. It is made of recycled waste, highly durable, and does not require pesticide treatment. In contrast, the use of wood treated with preservatives, which perhaps may have an advantage in terms of durability, but would cause health risk to the occupants of the building (Environmental Building News, 2000).
Energy use within a structure is also an important factor when building green. The types of windows and positioning of the structure to take advantage of the prevailing cooling breeze and sunlight can reduce demand for energy use. In addition, the installation of recovery system can reduce cooling and heating cost.

On-site generation of renewable energy by using solar, wind and biogas can significantly reduce fossil energy demands. Water use is another important consideration in the construction of green buildings. Gray water is wastewater from dishwashing and washing machines. It can be stored and reused in irrigation and other non-potable purposes after being treated.

The growth and development of our communities have great impacts on the natural environment. Manufacturing, design, construction, operation, maintenance and removal of buildings are responsible for the consumption of many natural resources (WNCGBC, 2013). On the other hand, there are incalculable environmental, economic and social benefits, which can be obtained by going green. Outstanding gains of green buildings include:

- Save energy and resources, recycle waste materials and minimize emission of toxic substances through buildings life cycle.
- Harmonies with the local climate, culture, traditions and the surrounding environment.
- Sustain and improve the quality of life, whilst maintaining the capacity of the ecosystem at local and global levels.
- Make efficient use of resources, achieve significant operational savings, make occupants healthier and increase their productivity. ([http://www.greenbuilingindex.org/why-green-builings.html](http://www.greenbuilingindex.org/why-green-builings.html), Retrieved on 13th Oct, 2013)
- In spite of the limited natural resources, Jordan has abundance of renewable energy resources including solar, wind and biogas.

**Does greening cost more?**

Within the construction industry, there are professionals who yet think that building with sustainable design technologies inherently costs more. Others, however, believe that while sustainable design may cost more up-front, the benefits and energy saving, health and other wellness factors create savings over the course of several years.

There are studies which have investigated and quantified how much a sustainable design costs (see Kats, 2003). Some costs are not easily quantifiable though, such as occupant’s health, wellness and human comfort. Even though, the cost of a green building can be worked out. Yet, there are external issues that can make difference in the final cost depending on the level of greenness desired.

Kats (2003) has issued a study that serves to dispel the myth that a sustainable design significantly costs more. He explains that while building green may indeed incur 2% more on average in cost up-front, it is usually a result of the more intensive design and construction process that is required in sustainable design projects. 33 green buildings from across the United States have been compared with conventional designs for the same ones that have been included in the study. The average premium for these green buildings has been slightly less than 2% or US$ 3 to 5 per square foot, substantially lower than what has been commonly perceived.
Kats (2003) also investigates positive qualitative impacts that are more difficult to measure such as increased productivity, employer morale and better occupants’ health. He observes that green buildings provide financial benefits which conventional buildings do not. These benefits encompass energy and water savings, reduce waste, improve indoor environmental quality, reduce occupants’ health costs, maintain greater occupant comfort/productivity and lower operation and maintenance costs. In the meantime, he adds that integrating “sustainable” or “green” building practices into the construction of state buildings is a solid financial investment (Kats, 2003).

Of course, one can admit that every building or project is different. However, diversified factors may contribute to varying budget outcomes. For instance, installing photovoltaic systems and/or an advanced gray water system in a green building in Jordan, where most of such systems are imported, can substantially add to the overall project cost. Budget can be even higher due to involving inexperienced teams, while additional scope of work would be determined by the additional skills and efforts required to support the design team in achieving and implementing high performance design. Effective integrated design requires that the design team and client should explore all the program possibilities, design permutations and optimization of the many technical and natural systems engaged in the building, site and watershed (Reed, 2003).

Life cycle cost analysis is a useful means in sustainable design construction so as to highlight the true cost of a building. Often, it is considered the best way to determine the real impacts of product. Although the technique is still maturing, especially the aspects dealing with ultimate impacts on human and ecosystem well-being, it became internationally recognized as an approach to assessing the comparative environmental merits of products or processes (Trusty and Horst, 1999).

