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# Nanoarchitecture and Global Warming

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**Abstract**— As result of globalization, new notion called the global problems has appeared such as the financial crisis, global warming, and Climate change and biodiversity affecting the whole world in general and the third world developing countries in particular resulting from the developed countries actions. One of these solutions is using the nanotechnology and the environmental materials in architecture so as to reduce energy consumption in the public buildings to reduce its heat emissions. Hence, reaching the main purpose of this study finding the best ways to reduce the carbon dioxide emissions harming the environment. Also on the private or individual level, it leads to zero carbon architecture through using nanotechnology, and nanoarchitecture. This will be done through case studies in Bibliotheca Alexandrina, it is to convert the building to be environmentally friendly and based on renewable energy and to minimize the consumption of the building for electricity generated from burning of petroleum products without influence a performance of the building and the performance of his job required him to even raise the operational efficiency and interaction with users in the highest as well as with the environment in which the existing building so that it responds in an intelligent way to make it deals with the climatic changes of the existing environment of the highest degree of effectiveness.

**Index Terms**— Nanotechnology, Nanoarchitecture, Global Warming, Climate Change, Zero Carbon, Clean Energy, Energy Consumption.

## 1 INTRODUCTION

THere is no doubt that dealing seriously with the issue of Global Warming has become inevitable to all political systems in various parts of the world, which drives all over the world, including Egypt, to stand side by side to address the threats to the planet that brings us together and makes us take responsibility for future generations as Today we take decisions in accordance with the principle of common but di ferentiated responsibilities and reduce negative effect of global warming.

Egypt is one of the world's most threatened as a result the negative effects of global warming, both in terms of agricultural productivity, or water resources, or health, but the threat caused by sea level rise comes on top of those risks, as you know you that the Nile Delta, along the coastline of the Mediterranean are threatened drowning if sea level rises, which may result in the displacement of millions of these densely populated area, as well as the loss of thousands of acres of fertile agricultural land.

The Egyptian electrification rate in 2008 was approximately 99.4 percent, according to the International Energy Agency (IEA); this rate is among the highest in Africa with a 100 percent urban access to electricity and 99.1 in rural areas. Nonetheless, approximately 500,000 people still lack access to electricity. With the grounds that Egypt is a net importer of oil in the media used in electric power generation, The total carbon dioxide emissions in 2001/2000 1.7 tons per capita compared with 2 tons in 1999 and 1.1 tons in 1980.


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92% Of Egypt's dependence on fossil fuels. Currently, 6.33kg GDP per unit of energy (equivalent to Oil) compared to 4.8kg (oil equivalent) only in 2000 and 3.9 kg (oil equivalent) in 1990. The main source of emissions of greenhouse gases in the cobustion Fuel come from the energy sector (22%), industry (21%), transport (18%) and the agricultural sector (15%). Egypt is among the countries that climate change represents for her a real threat because of dense population areas. It also will allow development projects to reduce greenhouse gas Global warming an opportunity for Egypt to raise the level of energy Transport and industry so it has in cooperation with several friendly countries in the implementation of projects and pr grams aimed at developing the use of new and renewable ene gies, green building and capacity development, and policy development of environmental action in Egypt.

The Egypt because of its unique geographical location, attaches great importance to developing new and renewable energies, such as wind, solar, and bioenergy, and we hope that we get to produce 20% of the total energy in Egypt by 2020. At the local level for the consumption of electric power in the city of Alexandria, the total domestic consumption of electricity is 1858 MW for the year 2010 with a total production of West Delta Electricity Production Company, which consists of 8 stations (5 steam stations, and 2 gas stations and 1 station morkaba) 2949 MW.

It is necessary to classification buildings as sustainable building for reducing energy consumption and use international measurement system like (LEED, BREM, etc..) for measure government buildings of global classification in achieving sustainability and that its terms the economy and control maximum in energy use and therefore are considered Industrial buildings and public buildings of more categories of buildings consumption of electricity and for the continuation of work by for long hours without breaks, is Bibliotheca Alexandrina that public buildings, which increases the rate of electricity consumption since they serve the public for more than 12 hours .

