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FACULTY OF ENGINEERING

Nanoarchitecture and Global warming

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Presented to the Department of Architecture
Faculty of Engineering, Alexandria University
In Partial Fulfillment of the Requirements for the degree

of

Doctor of Philosophy

In

Architecture

By:
Ossama Mohamed El-said Omar
Master of Science in Architecture, Alexandria University

May 2012

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Part Two: Contemporary Trends Environment Conscious

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List of Abbreviations:

BTU	British thermal unit = 1.060 KJ (joules)
CAIT	Climate Analysis Indicators Tool
CCS	Carbon capture and sequestration
CFCs	Chlorofluorocarbons
CIE	The Centre for International Economics
CSP	Concentrating solar power
DOE	Department of Energy
EPA	US Environmental Protection Agency
EIA	The US Energy Information Administration
ETC	Evacuated tube collectors
FAO	Food and Agriculture Organization of the United Nations
GHG	Greenhouse gases
GIEC	Intergovernmental group on the evolution of the climate
GW	Global warming
GT	Gigatonnes
IPCC	The Intergovernmental Panel on Climate Change
ICIJ	The International Consortium of Investigative Journalists
IR	Infrared radiation
USGBC	United States Green Building Council
LEED	The Leadership in Energy and Environmental Design
LRT	Light Rail Transit
MIT	Massachusetts Institute of Technology
Mt	Million tones
NT	Nanotechnology
NREL	National Energy Renewable Laboratory
NVS	Nano Vent-Skin
OLED	Organic light-emitting diode
PRT	The Personal Rapid Transit
QBTU	1 QBtu = annual energy output of 40 - 1,000 MW power plants
TiO2	Titanium dioxide
UNFCCC	The United Nations Framework Convention on Climate Change
ZCA	Zero carbon architecture
ZEH	Zero Energy Homes
CFCs	Chlorofluorocarbons
UHI	Urban Heat Island
SW	Swarm Architecture
SI	Swarm intelligent
BREEAM	Building Research Establishment Environmental Assessment Method
MLIT	Ministry of land, infrastructure and transport
JaGBC	Japan Green Build Council
JSBC	Japan Sustainable Building Consortium
CASBEE	Comprehensive Assessment System for Building Environmental Efficiency
BEE	building environmental efficiency

Q	Quality
L	load
BEE numerator Q	Building environmental quality and performance
BEE denominator L	Reduction of building environmental loadings
BMS	Building Management Systems
BIM	Building information modeling
VDC	virtual design and construction project manager
PLM	Product Lifecycle Management
CNT	carbon nanotubes
SWNTs	Nanotubes consist of single-walled
MWNTs	Nanotubes consist of multi-walle
CVD	chemical vapour deposition

0.1 Definitions

1- The Globalization: -

Globalization is international integration. It can be described as a process by which the people of the world are unified into a single society. This process is a combination of economic, technological, socio cultural and political forces. *[http://en.wikipedia.org/wiki/globalization.html. Retrieved June, 2010.], (1/06/2010, 3.00)]* (Figure 1.1)

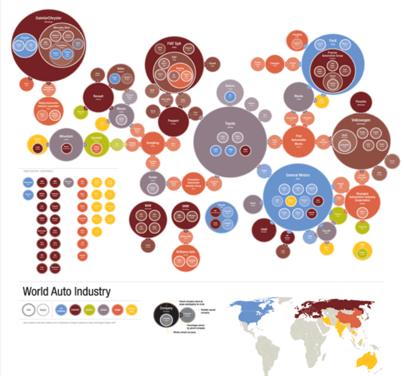


Figure 1.1: The Shape of Globalization
Source: [http://www.onlinemarketing, Retrieved September, 2011-09-01]

2- The Global warming: -

The increase in the average temperature of Earth's near-surface air and oceans since the mid-20th century and its projected continuation. *[http://en.wikipedia.org/wiki/globalwarming.html. Retrieved June, 2010.], (3/06/2010, 4.00)]* (Figure 1.2)

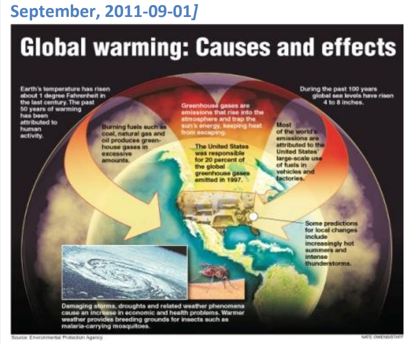


Figure 1.2: Global Warming Definition
Source:[http://www.greenscroll.org, Retrieved September, 2011-09-01]

3- The Climate change: -

The change in the statistical distribution of weather over periods of time that range from decades to millions of years. It can be a change in the average weather or a change in the distribution of weather events around an average. *[www.climatechange.com], Retrieved June, 2010.], (3/06/2010, 4.30)]* (Figure 1.3)

Figure 1.3: Lobbyists on Climate Change by Sector 2003, 2008
Source:[http://www.publicintegrity.org,Retrieved September, 2011-09-01]

4- Greenhouse gases: -

Gases in an atmosphere that absorb and emit radiation within the thermal infrared range. *[Prevent Air Pollution, Dr.Mohamed El-Ray. (2009).]* (Figure 1.4)

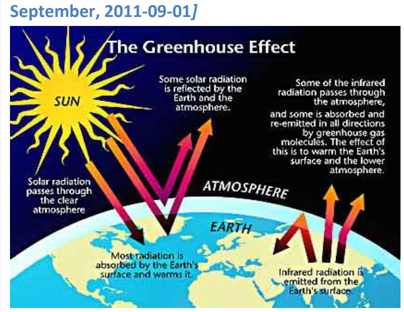


Figure 1.4: Greenhouse Effect

5- The Nanotechnology: -

Shortened to "**nanotech**", is the study of the controlling of matter on an atomic and molecular scale. Generally nanotechnology deals with structures of the size 100 nanometers or smaller in at least one dimension, and involves developing materials or devices within that size. *[Nonmaterial's, Nanotechnology And Design, Michael F.Ashby. (2009).]* (Figure 1.5)

6- Renewable energy: -

Renewable energy is energy generated from natural resources such as sunlight, wind, rain, tides, and geothermal heat, which are renewable (naturally replenished). *[Prevent Air Pollution, Dr.Mohamed El-Ray. (2009).]* (Figure 1.6)

7- Cyber Society:-

The mesh (space or virtual reality) of electronically based communications created by the world-wide network of computer users. Although it is conventional to distinguish between "information technology" (the term applied to any computer-based application or process, such as is found in the case of office automation), on the one hand, and „telecommunications technology" (for example fax machines or video conferencing), on the other, the multi-media integration of almost all technologies of communication via computers has effectively made this distinction redundant. The newer terminology of cyberspace refers to. *[http://www.highbeam.com/doc/1O88-cybersociety.html], Retrieved June, 2010.], (3/06/2010, 4.30)]* (Figure 1.7)

8- Cyber Space:-

Unlike most computer terms, "cyberspace" does not have a standard, objective definition. Instead, it is used to describe the virtual world of computers. For example, an object in cyberspace refers to a block of data floating around a computer system or network. With the advent of the Internet, cyberspace now extends to the global network of computers. So, after sending an e-mail to your friend, you could say you sent the message to her through cyberspace. However, use this term sparingly, as it is a popular newbie term and is well overused. The word "cyberspace" is credited to William Gibson, who used it in his book, Necromancer, written in 1984. Gibson defines cyberspace as "a consensual hallucination experienced daily by billions of legitimate operators, in every nation, by children being taught mathematical concepts... A graphical representation of data abstracted from the banks of every computer in the human system. Lines of light ranged in the non-space of the mind, clusters and constellations of data" (New York: Berkley Publishing Group, 1989), pp. 128. *[http://www.techterms.com/definition/cyberspace], Retrieved June, 2010.], (3/06/2010, 4.30)]* (Figure 1.8)

9- Nanoarchitecture :-

Nanoarchitecture is the conversion of architecture in the new nano revolution in the 21st Century. The use of nanotechnology in architecture varies from materials, equipments, to Forms and design theories. *[NanoArchitecture, Nanotechnology and Architecture, Architect Maged Fouad El-Samny].* (Figure 1.9)

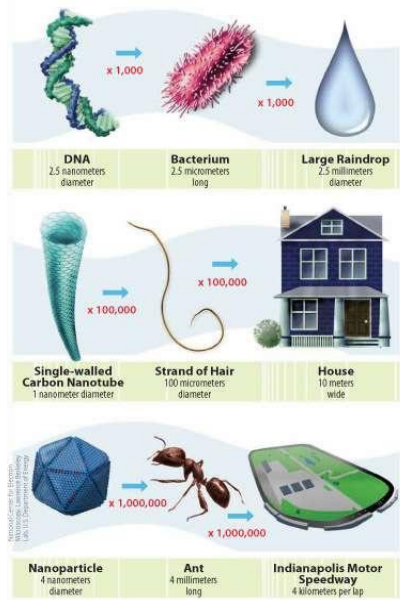


Figure 1.5: Nanotechnology Scale
Source:*[Nonmaterial's, Nanotechnology And Design, Michael F.Ashby. (2009).]*

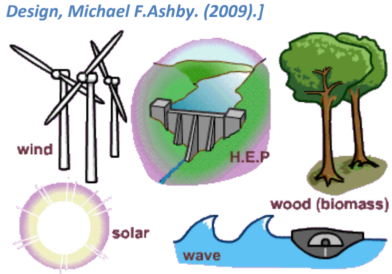


Figure 1.6: Renewable Resources
Source:*[http://www.tutorvista.com/biology/environmental-resources* Retrieved September, 2011-09-

Figure 1.7: Cyber Society
Source:*[http://beccysoc.webs.com/*Retrieved September, 2011-09-01*]*

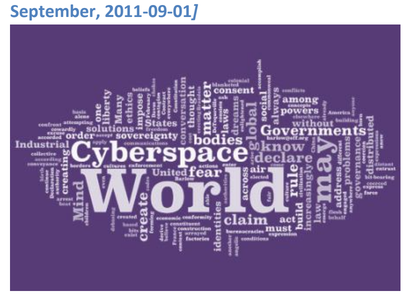


Figure 1.8: Cyber Space
Source:*[http://beccysoc.webs.com/*Retrieved September, 2011-09-01*]*

10- Green Nanoarchitecture:-

Fear of nano technology has led to taking precautions against its side effects on man and the environment. Hence, the importance of the approach of and the insistence on continuity in the employment of new technology in the field of architecture so as to make the green nano architecture a guarantee for benefiting from nano technology and for avoiding its side- effects on society and the environment. *[http://en.wikipedia.org/wiki/green nano architecture.html. Retrieved June, 2010.], (3/06/2010, 4.00)]* (Figure 1.10)

11- Ecological Architecture:-

Ecological architecture could also be called green architecture or sustainable architecture. It would be defined as buildings that are built with the environment in mind, i.e. energy efficiency, earth friendly building materials, etc. *[http://en.wikipedia.org/wiki/ecologicalarchitecture.html. Retrieved June, 2010.], (3/06/2010, 4.00)]* (Figure 1.11)

12- SUSTAINABILITY:-

In 1987, the World Commission on Environment and Development developed a definition of sustainability that was included in its findings, which became known as the Brundtland Report. It stated that:

Sustainable development meets the needs of the present without compromising the ability of future generations to meet their own needs.

[http://www.bathtram.org/tfb/tE04.htm], Retrieved June, 2010.], (3/06/2010, 4.00)] (Figure 1.12)

13- Zero Carbon Architecture :-

Architecture which are specifically engineered with GHG reduction in mind. So by definition, (ZCA) are buildings which emit significantly less GHG than regular buildings. *[http://www.huffingtonpost.com/phillip-jones/zero-carbon-design-and-ar_b_174775.htmlRetrieved June, 2010.], (3/06/2010, 4.00)]* (Figure 1.13)

Figure 1.9: Nanoarchitecture, Springtecture, Public Lavatories by Singu-Cho, Japan.

Figure 1.10: Green Nanoarchitecture
Source:[http://beccysoc.webs.com/Retrieved September, 2011-09-01]

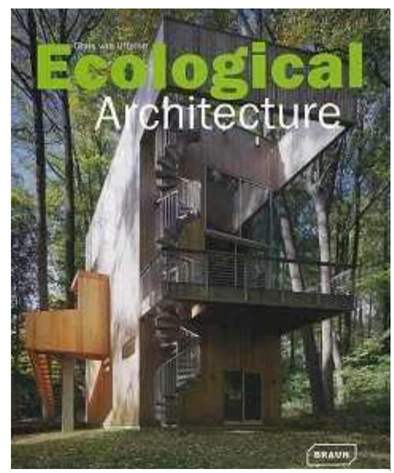


Figure 1.11: Ecological Architecture
Source:[http://beccysoc.webs.com/Retrieved September, 2011-09-01]

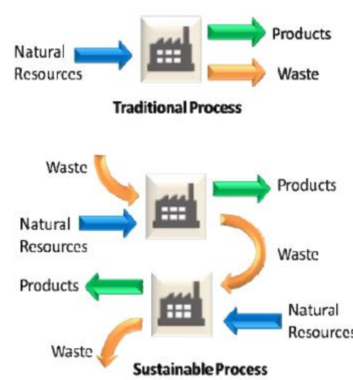


Figure 1.12: Sustainability

14- Zero Carbon City:-

A zero-carbon city is a settlement powered exclusively by renewable energy sources.To become a zero carbon city, an established modern city must collectively reduce emissions of greenhouse gases to zero and all practices that emit greenhouse gases must cease. Also, renewable energy must supersede other non-renewable energy sources and become the sole source of energy, so a zero-carbon city is a renewable-energy-economy city. This transition which includes decarbonising electricity (increasing the importance of the sources of renewable electricity) and zero-emission transport, is undertaken as a response to climate change and peak oil. *[http://en.wikipedia.org/wiki/Zero-carbon_city, Retrieved June, 2010.], (3/06/2010, 4.00)]* (Figure 1.14)

15- Nanosolar Energy:-

Nanosolar is a developer of solar power technology. Based in San Jose, CA, Nanosolar has developed and commercialized a low-cost printable solar cell manufacturing process. The company started selling panels mid-December 2007, and plans to sell them at around $1 per watt. When first announced that was just one fifth the price of the silicon cells, but in 2010 brand name silicon cells sell from around $1.70 reducing Nanosolar's cost advantage significantly. These solar cells successfully blend the needs for efficiency, low cost, and longevity and will be easy to install due to their flexibility and light weight. Estimates by Nanosolar of the cost of these cells fall roughly between 1/10 and 1/5 the industry standard per kilowatt. *[http://en.wikipedia.org/wiki/Nanosolar, Retrieved June, 2010.], (3/06/2010, 4.00)]* (Figure 1.15)

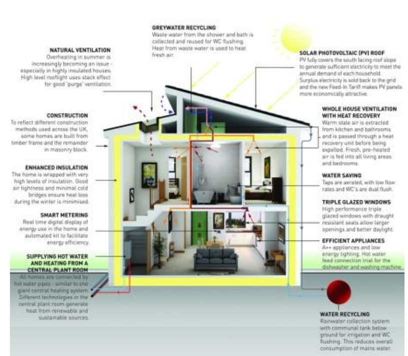


Figure 1.13: Zero carbon Architecture.

Figure 1.14: Nanocity India (Zero carbon)

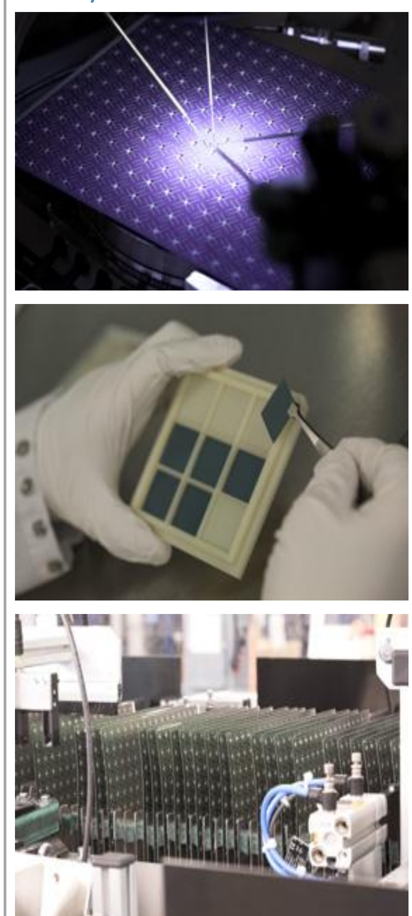


Figure 1.15: Nanosolar Energy.

0.2 Preface

As result of globalization, the world has become like one small village (Figure 1.13). New notion called the global problems has appeared such as the financial crisis, global warming, and Climate change (Figure1.14) and biodiversity affecting the whole world in general and the third world developing countries in particular resulting from the developed countries actions. It becomes necessary to address and face such global problems through the collaboration between all the world countries to reduce these impacts which will effect directly and strongly on the third world countries more than the developed countries because of their technological possibilities or advances enabling them facing such threats. Therefore, we must address and face these problems by providing future solutions minimizing their impacts. 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. Thus, using these materials in the public buildings will affect the architectural trends and thinking schools in the Middle East due to the different properties of these materials. A vast majority of climate scientists agree that global warming is happening and that it poses a serious threat to society. They also agree that it is being caused largely by human activities that release greenhouse gases, such as burning fossil fuels in power plants and cars and deforesting the land. Hence, reaching the main purpose of this study finding the best ways to reduce the carbon dioxide emissions harming the environment. Furthermore, it leads to zero carbon environment on the public level. Also on the private or individual level, it leads to carbon free architecture through using nanotechnology, and nanoarchitecture. Nanoarchitecture contributes effectively in creating spaces and zero carbon environment. More over depending on a clean and renewable energy producing a clean reliable energy without harming the environment. *[GLOBAL WARMING IS MAN-MADE, Vincent di Norcia. 2008].*

The global energy balance (Figure 1.16) is the balance between incoming energy from the Sun and outgoing heat from the Earth. The global energy balance regulates the state of the

Figure 1.16: Globalization " World is Small Village"
Source:[http://flatclassroomproject2008.wikispaces.com/Globalization+and+Outsourcing, Retrieved September, 2011-09-01]

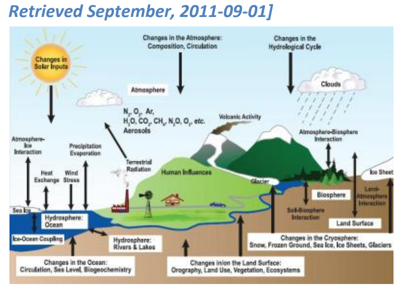
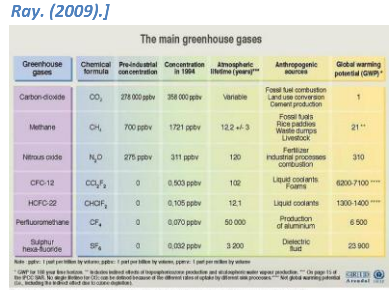


Figure 1.17: Climate Change Diagram
Source: [Prevent Air Pollution, Dr.Mohamed El-Ray. (2009).]



The main greenhouse gases

Greenhouse gases	Chemical formula	Pre-industrial concentration	Concentration in 1994	Atmospheric lifetime (years)***	Anthropogenic sources	Global warming potential (GWP)*
Carbon-dioxide	CO_2	278 000 ppbv	358 000 ppbv	Variable	Fossil fuel combustion Land use conversion Cement production	1
Methane	CH_4	700 ppbv	1721 ppbv	12.2 +/- 3	Fossil fuels Rice paddies Waste dumps Livestock	21 **
Nitrous oxide	N_2O	275 ppbv	311 ppbv	120	Fertilizer industrial processes combustion	310
CFC-12	CCl_2F_2	0	0,503 ppbv	102	Liquid coolants Foams	6200-7100 ****
HCFC-22	$CHClF_2$	0	0,105 ppbv	12,1	Liquid coolants	1300-1400 ****
Perfluoromethane	CF_4	0	0,070 ppbv	50 000	Production of aluminium	6 500
Sulphur hexa-fluoride	SF_6	0	0,032 ppbv	3 200	Dielectric fluid	23 900

Figure 1.18: The Main Greenhouse Gases *Source: [Prevent Air Pollution, Dr.Mohamed El-Ray. (2009).]*

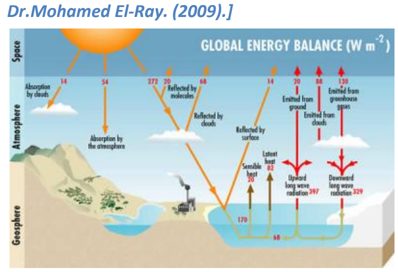


Figure 1.19: Global Energy Balance
Source: [http://www.bom.gov.au.]