**Challenges to green architecture:**

Many governments throughout the world have committed themselves to the goal of sustainability and green architecture. However, there is a host of obstacles in both spheres. Such barriers need to be thoroughly studied with specific strategies mapped out to eventually remove them. It is rather obvious, that the international institutions concerned with sustainable development operate in a fragmented manner. Each has a different focus on policy aspects and priorities. In a sense, each of the three pillars of sustainable development i.e. - economy; society and environment - is dealt with separately, governed by different organizational missions and goals. There are several categories of obstacles to green architecture including financial, legislative and social constraints. The legislative obstacles are outside the scope of this article.

**Financial constraints:** The financial aspects can be considered as a barrier to the use of bio-climatic principles in the building sector. As mentioned earlier, the largest obstacle for widespread adoption of green architecture, particularly in the developing countries, is its cost. The biggest bulk of extra cost is due to the increased architecture and engineering design time, modeling costs and time necessary to integrate sustainable building practices into projects. Generally, the earlier green building features are incorporated into the design process, the lower the cost can be (Kats, 2003).

Although many Arab countries have declared their commitment to the green environment principles, developers have scaled down their enthusiasm, particularly after the storming world financial crisis of 2008. Other challenges facing the green building industry include: resistance to change, limited post occupancy evaluation and split incentives for owner-tenant.
Financial opportunities: The primary economic benefit from a green building occurs at the household and/or tenant level in terms of realized savings in energy and water bills. While there are contrasting views on the up-front costs, construction costs need not increase substantially as a result of added improvements in the building’s energy and water efficiency.

In many advanced industrial countries of Europe and North America and elsewhere, a growing number of households/tenants have installed efficient photovoltaic systems in their buildings, thus producing sufficient electricity for their need. Furthermore, they contribute the surplus power to the local community through the network. However, increasing numbers of eco-neighborhoods, urban eco-villages and eco-cities are found in Germany, Sweden, Denmark, Italy, Australia, Japan, South Korea and elsewhere. Those unique projects are either entirely or partially green, serviced by effective systems of sustainability. Ironically, the Electricity Company in Jordan places strict measures on consumers who install photovoltaic panels. Consumers are only allowed a limited rate of their ordinary electricity bill. The company mistakenly thinks that it would bankrupt once the number of consumers drop through increasing dependence on clean energy.

Various options can be thought of to overcome financial obstacles, among which are:

- To proceed with tax relief for people who accept to pay a higher cost for energy efficient measures in their properties. It is also necessary to study efficient financial tools aimed at stimulating great investment in the energy saving and environmental pollution reducing sectors (Maiellaro, 2001).
- Examples of fiscal and economic instruments include tax exemptions, subsidies, soft loans and grants. Tax exemptions are efficient in stimulating sales of clean technologies. Grants and subsidies are well suited to low-income households. Soft loans work well in combination with performance standards to encourage more tenants to carryout energy efficient improvements. These can be granted through a third party, in which government agencies and/or non-profit donors provide financial investments to banks, which in turn establish low interest rates for green technology low-income customers (compare UNEP, 2011b).
- A greener building should not necessarily be expensive. There are some products that might individually cost more, but if good design practice and planning have been applied, the costs are often comparable (Rasmussen, 2002).
- Green buildings also require consumers to think of long-term costs. A more efficient heating system might cost more up-front, but will save money on the long-term due to lower energy bill and reduced maintenance (Rasmussen, 2002).
- Advocates of green buildings also urge for a broader definition of the cost, including costs to personal health and environment well-being (Rasmussen, 2002).
- It is also known that costs of depleting energy resources continue to follow the current rising trends, in turn making conventional buildings more expensive. Green buildings are also more desirable to own, rent and work in. Therefore, they hold much of their retail values (Hagan, 2001).

Social constraints: Social aspects are still the main challenges to green building, and thus need further awareness. One of the principal obstacles is the resistance to change to greening. Although green materials and green design strategies are becoming more feasible nowadays, many people yet make choices with little or no notice to their rewarding benefits. Acute shortage of data about the development of bio-climatic design
among all categories of citizens let alone professionals, technicians and customers also exists. Even the more expert categories employed in the building sector happen to be inadequately educated and/or poorly trained (compare Maiellaro, 2001).

