Sustainable Approach for Developing Urban Environment in Egypt

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1. Abstract
This paper discusses and defines sustainable approach, particularly green architecture, for environmental and economic issues of urban development in Egypt. The green architecture was investigated to define its capabilities in decreasing the environmental impacts and economic costs of urban development. As a result of its massive capabilities for improving energy performance of buildings, the green architecture has been invested worldwide. Moreover, Egypt's current and future energy indicators such as resources, production and consumption of buildings were analyzed and assessed in relation to the environmental impact. The findings proofed that the current energy consumption and its rate of growth and, in turn, environmental impact, are quite significant, particularly in residential areas, which is responsible for 10.2% of the annual total CO2 emission as a result of energy consumption. Therefore, it is highly recommended the importance of applying the green architecture, particularly photovoltaic technologies for urban development in Egypt. The results indicate that solar, biomass and wind energy are the most suitable renewable energy systems for implementation of urban development in Egypt. A general development policy for implementation of renewable energy resources in urban development in Egypt is also proposed, as a solution to reduce negative effects of energy consumption of residential sector on urban environments

2. Keywords
Sustainable approaches, urban environment, renewable energy resources, energy consumption, negative impacts, solar energy, wind energy, biomass energy, sustainable development, Egyptian environment, Green Architecture.

3. Introduction
The environmental resources, currently, are facing serious concerns regarding its ability to last and, in turn, serve future generations. This is because the environmental quality, in fact, has been suffering from major issues such as; "Ozone Depletion", "Global warming", "Deforestation", "Air, land, and water contamination", and "Run out of nonrenewable energy resources" [1]. These issues are mainly a result of international crises and aggressiveness (abuse of the environment), particularly growth rate of world population and, in turn, energy consumption. It is expected that the environmental impact of these crises will be doubled with the same growth rate of world population and energy consumption. The world population is expected to be doubled during the period of 2003 to 2100 from 5308 million to about 9910 million. Consequently, the growth rate of energy consumption will increase from 420 quadrillion (10^{15}) Ton Oil Equivalent to 780 quadrillion TOE [1].
The planners and architects as one of the main parties that have major direct influences on the environment; have been criticized for their role in accelerating the world's environmental crises. Different governmental reports, papers and studies, have proved that the construction process in the world consumes about 34% of the world's energy in embodied energy [5]. Embodied energy is the sum of all energies used in building construction such as; manufacturing of building materials, transportation of construction

materials, construction process, and building's energy needed for lighting and air conditioning. Therefore, renewable energy resources provide a motivating factor in the efforts of the planners and architects to discover more environmental urban development.

In Egypt, with population size of about 65 million in 2001, the buildings sector consumes 19.2% of the total energy consumption, and about 39.1% of the total electricity consumption, which produces 10% of the total CO2 emission [13]. The architects in Egypt are responsible for executing and establishing environmental buildings and communities that reduce energy and electricity consumption in buildings sector. This is because their way of planning and design influence directly energy consumption in the design and construction of projects.

Accordingly, the purpose of this paper is to provide the Egyptian architects and planners with new design approaches that facilitate fulfilling energy future requirements. These design approaches include utilizing natural and renewable resources of energy on site, such as solar, biomass, and wind energy. The utilization of renewable energy resources, in fact, replaces the traditional oil based energy resources and plays an important role in increasing efficiency of energy consumption in buildings to achieve sustainable development objectives and, in turn, reduce negative impact of pollution on Egyptian urban environments.

4. Background

4.1. Definition, Concept and Principles of Green Architecture

4.1.1. Definition of Green Architecture:

A general definition for Green Architecture was draw up as a result of reviewing all of its definitions, as of the following: "Green Architecture is a movement in contemporary architecture, which was inspired by ecological characters of the plants and its harmony with nature. The Green Architecture considers the building process as a living plant that has a cycle of life. It is born, grows and dies without having any negative impacts on surrounding environment".

The aim of Green Architecture is creating friendly physical development to the environment through designing energy-efficient buildings and managing natural resources effectively. This entails passively and actively harnessing natural renewable energy resources and using materials, which have least possible impact on the environment, particularly during processing, manufacturing, application, and disposal of these materials. Green Architecture depends mainly on natural resources and recycling principle, which produce no waste.

4.1. 2. Green Architecture Concepts:

The Green architecture embraces a number of principles, during different phases of design, from many fields such as site studies, form, energy, materials, recycling, and all have relation with environment to produce coherent framework for implementing sustainable design. Therefore, to demonstrate a green architecture, it is necessary to demonstrate the green principles.

Many buildings, currently, embody at least one of the various green characteristics. These buildings cannot be called "green". A green building must embrace all principles of green architecture, which overlaps and must be applied holistically. The main principles guiding our green design are: Harmony with nature, site interpretation, working with climate,

using renewable resources of energy, using recycling of C& D materials, rationalizing new resources, creating healthy indoor environment, conserving energy, fulfilling user needs and rationalizing cost. (Figure 1)