## 2. CONCEPT AND ANALYSIS OF CASE STUDY

Alexandria`s new library recreates the ancient repository for literature and history founded by Alexander the Great some 2.300 years ago, and provides one of the largest and most impressive research and rare-book storage facilities in the world. An international competition for its design was held in1989 and won by the then little-known Norwegian architectural firm Snohetta. The design is grand yet deceptively simple: a huge inclined silver disc that appears to rise over the Mediterranean Sea covers a stepped reading room over 14 terraces. The circular from follows in the tradition of many great reading rooms, while the stepped section and regular structural grid respond to the functional requirements of book storage. Human scale is provided by a grove of slender concrete columns that grows out of the gently cascading interior landscape to hold up rectangular bays of roof lights. These clerestories face due north and are angled diagonally to reflect light indirectly into the space below, animating the reading room like a giant sundial as the sun crosses the heavens. A massive south-facing wall inscribed with examples of all the world`s text appears fortress-like in comparison to the shining sophistication of the roof, and encloses the building, protecting it from the harsh climate.

The dimensions of Bibliotheca Alexandrina are vast the library has shelf space for eight million books, with the main reading room covering 70,000 m² on eleven cascading levels. The complex also houses a conference center; specialized libraries for maps, multimedia, the blind and visually impaired, young peo ple, and for children; four museums; four art galleries for temporary exhibitions; 15 permanent exhibitions; a planetarium; and a manuscript restoration laboratory. The library's architeture is equally striking. The main reading room stands beneath a 32-meter-high glass- panelled roof, tilted out toward the sea like a sundial, and measuring some 160 m in diameter. The walls are of gray Aswan granite, carved with characters from 120 different human scripts.

Based on all of the above-mentioned information concerning the Bibliotheca Alexandrina, it is to convert the building to be environmentally friendly and based on renewable energy and to minimize the consumption of the building for electricity generated from burning of petroleum products without influence a performance of the building and the performance of his job required him to even raise the operational efficiency and interzaction with users in the highest as well as with the environment in which the existing building so that it responds in an intelligent way to make it deals with the climatic changes of the existing environment of the highest degree of effectiveness. To achieve that goal will go down two parallel tracks which are as follows:

### 2.1 First Track: Diversion energy of Bibliotheca Alexandrina from electric power to renewable energy gradually.

Through the study of the climate of Alexandria in particular and knowledge of climatic conditions experienced by Bibliotheca Alexandrina, we find that the average brightness of the sun (rate exposure Bibliotheca Alexandrina to the sun) is from 7-12 hours per day and the following presentation of the characteristics of climate of Alexandria and the surrounding Bibliotheca Alexandrina:

- Alexandria, Egypt latitude & longitude; 31°12'N 29°57'E.
- Altitude; -2 m (-7 ft).
- The average temperature in Alexandria, Egypt is 21.3 °C (70 °F).
- The range of average monthly temperatures is 12 °C.
- There is an average range of hours of sunshine in Alexandria of between 7.0 hours per day in January & December and 12.0 hours per day in June, July & August.
- On balance there are 3594 sunshine hours annually and approximately 9.8 sunlight hours for each day.