As far as human health is concerned, poor indoor quality of air resulting from factors such as tighter building structures, bad ventilation, air pollution, faulty air-conditioning systems, occupants’ related pollutants, construction materials that emit high level of VOC and poor maintenance practices, all of which can sharply decrease the quality of indoor environment. The USEPA ranked air pollution among the top five environmental risks of public health. Unhealthy indoor air is found in up to 30% of new and renovated buildings in the US (Lippiatt and Norris, 1995).

Sick Building Syndrome (SBS) and Building Related Illness (BRI) have become more common in workplaces, and thus increasing building owner and employer costs due to sickness, absenteeism and increased liability claims. It has been estimated that SBS and BRI cost roughly US $ 60 billion each year in medical expenses and lost worker productivity in the United States (Lippiatt and Norris, 1995).

Contractors and builders rarely keep abreast with new construction techniques, alternative technologies, materials, material recycling, waste management and green building systems. For the most, these are new concepts of clean technology which take time to acclimatize with. The techniques of solar heating/cooling are well rehearsed, even though, the uptake of them remain outside the mainstream of construction industry. The common reason given for this is the cost! Behavioral changes need no cost and might increase sustainability (compare Vale and Vale, 1999).

In all parts of the developed world, construction is highly controlled through both building codes and regulations that specify materials and methods which are considered suitable for safe construction. The stringent legislative framework is often a challenge for green buildings. Most pioneering eco-designers have found out that before they could build the way they want, they would first have to campaign to change local codes (Wilhide, 2002).

While environmental and socioeconomic potentials of greening the building sector is promising, recent international and regional studies of the sector point to industry and market barriers for the widespread adoption of green building practices (El Andalousi et al., 2010, UNEP, 2007, UNEP, 2011b, WBCSD, 2009). These include obstacles related to the structure of industry, financial constraints and misplaced incentives among others (UNEP, 2007, UNEP, 2011b).

Social opportunities: Undoubtedly, due to climate change, the globe is facing a drastic critical time, in which the world community needs to make a conscious choice towards a more sustainable way of life. If such change does not occur soon, our environment will continue further deterioration and the world community shall pay a heavy price. Climate change is alarming, resulting in recurring natural disastrous in every corner of the universe. Reluctant human behavior is caught responsible, to a great extent, for impeding progress of sustainable environment.

Targeted communication campaigns through mass-media, schools, universities, public institutions and community centers should shoulder the responsibility of enlightening people about how to lead a sustainable lifestyle. Stakeholders, particularly top decision makers, public authorities, professionals, architects,
engineers, scientists, builders and contractors should be more committed to protect our sensitive environment. However, all public and educational institutions have not yet done enough on their behalf with regard to sustainability, greening existing buildings and dissemination of technical know-how among stakeholders. Training laymen on simple practical measures to reduce waste and act friendly with the environment can also be useful. Another important social benefit of pursuing green building practices includes the creation of new jobs and new industries.

Admitting the existing paucity of expertise and necessary knowledge to implement high profile green building initiatives in Jordan, universities and polytechnics should introduce more relevant curricula in order to bridge such gap. The Jordan Engineering Association should embark on introducing regular training programs for its affiliated members. These programs should focus on sustainable design in buildings including developed energy efficiency techniques. Jordan government should also carry the responsibility for enforcing green building policies including procurement, contract specifications, construction performance and building codes, so as to regulate and effectuate municipal standards.

**Light at the end of the tunnel!**

Early integrated design offers great opportunities for reasonable cost of green buildings, and thus influencing better environmental performance. However, the adoption of international prototype approaches to architecture and construction engineering in university curricula proved to disregard the necessary basics of green education and sustainable techniques including codes addressing energy efficiency, water use and construction impacts on the environment.

Surprisingly, Arab vernacular architecture remains a good example of environmentally friendly buildings to learn from. Unfortunately, there are very few local architects and construction engineers who can work with full potential climatic design and thermal performance modeling of buildings. As a result, the dominant design approaches are insufficiently tuned to local climatic conditions and sustainability.

There are some encouraging signs vaguely appearing on the horizon. Regionally based trade and professional publications on construction, architecture, building materials and engineering are increasingly profiling and displaying the course of green techniques in buildings (The Big Project, 2010).