Earth's climate, and modifications to it as a result of natural and man-made climate forcing, cause the global climate to change. *[http://en.wikipedia.org/wiki/Global_warming, Retrieved Nov. 1st, 2010]*

The Earth atmosphere contains a number of greenhouse gases, which affect the Sun-Earth energy balance. The average global temperature is in fact 33°C higher than it should be. Greenhouse gases (Figure 1.17) absorb electromagnetic radiation at some wavelengths but allow radiation at other wavelengths to pass through unimpeded. The atmosphere is mostly transparent in the visible light (which is why we can see the Sun), but significant blocking (through absorption) of ultraviolet radiation by the ozone layer, and infrared radiation by greenhouse gases, occurs. The absorption of infrared radiation trying to escape from the Earth back to space is particularly important to the global energy balance. Such energy absorption by the greenhouse gases heats the atmosphere (Figure 1.18), and so the Earth stores more energy near its surface than it would if there was no atmosphere. The average surface temperature of the moon, about the same distance as the Earth from the Sun, is -18°C. The moon, of course, has no atmosphere. By contrast, the average surface temperature of the Earth is 15°C. This heating effect is called the natural greenhouse effect. *[http://en.wikipedia.org/wiki/Global_warming, Retrieved Nov. 1st, 2010]*

Greenhouse gases are gases in an atmosphere that absorb and emit radiation within the thermal infrared range. Greenhouse gases greatly affect the temperature of the Earth; without them, Earth's surface would be on average about 33 °C (59 °F) colder than at present. Human activities since the start of the industrial era around 1750 have increased the levels of greenhouse gases in the atmosphere (Figure1.15). The "greenhouse effect" is the warming that happens when certain gases in Earth's atmosphere trap heat (Figure1.19). These gases let in light but keep heat from escaping, like the glass walls of a greenhouse. First, sunlight shines onto the Earth's surface, where it is absorbed and then radiates back into the atmosphere as heat. In the atmosphere, greenhouse gases trap some of this heat, and the rest escapes into space. (Figure1.20)

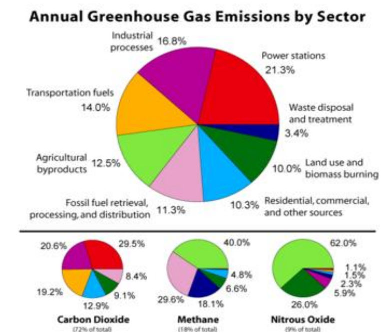


Figure 1.20: Global anthropogenic

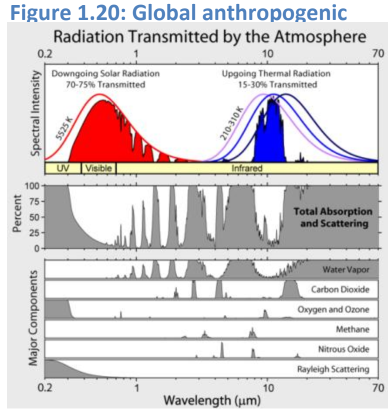


Figure 1.21: Atmospheric absorption and scattering at different electromagneticwavelengths.*Source:[http://en.wikipedia.org/wiki/Greenhouse_gas, Retrieved September, 2011-09-01]*

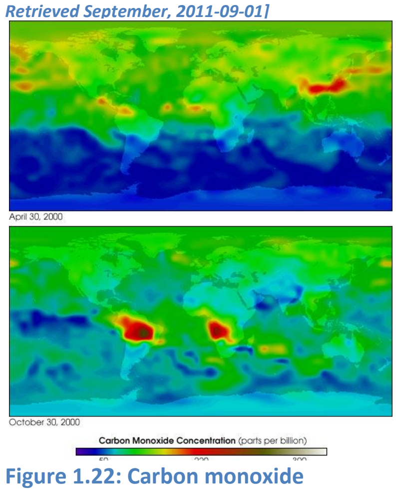


Figure 1.22: Carbon monoxide

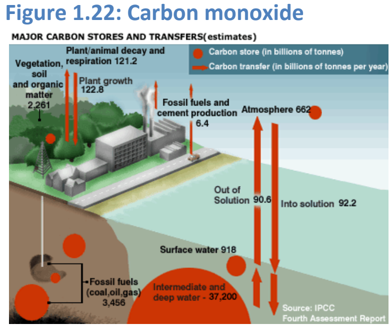


Figure 1.23: Carbon Store

0.3 Outline

Ever since the humanity existed and the man is expanding the geographic realm of his economic, political, social and cultural contacts. In this sense of extending connections to other peoples around the world, globalization is nothing new. Also, as a process of change that can embody both great opportunities for wealth and progress and great trauma and suffering, globalization at the beginning of the 21st century is following a well established historical path. The effect of globalization on architecture is notably seen in the building designs, technology, style, and the architectural thinking. The use of classic architectural styles has become unfamiliar since the revolution of modernization in the second half of the 20th century.

Nevertheless, it continues to develop and evolve forming a world style that has nothing to do with the regions, or origins; buildings can be built using materials from everywhere and placed anywhere in the world, promoting its city to a higher calibrate to cope with the new world pace towards modernity and new technology.

After all, we can think in this research in three trends:-

The first trend is to study the possibilities of using the nanotechnology through the use of nanomaterials in the public buildings, its impact on energy consumptions rates, the possibilities of importing the nanomaterial from abroad, its economic feasibility studies (or its economic analysis), how to produce these materials in the local market, and its impact on the local architecture. Making the architects use these materials after studying its impacts or influences explained by a practical case study applying the impact of using these material on energy consumptions.

The second trend is to study the nanotechnology impact on the architecture and thinking schools. The important of using this technology and knowledge on the different architectural trends and its negative or positive impacts. Evaluating the architecture performance in the light of using such technology. Reaching to the evaluation standards bases, and concepts to evaluate the architecture schools and the architectural thinking whether it is affected by nanotechnology or not, and agreeing or rejecting it and assessing this evaluation from the philosophical point of view.

The Third trend aims to focusing on the necessity of activating the use of nanotechnology and knowledge in the education and updating the students nanotechnology knowledge and this knowledge effect on their design trends illustrated by a case study of different students groups from different architecture universities explaining this knowledge impact on the students, their architectural or design trends, and studying the importance of using such technology in the educational syllabus and system in order to harmonize between the academic study and the international developments in intellectual trends of contemporary architecture.

0.4 Research Structure Chart

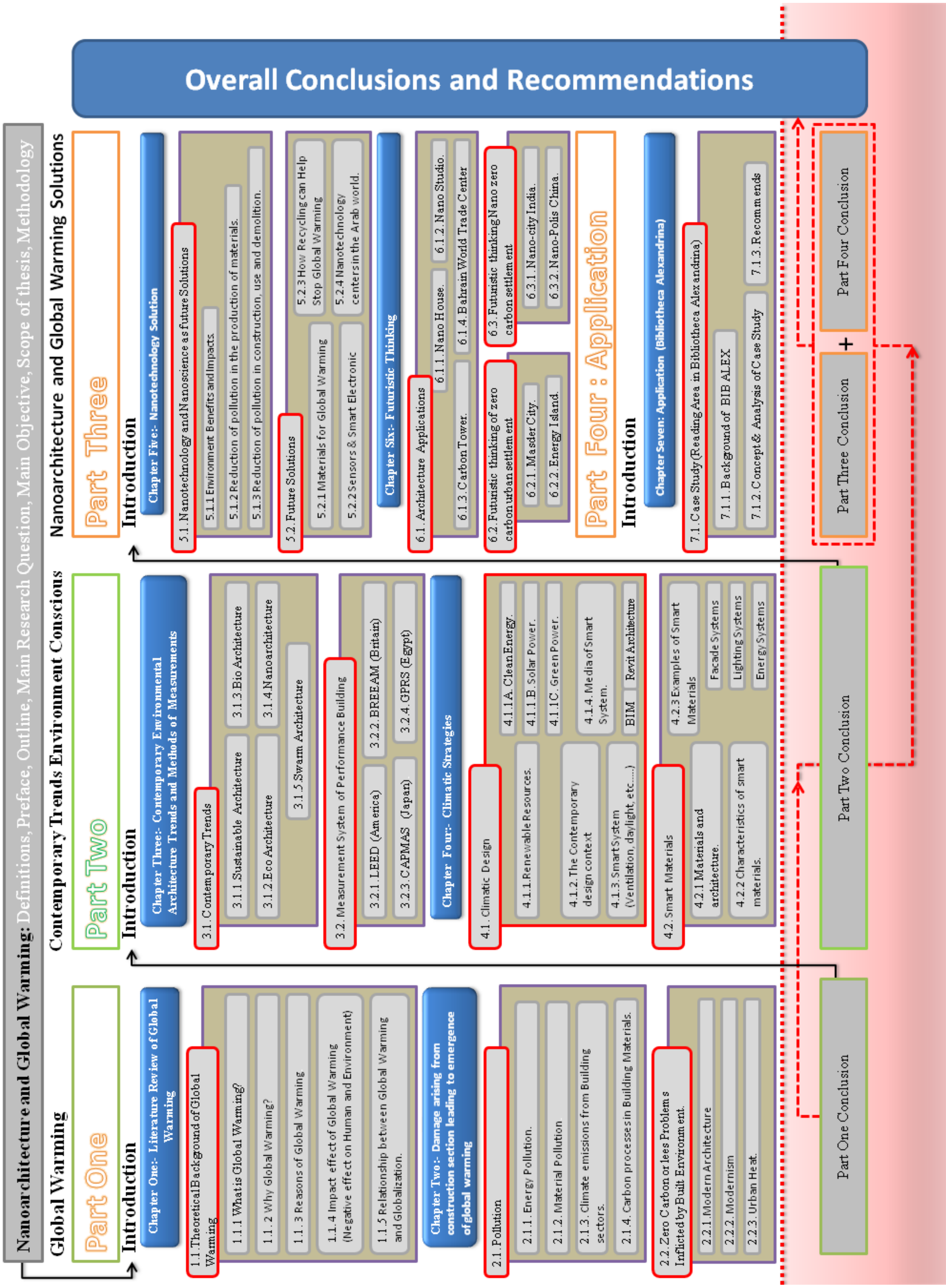


Figure 1.24: Research structure chart

0.5 Main Research Questions

"How can reduce global warming effects by using nanotechnology in Building Sectors "

This is the main question of the study. Also it includes other questions:

- What are the possibilities of using the nanotechnology through the use of nanomaterials in the public buildings, its impact on energy consumptions rates, the possibilities of importing the nanomaterial from abroad, its economic feasibility studies (or its economic analysis)?
- how to produce these materials in the local market, and its impact on the local architecture, Making the architects use these materials after studying its impacts or influences explained by a practical case study applying the impact of using these material on energy consumptions?
- What is – Global Warming?
- What cause of global warming?
- How we can stop global warming?
- What effects of global warming?
- What is the relationship between Nanoarchitecture and Global Warming?
- How Nanoarchitecture can reduce the global warming?
- Why Nanomaterials is helpful than micro?
- What is the techniques which can reduce global warming?
- How we can reach the clean energy inside the building?
- What effects of Clean Energy on (Human – Environment – Building) ?
- How we can reduce green house gases?
- How we can achieve Zero Carbon Architecture?

0.6 Main Objective

The Nanoarchitecture Role in Reducing the Global Warming and Carbon Dioxide Emissions Supporting/Optimizing/Contributing the Sustainable Architecture Design.

0.7 Scope of Thesis

How to reach to climatic material which can provide us with clean energy inside buildings to reduce the global warming effects especially in Egypt by reach the possibilities of using the nanotechnology through the use of nanomaterials in the public buildings, its impact on energy consumptions rates, the possibilities of importing the nanomaterial from abroad, its economic feasibility studies (or its economic analysis), how to produce these materials in the local market, and its impact on the local architecture. Making the architects use these materials after studying its impacts or influences explained by a practical case study applying the impact of using these material on energy consumptions.

0.8 Methodology

Four issues will be discussed:

First Issue: Global Warming.

This part covers the theoretical and analytical study of global warming, its negative impacts, and determining the architecture and building role in increasing the global warming. Literature review of Pollution like energy pollution, material pollution, climate emissions from building sectors, carbon processes in building materials and at the end of part one it deals with zero carbon or less problems inflicted by built environment which talk about global architecture, globalization and urban heat.

References for this part are:

1. A Handbook on Low-Energy Buildings and District Energy Systems: Fundamentals, Techniques, and Examples by L.D. Danny Harvey.

2. Global warming by John Houghton.

Second Issue: Contemporary Trends Environment Conscious.

This part deals with new trends of architecture (swarm architecture, eco-architecture, nanoarchitecture, green architecture) in providing future solutions depending on scientific and technical bases for the developing problems suitable for the twenty-first century like global warming, Measurement System of Performance Building, climatic design and smart materials.

References for this part are:

1. Nanomaterials,Nanotechnologies And Design An Introduction For Engineers And Architects by Michael F.Ashby.

2. Smart Materials and New Technologies for Architecture and Design Professions by Michelle Addington and Daniel schodek .

3. Nano Materials in Architecture, Interior Architecture and Design by Sylvia leydecker.

Third issue: Nanoscience and Nanotechnology as Future Solutions .

This part discusses producing Eco-friendly nanomaterials, Developing Solutions for Global Warming Emissions Problem like Reduction of pollution in the production of materials. study the possibilities of using the nanotechnology through the use of nanomaterials in the public buildings, its impact on energy consumptions rates, the possibilities of importing the nanomaterial from abroad, its economic feasibility studies (or its economic analysis), how to produce these materials in the local market, its impact on the local architecture and the Egypt`s current situation. What we need to fix it? And what we need to improve this situation?

References for this part are:

1. The Ecology of Building Materials Second Edition, Bjorn Berge. (2009).

2. Nonmaterial's, Nanotechnology And Design, Michael F.Ashby. (2009).

Four Issue: Nanoarchitecture and Global Warming Solution.

These parts discuss/explain the architecture models, and analyzing how we can design to achieve the sustainability in the future. Making the architects use these materials (smart materials) after studying its impacts or influences explained by a practical case study applying the impact of using these material on energy consumptions. Also how we can use smart system in the design to reduce losing energy.

References for this part are:

1. 70 Million Years of Building Thermal Envelope Experience: Building Science Lessons from the Honey Bee. R. Christopher Mathis. Member ASHRAE.2007.

Conclusions: -

How nanoarchitecture provide contemporary environmental solutions to achieve sustainable development in knowledge era.

Part One: Global Warming

Introduction

Chapter One: literature Review of Global Warming

1.1 Theoretical Background of Global Warming.

1.1.1 What is Global Warming?

1.1.2 Why Global Warming?

1.1.3 Reasons of Global Warming.

1.1.4 Impact effect of Global Warming.

1.1.5 Relationship between Global Warming and Globalization.

Chapter Two: Damage arising from Construction Section leading to Emergence of Global Warming

2.1 Pollution.

2.1.1 Energy Pollution.

2.1.2 Material Pollution.

2.1.3 Climate emissions from Building sectors.

2.1.4 Carbon processes in Building Materials.

2.2 Zero Carbon or Less Problems Inflicted by Built Environment.

2.2.1 Modern Architecture.

2.2.2 Modernism.

2.2.3 Urban Heat.

Part One Conclusion.

Part One: Global Warming
Introduction…

The research investigates the importance of the use of new up-and-coming technologies as an outcome of **globalization**. Such international integration has greatly influenced architecture and the way we plan it, thanks to the new technological inventions that comes up hastily, fast mobility and the ease of communication. **Knowledge Society** and Nanotechnology as a result of the global cooperation in technology has become the cutting-edge technology of **the 21st century**.

The progress of digital programs and hardware had a great impact on the discovery of new science and highly advanced technologies (Figure1.25). This will lead to technologies and substances of great quality. All this contributed to reaching green and clean environmental solutions (Figure1.26) and Nanotechnology is one of the explored sciences. Through the **Nanoscience**, **Nanotechnology**, **Nanoarchitecture**, **biological science** and **ecological science** was introduced and it introduced a new trend of architecture which added sustainable green solutions to maintain the environment to reduce harmful effects of global warming. (Figure1.27)

This Part provides a broad review of pervious work done in the field of Global Warming particularly in building sector.

The work in this part consists of two chapters:

- First it deals with preface of the problem and literature review of theoretical background of Global warming which trial for answering important questions: What is Global Warming? And Why Global Warming? What cause of global warming? What effects of global warming? Also we will discuss the reasons of Global Warming. At the end of this part we will explain relationship between Global Warming and Globalization.

- Second it summarizes the literature of Pollution like energy pollution, material pollution, climate emissions from building sectors, carbon processes in building

Figure 1.25: Advanced Technologies *Source: [http://claypeck.com/2011/01/03/a-digital-fast/, Retrieved September, 2011-09-01]*

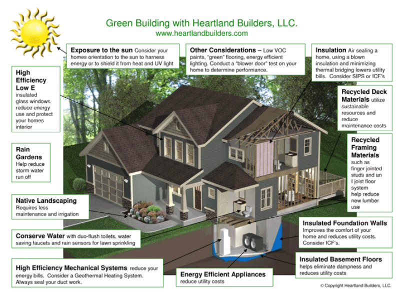


Figure 1.26: Green Building *Source: [http://saungdesign.blogspot.com, Retrieved September, 2011-09-01]*

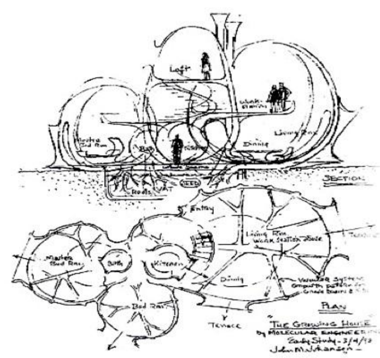


Figure 1.27: Nanoarchitecture *Source: [http //johnmjohansen.com/Nanoarchitecture-II.html, Retrieved September, 2011-09-01]*

materials and at the end of part one it deals with zero carbon or less problems inflicted by built environment which talk about modern architecture, modernism and urban heat.

- Finally, we will find the conclusion of part one which we reach after first and second part and explain relationship between chapter one and two.

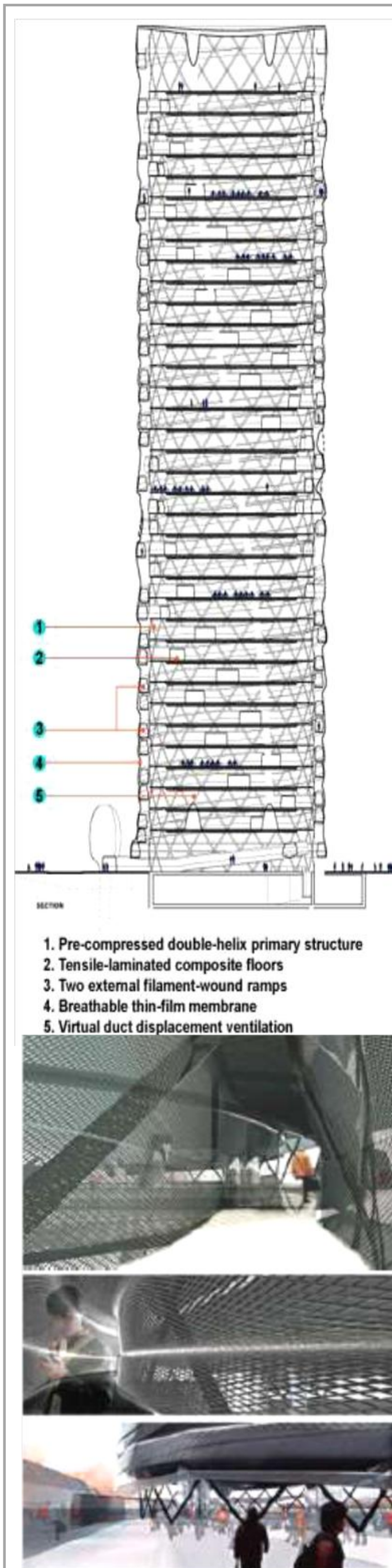


Figure 1.27: Nanoarchitecture *Source: [http //johnmjohansen.com/Nanoarchitecture-II.html, Retrieved September, 2011-09-01]*

Chapter One:

1.1 Theoretical Background of Global Warming.

1.1.1 What is Global Warming?

Global Warming (GW) is the increase in the average temperature of Earth's near-surface air and oceans since the mid-20th century and its projected continuation. Global surface temperature increased 0.74 ± 0.18 °C (1.33 ± 0.32 °F) between the start and the end of the 20th century**.** Global warming has become familiar to many people as one of the most important environmental issues of our day. This review will describe the basic science of global warming; it‘s likely impacts both on human communities and on natural ecosystems and the actions that can be taken to mitigate or to adapt to it. As commonly understood, global warming refers to the effect on the climate of human activities, in particular the burning of fossil fuels (coal, oil and gas) and large-scale deforestation-activities that have grown enormously since the industrial revolution, and are currently leading to the release of about 7 billion tons of carbon as carbon dioxide into the atmosphere each year together with substantial quantities of methane, nitrous oxide and chlorofluorocarbons (CFCs). *[Global warming, John Houghton, Hadley Centre, Meteorological Office, Exeter EX1 3PB, UK (2002), Retrieved June 1st, 2009].*

These gases are known as greenhouse gases. The basic principle of global warming can be understood by considering the radiation energy from the sun that warms the Earth’s surface and the thermal radiation from the Earth and the atmosphere that is radiated out to space. On average, these two radiation streams must balance. The greenhouse effect arises because of the presence of greenhouse gases in the atmosphere that absorb thermal radiation emitted by the Earth’s surface and, therefore, act as a blanket over the surface (Figure1.28). It is known as the greenhouse effect because the glass in a greenhouse possesses similar properties to the greenhouse gases in that it absorbs infrared radiation while being transparent to radiation in the visible part of the spectrum. If the amounts of greenhouse gases (Figure1.29) increase due to human activities, the basic radiation balance is altered.