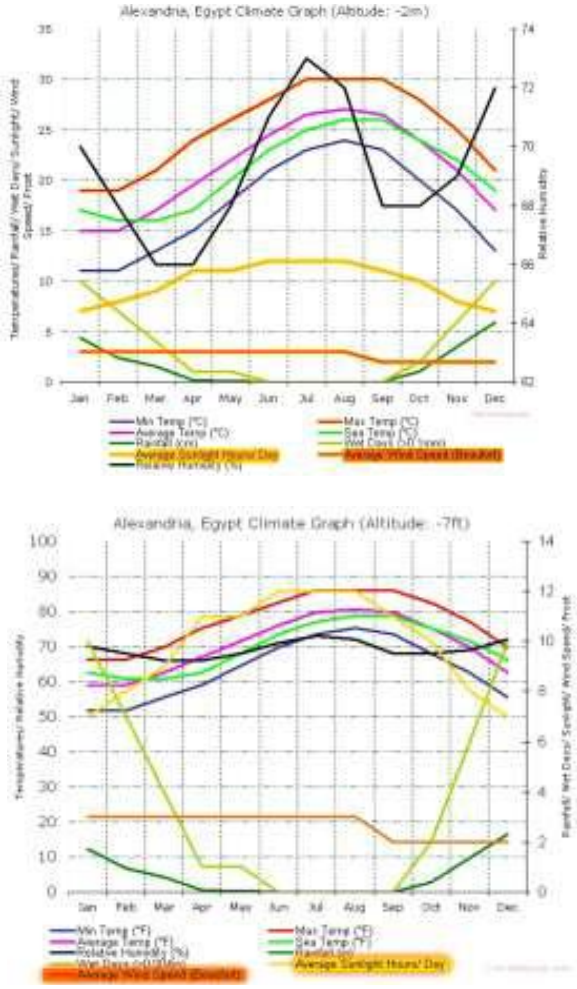



Figure 1. Alexandria Climate Guide.

The new design consists of renewable energy sources to move Bibliotheca Alexandrina from electrical energy to clean energy through three main sources are as follows:

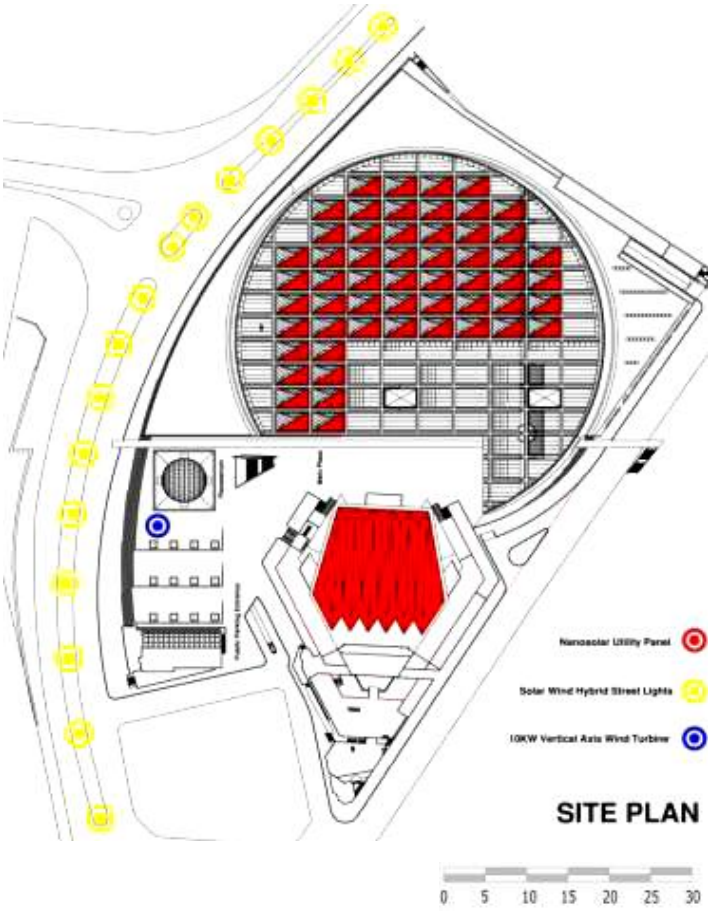



Figure 2. New Site plan with three elements places.

## A. NANOSOLAR UTILITY PANEL:

The direction of slope the roof of bibliotheca Alexandrina is far from the right direction of sunrise and sunset at 16 degree and reach the highest performance of Nanosolar cells must be those cells facing the direction of sunrise at an angle of inclination of 30 to 35 degree and hence the development of Nanosolar cells on the roof of Bibliotheca Alexandrina will lose 3 to 4 hours of the actual shine of the sun per day and that will put Nanosolar cells on the roof of conference hall and appropriate to the direction of sunrise and sunset.

The dimensions of triangle Panel is (7.8 x 12.6 x 0.5 = 50 m2), and the number of available triangle on the roof of Bibliotheca Alexandria are (57 triangle) so the total area available on roof is (57 x 50 m2 = 2800 m2). From mechanical drawing of Nanosolar panels dimensions is (1.937 x 1.03 = 2 m2), so the number of available panels will put on the roof of Bibliotheca Alexandrina is (2800 / 2 = 1400 Nanosolar panels). Also the total area of Conference hall is (2200m2) and the number of available panels will put on the roof of Conference hall is (2200 / 2 = 1100 Nanosolar panels).