The results from a recent design competition for social housing held by the Center for the Study of the Built Environment (CSBE) in Jordan, has produced consistent cost estimates for up-front construction costs of greener buildings that were comparable to conventional ones (CSBE, 2010). Incorporating life cycle costing into analysis of greener buildings clearly demonstrates a reduction in monthly ownership and maintenance costs by up to 30% (CSBE, 2010), making them an even more attractive option in social housing schemes.

In 2013, the “Jordan Green Building Guide” was issued. The guide in-holds comprehensive technical standards and criteria which came in seven chapters. It includes: green building management, site sustainability, water efficiency requirements, energy efficiency requirements, healthy indoors environment, materials and resources. Hopefully, such guiding principles could be culminated into a bylaw, in order to maintain the compelling standards, create a noticeable shift in construction practices, reform building regulations and incorporate a sound green transformation. In terms of green construction works and building materials, the published codes and standards can form the main institutional levers for ruling construction practices and material selection in Jordan.
In addition to an early stage of design and use of appropriate construction technology in green buildings, environmental performance can be improved through the choice of efficient installations and components such as: heating and cooling systems, lighting appliances and water fixtures. The potential savings from promoting rational energy appliances can be substantial.

The wide scale adoption of solar water heating systems in Jordan has recently encouraged the municipalities to limit issuing the “occupancy permit” for new residential units unless serviced by solar water heating systems. The absence of such permit deprives a new building from access to public water, electricity and sewage services. This successful action is a result of an extended technical and institutional support for the industry and favorable market conditions for the low and medium income households/tenants to purchase solar water heating units at a good reachable price. Unfortunately, it has been observed that some landlords remove the solar water heating units once the “occupancy permit” has been awarded. Regular municipal inspections could perhaps put an end to such irresponsible practice.

On the regional scale, the Arab League issued in December 2010 the first Pan Arab energy efficiency guidelines. Such guidelines stipulate the development of national energy efficiency action plan (NEEAP) and provide recommendations for energy conservation in buildings (Arab League, 2010). The Regional Center for Renewable Energy and Energy Efficiency (RCREEE) is another agent working on the regional level, spearheading thus 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). It should be mentioned, however, that the United Arab Emirates, Qatar and Oman are achieving remarkable progress in sustainable buildings.

*Green transformation in buildings:* It goes without saying that Jordan is desperately in need of a proactive green building policy at the national level. Four levels of green transformation can be detected in the building sector. These are: design and engineering choices, construction processes and materials, installations and systems for the provision of basic services such as energy, water and mobility. The latter dimension mainly concerns urban center and district scales, but in some cases can be tightly linked to or influenced by project developers.

Environmental performance improvements can be achieved at every level. However, the greatest opportunities with the lowest costs can be achieved at the early stages of design and engineering. Comprehensive design incorporating adequate environmental principles in various design stages including: building form, orientation and other architectural aspects yields the highest results (WBCSD, 2009).

Major opportunities can also be found in the maintenance and retrofitting of existing buildings. In Jordan, for example, potential energy saving of 20% has been estimated through cost-effective retrofitting of existing commercial buildings, with a payback of less than 1.6 years on required investments (Shahin, 2006). A study conducted by the USGBC (2006) reveals that by retrofitting existing buildings, owners could save, on average 90% per square foot annually in energy costs. Furthermore, these savings can earn back the investment in 2 to 2.5 years.

In the residential sector, feasible measures such as the upgrading of lighting and water fixtures, as well as energy and water leakage inspections can yield on average 30% savings. However, adapting behavioral patterns constitute a key element in achieving 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. An analysis issued by the World Business Council for Sustainable Development (WBCSD, 2009) concluded that wasteful behavior can add one third to a building’s energy performance, while conservation behavior can save a third.

Ironically, 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). Buildings involve diverse knowledge areas, a wide range of physical resources and a desperate network of actors. This network of actors, however, dissolves after the completion of a building project and a new network is created with the initiation of a new project, not often with the same constellation of actors (Manseau and Seaden, 2001). The project based form of organization and the fragmented nature of the construction industry have been widely cited as presenting challenges and barriers for green transformation of the sector.