The balance (Figure1.30) can be restored through an increase in the Earth’s surface temperature. The effect was first recognized by the French scientist Jean-Baptist Fourier in 1827.

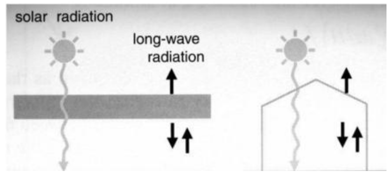


Figure 1.28: A greenhouse has a similar effect to the atmosphere on the incoming solar radiation and the emitted thermal *Source: [Global warming. John Houghton, Hadley Centre, Meteorological Office, Exeter EX1 3PB, UK (2002), Retrieved June 1s, 2011-09-01]*

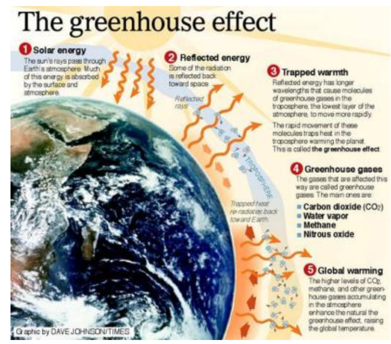
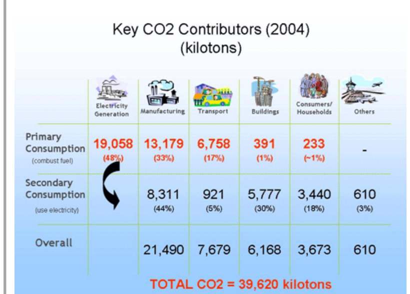


Figure 1.29: greenhouse effect *Source: [http://www.suratclimatechange.org/page/2/greenhouse-effect.html, Retrieved June 1s, 2011-09-01]*



Key CO2 Contributors (2004) (kilotons)

	Electricity Generation	Manufacturing	Transport	Buildings	Consumers/ Households	Others
Primary Consumption (combust fuel)	19,058 (48%)	13,179 (33%)	6,758 (17%)	391 (1%)	233 (~1%)	-
Secondary Consumption (use electricity)		8,311 (44%)	921 (5%)	5,777 (30%)	3,440 (18%)	610 (3%)
Overall		21,490	7,679	6,168	3,673	610

TOTAL CO2 = 39,620 kilotons

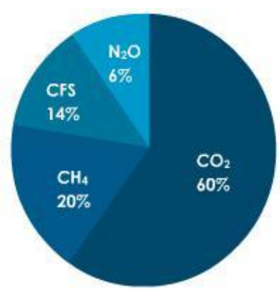


Figure 1.30: Greenhouse Gasses by sectors. *Source: [http://www.tutorvista.com/content/biology/biology-iv/environmental-changes/green-house-gases.php,Retrieved June 1s, 2011-09-01]*

A British scientist, John Tyndall around 1860 measured the absorption of infrared radiation by carbon dioxide and water vapors and suggested that a cause of the ice ages might be a decrease in the greenhouse effect (Figure1.31) of carbon dioxide. It was a Swedish chemist, Santé Arrhenius in 1896 who first calculated the effect of increasing concentrations of greenhouse gases; he estimated that doubling the concentration of carbon dioxide would increase the global average temperature by 5–6°C. As we shall see later this estimate is not too far from our present understanding.

We have been familiar for a long time with problems of *air quality* caused by the emissions of pollutants such as the oxides of nitrogen or sulfur into the atmosphere from local sources. That is *local pollution*. Measures to reduce such pollution especially in major cities are actively being pursued. Global warming is an example of *global pollution*. Because of the long life time in the atmosphere of many greenhouse gases such as carbon dioxide, their effects impact on everyone in the world. Global pollution can only be countered by global solutions. *[Global warming. John Houghton, Hadley Centre, Meteorological Office, Exeter EX1 3PB, UK (2002), Retrieved June 1st, 2009].*

The available options are mitigation to reduce further emissions; adaptation to reduce the damage caused by warming; and, more speculatively, geo engineering to reverse global warming. Most national governments have signed and ratified the Kyoto Protocol aimed at reducing greenhouse gas emissions. (Figure1.32)

1.1.2 Why Global Warming?

Global warming is a phrase that refers to the effect on the climate of human activities, in particular the burning of fossil fuels (coal, oil and gas) and large-scale deforestation, which cause emissions to the atmosphere of large amounts of greenhouse gases, of which the most important is carbon dioxide. Such gases absorb infrared radiation emitted by the Earth's surface and act as blankets over the surface keeping it warmer than it would otherwise be. Associated With this warming are changes of climate. The basic science of the greenhouse effect that leads to the warming is well understood. More detailed understanding relies on numerical models of the climate that integrate the basic dynamical and physical equations describing the complete climate system (Figure1.33). Many of the likely characteristics of the resulting changes in climate (such as more frequent heat waves, increases in rainfall,

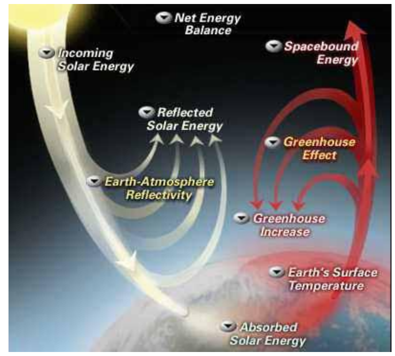


Figure 1.31: The global energy balance the amount of energy the Earth receives from the Sun is balanced by the amount it loses back to space. *Source:[http://en.wikipedia.org/wiki/Global_warming,Retrieved Sept., 2011-09-09]*

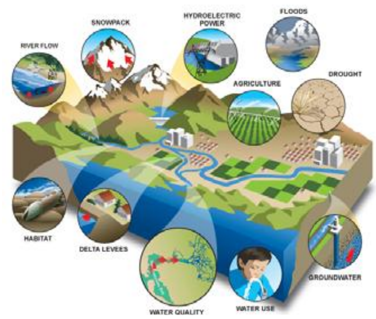


Figure 1.32: Major components needed to understand the climate system and climate change. *Source:[http://en.wikipedia.org/wiki/Global_warming,Retrieved Sept., 2011-09-09]*

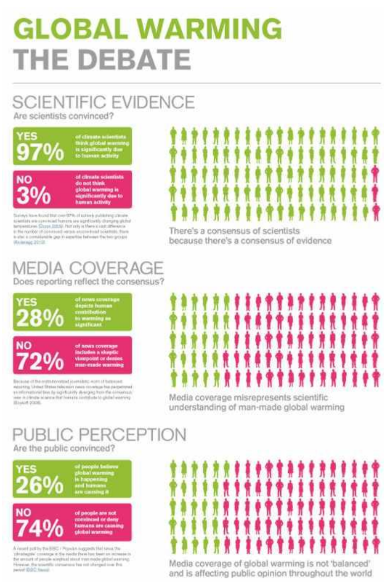


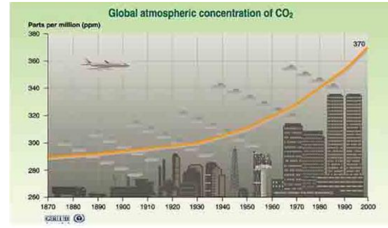
Figure 1.33: The DEBATE (Kyoto Protocol) *Source [http://global-warming articles.org/? p=173, Retrieved Sept., 2011-09-09]*

increase in frequency and intensity of many extreme climate events) can be identified. Substantial uncertainties remain in knowledge of some of the feedbacks within the climate system (Figure1.34) (that affect the overall magnitude of change) and in much of the detail of likely regional change. Because of its negative impacts on human communities (including for instance substantial sea-level rise) and on ecosystems, global warming is the most important environmental problem the world faces. Adaptation to the inevitable impacts and mitigation to reduce their magnitude are both necessary. International action is being taken by the world's scientific and political communities. Because of the need for urgent action, the greatest challenge is to move rapidly to much increased energy efficiency and to non-fossil-fuel energy sources. *[Global warming. John Houghton, Hadley Centre, Meteorological Office, Exeter EX1 3PB, UK (2002), Retrieved June 1st, 2009].*

Global warming is already taking place and has become the biggest challenge of our time. The challenge is to find ways for the world to switch from a path of increasing emissions to a path of more high advanced technologies (nanotechnologies) where the majority of the GHG emissions (Figure 1.32, 1.33) are eliminated. The concept of green buildings is mainly the idea of how to save energy consumption in buildings and reduce carbon dioxide emissions. *[Energy and Climate Department of the Bellona Foundation, "How to Combat Global Warming", Oslo, 2008].*

Buildings have a significant impact on energy use and environment. Commercial and residential buildings use almost 40% of the primary energy and approximately 70% of the electricity in the United States (EIA 2005) (Figure 1.35). The energy used by the building sector continues to increase, primarily because new buildings are constructed faster than old ones are retired. Electricity consumption in the commercial building sector doubled between 1980 and 2000, and is expected to increase another 50% by 2025 (EIA 2005) (Figure 1.37). *[P.Torcellini. "Zero Energy Buildings: A Critical Look at the Definition". National Energy Renewable Laboratory (NREL). June 2006].*

The **Kyoto Protocol** (2005) is a protocol to the United Nations Framework Convention on Climate Change (UNFCCC), aimed at fighting warming. The objective of the Kyoto climate Change conference (Figure 1.37) was to establish a legally binding international agreement, whereby all the Participating nations commit themselves to tackling the issue of global warming and GHG emissions. The target agreed upon was an average reduction of 5.2% from 1990 levels by the year 2012. *[Dr. Alois Rhiel, "Application of nanotechnologies in the*



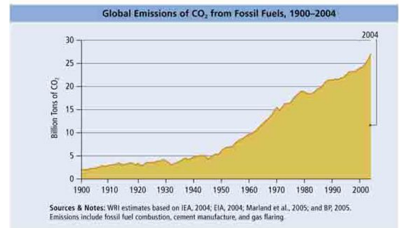
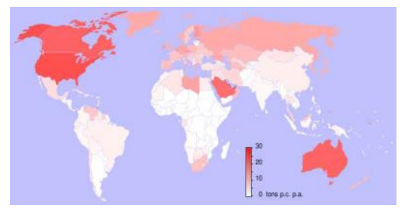


Figure 1.14: Global Emissions of CO2 from Fossil Fuels, 1900-2004



	Country	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
1	Qatar	25.2	36.7	54.3	61	58.8	58.6	59.1	65.7	56.9	63.2	56.3	43.1	42.2	38.9	48.4	58.7	56.2
2	United Arab Emirates	29.4	30.2	29.5	31.1	33.1	30.3	16.9	16.4	34.1	29	39	33.2	26.6	33.7	33.5	33.1	32.8
3	Kuwait	19	5.2	10	16.9	20.8	30.8	28.5	33.8	32.3	31.4	31.9	28.8	26.2	28.9	31.1	33.3	31.2
4	Bahrain	24.1	22.6	20.1	27.8	27.2	27.7	26.3	28.5	29.6	28.3	30.4	22.7	24.7	25.3	25.4	27.2	28.8
9	United States	19	18.8	18.6	19.5	19.5	19.3	19.5	19.8	19.7	19.7	20.2	19.6	19.6	19.4	19.5	19.5	19
11	Australia	17.4	16.8	17.1	17.3	17.2	17.2	18.1	18.1	18.7	17.3	17.2	16.6	17.1	17.1	17	18	18.1
14	Saudi Arabia	13.2	16	16.7	18	17.4	12.9	13.8	11.3	10.5	11.2	14.3	13.9	14.8	14.4	15	15.5	15.8
33	Russia			13.9	12.7	10.8	10.5	10.4	10	9.6	9.6	9.8	9.8	9.8	10.2	10.4	10.5	10.9
35	Japan	9.5	9.5	9.7	9.5	10	10.1	10.3	10.3	9.9	9.7	9.9	9.8	9.9	10.1	10.3	10.2	10.1
36	Germany		12.1	11.6	11.3	11.1	11	11.2	10.9	10.8	10	10.1	10.3	10	10	9.9	9.7	9.7
119	Egypt	1.4	1.4	1.4	1.6	1.4	1.6	1.7	1.7	1.9	1.9	2.1	1.9	2	2	2.1	2.4	2.2

Figure 1.35: CO2emissions per capita for the year 2006 by list of Countries.
Source [The International Energy Agency (IEA), 2009]

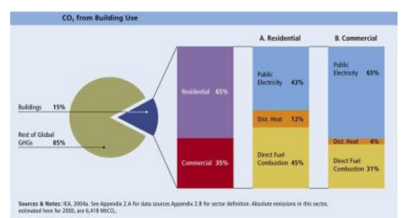


Figure 1.36: CO2 from Building Use

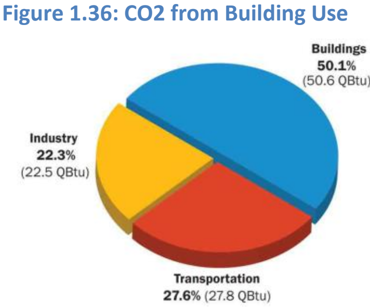
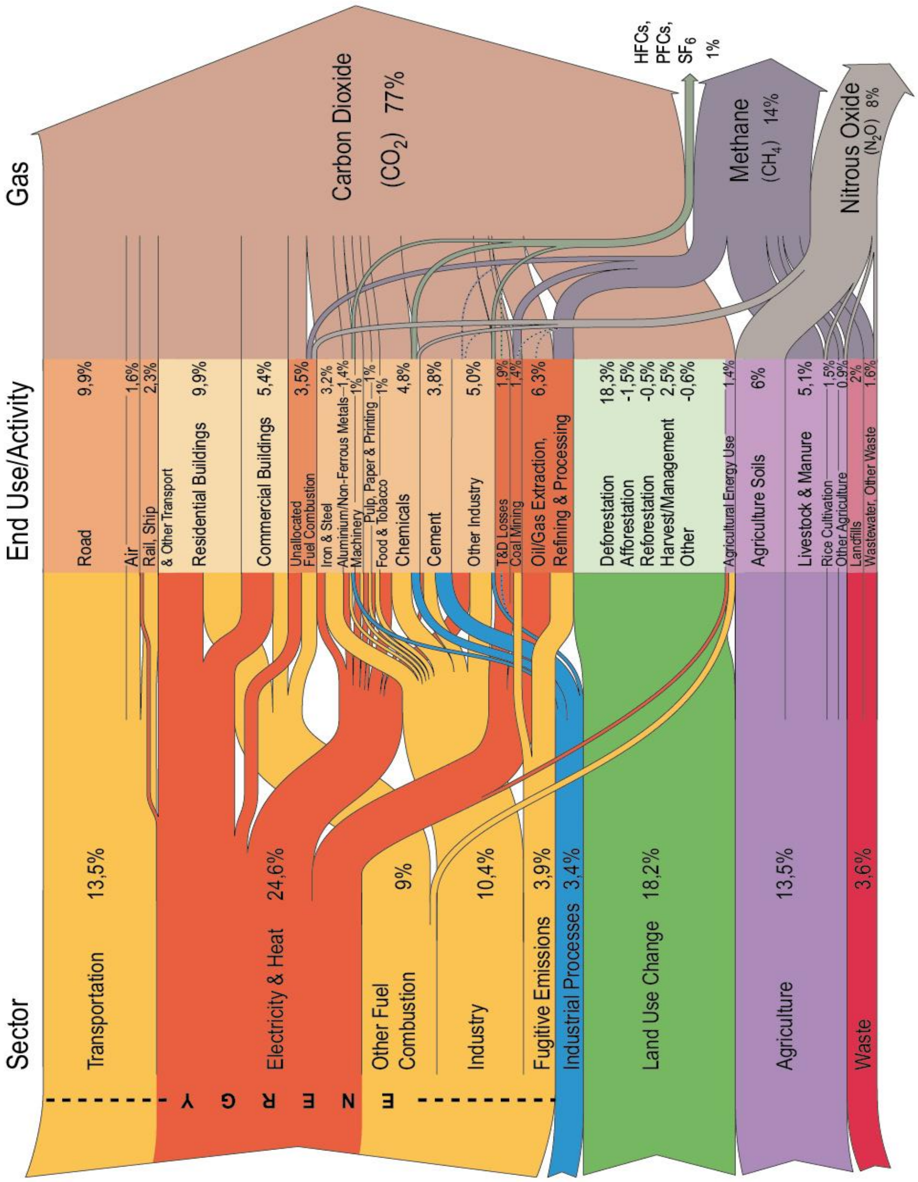


Figure 1.37: U.S Energy Consumption by Sector



energy

Figure 1.38: ***World Greenhouse gas emissions by sector***. ***Source: World Resources Institute, Climate Analysis Indicator Tool (CAIT)***

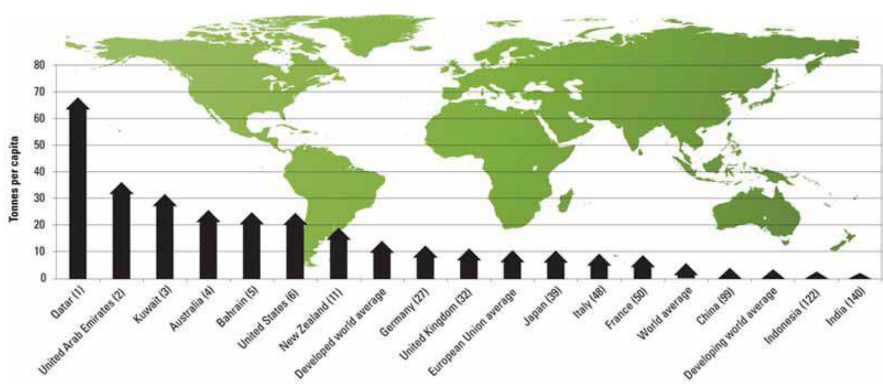


Figure 1.39: shown GHG emissions by country for the year 2000 *Source: World Resources Institute, 2005, using data from 2000.*

sector", Hessian Ministry of Economy, Transport, Urban & Regional Development, 2009].

The 2009 United Nations Climate Change Conference, commonly known as the **Copenhagen Summit** (Figure 1.40), the document recognized that climate change is one of the greatest challenges of the present day and that actions should be taken to keep any temperature increases to below 2°C. The document is not legally binding and does not contain any legally binding commitments for reducing CO2 emissions. The implementation of the Copenhagen Accord will be reviewed by 2015. This will take place about a year-and-a-half after the next scientific assessment of the global climate by the Intergovernmental Panel on Climate Change (IPCC*). [Michael R. Bloomberg, "Inventory of new York city - Greenhouse gas emissions ", New York, 2007]*(Figure 1.36)

1.1.3 Reasons of Global Warming.

Global warming is a phenomenon that has been discussed widely nowadays and global warming causes are one of the most studied subjects presently in the world. Throughout the world many governments, institutes and universities are trying to find out what are the **causes for global warming** (Figure 1.41). The causes are split up into two groups, **man-made** or **anthropogenic causes**, and **natural causes**. *[Source is http://library.thinkquest.org/J003411/causes.htm March 2011-03-26].*

Natural causes are causes created by nature. One natural cause is a release of methane gas from arctic tundra and wetlands. Methane is a greenhouse gas. A greenhouse gas is a gas that traps heat in the earth's atmosphere (Figure 1.43). Another natural cause is that the earth goes through a cycle of climate change. This climate change usually lasts about 40,000 years.

Man-made causes probably do the most damage. As the effects of global warming is becoming more and more evident, many of us have started to realize that steps have to be taken to control Global warming at the earliest and various countries and people have started working towards it. The earth, the 3rd planet of our solar system, the planet brimming with life and beautiful landscape, is on the verge of getting destroyed. The main reason is global warming. Global warming is the slow and steady increase in the temperature of earth and its atmosphere (Figure 1.42). The increase in the temperature of earth has caused many effects like the melting of ice in Polar Regions, increase in disease occurrences, drastic climatic

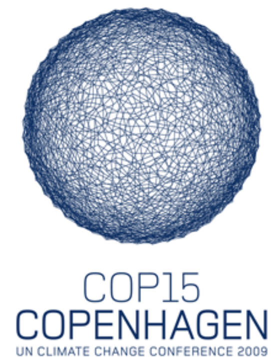


Figure 1.40: Copenhagen Summit

Figure 1.41: Reasons of Global Warming [*source is: vizu.typepad.com Retrieved March 2011-03-26]*

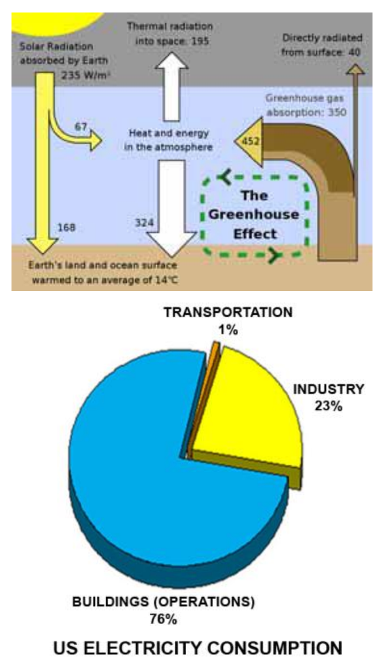


Figure 1.42: US Electricity Consumption *and Greenhouse Effect.*

changes including rainfall and dry periods. *Source is: http://library.thinkquest.org/J003411/causes.htm March 2011-03-26].*

The man which thinks of himself as the most intelligent thing on earth is knowingly or unknowingly destroying its own habitat. The activities of man has lead to an increase in the so called greenhouse gases (Figure 1.43) which include carbon dioxide, methane, nitrogen oxide etc. the gases have created an effect of green house on the earth‘s surface which prevents the reflection of the rays from sun and thus causes the increase in temperature (Figure 1.44). Carbon dioxide concentration in the air has increased due to the emissions from cars, airplanes, power plants, industries etc. another reason for it is the deforestation. Forests have been cut down paying way for agriculture, industries and cities. The trees were natural regulators of carbon dioxide which used to control its level's in the atmosphere (Figure 1.45).