From Nanosolar Datasheet beside:

- (41.4 x 5.5) / (53.2 x 6.4) = 0.66 , (1400 x 0.66 x 220 )/ 1000 = 203 KW.
- (220 x 0.66 x 110) / 1000 = 159.72 kw

Shine hours per day from 6 am until 5 pm = 12 hours per day but because that the direction of slope the roof of bibliotheca Alexandrina is far from the right direction of sunrise and sunset at 16 degree so we will calculate as 7 hours because we lose 4 hours from 6 am to 10 am.

- (203 kw x 7 hours = 1423 kwh = 1.423 mwh/day), (1.423 x 30 day = 44.69 mwh/month) for Bibliotheca Alexandrina roof.

- (12 hours x 159.72 kw =1916.64 kwh / day) (30 days x 1.916 mwh = 57.48 mwh/ month) forConference hall roof.

**Total energy produced from the use of Nanosolar cells is 102.17 mwh/month**

Figure 3. Bibliotheca Alexandrina renewable energy sources.

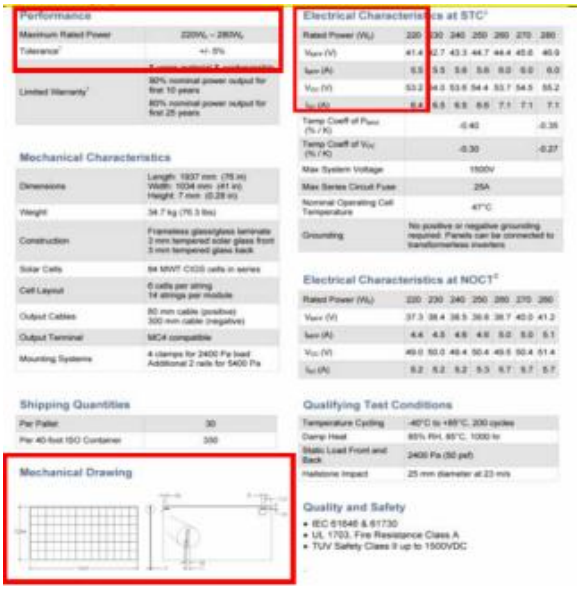



Figure 4. Nanosolar Cells Datasheet

### B. 10KW Vertical Axis Wind Turbine:

The whole unite consists of pillar, wind generator, storage batteries and inverter / controller. The Mill is pushed by wind at speed from 4m/s to 25m/s to rotate to make the generator produced power in AC form. Then the power will be changed into DC form by the charging controller to be saved in storage batteries. As last, DC power is changed into standard AC power through the inverter. The average wind speed all over the years is 8m/s, from the power curve of the 10 kw VAWT we found that the power corresponding to 8 m/s is 4 kw. The average wind blowing time over the year is calculated to be around 12 hours / day.

**Total energy is (4kw x12 hours x 30 days = 1440 kwh / month = 1.44 Mwh / month)**

Figure 5. 10KW Vertical Axis Wind Turbine Data sheet and diagrams.

### C. Solar Wind Hybrid Street Lights:

Two lighting systems are designed into one combined system, if some days there is sunlight but no wind energy, the solar panel charges the battery. Similarly if some days there is wind energy but no sunlight, the wind turbine can power the battery. If both wind & solar energy is enough, both can charge the battery. The wind turbine continues to work around the clock supplying energy for the system. The lamp has been designed to maximize efficient use of the energy generated using a energy-saving luminaries which is switched automatically by a light sensor. It is intended for permanent installations and can be located in the remotest of sites since no mains services are required saving on installation costs, inconvenience and time. Whole system is virtually maintenance free and there are NO daily running costs the power is completely free and clean.

Figure 6. Solar Wind Hybrid Street Lights outdoors.

### D. Other specifications:

- As part of Bibliotheca Alexandrina to reduce the co-sumption of the internal lighting in the reading area can replace (the halogen lamps150 watt, fluorescent 26 watt, fluorescent 21 watt and metal halide 150 watt) by high pressure sodium and LED`S lamps for saving up to 89% of the power when using LED tubes instead of fluorescent, save same when using LED panels.