**Pioneering public green buildings in Jordan:**
It is so intricate to collect adequate information about the very few existing green buildings in Jordan, particularly when the necessary data is neither documented nor released on the national level. Yet, a local “Rating System” has not been adopted, and thus none of these chosen pioneering examples can be ranked. This paper briefly highlights the unique experience of two projects of public green buildings in Amman, which are: The Embassy Building of the Kingdom of the Netherlands; and the WHO Building.

**The Embassy Building of the Kingdom of the Netherlands in Amman.**
(Al Nasa’a, 2009).

**Location:** Abdoun, Amman  
**Client:** Dutch Ministry of Foreign Affairs.  
**Total Area:** 1253 sq. m. (including both existing and new areas for the main building and annexes).  
**Architect:** Rudy Uytenhaak Architects, Netherlands.

Embassy of the Kingdom of the Netherlands in Amman: Perspective  
Source: Al Nasa’a (2009)
Design Concept: An existing villa was converted into the Dutch embassy offices. The existing basement and ground floor were kept with minor alterations. A steel structure carries a new glazed pavilion (parasol system) containing new office spaces were added above the existing structure. However, floating stone plates were fixed on the roof. Each plate is tilted in different direction so that there are enough spaces between them for natural ventilation. A number of ventilation holes were also placed on the roof. They include skylights to maximize daylight inside the building.

Green Features: Automatically controlled, movable canvas for shading, were erected on the first floor windows with manual overrides. Solar units were installed on the roof including photovoltaic panels and water heaters. Stone and concrete were used for the building envelop to increase thermal mass. The mechanical indoor air circulation system for heating and cooling maintains the thermal comfort (thermostats). The system operates with individual control. The villa’s original swimming pool was converted into a thermal storage tank for HVAC systems. Energy efficient lighting fixtures and electrical appliances were used throughout the building. The garden is mainly rendered with hard landscaping features, while the applied materials are of high solar reduction impact (SRI) value.

Embassy of the Kingdom of the Netherlands in Amman: Section
Source: Al Nasa’a (2009)

Water: The applied system targets 30% reduction in water use, while low flow fixtures were used in the building and drought resisting soft landscaping including plants render the outdoor space.

Electrical System: The use of photovoltaic panels to supply power to all office computers saves 4.3% from the total load. In the meantime, the harvested daylight in all offices saves 2.8% from the total load. Thus, the approximate savings which were estimated for running cost equals to JDs 1, 149 per year.

HVAC Systems: Estimated annual energy generated from solar collectors equals 5, 415 kWh/year, while the running cost for heating and cooling amounts to JDs 7, 086 per year, compared with the annual cost without sustainable features that reaches JDs 10, 935 /year (Al Nasa’a, 2009).
**WHO Headquarter Offices in Amman.**

Location: Al Abdali, Dakhiliyeh Roundabout, Amman, (area of 2,500 m2)
Client: The World Health Organization Office (WHO) and Regional Centre for Environmental Health Activities (CEHA).
Area: The total built-up area is 3,900 sq.m

Description: A four story office building:
• Basement floor: for parking and services
• GF: for the common facilities between WHO and CEHA, such as a reception hall, meeting rooms, library and video conference.
• First floor: for WHO facilities
• Second floor: for CEHA

Design office: Engicon, (Multi-disciplinary consulting firm performing engineering tasks in the Middle East and across the Arab World).

Design Approach: The designer tried to show that a Green Building can still be modern, innovative and attractive; incorporating client’s requirements for space, image and identity. The use of ashlar (natural stone) as the prime local building material was maintained with attractive massing. The facades feature a balanced
proportion between glazing, stone and steel. The internal facilities were distributed efficiently, providing attractive internal spaces and smooth functional flow.

**Green Features:** Low Emitting and fuel efficient vehicles, 50% of the parking spaces were placed under cover and under the building. Steel structure sunshade for outdoor car parking were fixed, composed from steel horizontal and vertical pipes with 4mm "Alucobond" sheets cover (light composite material consisting of two white aluminum cover sheets and a plastic core of a certain solar reflectance value) and tension cables. Solar photovoltaic panels are used for lighting exterior areas. Total renewable energy produced equals 2.5% out of the total energy consumption in the building and site. Also efficient lighting fixtures are used.