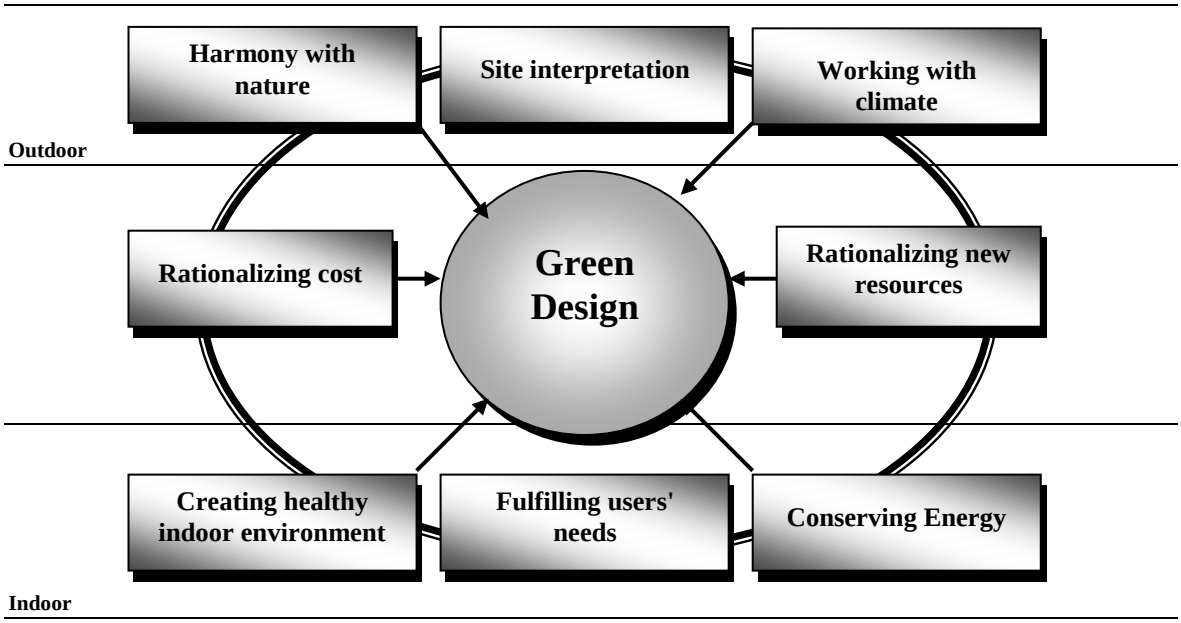


Figure (1): The main principles guiding our green design are:

1. Harmony with nature.
2. Site interpretation.
3. Working with climate.
4. Rationalizing new resources.
5. Creating healthy indoor environment.
6. Conserving Energy.
7. Fulfilling users' needs.
8. Rationalizing cost.

4. 1. 3. Comparison between Environmentally Sensitive, Sustainable, and Green Architecture:

To provide concrete evidences that support the capabilities of the Green Architecture, in terms of providing overall solutions for decreasing buildings environmental impact, a comparison was conducted between Green Architecture, Environmentally Sensitive Architecture and Sustainable Architecture, which explains their capabilities as follows: Environmentally Sensitive Architecture respects its surrounding environment in the terms of energy efficiency to ensure that the building's use of energy is minimal, ecological construction materials do not emit toxic substances, and building form relates to its region and climate. Sustainable Architecture uses all resources in environmental and economic manners; consumes 100% recyclable materials, uses energy supplies of 100% renewable and non-polluting fuels, and balances between environmental constraints and economic requirements. In comparison, Green Architecture takes in consideration building life cycle, air, water and land quality. It also creates healthy indoor environment, fulfills users' needs and provides a holistic approach for building design (Figure 2).

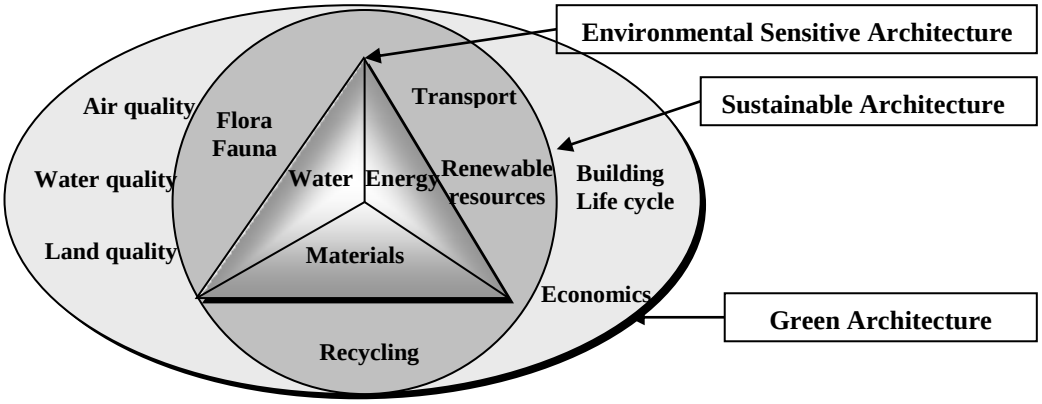


Figure (2): The scope and relation between Green, Sustainable, and Environmental Sensitive Architecture.

4. 2. World Energy Consumption and Global Environmental Impact

4. 2. 1. World Energy Consumption

The world total annual primary energy consumption in 2003 was 420 quadrillion (10^{15}) Ton Oil Equivalent with 4.6% growing rate, only 6% of which produced by renewable resources of energy. At the same time, the oil consumption was responsible for producing 13500 Million Ton of CO2 [5]. The construction process produces 34% of the world total of CO2 emissions, followed by transportation and industry. EIA prediction and assessment of impacts and negative effects of buildings on the environment concluded three major sources: construction materials, energy used in operation, and waste of creation, operation and disposal. Their impact on the environment is enormous: 60% of the raw materials processed world-wide, are used in the construction of buildings; 53% of man-made carbon dioxide is produced through the heating, lighting and ventilation of buildings; and 20% of all material delivered to construction sites ends up in landfill.

4. 2. 2. Global Environmental Impact

Many global environmental impacts have occurred worldwide as a result of buildings energy consumption, the most significant of them are: increased risk of global warming, global climate change, acid rain, and depletion of fossil fuel resource. Carbon dioxide emissions are estimated to contribute to 50% of global warming. Associated with carbon dioxide production from the burning of coal and oil are emissions of sulphur dioxide and oxides of nitrogen. These contribute to acid rain, which is thought to have caused damage to the world's lakes, plants, forests and fisheries. Acid rain also damages buildings through increased corrosion.