  Halogen Lamps consumption:

  (150 x 500 x 7) / 1000 = 525 kwh per day x 30 = 15.750 MWH / Month.

  Fluorescent 26 watt consumption:

  (26 x 500 x 7) / 1000 = 91 kwh per day x 30 = 2.730 MWH / Month.

  Fluorescent 21 watt consumption:

  (21 x 15000 x 7) / 1000 = 2205 kwh per day x 30 = 66.150 MWH / Month.

  Metal halide 150 watt consumption:

  (150 x 1000 x 7) / 1000 = 1050 kwh per day x 30 = 31.50 MWH / Month.

  **Total Consumption of lighting in reading area is: 116.13 MWH/Month.**

- Replace (the halogen lamps50 watt) for saving up to 89% of the power when using LED tubes.

- Chillers should be switched from ordinary cooling towers to Marine Chiller type which using sea water for cooling to saving up to 30% of the power of cool-ing consumption.

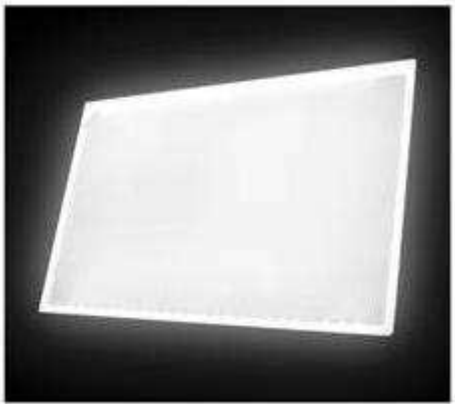



Figure 7. Marine Chiller type and LED`s panels.

After what has been presented of the elements on this track, it is necessary to alert that those elements are not affected negtively on the front of elevation of Bibliotheca Alexandrina where they merge with the void of plaza and this is what a pears in the external picture, which describes the heights of these elements and places in the plaza of Bibliotheca Alexadrina.


Figure 8. External Elements of renewable energy sources in plaza of Bibliotheca Alexandrina.

## 2.2 Second Track: Changing materials used in construction, internally and externally to Nanomaterials

In this track we will change materials from bad chooses which had bad properties to Nanomaterial`s which works to raise the efficiency of building and create smart internal environment to interact with users. Like below suggestions:

### A. Thermal insulation: Vacuum insulation panels (VIPs)

Vacuum insulation panels (VIPs) are ideally suited for providing very good thermal insulation with a much thinner insulation thickness than usual. In comparison to conventional insulation materials such as polystyrene, the thermal conductivity is up to ten times lower. This results either in much higher levels of thermal resistance at the same insulation thickness or means that thinner insulation layers are required to achieve the same level of insulation. In other words, maximum thermal resistance can be achieved with minimum insulation thickness. At only 0.005 W/mK, the thermal conductivity of VIPs is extremely low.

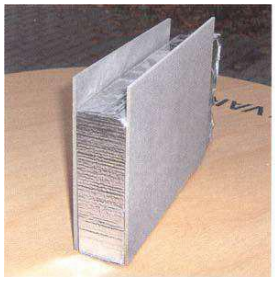


Figure 9. Vacuum insulation panels with a protective encasement and Different sized vacuum Insulation panels in storage.

The historical precursor to vacuum insulators is the thermos flask, which functions according to the same basic principle: low thermal conductivity is achieved not, as usual, by enclosing pockets of air but by evacuating the air entirely, i.e. the creation of a vacuum. In thermos flasks the air between twin-walled glass vessels is evacuated, whilst the cylindrical form withstands the high pressure created by the vacuum. This approach is more difficult for flat insulation layers as they are unable to withstand the pressure. The solution to the problem is the use of an extremely fine fill material with a nanoscalar porosity of around 100 nm. A comparatively low pressure is then sufficient to evacuate the air making it possible to construct panels that can be used in building construction. The thickness of these VIPs ranges from 2 mm to 40 mm. Vacuum insulation panels can be used both for new building constructions as well as in conversion and renovation work and can be applied to walls as well as floors. In all cases, vacuum insulation panels offer great potential in the general context of improving energy efficiency through better insulation and accordingly contribute to reducing the amount of CO2 emissions. In future, improvements in the production of VIPs can be expected, facilitating a more widespread application of highly efficient insulation materials. In the context of the ongoing debate on global warming, their worldwide potential is vast. The lifetime of modern panels is generally estimated at between 30 and 50 years, with some products exceeding 50 years. A number of factors contribute to this, including the integrity of the skin, the degree of vacuum within, the seal and last but not