Another is the CFC which is used in refrigerators, in fire extinguishers which destroys the natural ozone layer. The ozone layer was a natural barrier which used to prevent the harmful ultra violet rays of the sun. Without this layer, the rays fall on the earth and cause the temperature to increase. Researchers have found an ozone hole in our atmosphere, which they say is the main reason for the melting of glacier's in the Polar Regions. Earth which mainly consists of developing or underdeveloped countries, which holds a major population needs electricity for the day to day activities. The electricity supply is mainly satisfied by burning fossil fuels. The fossil fuel on burning releases carbon dioxide which causes global warming.

The causes of the global warming have been in work for a long time and slowly it has caused the increase in the temperature. The satisfactory fact is that at least now the governments of various countries and its people have started to understand that they are one of the causes for the global warming. Therefore combined efforts by the different countries have started to control the global warming and thereby prevent our habitat from destruction. Awareness, alternative forms of energy, conservation of energy, and reforestation can help. (Figure 1.46) *[Source is: http://ezinearticles.com/?The-Prime-Reasons-and-Causes-Of-Global-Warming&id=652734, Retrieved Nov. 1st, 2009].*

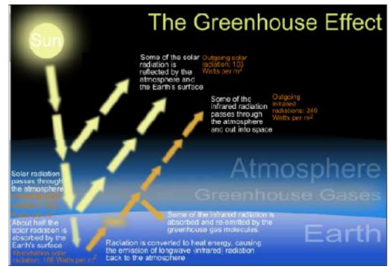


Figure 1.43: The Greenhouse Effect
Source:[http://www.greenscroll.org, Retrieved September, 2011-09-10]

Figure 1.44: Greenhouse Gases
Source:[http://www.greenscroll.org, Retrieved September, 2011-09-10]

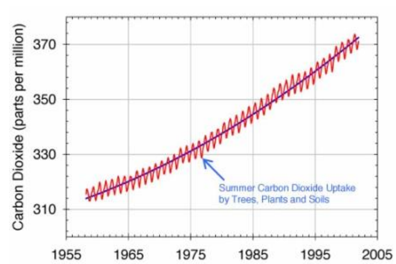


Figure 1.25: Carbon Dioxide Carve
Source: [http://jcmooreonline.com/tag/global-warming, Retrieved September, 2011-09-10]

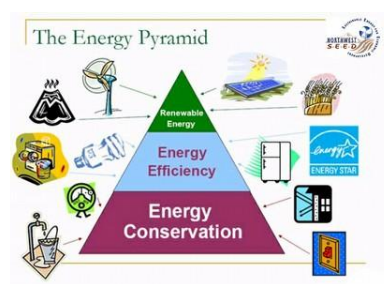


Figure 1.46: The Energy Pyramid
Source:[http://nwcommunityenergy.org/biogeo/efficiency, Retrieved September, 2011-09-10]

1.1.4 Impact effect of Global Warming.

There are many impact effect of global warming like:

1- **Greenland:**

Greenland is losing mass at 3% per decade and melting rates have accelerated. Melting in 2004 was occurring at 10 times the rates observed in 2000. Pools of melt water are visible on the surface each summer and melt water is percolating down through crevasses to lubricate the ice. As rivers of ice‖ speed up, the potential for slippage of large glaciers from Greenland increases (Figure 1.47). *[Source is: http://earth-habitat.blogspot.com/, Retrieved Sep. 12, 2011].*

Figure 1.47: Extent of summer ice melt in Greenland in 1992 (left) and in 2002 (right) *source is: http://earth habitat.blogspot.com/Retrieved March 2011-03-26]*

2- **Montana Regions:**

In highland regions in Africa, Central and South America, and Asia plant communities are migrating upward, glaciers are retreating and mosquitoes are being found at high elevations. Underlying these changes are higher temperatures (an upward shift of the freezing isotherm) and thawing of permafrost (permanently frozen ground) (Figure 1.48). *[Source is: http://earth-habitat.blogspot.com/, Retrieved Sep. 12, 2011].*

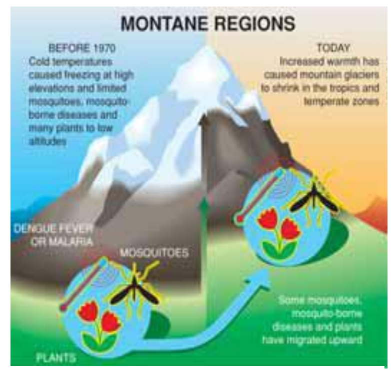


Figure 1.48: Montana Regions
Source:[http://www.greenscroll.org, Retrieved September, 2011-09-10]

3- Current sea level rise:

Current sea level rise has occurred at a mean rate of 1.8 mm per year for the past century, and more recently at rates estimated near 2.8 ± 0.4 to 3.1 ± 0.7 mm per year (1993-2003). Current sea level rise is due significantly to global warming, which will increase sea level over the coming century and longer periods. Ocean temperatures increase more slowly than land temperatures because of the larger effective heat capacity of the oceans and because the ocean loses more heat by evaporation. Sea levels are expected to rise between 7 and 23 inches (18 and 59 centimeters) by the end of the century, and continued melting at the poles could add between 4 and 8 inches (10 to 20 centimeters). (Figure 1.49)

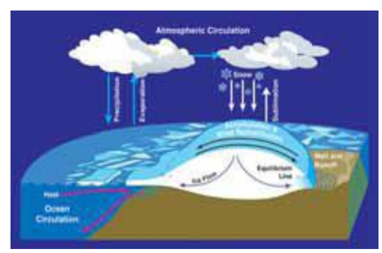


Figure 1.49: Current Sea Level

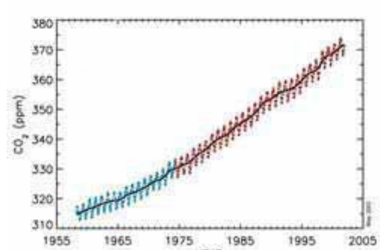


Figure 1.50:The Keeling Curve shows a pattern of steadily increasing carbon dioxide in the atmosphere
Source:[http://www.greenscroll.org, Retrieved September, 2011-09-10]

4- **Glaciers:**

Glaciers grow and shrink; both contributing to natural variability and amplifying externally forced changes. Glaciers are retreating almost everywhere around the world, including in the Alps, Himalayas, Andes, Rockies, Alaska and Africa. *[Source is: http://earth-habitat.blogspot.com/, Retrieved Sep. 12, 2011].*

5- **Co_2 Levels:**

Levels of Carbon Dioxide are higher today than at any time in past 650,000 years. Scientists reconstruct past climate conditions through evidence preserved in tree rings, coral reefs and ice cores. For example, ice cores removed from 2 miles deep in the Antarctic contain atmospheric samples trapped in tiny air bubbles that date as far back as 650,000 years. These samples have allowed scientists to construct a historical record of greenhouse gas concentration stretching back hundreds of thousands of years. (Figure 1.50) *[Source is: http://www.oceanchampions.org/GlobalWarming/, Retrieved Sep. 12, 2011].*

6- **Ozone hole:**

The Antarctic ozone hole is an area of the Antarctic stratosphere in which the recent ozone levels have dropped to as low as 33% of their pre-1975 values. The ozone hole occurs during the Antarctic spring, from September to early December, as strong westerly winds Start to circulate around the continent and create an atmospheric container. (Figure 1.52)

7- **Other Effects of Global Warming:**

- Some butterflies, foxes, and alpine plants have moved farther north or to higher, cooler areas.
- Hurricanes and other storms are likely to become stronger.
- Some diseases will spread such as malaria carried by mosquitoes.
- Precipitation (rain and snowfall) has increased across the globe, on average.
- Less fresh water will be available. If the Quelccaya ice cap in Peru continues to melt at its current rate, it will be gone by 2100, leaving thousands of people who rely on it for drinking Water and electricity without a source of either.
- Floods and droughts will become more common. Rainfall in Ethiopia, where droughts are already common, could decline by 10 percent over the next 50 years. (Figure 1.53)

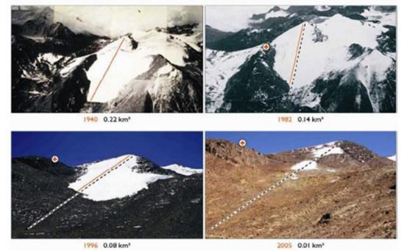


Figure 1.51: Glaciers Grow

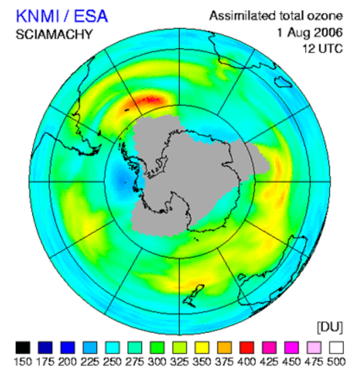


Figure 1.52: O Zone Hole. *[Source is: vihttp://imagesofglobalwarming.org/?p=232 Retrieved March 2011-03-26]*

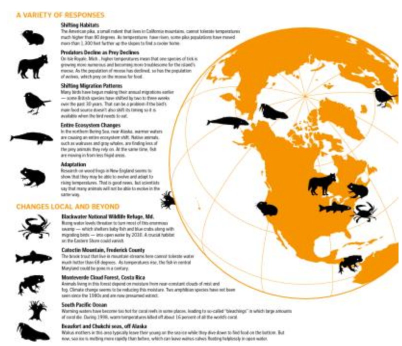


Figure 1.33: Other Effects of Global Warming
Source:[http://www.oceanchampions.org/GlobalWarming/globalwarming.htm Retrieved September, 2011-09-15]

1.1.5 Relationship between Global Warming and Globalization.

Based on the previously mentioned definitions, and as result of globalization, the world has become like one small village. New notion called the global problems has appeared such as the financial crisis, global warming, Climate change and biodiversity affecting the whole world in general and the third world developing countries in particular resulting from the developed countries actions. It becomes necessary to address and face such global problems through the collaboration between all the world countries to reduce these impacts which will effect directly and strongly on the third world countries more than the developed countries because of their technological possibilities or advances enabling them facing such threats. Therefore, we must address and face these problems by providing future solutions minimizing their impacts. (Figure 1.54) *[Source is: https://www.llnl.gov/str/December02/December50th.html, Retrieved Sep. 15, 2011].*

Figure 1.54: Globalization Source: *[https://www.llnl.gov/str/December02/December50th.html, Retrieved September, 2011-09-15]*

There are many effects of Globalization (Figure 1.55):

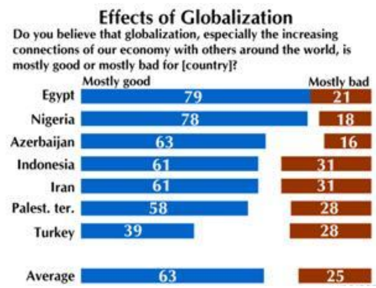


Figure 1.55: Effects of Globalization Source:*[http://globalenglishblog.com/2011/08/30/is-there-a-globalization-penalty/, Retrieved September, 2011-09-15]*

1- Cultural - growth of cross-cultural contacts; advent of new categories of consciousness and identities such as Globalism - which embodies cultural diffusion, the desire to consume and enjoy foreign products and ideas, adopt new technology and practices, and participate in a "world culture".

2- Social - the achievement of free circulation by people of all nations. (Figure 1.56)

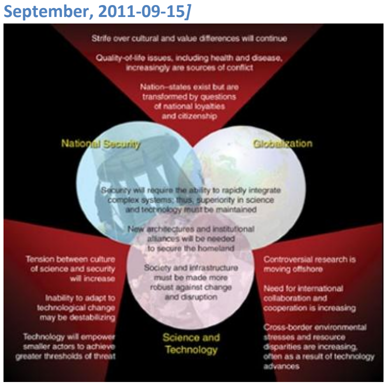


Figure 1.56: Globalization and Social Source:*[https://www.llnl.gov/str/December02/December50th.html, Retrieved September, 2011-09-15]*

3- Informational - increases in information flows between geographically remote locations.

4- Ecological - the advent of global environmental challenges that cannot be solved without international cooperation, such as climate change, cross-boundary water and air pollution, overfishing of the ocean, and the spread of invasive species. Many factories are built in developing countries where they can pollute freely. (Figure 1.57)

Figure 1.57: Measuring Globalization

5- Spreading of multiculturalism, and better individual access to cultural diversity (e.g. through the export of Hollywood and

Bollywood movies). However, the imported culture can easily supplant the local culture, causing reduction in diversity through hybridization or even assimilation. The most prominent form of this is Westernization, but Sinicization of cultures has taken place over most of Asia for many centuries. (Figure 1.58)

6- Greater international travel and tourism.

7- Greater immigration, including illegal immigration.

8- Spread of local consumer products (e.g. food) to other countries (often adapted to their culture).

9- World-wide fads and pop culture such as Pokémon, Sudoku, Numa, Origami, Idol series, YouTube, Orkut, Facebook, and MySpace. (Figure 1.60)

10- World-wide sporting events such as FIFA World Cup and the Olympic Games. (Figure 1.59)

11- Formation or development of a set of universal values.

12- Development of a global telecommunications infrastructure and greater transformer data flow, using such technologies as the Internet, communication satellites, submarine fiber optic cable, and wireless telephones.

13- Increase in the number of standards applied globally; e.g. copyright laws, patents and world trade agreements.

14- The push by many advocates for an international criminal court and international justice movements.

15- Localization: In the world of architecture, the struggle between globalizing and anti-globalizing forces will continue, as it has for centuries. Yet I'm betting that, even a hundred years from now, cities such as Paris, Rome, London and St. Petersburg will still retain their traditional architectural allure and still be worth visiting, regardless of which force prevails. Localization is closely associated with the politics of identity (Figure 1.61). Identity is community and place-related and the individuality of community and place are undermined by global homogenization. Migration, instantaneous communication and increased travel all threaten and dislocate community identity. At the same time, members of communities can intensify their association with one another and their place of origin over long distances with the internet and the other communication media.

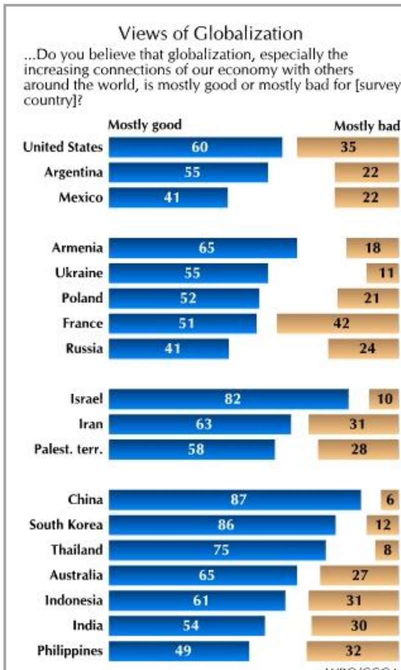


Figure 1.58: View of Globalization

Figure 1.59: FIFA World Cup Source:[http://www.worldpublicopinion.org/pipa/articles/btglobalizationtradera/349.php?nid=&id=&pnt=349&lb=btgl, Retrieved September, 2011-09-15]

Figure 1.60: Facebook

Figure 1.61: Globalization Source:[https://www.llnl.gov/str/December02/December50th.html, Retrieved September, 2011-09-15]

The same phenomena can also promote the local cohesion of ethnic communities or micro states. To be Catalonian is not ethnic, it is to speak Catalan in Catalonia and Catalan-language television is an important agent in the consolidation of an increasingly independent Catalonia. The widely dispersed Sami community, an ethnic micro-nation recognized across Norway, Sweden, Finland and Russia, is brought together by a dedicated Sami website. (Figure 1.62) *[Source is: Architecture and the Global City. Lewis,R.www.journalinks.nl/Mijn%20webs/Architecture%20and%20the%20Global%20City.do c, (2002), Retrieved June 1st, 2008].*

16- Complexity of Globalization: Globalization itself is, however, more complex than the simple expansion of Western capital and concomitant spread of products, culture and style. The creation of the rights of the individual over their resident community or state has changed the role of the relationship between the state and the individual (Figure 1.63). At the same time, the free movement of global corporations and capital has restricted the ability of the state to maintain an autonomous economy. Aggressive nationalism, which in the nineteenth century often led to the Suppression and incorporation of diverse groups to form nation-states, is no longer a functional necessity for defense or economic containment. 'The nation-state has become too small to solve global problems and too large to deal with local ones.' As the power of the nation-state declines, regional, local and ethnic identities re-emerge. In 1990 there were 800 micro-national movements in a world of fewer than 200 states. This is localization, the other face of globalization. It might be expected that in the technologically advanced and prosperous parts of the world, now that have got the technological advantages, shouldn't piously recommend that other parts of the world do without them, in order to preserve their indigenous cultures and limited world resources. Not just geographically speaking but also chronologically, as the contemporary times has to have a different way of solving matters than any other time since each era/age has its own technology that helps to solve its problems (Figure 1.64,65).*Sourceis:[www.journalinks.nl/Mijn%20webs/Architecture%20and%20the%20Global%20City.do c, (2002), Retrieved June 1st, 2008].*

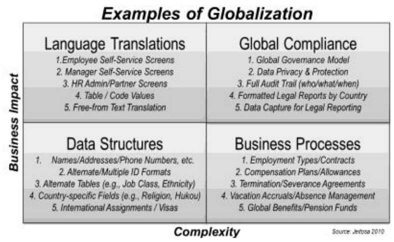


Figure 1.62: Examples of Globalization

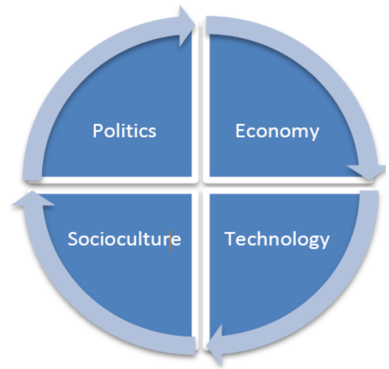


Figure 1.63: Globalization is a combination between Politics, Economy, Socioculture and Technological forces.

Figure 1.64: A hundred years ago only 10% of the planet lived in cities; by 2050 up to 75% of the world's population of 8 billion will be living in urban areas.

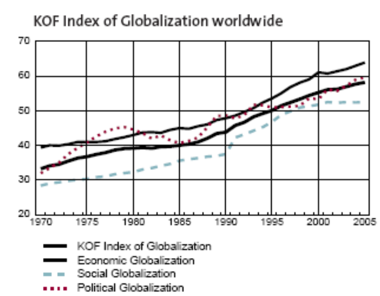


Figure 1.45: Chart 1 shows how globalization has developed over time measured by the average of the individual country.