4.2.3. Environmental Impact Assessment.

The past two decades have been characterized as a major step in dealing with the environmental issues, including specific legislations for water and air pollution control, solid- and hazardous-waste management, resource protection, and soil and groundwater remediation. The most significant procedure is "Environmental impact assessment" (EIA) which identifies and evaluates the potential impacts of proposed projects, plans, programs, or legislative actions relative to the physical-chemical, biological, cultural, and socioeconomic components of the total environment [3]. The primary purpose of the EIA process is to encourage the consideration of the environment in planning and decision making and to ultimately arrive at actions which are more environmentally compatible.

4.3. Renewable Resources Technology

With the concept of sustainable development as an important ethic of the 1990s, the rate of increase of nonrenewable energy use is declining and renewable resources technology has entered the mainstream. Renewable resources, can offer reasonable solutions if long-term costs are highly concerned and reviewed.

There are three types of renewable resources: solar, wind, and biomass energy:

- **Solar Energy:** The center of our solar system delivers $50^{(240,000)}$ TOE/year to earth, an amount 16,000 times greater than is currently utilized on the planet [9]. Solar energy has two systems; passive solar systems and active solar systems photovoltaic energy.

- **Biomass Energy:** It is the conversion of organic feed stocks of wood or peat, into useful forms of energy: heat, electricity or liquid fuels. The biomass energy conversion technologies include: *1.Combustion:* the most common technology, but is usually economic only when the raw material is available at little or no cost and when the source is near the burning site. *2. Waste-to-energy conversion:* municipal solid waste (MSW), which is collected and disposed in landfills at considerable cost, is converted to gaseous or liquid fuels, and *3. Gasification:* The conversion of biomass to other fuels through the presence of oxygen to produce primarily gaseous fuels [11].

- **Wind Energy:** wind-power plants compete today with electric utilities to supply economical clean power in many parts of the world. In 2003, more than 27,000 grid connected wind turbines were operating. Collectively these turbines are producing more than 8 million MWh/ year energy [5,14]. Improved turbine designs and plant utilization have contributed to decline in large-scale wind energy generation costs from 35 cents/kWh in 1990 to less than 5 cents/kWh in 2003.

5. Trends of Green Architecture Design

During the last few decades, different countries have experienced green architecture within their urban development. The paper, accordingly, investigated different trends which support principles of green architecture and integrated technology within architecture. The analysis focused on the urban scale and supported with some international examples.
In selecting examples for analysis certain limits used such as: time of establishment within the last 5 years, the project should be either operated or designed during the period of 1998-2002, and it should experience more than one green architecture concept. Methodology of analysis includes: investigating and defining the project, design criteria and concept, and green architecture methods implemented in each project.

Each example, moreover, assessed to define: most influential green concept on the design, percentage of renewable materials enhanced and energy savings. The assessment gave credits to projects, which sufficiently utilized concepts such as: site sustainability, form sustainability, energy sustainability, material efficiency and recycling in buildings. The list of assessed projects includes:

- Greenwich Millennium Village, London. UK, 2001 [16].
- Hockerton Energy Project, Nottinghamshire, Germany, 1999 [2].
- Bedzed: The Housing Project, Sutton, London. UK, 2001 [4].

The analysis of these projects shows the following approaches:

5.1. Site sustainability approaches:

- Creating a variety of spaces in master plan that are sheltered and defined by buildings. These spaces include ecological areas offering wetland environment for migrating birds as well as a lake for human recreation proposed as fingers of green space between buildings "*Greenwich Millennium Village*".
- Optimizing site coverage to increase the area available for landscaping and to allow storm water to be absorbed on site "*Hockerton Energy Project*".
- Using all roof spaces as gardens to maintain green space "*Bedzed Housing Project*".
- Reduce the virtual impact of parked cars by locating the cars wherever possible in a secure podium spaces under the landscaped courtyards "*Greenwich Millennium Village*".
- Covered secure bike spaces into communal areas to encourage bike use "*Hockerton Energy Project*".
- Using recycling system on site for grey water to minimize water consumption "*Bedzed*".