least the correct installation of the product. Humid environments reduce the overall lifetime of the product. The panels can be recycled.


Figure 10. VIP insulation places in roof of Bibliotheca Alexandrina.

| Properties | Old materials ( Rock wool ) | New Material ( VIPs) |
|---|---|---|
| Thermal Conductivity | 0.04 W/(mK) at an average temperature of 22.5°C. | 0,004 W/(mK) at an average temperature of 22,5°C , the thermal conductivity is up to ten times lower |
| Thickness | The thickness of these Rock wool ranges from 15 mm to 50 mm. | The thickness of these VIPs ranges from 2 mm to 40 mm. |
| Benefits | • Highly durable insulation product<br>• Able to be used at higher temperatures<br>• Performance is not adversely affected from contact with water.<br>• Non combustible | • Performance is not adversely affected from contact with water.<br>• Non combustible.<br>• More thermal conductivity up to 10 times lower.<br>• Non combustible.<br>• The thickness is small than Rock wool.<br>• Able to be used at higher temperatures |

Figure 11. Comparison between Rock wool and VIPs thermal insulation.

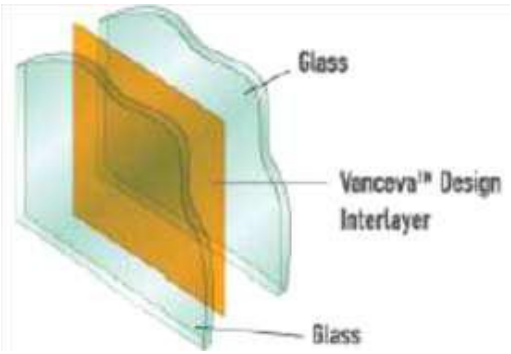
### B. SOLAR PROTECTION: (KALWALL + NANOGEL)

Solar protection against heat gain from solar radiation is offered by two kinds of self darkening glass. Electrochromatic switchable glazing was previously available on the market, but has since largely disappeared due to two main disadvantages: a constant electric current was necessary to maintain a darkened state and larger glass surfaces often exhibited optical irregularities. The advent of nanotechnology has provided a new means of integrating electrochromatic glass in buildings. The primary difference to the earlier product is that a constant electric current is no longer necessary. A single switch is all that is required to change the degree of light transmission from one state to another, i.e.

One switch to change from transparent to darken and a second switch to change back. Different levels of light transmission with various darkening effects are also possible, either as a smooth gradient or clearly differentiated. The electrical energy required to color the ultra-thin nanocoating is minimal. The switching process itself takes a few minutes, which can appear quite slow. The range of panel sizes currently available is relatively limited as the products have only recently come onto the market - the maximum size at present is 120 X 200 cm.

Further panel sizes and improved switching speeds can be expected in the future. The integration of electro chromatic glazing in a building's technical services affords greater control, although it is still advisable to allow users the ability to control glass panels individually. It is generally possible to combine the electro chromatic function with other glazing properties such as laminated safety glass or thermal or noise insulating glazing. In future coloured glazing should also be available, expanding the design possibilities greatly.

Photo chromatic glass is another solution for darkening glass panels. Here the sunlight itself causes the glass to darken automatically without any switching. In both cases blinds or curtains may no longer be necessary. Glare-free light and shading is particularly important for office interiors with computer workstations. Both variants also provide partial shading rather than complete closure so that a degree of visual contact to the world outside always remains. Nanotechnology has made it possible to provide an energy-efficient means of solar protection that can also be combined with other glass functions.