Chapter Two:

2.1 Pollution.

People in every industrialized country have daily contact with pollution problems: Climate gas emissions are already almost certainly the cause of most extreme weather events. Between 80 and 90% of all cases of cancer are influenced by environmental factors and the prevalence of allergies is rapidly increasing. At the same time, the rate of extinction of animal and plant species is accelerating – between 1900 and 1950 one species each year disappeared, while in 1990 alone, between one and three species disappeared every hour. Species have always died out and new ones have appeared, but the rate of extinction today is 100 to 1000 times greater than the natural rate (Lawton and May, 1995) (Figure 1.66).The building industry is directly or indirectly responsible for a great deal of humankind‘s environmental pollution. This can be referred to in terms of energy pollution and material pollution. (Figure 1.67) *[Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009)]*

2.1.1 Energy Pollution.

Energy pollution relates closely to the amount and source of energy used in the production of materials. Transport both of raw materials and finished products are also a decisive factor. (Figure 1.68)

Sources of energy vary a great deal from country to country. In Scandinavia, hydropower is quite common, whereas in Great Britain and Europe the main sources are still fossil fuels and nuclear power. Renewable are increasing only very slowly. The use of nuclear power implies risks of radioactive emissions, especially in the management of waste. Fossil fuels cause the greatest emissions of climate gases including carbon dioxide (CO2), acids such as sulphur dioxide (SO2) and substances forming photochemical oxidation, such as nitrogen oxides (NOX) (Table 2.1). Combustion of waste can also cause serious pollution depending on its composition. Bio energy in its various forms is not unproblematic either. Apart from competition with food supplies, it is normally to be regarded as climate neutral, assuming replantation. The renewable sources such as wind, wave and solar are generally unproblematic but none of them are without some environmental consequences. *[Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009)]*

Figure 1.66: Pollutions *Source: [http://www.stormfax.com/airwatch.htm, Retrieved September, 2011-09-17]*

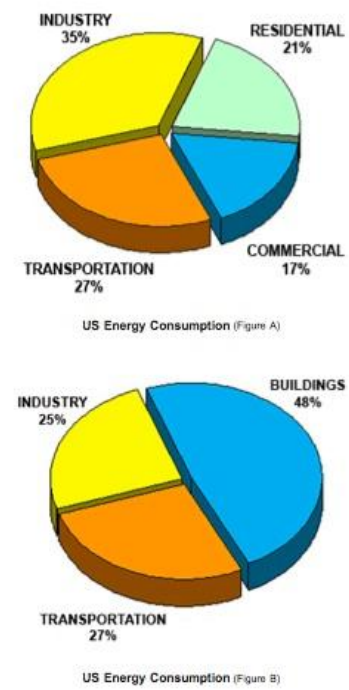


Figure 1.67: US Energy Consumption *Source:[http://www.stormfax.com/airwatch.htm, Retrieved September, 2011-09-17]*

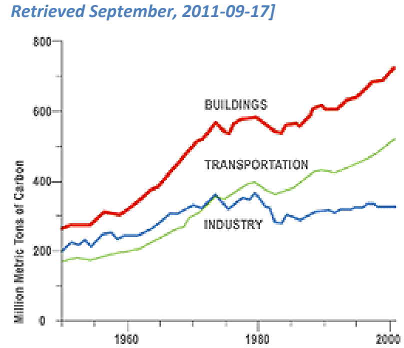


Figure 1.68: Pollution from Building, Transportation and Industry Sections. *Source:[http://www.stormfax.com/airwatch.htm, Retrieved September, 2011-09-17]*

Sources	CO_2 [g/MJ]	SO_2 [g/MJ]	NO_x [g/MJ]
Oil	75	0,18	0,1
Natural gas	55	0	0,04
Coal	91	0,20	0,15
Coke	103	0,36	0,15
Mixed domestic waste	25	0,05	0,09

Table 2.1: Energy-related pollution in production processes based on direct use of fossil fuels and mixed domestic waste ***(Source: Naturva_rdsverket, Stockholm 2007)***

The Table do not include emissions from extraction and transportation of the fuels, where about 15% should be added. Electricity is usually produced from a combination of sources also including nuclear power, biomass, hydropower etc and the rate of utilization is a lot lower than by direct combustion. The climate impact for electricity produced in the OECD countries is estimated to be 110 g CO2 per MJ (IEA/OECD, 2007). (Source: Naturva_rdsverket, Stockholm 2007)

Type of transport	*CO_2 (g/ton km)*	*SO_2 (g/ton km)*	*NO_x(g/ton km)*
By air	1650	0.9	7.7
By road			
- Light truck (14 tonnes), diesel	175	0.04	1.8
- Heavy truck (40 tonnes), diesel	50	0.03	0.55
By rail, *diesel*	18	0.005	0.36
By sea			
- Small ship (less than 3000 tonnes), diesel	25	0.4	0.7
- Large ship (larger than 8000 tonnes), diesel	15	0.26	0.43

Table 2.2: Pollution from transport (Source: NTM Network for Transport and Environment, Sweden 2008).

Amount (g/ton)	*Elements*
Greater than 100 000	O, Si
100 000–10 000	Al, Fe, Ca, Na, K, Mg
10 000–1000	H, Ti, P
1000–100	Mn, F, Ba, Sr, S, C, Zr, V, Cl, Cr
100–10	Rb, Ni, Zn, Ce, Cu, Y, La, Nd, Co, Sc, Li, N, Nb, Ga, Pb
10–1	B, Pr, Th, Sm, Gd, Yb, Cs, Dy, Hf, Be, Er, Br, Sn, Ta, As, U,Ge, Mo, W,Eu, Ho
1–0.1	Tb, I, Tm, Lu, Tl, Cd, Sb, Bi, In
0.1–0.01	Hg, Ag, Se, Ru, Pd, Te, Pt
0.01–0.001	Rh, Os, Au, Re, Ir

Table 2.3: Natural occurrence of the elements in the accessible part of the Earth's crust ***Source: (H€agg, 1984. See also the Periodic).***

ELECTRICITY AND CLIMATE, Electricity comprises a varying fraction in the energy system of deferent countries. Clean and convenient at the point of use, it never the less usually has huge impacts farther upstream. The source of building materials (Figure 1.69) used may thus be of great importance. Aluminum produced with clean hydropower in Norway has a very small impact compared to aluminum produced with coal-based electricity in England. However, with electricity markets becoming in creasingly global, our focus should be on the global energy mix for the production of electricity. This is difficult to ascertain but can be roughly estimated as being produced from the following sources: 66%fossilfuels, 16%atomic power and 18% renewable (Figure 1.70). More detailed information is available for the OECD countries and is used as a basis for the tables of this book. But it is important to remember that the same materials imported from quickly developing countries such as China may have far higher climate impacts related to electricity production (Figure 1.71). *[Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009)]*

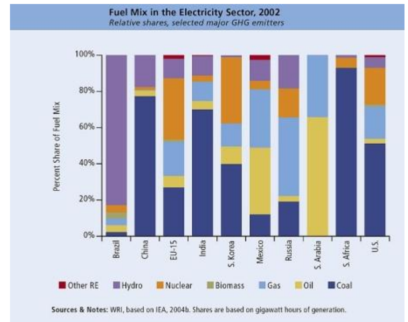


Figure 1.69: Electricity and Climate. *Source:[http://worldnuclear.org/education/ueg.htm, Retrieved September, 2011-09-17]*

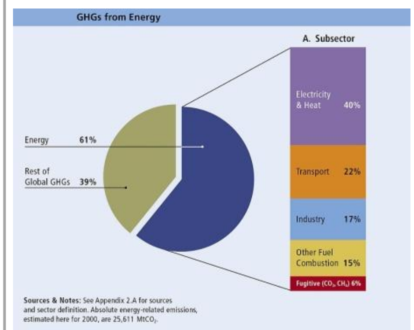


Figure 1.70: GHGs from Energy. *Source:[http://worldnuclear.org/education/ueg.htm, Retrieved September, 2011-09-17]*

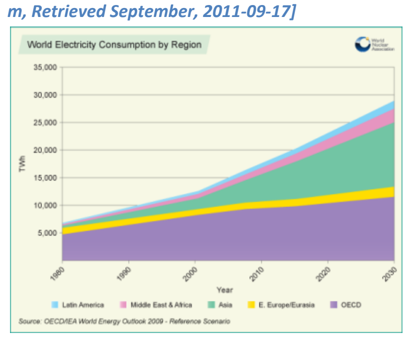


Figure 1.71: World Electricity Consumption by Region. *Source:[http://www.stormfax.com/airwatch.htm, Retrieved September, 2011-09-17]*

2.1.2 Material Pollution.

Material pollution relates to pollutants in the air, earth and water stemming from the material itself and from its constituents when being processed, used and during decay. The picture is extremely complex, considering that about 80 000 chemicals are in use in the building industry, and that the number of health-damaging chemicals has quadrupled since 1971. Long-term and not easily reversible damage to groundwater systems and local biotopes also occurs during extraction and mining. Some mines dating back to antiquity still cause serious health and pollution consequences today (Grattan et al., 2003) (Figure 1.72). *[Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009)]*

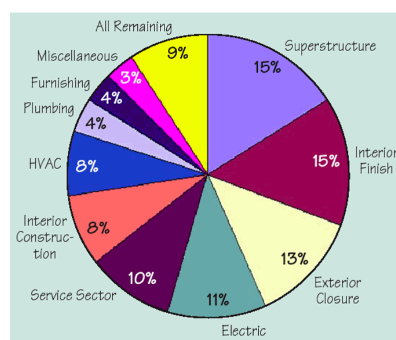


Figure 1.72: Materials Pollution *Source:[http://www.stormfax.com/airwatch.htm, Retrieved September, 2011-09-17]*

Material pollution from construction consists of emissions, dust and radiation from materials that are exposed to chemical or physical activity such as warmth, pressure or damage. Within the completed building these activities are relatively small, yet there is evidence of a number of materials emitting gases or dust which can lead to health problems for the inhabitants or users; primarily allergies, skin and mucous membrane irritations. The electrostatic properties of different materials also play a role in the internal climate of a building. Surfaces that are heavily negatively charged can create an electrostatic charge and attract dust. Electrical conductors such as metals can increase existing magnetic fields. Building materials can also contain radioactive constituents such as radon gas that can be emitted to the indoor air. (Figure 1.73)

Waste is part of the pollution picture though, as waste materials move beyond the scope of everyday activity, it tends to be overlooked. The percentage by weight of environmentally hazardous materials in demolition waste is relatively small, but is still a large quantity and has a considerable negative effect on the environment. Whilst some materials can be burned in an ordinary incinerator, others need incinerators with highly efficient flue gas purifiers. Few incinerators can do this efficiently – many still emit damaging compounds such as SO2, hydrogen chloride (HCl), heavy metals and dioxins. Depending on the environmental risk, disposal sites must ensure that there is no seepage of the waste into the water system. The most dangerous materials are those containing heavy metals and other poisons, and also plastics that are slow to decompose and cause problems because of their sheer volume (Figure 1.74).

There is an evident correlation between the natural occurrence of a material and its potential to damage the environment (Table 2.3). If the amount of a substance in an environment (in air, earth, water or organisms) is increased, this increases the risk of negative effects (Figure 1.76).

Global climate change (Figure 1.75) is probably the greatest threat we face today (IPCC, 2007). A wide range of greenhouse gases must be considered (Table 2.4). Carbon dioxide comprises over half of all greenhouse gas emissions. The three principal anthropogenic sources of these climate gases are energy production, chemical industry and waste cycles. Of these, the energy related sources dominate. They stem mainly from fossil fuel combustion in power plants and the transport sector (Table 2.2). *[Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009)]*

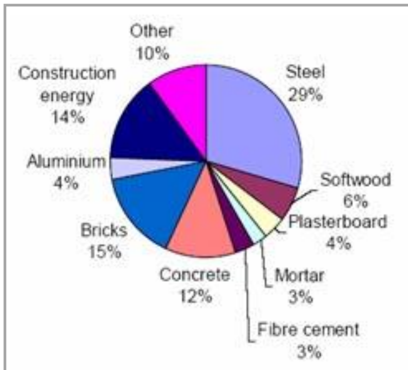


Figure 1.73: Materials Pollution from building sector ***Source: [http://www.stormfax.com/airwatch.htm, Retrieved September, 2011-09-17]***

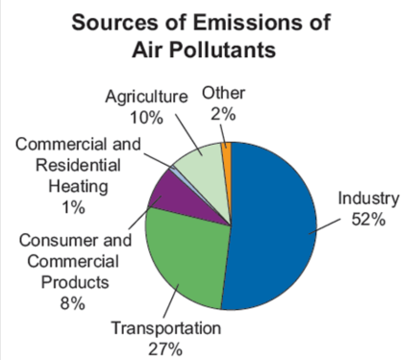


Figure 1.74: Sources of Emissions of Air Pollutants

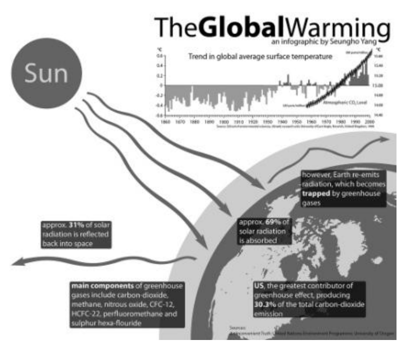


Figure 1.75: Global Climate Change ***Source: [http://world-nuclear.org/education/ueg.htm, Retrieved***

Figure 1.76: Pollutions Source. ***Source: [http://world-nuclear.org/education/ueg.htm, Retrieved September, 2011-09-17]***

2.1.3 Climate emissions from Building sectors.

The construction sector is responsible for a large part of the total global emissions of climate gases (Figure 1.77). This has been estimated to about 30–40% (United Nations Environment Program, http://www.unep.org) (Figure 1.78) and relates to operational emissions (heating, lighting, etc) on the one hand, and on the other hand emissions related to production, maintenance and demolition. Impacts related to the production of materials correspond closely to the embodied energy in the materials though chemical emissions from the products can also play a role.

An important example is calcinations of lime during cement production, where large amounts of CO2 are released. Other significant contributions come from volatile organic compounds (VOCs) in the paints industry and are per fluorocarbons (PFCs) from aluminum production. Hydro fluorocarbons (HFCs), often used as foaming agents in insulation materials, are also potent greenhouse gases. These will continue to be emitted throughout the product‘s lifetime. In a 50-year lifecycle for conventional buildings, about 10 to 20% of the total greenhouse emissions will be associated with the materials used. However, in the case of low energy buildings, where the heating related load is less and the materials use is higher, this proportion can exceed 50% (Gielen, 1997). It has been estimated that the production and transport of building materials accounts for 7 to 9% of all climate emissions (Figure 1.79) in Western Europe; the main contributors being steel, cements and plastics (Kram, 2001). It should be noted that the point in time when these climate emissions are addressed is of great importance. If we wait for 20 years before reducing emissions then the reductions needed will have to be 3 to 7 times more in order to achieve the same effect (Kallbekken and Rive, 2005). This means that material choices are even more important, since their climate emissions mainly occur during the production phase; in other words in the present and immediate future – as compared to reduced heating-related emissions in, say, 40 years‘ time (Figure 1.79). *[Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009)]*

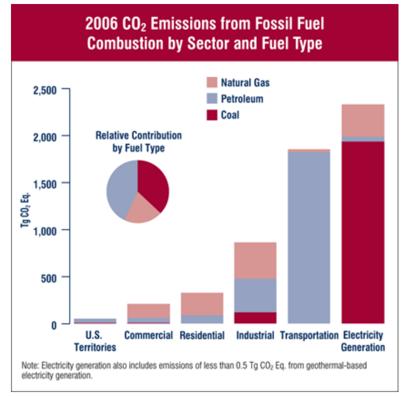


Figure 1.77: CO2 Emissions by sectors. *Source:[http://www.epa.gov/climatechange/emissions/co2_human.html, Retrieved September, 2011-09-18]*

Figure 1.78: United Nations Environment Programmed *Source:[http://www.unep.org, Retrieved September, 2011-09-18]*

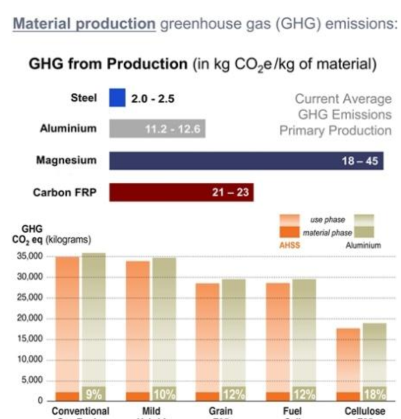


Figure 1.79: Climate emissions from Production. *Source:[http://planetgreen.discovery.com/work-connect/combat-climate-change-auction.html, Retrieved September, 2011-09-18]*

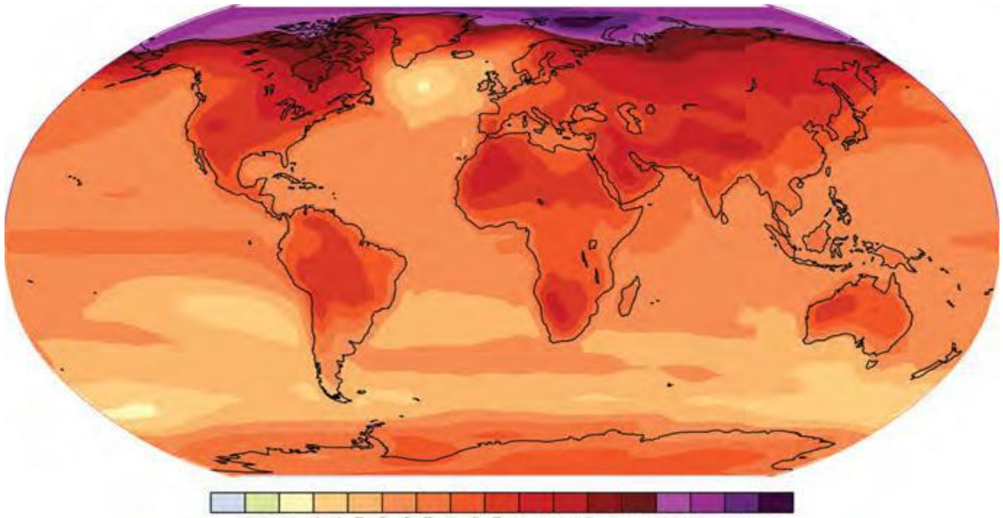


Figure 1.80: Projected surface temperature changes for the late 21st century (2090–2099). Temperatures are relative to the period 1980–1999 (IPCC, 2007).

Substance	*CAS No*	*GWP [kg CO_2-ekv./kg]*	*Possible occurrence*
Carbon dioxide	124-38-9	1	Processes based on fossil fuels, cement and lime production, waste treatment (incineration)
Chloromethane	74-87-3	16	Plastics, synthetic rubbers, insulation foams
Dichloromethane	75-09-2	15	Paints, insulation foams
Hydrochlorofluorocarbons			Insulation foams
- *HCFC 22*	75-45-6	1700	
- *HCFC 141b*	1717-00-6	630	
- *HCFC 142b*	75-68-3	2000	
Hydrofluorocarbons			Insulation foams
- *HFC 134a*	811-97-2	1300	
- *HFC 152a*	75-37-6	140	
- *HFC 245*	460-58-6	950	
- *HFC 365*	406-58-6	890	
Methane	74-82-8	21	Animal materials (ruminants), steel and cement production (coal mining), waste treatment (landfills, incineration)
Nitrous oxide	10024-97-2	310	Plant materials (artificial fertilizers), waste treatment (incineration)
Pentane	109-66-0	11	Insulation foams
Sulphur hexafluoride	2551-62-4	23900	Double glazing
Perfluorcarbons PFCs			Aluminium production
- *Perfluoromethane*	75-73-0	6500	
- *Perfluoroethane*	76-16-4	9200	

Table 2.4: Important greenhouse gases related to the production, use and waste management of building materials.

The Global Warming Potential (GWP) of a gas is its relative potential contribution to climate change over a 100 year period where carbon dioxide CO2 = 1. Emissions of organic solvents used e.g. in paints, adhesives and plastics, will have a GWP of approximately 3 by reacting to CO2 in the atmosphere. These gases are however not considered as ordinary greenhouse gases and are therefore not mentioned in the table. Greenhouse gases presented in this table are given a grey color when they appear in the main text.

2.1.4 Carbon Processes in Building Materials.

During growth, plants absorb and bind large quantities of CO_2 from the air, as well as transferring a quantity to the surrounding soil. Each kilogram of dry plant matter contains about 0.5 kilograms of carbon. This corresponds to sequestration of 1.8 kilograms of CO_2 from the atmosphere. This carbon will remain intact until the material is combusted or decays (Figure 1.81).

Buildings in timber and other vegetal products, therefore, store carbon for as long as they stand. Assuming that the timber extracted is also being replanted, the overall stock of plant products in the system will be increasing. Carbon storage in building products can thus contribute to reducing the atmospheric CO_2-concentration over a long period and is therefore considered to be a significant contributor to reducing global warming. It "buys time", since this carbon will not be released back into the atmosphere before the buildings decay in 50 or 100 years' time (Figure 1.82).

The Kyoto protocol considers reduction options of CO_2 in a 100 year perspective. The lifetime of plant materials storing carbon will thus be critical; if buildings last for only 50 years, their climate effect will be estimated at 50% of that. However, timber constructions can easily have a far longer lifetime – and this can be further increased through more re-use in up to several cycles for some components.

There are other materials that can store carbon. Alkaline earth compounds such as magnesium oxide (MgO) and calcium oxide (CaO) are present in naturally occurring silicate rocks such as serpentine and olivine. When these react with CO_2 they form stable carbonates that can be used both as building blocks and as aggregates in concrete. In theory, there are sufficient of these minerals in the earth's crust to bind all anthropogenic emissions of carbon (Metz, 2006). However, the effects of mining, associated energy use and costs render this an unlikely scenario for the near future (Figure 1.83).

It should be noted that, whereas the production of cement and other calcium-bas ed building products causes emissions of very large quantities of CO_2 during the calcination of limestone (constituting approximately half of the emissions from the production, the rest resulting from energy use), part of this is later reabsorbed into the materials by carbonation. This

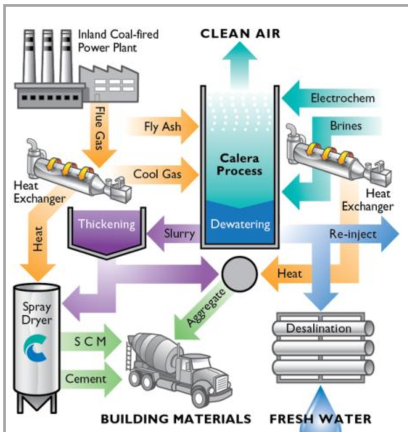


Figure 1.81: Carbon Processes in buildingmaterials. *Source:[http://www.recoveryinsulation.co.uk/energy.html, Retrieved September, 2011-09-18]*

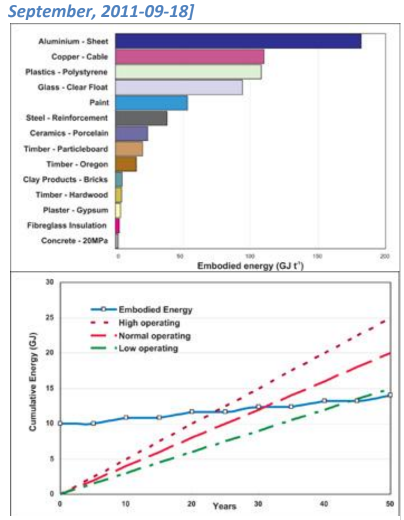


Figure 1.82: Cumulative Energy. *Source:[http://www.recoveryinsulation.co.uk/energy.html, Retrieved September, 2011-09-18]*

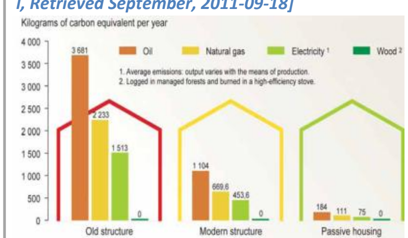


Figure 1.83: CO_2 emissions depending on the energy used for heating and hot water for a 100 square meter dwelling.