**Water:** Water efficient landscaping, reduced by 50%. Storm water management plan was implemented by harvesting the rain water from the roof and hardscape in winter, and from the condensate water from AC Units in summer, and stored in special tanks. (The collected water is used for WC flushing and irrigation). The project captures and treats 90% of the annual rain fall and the collected rain water is treated by a suitable filtration system. High efficiency and water conserving closets and urinals are used. Solar water thermal system and refrigerants with low ozone depleting potential (ODP) and global warming potential (GWP) were selected.

**Controllability of systems:** Lighting, Thermal Comfort Design, Daylight and views of 75% of spaces: Curtain walls of adequate amount and certain glazing characteristics were fixed on elevations: Transmittance (34%), Reflectance out (13%), Reflectance in (28%), Solar energy transmittance (17%), Solar energy reflectance (8%), Shading Coefficient (0.32), U-Value Summer W/m2 C (1.66).

**HVAC systems:** refrigeration and fire fighting systems are CFC free. The HVAC design and the building envelope meet thermal comfort conditions for human occupancy. Each space is provided with a separate thermostat.

WHO, Health and Environmental Benefits.  
Source: www.engicon.com
Conclusions:
Greasing of buildings offer incalculable positive advantages and sound response to the key environmental challenges in Jordan, such as water resources, land use, waste, sanitations, increasing energy demand and climate change.

The rapid growth in construction work and its significant negative impact on the environment with current and future growth in the building stock driven by high increase in population and urbanization ratios, make a strong cause to promote green building practices in Jordan, including the existing stock of buildings.

Generally, building practices are still promoting insufficient production characterized by poorly designed and insulated building envelops. Green building practices are expected to reduce electricity consumption and conserve water, at a time of soaring power demand and shortage of water resources in Jordan. Improving energy performance of buildings is among the most cost-effective way of reducing harmful emissions. However, appropriate measures should soon be taken to resolve the shortage of green housing for low-income groups and the urban poor. Such groups form the silent majority in Jordan.

Removing water and energy subsidies and directing a portion of these savings towards green public buildings and social housing will eventually help reducing the cost burden on low income households for basic services. In the meantime, such cross-subsidy removes one of the key market distortions and provides economic justification for green buildings in the housing sector.

Green transformation of the building sector also yields rewarding social and economic benefits. A key benefit of pursuing green building transformation includes increased value creation in terms of new jobs and new industries. The promotion of green building practices will have far reaching effects on sustainable urban transformation for economic growth in a country which is experiencing fast urbanization and escalating rates of youth unemployment, especially among university graduates.

Current greening initiatives and policy efforts are fragmented. They target selected parts of the value chain without considering the interactions within the building industry. In so far as they have achieved very limited success in creating effective transformation of the construction sector, it is high time for a change towards establishing resource efficient buildings.

Greasing of buildings and achieving sustainable urban transformation in Jordan require comprehensive, long-term strategies taking into consideration the special urban context, the structure of the construction industry, and the target segment in the building market.

For effective transformation in the building sector 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. Effective intervention strategies necessitate the identification of current performance levels and setting clear realistic targets in terms of energy and water performance for different types and uses of buildings.

Further intensive research work and the establishment of more convincing green building examples will advance sustainable technology and provide direct proof of its economic and health related benefits, and thus encouraging much wider adoption. Research in areas of life-cycle cost analysis over the full spectrum
of building construction, operation, post-occupancy and reuse or disposal is urgently needed. The more conventional buildings and their negative impacts on the environment become well-known, the more green building practices become widespread.

The green building movement is gaining more momentum worldwide. Each year yields additional advanced schemes, as well as more efficient clean technologies. This includes credit systems which rate buildings’ environmental performance. Certification programs for green buildings and the adoption of greening standards and practices should be globally recognized by standard-setting organizations. Hopefully, Jordan will soon overcome its shy performance of green architecture and actively join the world green movement.

Nevertheless, early stage integrated green design, proper green education, oriented incentives towards existing buildings’ owners and tenants, public and private sectors funding for renewable energy would yield better outcomes. Development of specialized curricula, programs and research in higher education institutes are urgently needed in Jordan. Encouraging the concept of green design as an add-on rather than an integrated process suits more the local culture.

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