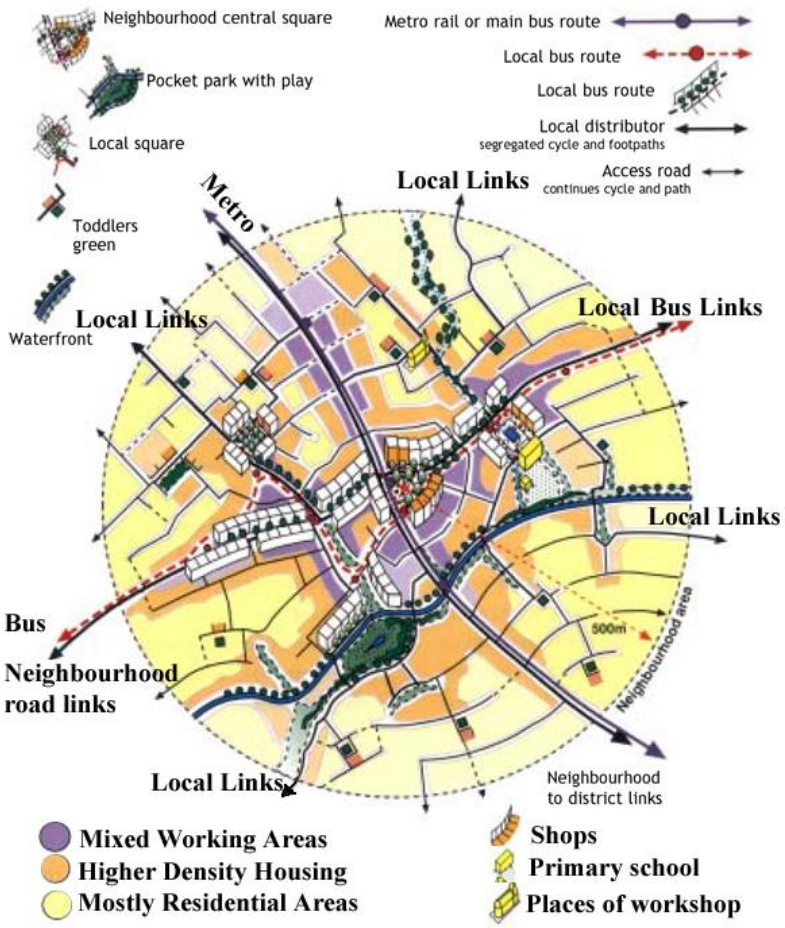


Figure (3): Design concept at Greenwich Millennium Village

5.2. Energy sustainability approaches:

- Using P.V. Technology; photovoltaic units on buildings roofs and solar panels on the south façade, which will generate about 65-100% of the project's renewable energy.
- A combined heat and power plant which uses biomass fuel (partially from landscape can produce about 20-30% of the project's total energy demand "*Greenwich Millennium Village- Hockerton Energy Project* ".
- Reducing total energy consumption by incorporating high levels of insulation, stepped form to allow the sun to penetrate sheltered courtyards, and using of daylight to avoid the use of electric artificial lighting.

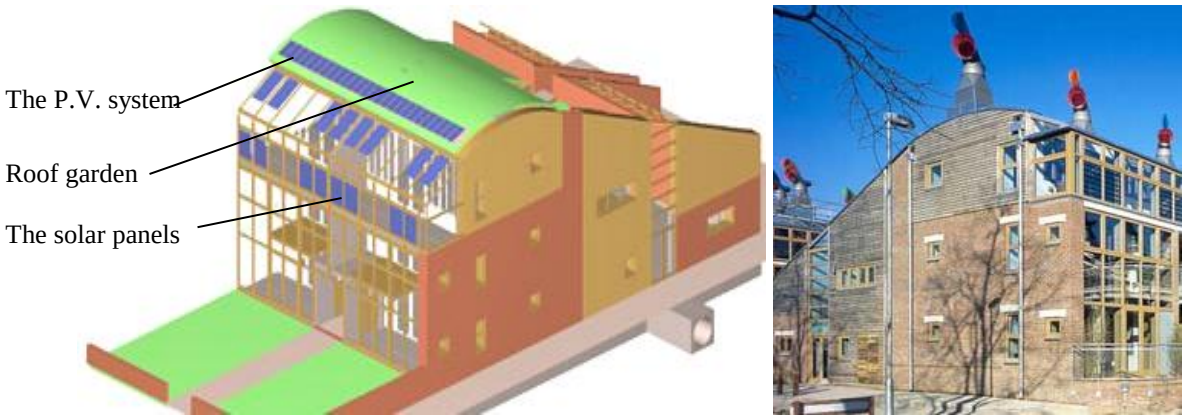


Figure (4): Computerized study model of one unit to study the use of P.V. Technology "Bedzed Housing Project".

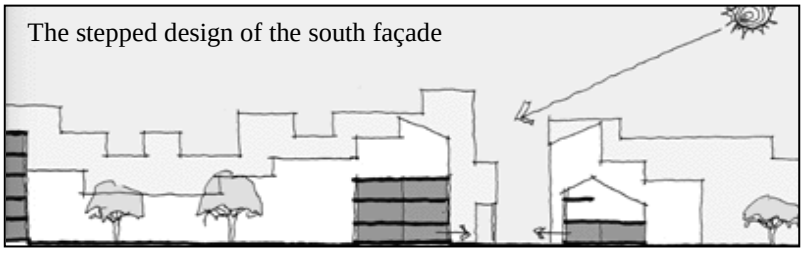


Figure (5): Reducing energy consumption "Greenwich Millennium Village".

5.3. Construction Materials Efficiency:

- Using local materials for construction and finishing to minimize pollution associated with transport of materials to the site " *Bedzed Housing Project* ".
- Reducing building costs and duration of the project by adding prefabricated cladding " *Hockerton Energy Project* ".

5.4. Recycling and sustainability:

- Using recyclable construction and finishing materials "*Bedzed Housing Project* ".
- Treating all grey water on site to use it for re-grey and collecting rain water to minimize water consumption "*Greenwich Millennium Village* ".

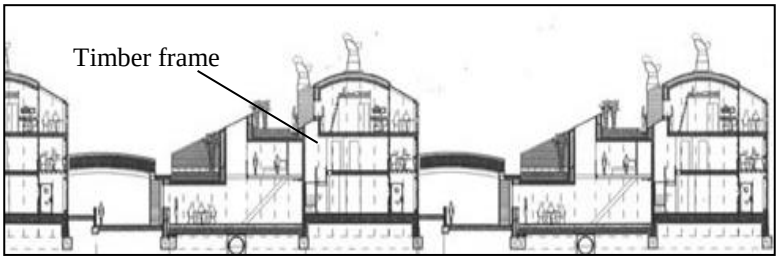


Figure (6): Using sustainable material like timber frame in construction "Bedzed Housing Project".

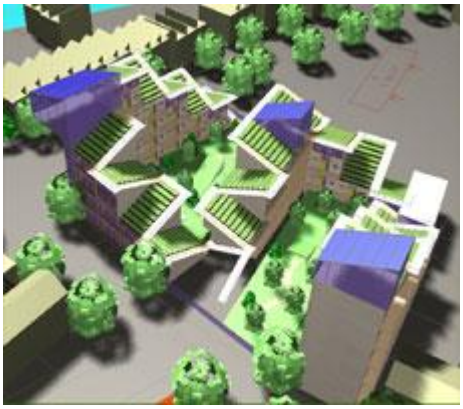


Figure (7): Using sustainable& local materials in construction "Hockerton Energy Project ".