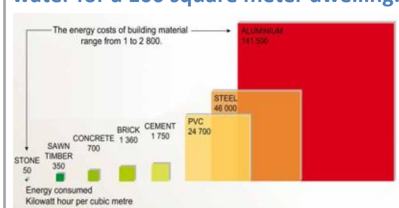


Figure 1.84: ***Energy cost of various construction materials***

requires the presence of air and water and takes place over many decades. In the course of a building's lifetime of say 50 years, of the order of 25 to 50% of the carbon originally emitted during calcination may be recaptured. This is significant, but does not greatly reduce the large emission impact of using these materials (Figure 1.84). *[Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009)].*

2.2 Zero Carbon or Less Problems Inflicted by Built Environment.

2.2.1 Modern Architecture.

How do forces and manifestations of modernism affect architecture and in particular the architecture of "global cities" (Figure 1.85) Is there even such a thing as "global‖ architecture". Is Modernism of architecture a new phenomenon, or has architecture always exhibited inherently globalizing tendencies? And in this era of modernism tendencies related primarily to economic, social and cultural phenomena, to what extent can and does architecture per se affect people`s sense and perception of global as opposed to local citizenship? Recall obvious modernism phenomena, conditions and contrasting trends (Figure 1.86).

Like following affects:

- Faster, data-intensive communication between distant, contrasting cultures.
- Increased sharing of cultural "products"
- Increased multinational business and industrial activity.
- Increased internationalization and standardization of technology.
- Increased international mobility for both business and tourism.
- Economic growth and, for some, rising personal incomes.
- Increasing desire for goods and services accompanied by unmet expectations.

All of these directly or indirectly affect architecture.

Figure 1.85: Designed by Sir Norman Foster HSBC World Headquarters and One Canada Square, from the western end of West India Quay.

Figure 1.86: ***The skyline of Dubai of United Arab Emirates shows how many skyscrapers are scattered along the city as a result of the welfare and revolutionary economic states in the region.***

Figure 1.87: The Beijing National Stadium, or the Bird Nest, designed by the Austrians Herzog and DeMeuron. Completed in 2008, to host the Beijing Olympic Games 2008; an international event that China has lingered for more than 7 years to host it. In a marvelous appearance and organization incorporating the latest technologies; the Olympic Games promotes the capital city of China as one of the most contemporary and globalized cities in the world.

Whether the effect is positive or negative depends on what you believe architecture should be (Figure 1.87). *[Source is: www.journalinks.nl/Mijn%20webs/Architecture%20and%20the%20Global %20City.do c, (2002), Retrieved June 1st, 2008.]*

The architectural manifestations of globalization are ubiquitous: skyscraping company headquarters and bank buildings, chains of standardized hotels, franchise restaurants, shopping malls, name-brand stores and boutiques, theme parks, fitness centres, and multi-screen cinemas. You would expect to find such structures and services in any city that calls itself “global” When abroad, how often have you felt especially comfortable in a hotel room similar to others you have stayed in, felt relieved perusing a menu with foods you recognize, or enjoyed shopping in a store whose merchandise and interior design are like the store at home? Increasingly familiar global architecture reflects the market needs and functional agendas of international business and industry (Figure 1.88), the corporate worlds of finance, manufacturing, retailing, travel and hospitality, recreation, and entertainment.*[Source is:.journalinks.nl/Mijn%20webs/Architecture%20and%20the%20Global%20City.do c, (2002), Retrieved June 1st, 2008.]*

The global culture (Figure 1.89) of commerce is driven by changing consumer expectations, market opportunities and business agendas. Their architectural manifestations include iconic, skyscraping banking towers (often built where they don't belong); chains of standardized hotels and franchise restaurants and shopping malls full of all-too-familiar name-brand stores. *[Source is: Will forces of globalization overwhelm traditional local architecture? Lewis, R. R. Washington Post, (2002, November 2nd).]*

Yet wouldn't you expect to find these in a city that called itself "global" Aren't you likely to feel more comfortable in a hotel room like others you have stayed in, perusing a menu with foods you recognize, or shopping in a store with merchandise like the store at home? The experience of strolling through malls at Canary Wharf in London's Docklands, at Potsdamer Platz in Berlin and at Manege Square in Moscow is fundamentally the same (Figure 1.90). *[Source is: Will forces of globalization overwhelm traditional local architecture. Lewis, R. R. Washington Post, (2002, November 2nd).]*

2.2.2 Modernism.

Modernism is international integration. It can be

Figure 1.88: The Roman use of the arch and their improvements in the use of concrete facilitated the building of the many aqueducts throughout the empire, such as the magnificent Aqueduct of Segovia and the eleven aqueducts in Rome itself.

Figure 1.89: the Wainwright Building in St. Louis, designed by Louis Sullivan

Figure 1.90: Europe's Gate, Madrid; the first intentionally inclined buildings in the world designed by Philip Johnson and John Burgee and commission in 1996.*Source:[http://www.recoveryinsulation.co.uk/energy.html, Retrieved September, 2011-*

described as a process by which the people of the world are unified into a single society. This process is a combination of economic, technological, sociocultural and political forces. It is also very often used to refer to economic globalization that is integration of national economies into the international economy through trade, foreign direct investment, capital flows, migration, and the spread of technology. (Figure 1.91) *[Source is: **In Defense of Globalization.** Bhagwati, Jagdish. Oxford, New York: OxfordUniversity Press. (2004).]*

Figure 1.91: A hundred years ago only 10% of the planet lived in cities; by 2050 up to 75% the planet lived in cities; by 2050 up to 75% of the world's population of 8 billion will be living in urban areas., Tokyo © Francesco Jodice.

In contemporary architectural discourse, theory has become more concerned with its position within culture generally. The notion that theory also entailed critique stemmed from post-structural literary studies. This, however, pushed architecture towards the notion of avant-gardism for its own sake - in many ways repeating the 19th century 'art for art's sake' outlook. Since the year 2000, this has materialized in architecture through concerns with the rapid rise of urbanism and globalization, but also a pragmatic understanding that the city can no longer be a homogenous totality. Interests in fragmentation and architecture as transient objects further such thinking (e.g. the concern for employing high technology). And yet this can also be tied into general concerns such as ecology, mass media, and economism. (Figure 1.92) *[Source is: http://en.wikipedia.org/wiki/Architectural_theory#Contemporary, Retrieved June 1st, 2008.]*

Figure 1.92: View of Manhattan Island in New Work, the proclaimed center of the world where culture diversity meets the fastest *growing business hub in the world in the past decades. In contrast, the rise of other Asian cities has almost eliminated the term "center of the world".*

Modernism ; is a new world architecture (Figure 1.93). We do not know its outcome or have a full picture of its nature as we are only in its earliest stages. Some commentators consider it to be 'highmodernity' and the realization of the ideals of the Enlightenment, while others believe it to be a new phenomenon of equal but different significance to the Enlightenment. At this stage, however, it is clearly a Western world order, dominated by north-Atlantic culture, and the most evident outcome has been the spread of north-Atlantic products and corporations. The effect is described by Helena Norberg-Hodge the co-founder of the IFG and ISEC: 'Western consumer conformity isdescending on the less industrialized parts of the world like an avalanche. "Development" brings tourism, Western films and products and, more recently, satellite television to the remotest corners of the Earth. All provide

Figure 1.93: The London Millennium Footbridge by Norman Foster (2000), is a pedestrian-only steel suspension bridge crossing the River Thames in London, *England, linking Bank side with the City*

overwhelming images o luxury and power. Adverts and action films give the impression that everyone in the West is rich, beautiful and brave, and leads a life filled with excitement and glamour. Advertisers make it clear that Westernized fashion accessories equal sophistication and "cool". *[Source is: http://www.encyclopedia.com/doc/1G1-176090683.html, Retrieved September 21, 2008.]*

In diverse "developing" nations around the world, people are induced to meet their needs not through their community or local economy, but by trying to "buy in" to the global market.' Put more succinctly by the professor of Business Administration Theodore Levitt, 'everywhere everything gets more and more like everything else as the world's preference structure is relentlessly homogenized'. *[Source is: http://www.encyclopedia.com/doc/1G1-176090683.html, Retrieved September 21, 2008.]*

Because technology purports to be, "scientific" it may be regarded as autonomous, not requiring reference to or validation by local cultures. The Millennium Bridge (Figure 1.93), like Foster's proposed viaduct, may be elegant, but couldn't these high-tech structures be placed anywhere on the globe? *[Source is: http://www.greatbuildings.com/discussion.html., Retrieved September 21, 2008.]*

2.2.3 Urban Heat.

An urban heat island (UHI) is a metropolitan area which is significantly warmer than its surrounding rural areas. The phenomenon was first investigated and described by Luke Howard in the 1810s, although he was not the one to name the phenomenon.. The temperature difference usually is larger at night than during the day, and is most apparent when winds are weak. Seasonally, UHI is seen during both summer and winter. The main cause of the urban heat island is modification of the land surface by urban development which uses materials which effectively retain heat. Waste heat generated by energy usage is a secondary contributor. As population centers grow they tend to modify a greater and greater area of land and have a corresponding increase in average temperature. The lesser-used term heat island refers to any area, populated or not, which is consistently hotter than the surrounding area (Figure 1.95).

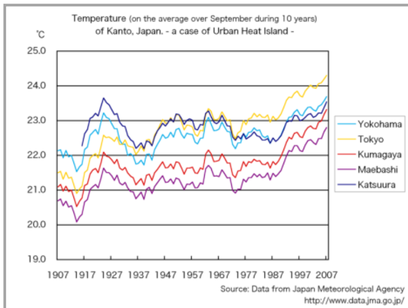


Figure 1.94: Tokyo, an example of an urban heat island. Normal temperatures of Tokyo go up more than those of the surrounding area. *Source:[http://www.recoveryinsulation.co.uk/energy.html, Retrieved September, 2011-09-18]*

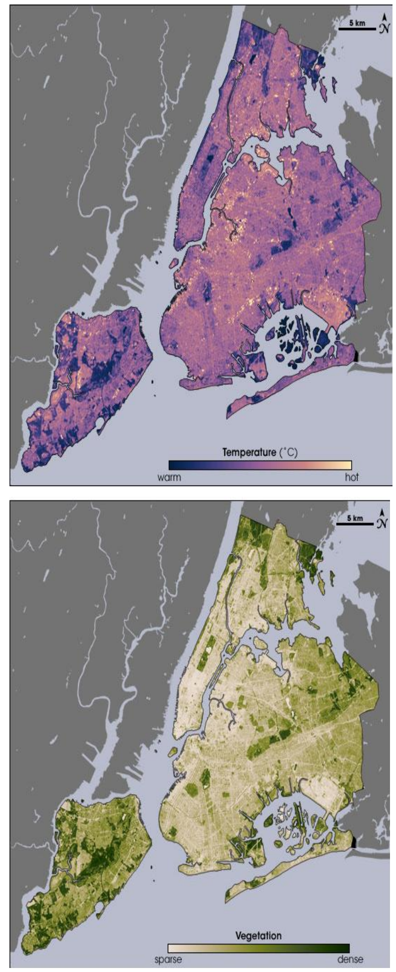


Figure 1.95: Thermal (top) and vegetation (bottom) locations around New York City via infrared satellite imagery. A comparison of the images shows that where vegetation is dense, temperatures are cooler. *Source:[http://en.wikipedia.org/wiki/Urban_heat_island, Retrieved September, 2011-09-18]*

[Source is: Glossary of Meteorology (2009). "Urban Heat Island". American Meteorological Society. Retrieved 2009-06-19]

Monthly rainfall is greater downwind of cities, partially due to the UHI. Increases in heat within urban centers increases the length of growing seasons, and decreases the occurrence of weak tornadoes. The UHI decreases air quality by increasing the production of pollutants such as ozone, and decreases water quality as warmer waters flow into area streams, which stresses their ecosystems.

Not all cities have a distinct urban heat island. Mitigation of the urban heat island effect can be accomplished through the use of green roofs and the use of lighter-colored surfaces in urban areas, which reflect more sunlight and absorb less heat. Despite concerns raised about its possible contribution to global warming, comparisons between urban and rural areas show that the urban heat island effects have little influence on global mean temperature trends. Recent qualitative speculations indicate that urban thermal plumes may contribute to variation in wind patterns that may influence the melting of arctic ice packs and thereby the cycle of ocean current. *[Source is: http://www.answers.com/topic/urban-heat-island, Retrieved September 21, 2008.]*

There are several causes of an urban heat island (UHI). The principal reason for the nighttime warming is that buildings block surface heat from radiating into the relatively cold night sky. Two other reasons are changes in the thermal properties of surface materials and lack of evapotranspiration (for example through lack of vegetation) in urban areas (Figure 1.96). Materials commonly used in urban areas for pavement and roofs, such as concrete and asphalt, have significantly different thermal bulk properties (including heat capacity and thermal conductivity) and surface radiative properties (albedo and emissivity) than the surrounding rural areas. This causes a change in the energy balance of the urban area, often leading to higher temperatures than surrounding rural areas (Figure 1.97).

Other causes of a UHI are due to geometric effects. The tall buildings within many urban areas provide multiple surfaces for the reflection and absorption of sunlight, increasing the efficiency with which urban areas are heated. This is called the "urban canyon effect". Another effect of buildings is the blocking of wind, which also inhibits cooling by convection. Waste heat from automobiles, air conditioning, industry, and other sources also contributes to the UHI. High levels of

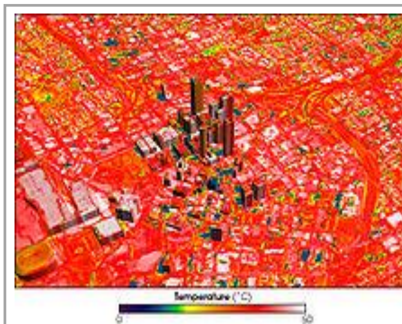


Figure 1.96: Image of Atlanta, Georgia, showing temperature distribution, with blue showing cool temperatures, red warm and hot areas appear white. *Source:[http://en.wikipedia.org/wiki/Urban_heat_island, Retrieved September, 2011-09-18]*

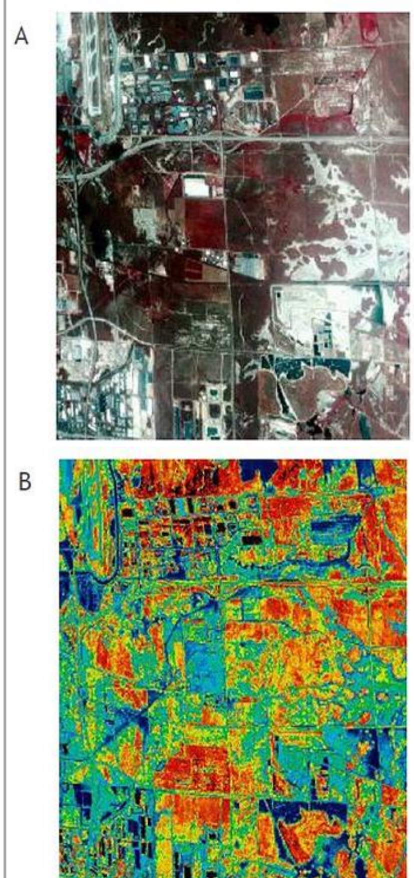


Figure 1.97: Images of Salt Lake City, Utah, show positive correlation between white reflective roofs and cooler temperatures. Image A depicts an aerial view of Salt Lake City, Utah, site of 865,000-square-foot (80,400 m2) white reflective roof. Image B is a thermal. *Source:[http://en.wikipedia.org/wiki/Urban_heat_island, Retrieved September, 2011-09-18]*

pollution in urban areas can also increase the UHI, as many forms of pollution change the radiative properties of the atmosphere (Figure 1.97). *[Source is: http://www.answers.com/topic/urban-heat-island, Retrieved September 21, 2008.]*

Some cities exhibit a heat island effect, largest at night. Seasonally, UHI shows up both in summer and winter. The typical temperature difference is several degrees between the center of the city and surrounding fields. The difference in temperature between an inner city and its surrounding suburbs is frequently mentioned in weather reports, as in "68 °F (20 °C) downtown, 64 °F (18 °C) in the suburbs". Black surfaces absorb significantly more electromagnetic radiation, and causes the surfaces of asphalt roads and highways to heat (Figure 1.98).

Another consequence of urban heat islands is the increased energy required for air conditioning and refrigeration in cities that are in comparatively hot climates. The Heat Island Group estimates that the heat island effect costs Los Angeles about US$100 million per year in energy. Conversely, those that are in cold climates such as Moscow, Russia would have less demand for heating. However, through the implementation of heat island reduction strategies, significant annual net energy savings have been calculated for northern locations such as Chicago, Salt Lake City, Huge parking, Industrial area in Vancouver, Dubai and Toronto.

Global Warming, the principal reason for the nighttime warming is that building block surace heat from radiating into the relatively cold night sky. Two other reasons are chanes in the thermal properties of surface materials and lack of evapotranspiration (for example through lack of vegetation) in urban areas. Materials commonly used in urban areas for pavement and roofs (Figure 1.98), such as concrete and asphalt, have significantly different thermal bulk properties (including heat capacity and thermal conductivity) and surfaceradiative properties (albedo and emissivity) than the surrounding rural areas. This causes a change in the energy balance of the urban area, often leading to higher temperatures than surrounding rural areas (Figure 1.99). *[Source is: http://www.answers.com/topic/urban-heat-island, Retrieved Sep.21,2008]*

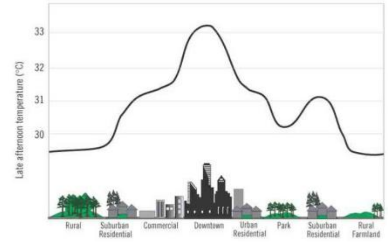
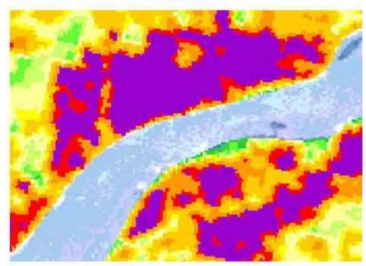
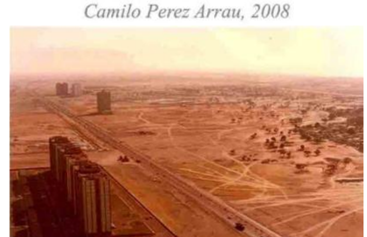


Figure 1.98: A depiction of the varying degree of the urban heat island effect as a function of land use. Gill et al. 2007found that an additional 10%green space can mitigate UHI by up to 4 °C (7 °F). *Source:[http://en.wikipedia.org/wiki/Urban_heat_island, Retrieved September, 2011-09-18]*

Huge parking and industrial area in Vancouver. Source : Google Earth, 2008



Thermal band of Landsat 5, 2004. Source : Camilo Perez Arrau, 2008



ı the last 25 years Dubai has grown by leaps and bounds. Billions of pounds have been pumped into Dubai.

Figure 1.99: Energy balance of the urbanarea. *Source:[http://en.wikipedia.org/wiki/Urban_heat_island, Retrieved September, 2011-09-18]*

Climate Change 2007, the Fourth Assessment Report from the IPCC states the following:

Studies that have looked at hemispheric and global scales conclude that any urban-related trend is an order of magnitude smaller than decadal and longer time-scale trends evident in the series (e.g., Jones et al., 1990; Peterson et al., 1999). This result could partly be attributed to the omission from the gridded data set of a small number of sites (<1%) with clear urban-related warming trends. In a worldwide set of about 270 stations, Parker (2004, 2006) noted that warming trends in night minimum temperatures over the period 1950 to 2000 were not enhanced on calm nights, which would be the time most likely to be affected by urban warming. Thus, the global land warming trend discussed is very unlikely to be influenced significantly by increasing urbanisation (Parker, 2006). Accordingly, this assessment adds the same level of urban warming uncertainty as in the TAR: 0.006°C per decade since 1900 for land, and 0.002°C per decade since 1900 for blended land with ocean, as ocean UHI is zero (Figure 1.100). *[Source is: http://www.answers.com/topic/urban-heat-island, Retrieved September 21, 2008.]*

The "ecological footprint" is a measure of sustainable development by which categories of human consumption are translated into areas of productive land needed to provide resources and assimilate waste products (Figure 1.101). Included in the calculations of the ecological footprint of a community, are the volumes of "imported" raw materials, food and fuel, taking into account land, water or air used for production or waste disposal. Cities in developed countries generally have a much larger ecological footprint than those in developing countries. For example, the average ecological footprint in Italy is 4 ha/person, representating 320% of the land available in Italy, while Switzerland and Germany have ecological footprints greater than 5 ha/person. London's ecological footprint is almost equivalent to the entire area of Britain's farmland. By comparison, the world's average ecological footprint is 2.4 ha/person (Figure 1.102,103). *[Source is: www.progress.org/ What We Use and What We Have: Ecological Footprint and Ecological Capacity, Retrieved September 21, 2008.]*

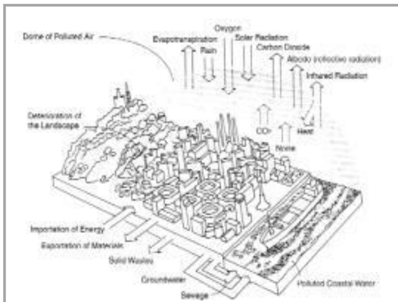


Figure 1.100: Input - output model of energy and material flows of a city.