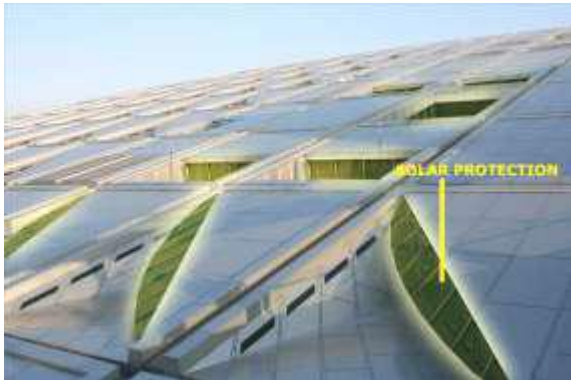




Figure 12. Replacing old glass with Solar protection in roof of Bibliotheca Alexandrina.

| Properties | Old materials (GT.1) | New Material (solar protection) KALWALL + NANOGEL |
|---|---|---|
| Light transmission index | Minimum 50% | 9-12% |
| Shading coefficient | Even or lower than 45% | Even or lower than 45% |
| Reflection | Max. 10 % | Max.10% |
| Total solar radiant heat transmission factor | Max. 40% | 0.08-0.11% |
| Color rendition | 96 | 95 |
| UV- reduction - factor | Minimum 85% | Minimum 95% |
| U value for this glazing | 1.35(W/m2k) | 0.28 (W/M2K) |

Figure 13. Comparison between old material and new material.

### C. Self-cleaning: Lotus-Effect

Many other material forms use self-cleaning technologies. Paints that are relatively thick in comparison to the thin coatings on glass are also touted as having self-cleaning properties and are based on similar technical principles. Titanium dioxide, zinc oxide, and other kinds of nanoparticles are used in paints to provide the photocatalytic action that loosens foreign particles to be carried away by water runoff. Titanium dioxide has long been used as a pigment in paints, but nano sized particles show greater photocatalytic actions than do the normal pigment-sized particles because of their greater relative surface area.

The subsequent runoff process can be enhanced using either hydrophilic effect. Artificial "lotus surfaces", created with the help of nanotechnology, do not as yet have any self-healing capabilities, but they can offer an effective means of self cleaning when properly applied. The Lotus-Effect is most well suited for surfaces that are regularly exposed to sufficient quantities of water, e.g. rainwater, and where this can run off. Small quantities of water often lead to water droplet "runways" forming or drying stains, which may leave a surface looking dirtier rather than cleaner without the presence of water, the use of such surfaces makes little sense.

These kinds of paints can be applied to many kinds of base materials, including metals. Applications that occur in a factory circumstance, as is common in metal panels used in vehicles, façade elements in buildings, and other products, are invariably better than simple hand painting or spraying. As with selfcleaning glasses, the self-cleaning processes are slow and do not work equally effectively with all kinds of surface deposits, but they do reduce the effort needed to clean the surfaces when necessary. Self-cleaning paints are being widely explored for use in automobile finishes. In all these cases, research needs concerning long-term efficacies noted previously are relevant.

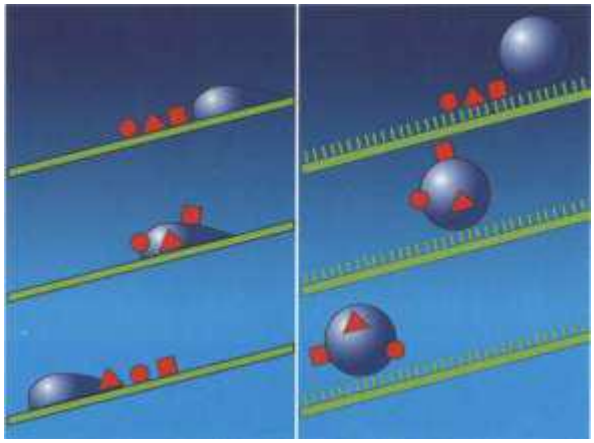



Figure 14. The surface which we will put the paints coated on it and the diagrams show clearly the difference between conventional surfaces and the Lotus-Effect

To summaries, in all areas not subject to mechanical wear and tear, the Lotus-Effect drastically reduces the cleaning requirement and surfaces that are regularly exposed to water remain clean. The advantages are selfevident: a cleaner appearance and considerably reduced maintenance demands.