6. Egyptian Energy Situation

6. 1. Egyptian Energy Resources

Egypt's main energy resources are: oil, natural gas, hydropower and coal. In 2002/2003, crude oil reserves were about 3.682 Billion Barrels of Oil Equivalent, while reserves of natural Gas reached about 10.64 BBOE [10,8]. The total primary energy production of crude oil, natural gases, coal and hydropower in 2001/02 was about 60.490 MTOE increased to 61.395 MTOE in 2002/03 [12,13]. Egypt has limited resources of coal in Bedah, Eioun Mousa, and Maghara, which reserve 27 million tons. Coal is used as a raw material and 1.8 million tons of it is annually imported for the iron and steel industries [7]. Hydropower energy resources were exploited from the High Dam, Aswan Reservoir, and Esna Station, with installed capacity of 2100 MW, 615 MW, and 90 MW respectively [12].

Renewable energy resources includes: solar, wind and biomass. The energy utilization from solar resources was estimated to be 170,000 TOE from and 3.8 millions TOE from biomass in 2002/2003 [13]. Solar energy is intensely available in all regions with a direct solar radiation 1970-3200 kWh/m2/year [13]. Egypt is applying solar photovoltaic (PV) technology, water pumping, desalination as well as small applications such as highway billboard illumination and hot water collectors. A hybrid power station using solar parabola concentrators and gas combined cycle of 130 MW was established at Korimat south of Cairo [13].

A wind atlas for Gulf of Suez region shows that wind speed is 11m/s in Gulf of Suez area and 7m/s in east Owainat area. Two wind farms with capacity of 4x100 KW has been generating power at Ras Gharib and Hurghada. The commercial wind farm in Hurghada

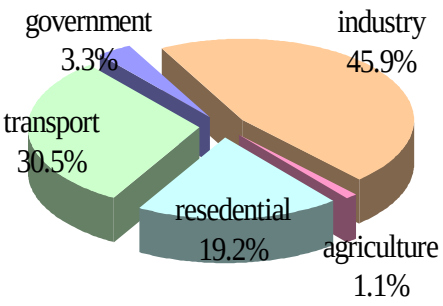
consists of 42 wind units with total power of 5000 KW, connected to the local electricity grid of Hurghada since 1993. The target for wind energy capacity is 600 MW by year 2010, with total electricity generation of 2.4 billion KWh/year. This will save a half million tons of oil equivalent/year [6]. Production of biomass energy using agricultural, animal, human and solid wastes has high potential in Egypt. The potential of generating energy from agricultural waste is estimated to be 3.6 MTOE which accounts for about 11% of the total commercial energy consumption. An 18 MW biogas power station using sanitary waste as fuel is already in operation at the Yellow Mountain, Cairo [7].

6. 2. Egyptian Energy Consumption

Egypt has had a long history of rapidly growing energy demand; which has slowed down during the periods of 1986-87 and 1994-95 to reach about 2.6 % per annum. The energy consumption increased from 32.45 MTOE in 2001/2002 to about 34.75 MTOE in 2002/2003 with a growth rate of 5.19% [13]. The present demand growth rates are 2.7 % for petroleum products, 13 % for gas, and 6.8% for electricity [13]. Industrial and agricultural development projects, housing and services all depend on available electricity. Total electricity generation was 14582 MW in 2001/2002, which increased to 15286 MW in 2002/2003 with a growth rate of 4.83%. The consumption of electricity increased from 64.86 TWh in 2001/2002 to 68.3 TWh in 2002/2003 with a growth rate of 5.7%. The major consumer of electricity is residential 39.1% of total electricity consumption, then, industry representing 37.8%. Electricity consumption has a positive growth rate in all economic sectors [13].

Table (1)
The Egyptian energy consumption of different economic sectors

Total Energy Consumption						
year	**Industry**	**Transport**	**Residential commercial**	**Agriculture**	**government**	**Total**
2000/ 2001	14.91 MTOE	9.90 MTOE	6.23 MTOE	0.34 MTOE	1.07 MTOE	32.45 MTOE
1999/ 2000	14.02 MTOE	9.65 MTOE	6.02 MTOE	0.33 MTOE	0.83 MTOE	30.85 MTOE
Growth	6.4%	2.5%	3.5%	3.2%	29.6%	5.2%
Share	45.9%	30.5%	19.2%	1.1%	3.3%	100%



6. 3. Energy Impact on Egyptian Environment

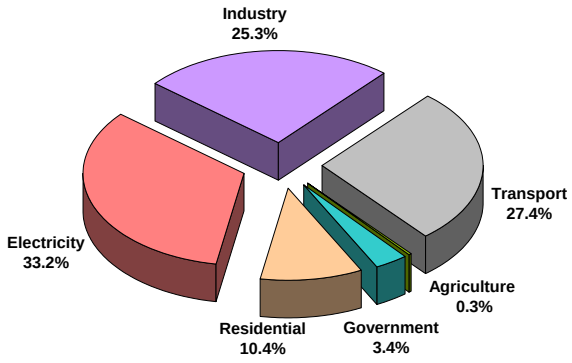
In Egypt, oil, gas industry and electricity generation are the major sources of air pollution by significant fugitive emissions of CO2, N2O and CH4 [6].

Oil spills are the well known energy-related source of water pollution due to their devastating after effects. Substantial offshore oil explorations and drilling activities are underway in Egypt's territorial waters. Large electric power plants require large amounts of water for cooling. Some plants in Egypt are built with "once through" cooling systems, in which waste heat is discharged directly into water bodies causing severe harm to the aquatic and marine life [6,7].