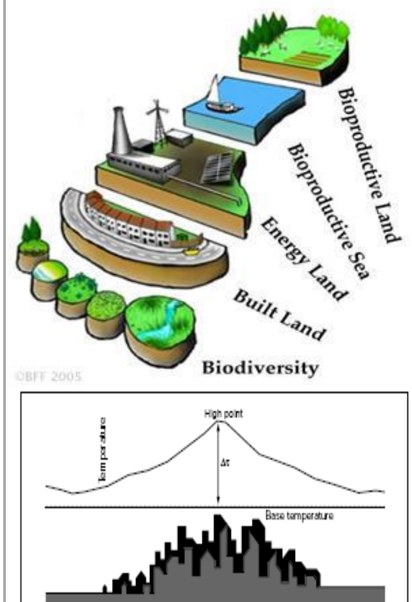


Figure 1.101: Urban heat island and ecological foot print.

Ecological Footprints per person in Canada [3]

	Ecological Footprint hectares per capita
Housing	0.89
Transportation	0.89
Consumer Goods	0.89
Services	0.3
Food	1.3
	(0.02 vegetable and fruit)
Total	4.27

Figure 1.102: Ecological Footprints

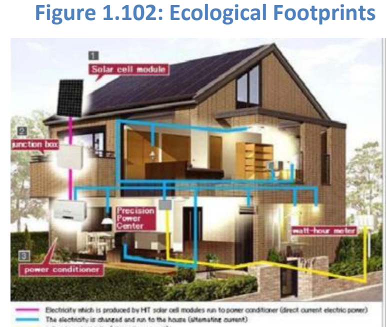


Figure 1.103: Smart System

Part One Conclusion.

It is possible to construct buildings that are climate neutral throughout their entire lifecycle. This requires that we take into consideration both the materials aspects as well as operational energy use. With the need to emphasize the seriousness of continued greenhouse gas emissions on the environment and humans and the economy will be achieved in terms of humanitarian and physical destruction.

First Principle: Choose Low Impact Materials and Constructions.

All materials chosen must have minimal fossil energy demand in production and transportation. Products with chemical emissions of greenhouse gases should be omitted. Using timber instead of concrete or bricks, for example, reduces emissions from the materials production by approximately 1 kg of CO2 per kilogram of timber used. Even with fairly moderate substitution, one may reduce the climate emissions by some 20 to 30%. Over 50%ispossible given less conventional materials and solutions. This also requires choosing materials that are easy to maintain and to modify and recycle. *[Source is: Nemry etal., 2001; Pingoudetal, 2003;Thormark, 2007, Retrieved September 21, 2009.]*

Second Principle: Reduce all Operational Energy, In Particular That Based on Fossil Fuels and Replace Them with Renewable Energies and Zero Carbon.

Operational energy includes space-heating, electricity and hot water. It is important to remember that choice of the best strategies will often depend on very local climatic factors. For example, in windy coastal regions improved air tightness measures will have far more effect than extra insulation. Need to encourage the use of clean energy reduction and control energy use in buildings and high-efficiency building materials modified.

Third Principle: Maximize Storage of Carbon.

Use as much construction material as possible that is of plant origin- in practice mainly timber - and in ways that ensure long life as well as reusability. Even in Finland, where timber construction is already dominant, it has been estimated that use of timber in construction could well be increased by 70%. A potential of up to 550 kilograms of timber products per square meter of floor area is achievable in small houses. This is based on the use of massive timber constructions in walls, floors and roofs. For larger building types, 300 to 400 kg/m2 may be realistic. *[Source is: Nemry etal., 2001; Pingoudetal, 2003;Thormark, 2007, Retrieved September 21, 2009.]*

Fourth Principle: United Nations Protocols (Kyoto, Copenhagen Summit).

Climate change has a negative effect on the ecosystem, biological, and therefore architecture, human, and will eliminate the theory of sustainability and the terms of the Kyoto treaty. There is interest in a global reduction of Global Warming as required by the United Nations treaties such as **Kyoto Protocol (2005)**, **Copenhagen Summit (2009)** with Principals:

1. Commitments to reduce greenhouse gases that are legally binding for annex I countries, as well as general commitments for all member countries.

2. Implementation to meet the Protocol objectives, to prepare policies and measures which reduce greenhouse gases; increasing absorption of these gases and use all mechanisms available, such as joint implementation, clean development mechanism and emissions trading; being rewarded with credits which allow more greenhouse gas emissions at home.
3. Minimizing impacts on developing countries by establishing an adaptation fund for climate change. Accounting, reporting and review to ensure the integrity of the Protocol.
4. Compliance by establishing a compliance committee to enforce commitment to the Protocol.

Fifth Principle: Architecture 2030.

Architecture 2030, independent organization, was established in response to the global warming crisis by architect Edward Mazria in 2002. 2030's mission is to rapidly transform the US and global Building Sector from the major contributor of greenhouse gas emissions to a central part of the solution to the global-warming crisis. This was the first time architects/planners, scientists, politicians, the media and academia were brought together to learn about and discuss the 'Building Sector' and its role in global warming. Issued **the 2030 °Challenge** asking the global architecture and building community to adopt the following targets:

• All new buildings, developments and major renovations shall be designed to meet a fossil fuel, GHG emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.
• At a minimum, an equal amount of existing building area shall be renovated annually to meet a fossil fuel, GHG emitting, energy consumption performance standard of 50% of the regional (or country) average for that building type.
• The fossil fuel reduction standard for all new buildings shall be increased to:
(60% in 2010), (70% in 2015), (80% in 2020), (90% in 2025). Carbon-neutral in 2030.

The first chapter of the first part, presenting the global warming as a global problem, its main causes, and the negative effects form construction and buildings sector. Also the relationship between globalization, and global warming, and its negative consequences on the third world countries "or the developing countries" which will move this effect to the whole world in form of high temperature rate. In the second chapter, presenting the different types of pollution happening in the whole world as a result of energy misusing, also using the harmful building materials on environment which producing carbon dioxide rising the temperature rates highly. At the end of the second chapter, explaining the crowded urban heat effects raising the temperature rates and its negative effects on the population areas.

In the second part, we will discuss the different architecture systems aiming to reduce e the negative effects of using the environment harmful materials in urban planning, and construction, and the different architecture schools aiming to use the environment friendly material, and targeted solutions for using the renewable energy without harming the environment, and depleting the natural resources. Also discussing the environmental design, the different renewable energy sources, smart materials, and systems used in building and construction to serve clean environment. Eventually presenting different examples of modern applications.

Part Two: Contemporary Trends Environment Conscious

Introduction

Chapter Three: Contemporary Environment Architecture Trends and Methods of Measurement

3.1 Contemporary Trends.

3.1.1 Sustainable Architecture.

3.1.2 Eco-Architecture.

3.1.3 Bio-Architecture.

3.1.4 Nanoarchitecture.

3.1.5 Swarm architecture.

3.2 Measurement System of Performance Building

3.2.1 LEED (America)

3.2.2 BREEAM (Britain)

3.2.3 CASBEE (Japan)

3.2.4 The Green Pyramid Rating System (GPRS) (Egypt)

Chapter Four: Climatic Strategies

4.1 Climatic Design.

4.1.1 Renewable Resources.

4.1.1.A Clean Energy.

4.1.1.B Solar Power.

4.1.1.C Green Power.

4.1.2 The Contemporary design Context.

4.1.3 Smart System (Ventilation, Daylight, etc…)

Part Two: Contemporary Trends Environment Conscious

Introduction…

Based on the previously part mentioned addressed the global warming as a major problem around the world, its major causes, and also the harmful effects of the Building sector. This part will introduce Architectural and urban solutions like Contemporary architecture trends to minimize the damaging effects resulting building sector through different directions which its main purpose to reduce the causes of the global warming, its benefits for the surrounding environment, and building emissions rates. As well as the friendly buildings measurement systems of different environment which has strict standards to maximize the effiency of the buildings without maximize its harmful emissions. (Figure 2.1)

This Part provides a broad review of pervious work done in the field of new trends of architecture particularly in building sector.

The work in this part consists of two chapters:

- First it deals with preface of new trends of architecture like eco-architecture, bio-architecture, sustainable architecture, nanoarchitecture (Figure 2.4) and swarm architecture which trial for answering important questions: How Nanoarchitecture can reduce the global warming? What are the techniques which can reduce global warming? How we can reach the clean energy inside the building? At the end of this part we will explain global measurements of the quality of construction System of Performance Building like (LEED in America, BREEAM in Britain and CAPMAS in Japan). (Figure 2.2)

- Second it summarizes the climatic design in three points, first point is renewable resource (clean energy, solar power, green power). Second point is Assess the climate through renewable energy and smart systems like (lighting system, ventilation system, plumbing system and etc…). Third point is smart materials which can use in building to reduce the carbon dioxide. At the

Figure 2.1: Global Architecture *Source: [http://directorioarco.blogspot.com/2009/04/support-global-architecture.html, Retrieved October, 2011-10-01]*

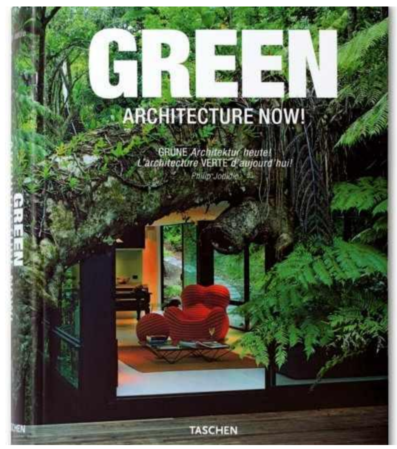


Figure 2.2: Green Architecture

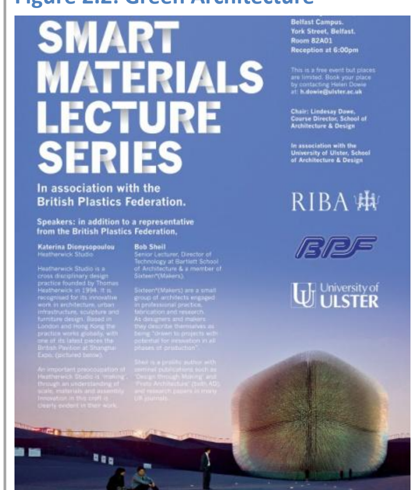


Figure 2.3: Smart Materials *Source: [http://placeni.blogspot.com/2011/03/riba-smart-materials-event-at-uu-wed.html, Retrieved October. 2011-10-01]*

end of this chapter we will find examples of smart materials (Figure 2.3) which using in building construction and some applications that combine smart materials and smart systems like (Nano Initiatives, Nano House, Nano Studio). (Figure 2.5) (Figure 2.6)

- Finally, we will find the conclusion of part Two which we reach after first and second part and explain relationship between Part Two and Three.

Figure 2.4: Nanoarchitecture. *Source: [http://placeni.blogspot.com/2011/03/riba-smart-materials-event-at-uu-wed.html, Retrieved October, 2011-10-01]*

Figure 2.5: Nano House. *Source: [http://www.qrbiz.com/buy_5-1ch-home-theater-system-hong-kong, Retrieved October, 2011-10-01]*

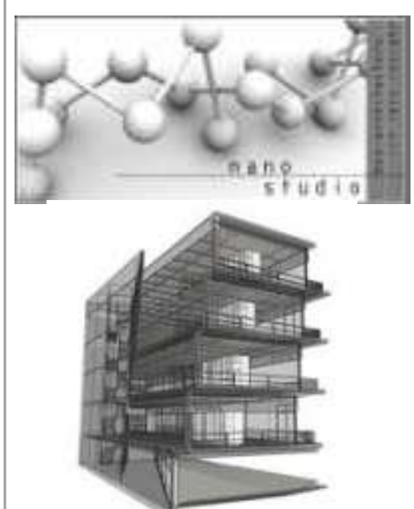


Figure 2.6: Using carbon nanotubes in a multistory building (Image courtesy of image Adam Buente + Elizabeth Boone/nanoSTUDIO).

Chapter Three: Contemporary Environment Architecture Trends and Methods of Measurement

3.1 Contemporary Trends.

3.1.1 Sustainable Architecture:

Why go sustainable? The reasons are numerous. Although sustainable buildings cost about the same as conventional ones, their improved aesthetics, comfort, and performance translate into higher initial sales prices and rents, and then to lower operating costs. Sustainable buildings are much cheaper to heat, cool, and light. Because they consume so much less energy, they produce correspondingly less pollution. Lower utility bills make them more affordable. Last but not least, they are healthier spaces in which to work or live. The ultimate goal is to reduce carbon dioxide emission and other waste for preservation and improvement of the world`s ecosystems and for the well-being of humanity. (Figure 2.7)

Before beginning the design work, consider these five principles:

- First, remember the importance of thorough planning. Sustainable design is front-loaded-the work comes at the beginning, the rewards later. Early decisions are in many ways the most important, so allow enough time for conceptual thinking. Do not " design in haste and repent at leisure"

- Second, sustainable design is more a philosophy of building than a building style. Most energy efficiency and other green technologies are essentially "invisible" that is, they can be blended into any architectural style. While green features can be highlighted to demonstrate a building`s connection to the environment, they do not have to dominate the design.

- Third, sustainable buildings do not need to be inordinately expensive or complicated. Although environmental awareness or rapid paybacks from reduced operating expenses could justify spending more money for a sustainable building, that`s usually not necessary.

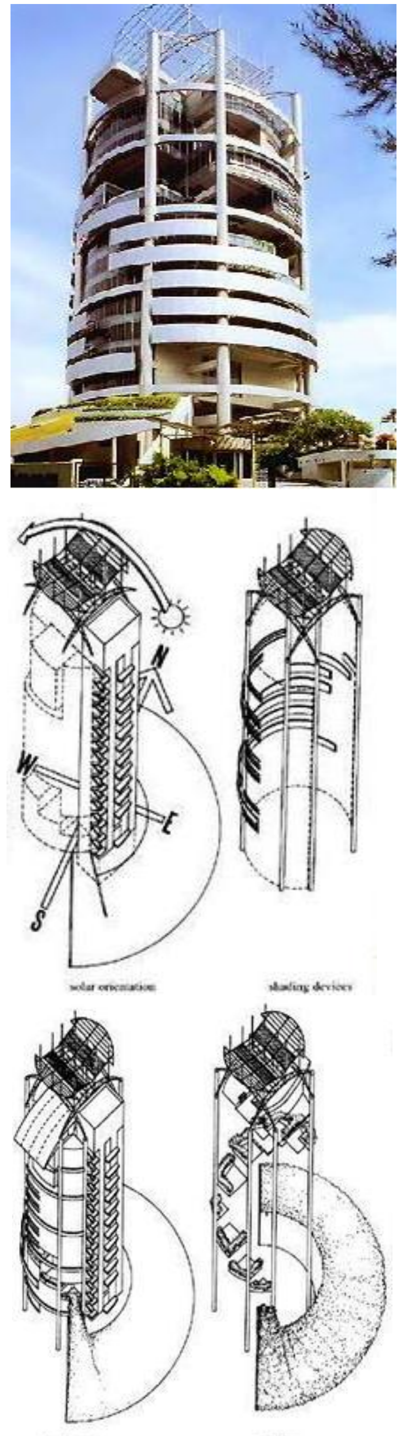


Figure 2.7: Menara-Mesiniaga *Source: [http://ecofuture.net/design/kenyeang/menara-mesiniaga/, Retrieved October 14, 2011]*

- Fourth, an integrated approach is critically important. If you design a conventional building, then throw a laundry list of technologies at it, you`re liable to end up with a piecemeal or "50 stupid things" approach- one that may cost and perform slightly better than a conventional building. On the other hand, adopting this primer`s recommendations in a systematic manner will result in a more livable, economical building. An integrated approach may incur higher prices for some pieces in order to achieve larger saving for the whole.

- Finally, although sustainable building will be more than just energy- efficient; minimizing energy consumption is so central a goal that it should serve as an organizing principle. Thus, the various design elements of a green building fall into three broad categories: energy-saving architectural features; an energy- conserving building shell; and energy-efficient furnaces, air conditioners, water heaters, lights, and other appliances. *[Source is: A Primer on sustainable building, Dianna Lopez. (1999)]*

Europe has provided the rest of the world a paradigm for green living throughout many facets of the built environment. Europe has many positive examples of balancing social needs with economic incentives through green space, biking initiatives and justice programs. Green skyscrapers have been no different. European cities have continued this balance through regulation and market driven development. (Figure 2.8)

Figure 2.8: Dragonfly, a metabolic
Source:[http://ecofuture.net/design/kenyeang/dragonfly a metabolic/, Retrieved October 14, 2011]

The concept of sustainable development can be traced to the energy (especially fossil oil) crisis and the environment pollution concern in the 1970s. The sustainable building movement in the U.S. originated from the need and desire for more energy efficient and environmentally friendly construction practices. There are a number of motives to building green, including environmental, economic, and social benefits. However, modern sustainability initiatives call for an integrated and synergistic design to both new construction and in the retrofitting of an existing structure. Also known as sustainable design, this approach integrates the building life-cycle with each green practice employed with a design-purpose to create a synergy amongst the practices used. *[Sourceis:http://en.wikipedia.org/wiki/Green_building#Goals_of_green_building, Retrieved October 14, 2011.]*

Sustainable building brings together a vast array of practices and techniques to reduce and ultimately eliminate the impacts of buildings on the environment and human health. It often emphasizes taking advantage of renewable resources, e.g., using sunlight through passive solar, active solar, and photovoltaic techniques and using plants and trees through green roofs, rain gardens, and for reduction of rainwater run-off. Many other techniques, such as using packed gravel or permeable concrete instead of conventional concrete or asphalt to enhance replenishment of ground water, are used as well.

While the practices, or technologies, employed in green building are constantly evolving and may differ from region to region, there are fundamental principles that persist from which the method is derived: Siting and Structure Design Efficiency, Energy Efficiency, Water Efficiency, Materials Efficiency, Indoor Environmental Quality Enhancement, Operations and Maintenance Optimization, and Waste and Toxics Reduction. The essence of sustainable building is an optimization of one or more of these principles. Also, with the proper synergistic design, individual green building technologies may work together to produce a greater cumulative effect. (Figure 2.9)

On the aesthetic side of green architecture or sustainable design is the philosophy of designing a building that is in harmony with the natural features and resources surrounding the site. There are several key steps in designing sustainable buildings: specify 'green' building materials from local sources, reduce loads, optimize systems, and generate on-site renewable energy.*[Sourceis:http://en.wikipedia.org/wiki/Green_building#Goals_of_green_building, Retrieved October 14, 2011.]* (Figure 2.10)

Sustainable Architecture comprises only a tiny component to reducing the carbon footprint of our civilization. In order to truly make an impact, the motivation from these entrepreneurs, policy makers and intellectuals needs to trickle down to the remaining public. (Figure 2.11) (Figure 2.12)

3.1.2 Eco-Architecture:

Ecological architecture would be defined as buildings that are built with the environment in mind, i.e. energy efficiency, earth friendly building materials, etc. we can conclude that in order to fully appreciate the ecological implications of any design the designer will need to analyze the built environment in terms of its flow energy and materials throughout its life cycle from their source of origin to their sink. Following from this analysis, the designer must simultaneously

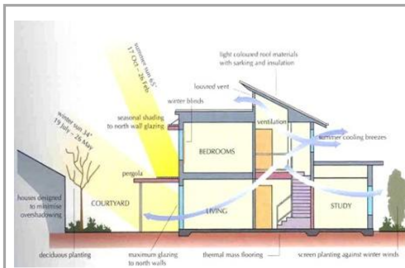


Figure 2.9: Sustainable Design and Building*Source:[http://www.buildingdesignideas.com/2011/07/21/green-building-and-design/, Retrieved October 14, 2011]*

Figure 2.10: Green Systems *Source:[http://blog.ggreendesign.com/2011/08/sustainable-design-from-builders.html, Retrieved October 14, 2011]*

Figure 2.11: Mumbai Recidence - Natural 3D Concept. *Source [http://www.efficient.ws/3d-masterplan-of-mumbai-green-architecture-by-bdp/2009/12/10/, Retrieved October 14, 2011]*

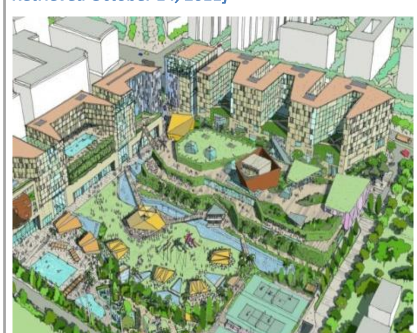


Figure 2.12: Mumbai Recidence - Green Architecture. *Source [http://www.efficient.ws/3d-masterplan-of-mumbai-green-architecture-by-bdp/2009/12/10/, Retrieved October 14, 2011]*

anticipate at the design stage all the desirable impacts on the ecosystems along this route. This analysis can be conveniently conceived using the concept of an open system, i.e., in terms of inputs to the system, functions within the system, outputs from the systems, and the relationship of the environment to the system. (Figure 2.13) *[Ecological Design Handbook, Fred A.Stitt, UK (2000), Retrieved October 1st, 2009].*

Figure 2.13: CR Land Guanganmen Green Technology Showroom *Source: [http://hosting999.net/images/, Retrieved October 1s, 2011-10-01]*

The terms sustainable design and ecological architecture are firmly a part of the contemporary culture of architecture and building. Architects are increasingly contractually, ethically, and legally required to design with respect to environmental criteria.