## 3. CONCLUSIONS

Through what has been presented in these article of the role of power plants in the production of energy by fuel and meet the needs of Alexandria and the required facilities and government departments and the different categories of buildings, and we pointed out to him by the increase in the rate of private consumption to public buildings because of the bad habits of those who made it and design the bad lighting internal and external What led to wasting a large amount of energy produced from power plants, and called by the government of the rationalization of electricity consumption and reduce consumption by not lighting the place in times of the morning as well as air conditioning in is need for it, and what resulted from it all of the increased emissions gases, affecting the general climate of Alexandria and also increase the burning of petroleum derivatives to increase the production of electricity. All of this led to the worsening problem of global warming and called on the government to

speed about to go to alternative energy new renewable and clean does not depend on burning petroleum derivatives in the framework of government support for the new direction toward clean energy as we mentioned in the door and support introduced gradually so that the aims that the Government relies on 25 % - 30% of clean energy by 2020 through the allocation of land for private companies and encourages entrepreneurs and investors in that area through the creation of fields of solar energy, windmills and convert that energy into electrical energy is provided to cover the whole villages and buildings in particular.

And after all that we can answer the most important questions in that article is:

- What is the role of clean energy to global warming?
- What is relationship between Nanoarchitecture and global warming, how it can be dealt with?
- How can integration of clean energy and Nanoarchitecture to reduce global warming?

The answer to these important questions is shown through many ways mentioned in part four:

**First Aspect:**

Shows the key role of clean energy and of solar cells and windmills to reduce the consumption of energy produced from burning petroleum and reliance on clean energy, which provide a rich source of energy as it is the Egypt of the climate allows to build fields of solar energy in the desert as well as the fields of windmills, which produces enormous energy and reliable in different parts of Egypt, such as Zafarana and Dabaa, etc., with the draw of it, though the cost of those fields above, it is given the amounts that will be provided over the years, those costs are minimal compared to what is spent now to cover the needs growing in the Arab world in general and Egypt in particular and the relationship of that energy to provide the needs of the public buildings of electricity.

**Second Aspect:**

The contribution of nanomaterials in raising the efficiency of the building and its operational and conservation of energy waste by insulating the building from the outside environment and to offer those articles of the solutions a healthy and environmentally friendly working on rationalizing electricity consumption and raise the performance of the building and through smart features and positive and which are produced especially for of their high qualities. Entry of nanomaterials in the manufacture of solar cells and clean energy solutions, providing the space because of their small size and increases its efficiency because of its qualities of high quality.

**Third Aspect:**

The role of governments and the country in support of investments in the direction of the markets to serve the country in terms of economic and environmental terms of creating a healthy environment and help in solving the global problem of global warming, which was attended by all industrialized countries, which must also be involved in solving them together. With the need for the alarm to be that support for clean energy and nanomaterials gradually so as to rely on and draw up plans for five years to rely on that energy and support the emergence of nanomaterials, including the advantages of a large serving architecture to solve the part responsible for global warming.

**Four Aspect:**

Through the study on Bibliotheca Alexandrina proved the close relationship between the sources of clean energy from solar cells and wind mills and between the nanomaterials parties of the equation and one up the outcome of important a conversion of existing buildings for energy electricity to the premises of sustainable clean renewable environmentally friendly and their respective roles in providing constructive solutions to solve the problem global warming and its relationship to architecture.

**Five Aspect:**

In the framework of the existing building converted from electric power to renewable energy should be taken in consideration the cultural interface of Bibliotheca Alexandrina and the introduction of any external components must be smoothly, harmony and consistently with the external elevation so as not to affect the value of building architecture.

**Six Aspect:**

Reference to the key role of this study and the role of nanotechnology to speed up solving the problem of global warming and that by controlling the material specifications reinstalled and that intervention in the construction of modern buildings as well as all the techniques used in clean energy and materials free of carbon and characterized by its low weight and strength in terms of hardness and small size in terms of dimensions and surfaces, and higher performance in terms of use all this increased the value of nanotechnology as an important factor and the accelerator to solve the problem of global warming.

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