In Egypt, the total Greenhouse gases emission is about 130 million tones of CO2 equivalent, according to 2002/2003 energy report [13]. Increasing concentration of CO2 emissions are the product of burning fossil fuels such as petroleum products, natural gas, and coal. 83% of total CO2 emissions in 2002/03 were due to the energy consumption. The three major consumers are electricity, transportation and industrial sector [6,7].

Table (2)
Emission of CO2 due to sectorial consumption of energy.2002/2003.

Sector	Total emission of CO2 (Million Ton)	
Industry	26.815 MT	25.3%
Transport	29.144 MT	27.4%
Agriculture	0.316 MT	0.3%
Government	3.574 MT	3.4%
Residential	10.986 MT	10.4%
Electricity	35.319 MT	33.2%
Total	109.974 MT	100%



(Ministry of Energy & Electricity. (2003). Energy in Egypt Annual Report).

6. 4. Experience of Implementing of Green Architecture in Egypt

The paper also analyzed different contemporary urban development projects newly established in Egypt in order to define to what extent green architecture or other environmental methods have been considered at all levels of urban development. The criteria for selecting international examples were also applied to the selection of Egyptian case studies. The selection of case studies includes urban development of:

- **El-Gouna Resort**, North Hurghada, 1989-1998.
- **Sirena Mövenpick Resort**, El Quseir, 1999.
- **Alexandria Library,** Alexandria, 2001.

After analysis of the previous projects, we can summarize the utilized approaches of green architecture concepts in Egypt as:

- ***Form Sustainability:***
  The projects developed architectural form, which is in harmony with its nature and complied with the hot climate conditions. The designers break the sharpness of the local climate by some architectural details in the façades; *Domes, Shaded pedestrian terraces, Ventilation exhaust towers, and Skylights*, to minimize the utilization of air conditioning.

- ***Construction Materials Efficiency:***
  The main construction of bearing walls utilized local rocks and local clay for domes and vaults. Also, local rocks utilized in all outdoor corridors and shaded terraces "*El-Gouna Resort – Sirena Movenpick Resort*".

- ***Recycling of Water:***
  A water treatment station has been used to reuse water in grey water after filtration "*El-Gouna Resort*".

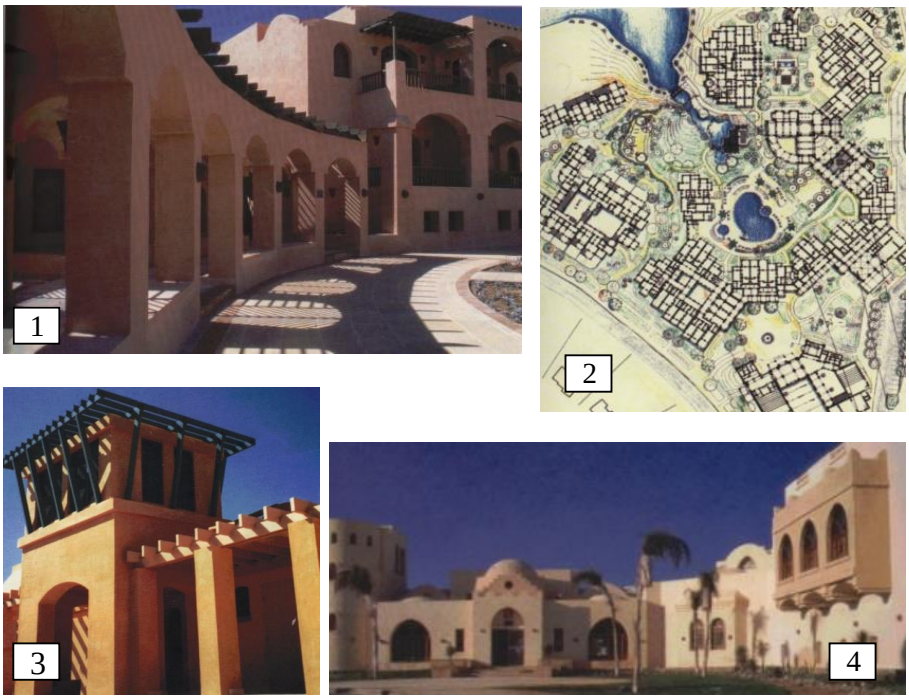


Figure (8): The main environmental elements used in El-Gouna Resort
1. The façade composition to maximize shades
2. The court hierarchy in plan from personal to local spaces.
3. Ventilation towers in a modern style to maximize air movement in outdoor corridors.
4. The utilization of domes, vaults, and shaded terraces in façade.

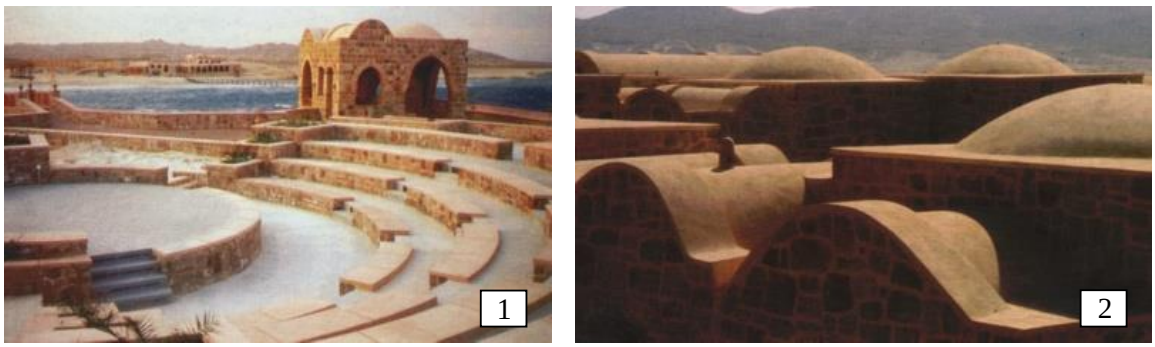


Figure (9): The main environmental elements used in Sirena Movenpick;
1. The project landscape is made of local bricks.
2. Domes and vaults are made of local clay.

Figure (10): The tetrahedrons in the ceiling act as passive solar convectors, pulling cool air if the electrical and mechanical systems failed.

The evaluation of implementing Green Architecture in the selected examples showed a lack of using recycling and renewable energy resources. Therefore, future guidelines and criteria were proposed to achieve Green Architecture objectives as of the following: utilizing of renewable sources of energy to produce electrical requirements of urban development. Solar systems both active and passive will be preferable because of the site location. Wind mills could be established at the project boundary. Green areas will also be preferable. More recycling systems should be applied such as reusing of rain water as grey water and recycling solid wastes.

7. General Indicators for Utilizing Green Architecture Principles in Egyptian Environment:

Over the past two decades electricity peak demand in Egypt reached 14,400 MW in year 2003. The annual average growth rate is approximately 6.5% [13]. This growth in energy demand is still exceeding with the economic and population growth. Considering the present and expected rates of GDP up to the year 2010 and taking into account diversification and utilization of all available energy resources, Egypt needs to add nearly 12,000 MW generating capacity up to 2010 [13]. Meeting such an escalating demand by the typical supply-oriented approach, this would accelerate the depletion of indigenous resources, eroded export revenues, and threatened the environment. Well-balanced strategies that use more renewable resources of energy must be adopted in the next years. To satisfy such needs, the Ministry of Electricity and Energy has launched an energy strategy as a base for development for the 21st century. One of the strategy objectives is to reach 3% of total power produced by 2010 from renewable and clean sources of energy. Therefore, the architects and planners could share in this responsibility that contribute to reduction of the energy and electricity consumption in urban development, particularly residential sector or, at least, meet this accelerating consumption from renewable resources of energy.

7. 1. Implementing Renewable Resources in Egyptian Urban Development

Egypt has a good potential of renewable resources. According to the 1994 Environmental Law, renewable energy has been considered as an integral part of the Egyptian energy policy framework. The renewable energy techniques that could be implemented in the Egyptian urban development are:

Biomass Energy is one of the most promising energies, which under utilization in Egypt. The architect could adapt its requirements as a fundamental part of the designing process

because it does not require complicated technologies; the required raw materials are available in low prices and the energy cost will be around 0.06-1 cents/KWh;

Solar Energy is highly recommended for the future urban development because Egypt's weather chart shows 94% of the year sunshine. Solar energy provides clean energy that produces no GHG emissions. It is highly modular, which allow installations in different stages without losing the economy of first one. It can also be designed to any capacity and its cost is decreasing. The solar energy reached 25-30 cents/KWh.

Wind Energy is also suitable for urban development, particularly along sea coasts of the Mediterranean Sea and the Red Sea because average wind speed is about 11 m/s. It is a clean and renewable source of energy that produces no emissions of GHG. It uses only 5% of the farm land leaving rest empty for urban development. The architects could use this land in housing projects and make the wind farm planted in the green open spaces. It is modular within the granularity of the turbine size. Standard wind turbines are now of 500-1,000 kW range; and its cost/kWh are decreasing rabidly reaching 5 cents/kWh. Therefore, wind power is one of the most suitable renewable systems for the economics of urban development in Egypt.

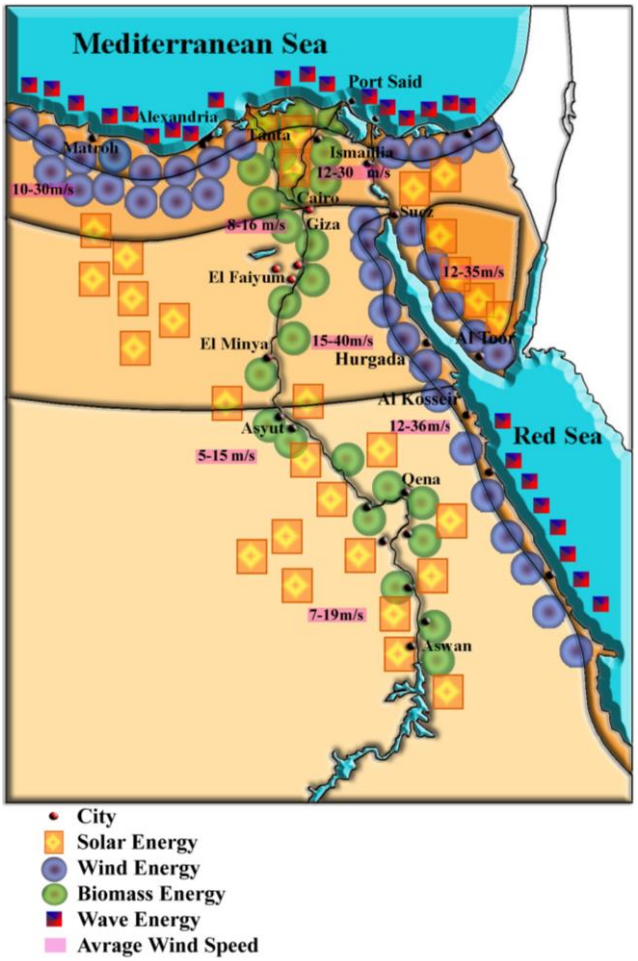


Figure (11): The renewable energy techniques that could be implemented in Egypt according to its climate regions.

7. 2. Proposed Development Policy for Improving the Egyptian Environment:

The above analysis of implementing Green Architecture experience defined that the implemented green methods in Egypt does not meet the international standards. Understanding the interrelationship between urban development and the environment can decrease significantly related environmental impact. The utilization of renewable energy resources in urban development is a safeguard for better future and must be the guide for decreasing environmental impact of spatial development. The analysis of the modern Egyptian urban environment raised up some issues, which should be considered for development policy such as:

- Lack of experience of green architecture or other environmental development approaches among the persons involved in the urban development process who are responsible for preparing development TOR, design process, reviewing and evaluating design process.
- Lack of coordination and collaboration between different parties concerned with the urban development such as environmental and administrative authorities, consultants, decision makers and owners.
- Difficulty in publishing, transferring and exchanging data and information throughout the EIA process. So, Egypt needs to enhance and develop environmental policy, short and long term, to overcome, correct and solve the cumulative environmental problems.

7. 2. 1. Short Term Strategy:

General recommendations for short term strategy focused on the activities of design process utilizing green architecture as of the following:

- Establishing a new research center for Green architecture. Its scope of work will be:
    - Assisting in outlining environmental management policy in environmental action plans.
    - Developing and monitoring Green Architecture systems in Egypt.
    - Searching for new appropriate, easy-to-apply, more quickly and cost-effect methods and procedures for Green Architecture and energy saving.
    - Search for new approaches of mitigation measures of built environment, economic, social, health and other impacts.
    - Publishing guidelines, annual reports, magazines and catalogs, including green architecture international trends and different stages of EIA process.
    - Training members involved in planning and evaluating green architecture and the EIA process; and presenting consultancy service for various participants in the EIA process, administrative authorities, decision-makers and proponents, and for concerned people with environmental aspects.
- Producing a code for “Green Design” to help architects with new design approaches that respect the natural resources of energy in site, reducing energy consumption and using recyclable construction materials.
- Establishing a quality control system for the urban development starting from the design process to the establishment, and operating and managing the development. It will also be responsible for identifying new mechanisms that can be applied to develop the existing urban areas with cost and energy saving.
- Emphasizing on the coordination between all agencies involved in the design process to avoid duplication of works, confusion in decision makings, handling

different cases with different requirements, overlapping between governmental agencies, etc.

7. 2. 2. Long Term Strategy:

The aim of this strategy is to reach a balanced ecosystem in Egypt through dealing with the urban environment as a part of one eco-system. Hence, the proposed strategy presents comprehensive recommendations which emphasize on:

- Integrating development policies such as urban, socio-economic and environmental policies at all development levels, national, regional and local.
- Unifying laws and regulations related, directly or indirectly, to the environmental conservation.
- Accelerating public awareness regarding importance of environmental quality. This awareness should also be oriented to utilization of renewable energy resources in our life. Within this process, all media facilities would be useful for achieving this purpose.
- Improving capabilities of personnel concerned, directly or indirectly, in the field of urban development and environmental conservation such as: environmental agency officers, national and local administrative authorities, consultants, elected popularity council members and decision-makers, at all levels. This could be achieved by:
    - Establishing technical training courses with clear syllabus of environmental conservation in relation to urban development. This syllabus must also include different approaches for enhancing and managing the urban environment such as Environmental Impact Assessment, Green Architecture, etc.
    - Sponsoring and adapting research works, workshops, conferences and symposiums in the field of improving and conserving the urban environment. This process should also be concerned with experiences of achieving environmental improvement worldwide.
- Establishing environmental technology information center that could be connected to similar centers in the world. This center could be concerned with databases of aspects, issues, experiences, policies, etc. for urban development and environment in Egyptian as well as in other countries worldwide. The purpose is to support concerned people with most updated accurate information.

8. Conclusion

The paper has discussed the role of Green Architecture principles and its integrated technology in improving Egyptian urban environment. The background has illustrated the negative impacts of energy consumption in the world, and the importance of utilizing renewable energy techniques as a development approach for increasing energy efficiency and, in turn, improving environment of urban areas. The results obtained from the analysis of the Egyptian energy situations and strategies; provide strong evidence that the environmental impact of urban development is significant. Three types of renewable energies systems are the most suitable for the Egyptian environment: solar, biomass and wind energy. These renewable energy systems could efficiently be enhanced in urban development.

In addition, it is not merely the enhancing of renewable resources, but also the integration of Green Architecture methods at all levels of development process that will allow effective and efficient consumption of energy with neglected environmental impact.

The results focused on the nature of Green Architecture, which could be applied to improve urban areas in Egypt. The framework techniques are not restricted to certain types, locations or sizes of spatial development. It takes the land resources, demographic issues physical pattern and energy demands into account. It also considers the capability of natural resources to support identified development through the coordination and collaboration schemes. It also emphasizes that the renewable energy methods should be integrated in all processes of the physical development such as: design, establishment, operation and management. Thus, the framework of the energy renewable methods will be the basic practical technique to achieve the integration within urban development. So, planners and architects have a considerable responsibility for integrating Green Architecture in the process of urban development. They could integrate renewable energy resources as fundamental elements in urban development process in coordination and collaboration with all concerned people. .

This procedure could have application to other approaches for improving urban environment in Egypt such as Healthy City, Healthy Community Movements, etc. The Egyptian government is currently preparing a general environmental policy and legislation to save and improve the quality of the environment of the country. The findings of this paper could be directly applicable in the formulation of this environmental policy and legislations. It could guide the reconsideration and implementation of the urban development policies with respect to the environment. The procedure developed will have a wide application to other countries in the Middle East or North Africa. Similar environmental characteristics and growth rates of energy consumption and demand exist in different Arab countries. The resources of these countries also have been facing pressure due to spatial development and economic interests with high demand of energy consumption.

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