There is a sense of urgency relating to the environmental crisis and government energy regulations indicate that future designs will need to be even more "sustainable" than current standards. There will need to be changes to current economic, social and political systems to allow for a new way of building and evaluating cities and buildings. (Figure 2.14) *[Source is CEPHAD 2010 // the borderland between philosophy and design research // Copenhagen //January 26 – 29, 2010.*

Figure 2.14: The Editt Tower

But this is not the first environmental crisis facing designers in recent memory, and in fact the term "ecological" in relation to architecture recalls the 1970´s "deep ecology" movement, which also brought sustainable design to the forefront. There are some similarities between the crisis in the 1970´s and the current climate crisis. Designers in the 1970´s faced a global energy crisis and also impending and seemingly unprecedented technological innovation. The initial ideas of computation and interactive design were seen as possibly helping the environmental crisis. Forty years later, we are trying to reduce harmful emissions and reduce energy use while still building new architecture. This will require substantial changes to the ways we make buildings and cities.

But where will the knowledge and desire to design and building buildings and cities in a new way come from? Technology and education are seen as presenting possible solutions, with Brian Edwards (2002) among other architects arguing for new processes and analysis tools, and Yeang (1999) and McDonough and Braungart (2002) seeking to bring knowledge to designers and users to allow for informed ecological decisions. There is the assumption that if we have the right tools and information, people will not have to be urged, we will choose to build ecologically and stop the ecological devastation of the planet. (Figure 2.15)

But are the "dark ages" described by urban planner Jane Jacobs (2004) looming, or more disturbingly as JG Ballard 2 notes with his ideas of ecological catastrophe, are they are already upon us? It is easy to see a bleak picture of the future, and much more rewarding as designers to look for solutions. Despite the fact that the basic principles of green design are obvious to all, buildings continue to be produced without basic environmentally sustainable premises in mind. At present rates of non-renewable energy resources, within the next 50 years the world will likely run out of non-renewable fossil fuels (Yeang 1999). Buildings rely on fossil fuels on many levels, throughout the lifecycle of the building, from machinery to materials to maintenance. As designers, it is increasingly difficult to sift through building regulations, media reports and analysis tools in order to design in harmony with the environment. Materials and processes that are non-damaging are not often readily available and clients are often driven by different agendas such as cost and speed. What's more, the majority of architects have been trained without any serious background in ecology or environmental biology. Yeang (1999) suggests that what we are doing now as a profession is not ecological, and that ecological design calls for a rapid and fundamental reorientation of our thinking and design approach with regard to the creation of our built environment. *[Source is: CEPHAD 2010 // the borderland between philosophy and design research // Copenhagen //January 26 – 29, 2010.]*

Strategies for designing and building architecture vary for cultural, geographical, climatic and economic issues. There is no one-size-fits-all approach to architectural design, yet there is a need for base guidelines as the impact of how other people act towards the built environment has widespread consequences even to those who are acting ecologically. The devastation of the environment does not observe national boundaries. Legislating and regulating helps to a local extent, education and architectural criticism and publishing encourages international debate but ultimately a relatively small number of people commission buildings, and a relatively small number of designers build them. Architecture is a social art (Yeang) and of course everyday culture needs to change alongside architectural. (Figure 2.16)

Beyond materials, lifecycle and energy use, even our approach to design must be ecological and sustainable. A

Figure 2.15: Lilypad, a Floating Ecopolis designed by Vincent Callebaut Architect, style is Contemporary eco-design

commonly cited definition of sustainability is as defined in the Brundtland Commission Report (1987) relating to meeting the needs of the present without compromising the ability of future generations to meet their own needs. But if architecture is "the will of an epoch translated into space" (Mies van der Rohe) then McDonough and Braungart (2002) rightly ask us to consider as users and inhabitants of cities and buildings "what are we trying to sustain?" *[Source is: CEPHAD 2010 // the borderland between philosophy and design research // Copenhagen //January 26 – 29, 2010.]*

Figure 2.16: Lilyupad the floating building

Figure 2.17: green skin structure

Ecological architecture, means building with minimal environmental impacts, and where possible, building to achieve the opposite effect; this means creating buildings with positive, reparative and productive consequences for the natural environment, while at the same time integrating the built structure with all aspects of the ecological systems (ecosystems) of the biosphere over its entire life cycle. Ecological architecture, Aims to respond to declining energy resources, e.g. using energy conservation, efficient insulation, rainwater, solar radiation, and wind-power, and recycling as much as possible. (Figure 2.17)

3.1.3 Bio Architecture:

Bio-Architecture (Figure 2.18) is a new science of **life force** in buildings, based on the science of how building makes and generates the required **Fractal Field**. The principles of biological architecture, sacred geometry and feng shui are being used. This is a way of taking a holistic approach to design, based on the understanding that everything is connected, alive and conscious. The design emerges from an expression of natural patterns, symmetries, shapes, universal symbols and ratios. Spiritual geometry is a universal language of truth, harmony, beauty, proportion, rhythm an order. Architects and designers draw upon concepts of sacred geometry when they choos particular geometric forms to create pleasing, harmonious, and spiritually uplifting spaces. *[Source is: http://www.simplyenjoy.info, Retrieved January 26 – 29, 2010.]*

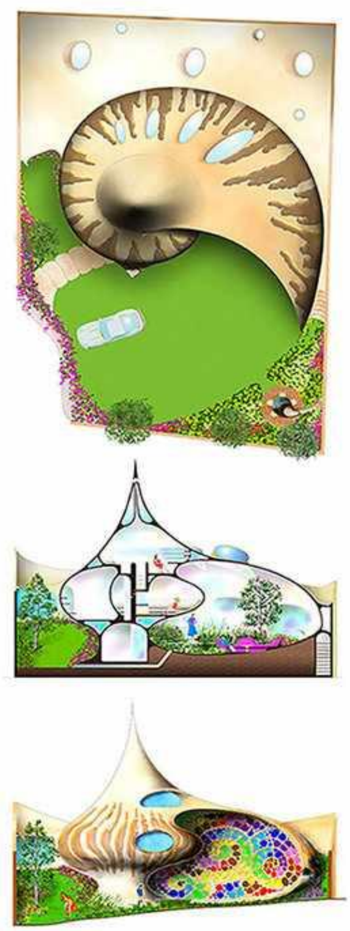


Figure 2.18: BIO Architecture house-snail .

Sacred Geometry is the study and practice of the pure principle set of operations that underpin all natural expressions and processes. In ancient times, this knowledge was considered vital, (quite literally) if one wished to create a truly sacred life within a sustainable community- health and harmony.

By studying and understanding the symmetry of electric fields causing health versus disease we rediscover that an overwhelming simple and yet compelling rule or pattern emerges. Applying this beautiful algorithm to architecture - we now see exactly why the design of living space must be exactly that - an electrically living space. An electrically alive space (sometimes called 'sacred') is simply the space where charge/chi can breathe efficiently and thus achieve the multiply connected / holographic and fractal-distributed resonance called awareness - the thrust of all living systems. (Figure 2.19) *[Source is: http://www.simplyenjoy.info, Retrieved January 26 – 29, 2010.]*

As nature uses shape to hold charge or life force, it makes complete sense to use nature's shapes and proportions for the shape of our spaces and buildings. In terms of architecture and design of space, I believe that by creating spaces that are based on the pure principles of natural design we provide a sacred environment that can nurture our bodies, minds and spirits. We can literally design to raise the vibration of the inhabitants. We can use our quantum consciousness to create the space, and to clear it of any stresses that do not serve life.

Principles of the built environment

- Design of architecture and living systems, so that space is fractal and phase conjugate – and therefore life enhancing.
- Working places where you reduce absenteeism to almost zero.
- Settings that reduce Electro-smog.
- Spaces that generate Life Force.
- Use natural geometries, shapes, forms, ratios and growth patterns to design our spaces in order to create life and truly sustainable systems. This is 'Full Spectrum Architecture' - not just 'green architecture'!
- How to include patterns of paramagnetic stones in buildings, such as Dolmens, Geometrical layouts, labyrinths.
- Spaces that attract and auto-organize electromagnetic charge fields. 'The more harmonic inclusiveness, the more fractality. The more fractality, the more life.'

The beehive and the pinecone are excellent examples of sacred architecture because as biological capacitors they implode charge, making life and bliss possible and sustainable. They are made of biologic di-electric (self-similar at atomic and molecular symmetry levels), what Reich used to call orgone

Figure 2.19: house-snail Designed by Javier Senosiain. *Source: [http://hosting999.net/images/, Retrieved October 1s, 2011-10-01]*

material, really names for fractal capacitive di-electric. The reason a beehive or a Celtic straw hut in sea spray makes things live so long is because they are good capacitors. Ancient dolmen sites, fresh eggs and even cathedrals hold life in bliss in the spell of their charge, because they are 'in charge' - that is - FULL OF CHARGE. Life occurs when biological structures learn to gather charge in enough different wavelengths to cause them to compress or "implode". When enough different waves gather in one place in the Golden Mean ratio they begin to suck in an infinite number of other waves - but always in Golden Mean ratio. This is the only way the universe has of arranging an infinite (in-PHI-knit) number of waves to gather at ONE point without hurting each other. *[Source is: http://www.simplyenjoy.info, Retrieved January 26 – 29, 2010.]*

The Main Objective of Bio-Architecture is that all life responds well to design that is in accordance with nature and avoids harmful materials and sharp corners, which literally bleed (hemorrhage) capacitive charge (for example-ancient feng shui principles have a scientific basis and make sense). The ultimate goal of bio-architecture is to create fractal charge fields that are implosive in nature and encourage life, positive DNA resonance and charge implosion (the electrical principle of life itself) (Figure 2.20)

The only definition of sacred (sustainable) architecture is the skill to fabricate a biological capacitor. The way success is measured in a building (or anything) is harmonic inclusiveness of charge density (life). (Figure 2.21) *[Source is: http://www.simplyenjoy.info, Retrieved January 26 – 29, 2010.]*

3.1.4 Nanoarchitecture:

Nanoarchitecture is the conversion of architecture in the new nano revolution in the 21st century. The use of nanotechnology in architecture varies from materials, equipments, to forms and design theories.

Nanotechnology + **Architecture** = **Nanoarchitecture**.

The biggest plans for the future of our built environment are actually very, very small. Nanoarchitecture would be the upcoming new architectural trend of the contemporary time. The impact of such new technology will exceed those of the precedent technologies because the intensity of the impact of any phenomenon is positively correlated with its pervasiveness. The circumstances indicate that the possible

Figure 2.20: Model of rose campion (Lychnis coronaria).

Figure 2.21: Spiral System.

impacts of nanotech will exceed even those of the past century revolt against classicism. (Figure 2.22)

The eight billion dollar per year nanotechnology industry has already begun to transform our buildings and how we use them; if its potential becomes reality, it could transform our world in ways undreamed of. Nanotechnology has the potential to radically alter our built environment and how we live. It is potentially the most transformative technology we have ever faced, generating more research and debate than nuclear weapons, space travel, computers or any of the other technologies that have shaped our lives.

When introducing new technologies to a field such as the construction industry, one should always first examine the benefits it can bring. In the case of the application of nanotechnology we are talking about added value, additional functionality, as well as market demand with regard to product development. Good design in principle is always based on demand, and in this way contributes to the evolution of both nanomaterials and the resulting nanoproducts - in the long term the materials and products for which there is a demand will become established whereas others will disappear from the market. The use of nanotechnology is therefore not an end in itself but follows an ongoing demand for innovation - as such it can also be a marketing factor. Independent of marketing factors, nanotechnology can make a concrete contribution to the following areas: (Figure 2.23)

- Optimization of existing products.
- Damage protection.
- Reduction in weight and/or volume.
- Reduction in the number of production stages.
- A more efficient use of materials.
- Reduced need for maintenance (easy to clean, longer cleaning intervals) and/or operational upkeep.

And as a direct result:

- Reduction in the consumption of raw materials and energy and reduced CO2 emissions.
- Conservation of resources.
- Greater economy.
- Comfort. *[Source is: **Nano Materials in Architecture, Interior Architecture and Design**, Sylvia Leydecker. (2008)]*

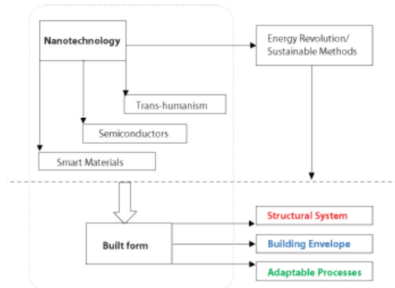
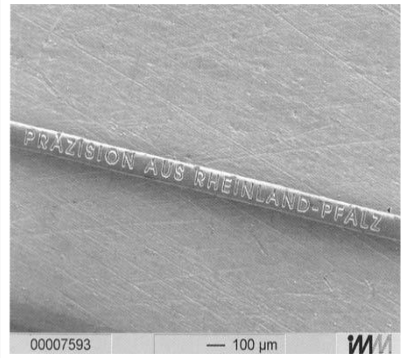


Figure 2.22: Plans for the future of our built environment.



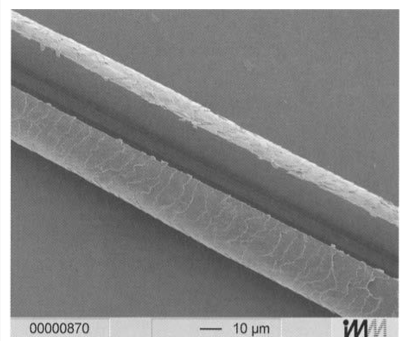


Figure 2.23: ***Microscopic image of a hair with inscription taken using a scanning electron microscope (SEM).***

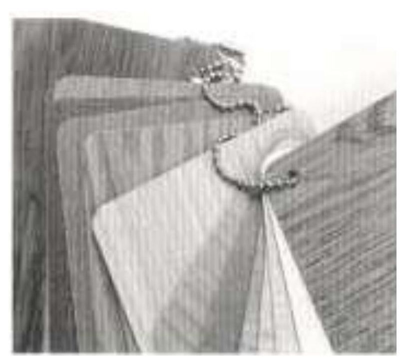


Figure 2.24: "Fakes" – laminates that simulate real materials. Real wood exhibits other haptic, acoustic and sensory properties than wood imitations.

In architecture two fundamentally different design approaches prevail when dealing with materials and surfaces (Figure 2.24).

A-Honesty of Materials – “what you see is what you get”:

This approach is favoured by those architects for whom authenticity is a priority and who value high-quality materials such as natural stone or solid woods.

B-Fakes – artificial surfaces that imitate natural materials:

For the most part, “fake” materials are chosen for cost reasons. Wood, whether in the form of veneer or synthetic wood-effect plastics, is considerably cheaper than solid wood. Even concrete or venerable walls can be had en plastique. Artificial surfaces are “brought to perfection” the grain can be tailored to appear exactly as desired; the color matches the sample precisely and does not change over the course of time. More and more “patinated” surfaces are being created that exhibit artificial aging: instant patinas precisely controllable. Certain design approaches prefer the provocation of deliberate artificiality. (Figure 2.25)

In future, a third option will be available:

C-Functional nanosurfaces, emancipated from underlying materials:

The properties of such ultra-thin surfaces can differ entirely from the material they enclose and can be transparent and completely invisible. Also possible are nanocomposites with new properties: nano particles or other nanomaterials are integrated into conventional materials so that the characteristics of the original material are not only improved but can be accorded new functional properties or even be made multifunctional. Surface materials that are customized to have specific functional properties are set to become the norm, heralding a switch from catalogue materials to made-to-measure materials with definable combination of properties – a perfectly modular system. (Figure 2.26) *[Source is: **Nano Materials in Architecture, Interior Architecture and Design**, Sylvia Leydecker. (2008)]*

Nanomaterials can extend our design possibilities. The aging process becomes a question of time frame – it can set in earlier or later according to the material chosen. Likewise, aesthetic, functional and emotional qualities can be expressed

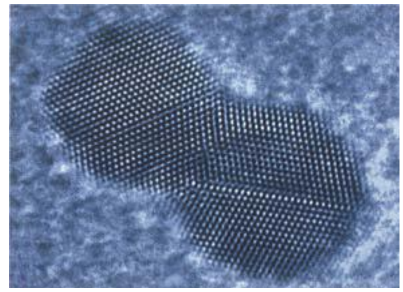


Figure 2.25: Minute detail with great effect: gold nanoparticle are responsible for the gold-ruby effect seen in medieval church windows. The atomic structure is clearly visible.

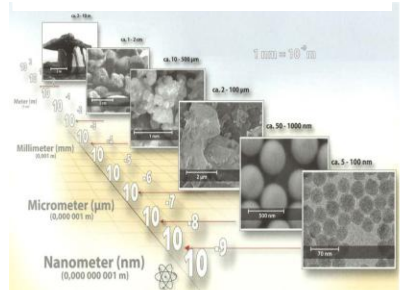


Figure 2.26: The diagram illustrates the order of magnitudes by comparing different scales, from the meter to the nanometer.

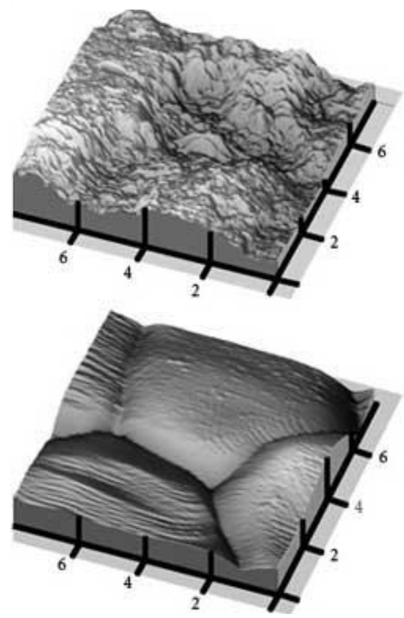


Figure 2.27: Microcraters and nanosurfaces. A rougher terrain engineered on the nanoscale (top) promoted bone adhesion and inhibited bacterial growth much better than the smoother surface engineered on the microscale (bottom). Units are in microns.

more easily – it is simply a matter of choice. As such, "Form Follows Function" applies more than ever and for all kinds of building tasks. (Figure 2.27) *[Source is: **Nano Materials in Architecture, Interior Architecture and Design**, Sylvia Leydecker. (2008)]*

3.1.5 Swarm Architecture:

Swarm Intelligence (SI) is an Artificial Intelligence technique involving the study of collective behavior in decentralized systems. Such systems are made up by a population of simple agents interacting locally with one other and with their environment. Although there is typically no centralized control dictating the behavior of the agents, local interactions among the agents often cause a global pattern to emerge. Examples of systems like this can be found in nature, including ant colonies, bird flocking, animal herding, honey bees, bacteria, and many more. (Figure 2.28) *[Sourceis:http://wiki.uelceca.net/msc1011/files/Swarm+Architecture+and+the+personalized+city.pdf,Retrieved September 10, 2011.]*

Swarm architecture (SA) is a true trans architecture since it builds new transaction spaces, which are at the same time emotive, trans active, interactive and collaborative. Swarm architecture feeds on data generated by social transactions economy. Swarm architecture is design, construct and operate in real time. Architecture becomes the discipline of building transactions. Architecture becomes the science of fluid dynamic structures and environments running in real time. Swarm architecture manifests itself as the inevitable evolution of architecture and the building industry. The innovative architect applies swarm theory in to the very fabric of society. (Figure 2.29)*[Sourceis:http://wiki.uelceca.net/msc1011/files/Swarm+Architecture+and+the+personalized+city.pdf,Retrieved September 10, 2011.]*

Swarm architecture is the computation of the group design itself that includes the design process, the fabrication process, and the process of interacting with the constructed environment. SA is considered as an input-processing-output (IPO) vehicle that is able to communicate in real time with other IPO systems. The urban environment from the point of view of SA no longer consists of isolated objects but the objects are linked to each other. For example, in urban planning, the building volume has a relationship with the plot, the plot has a

Figure 2.28: Cairo Tower by Urban A&O.

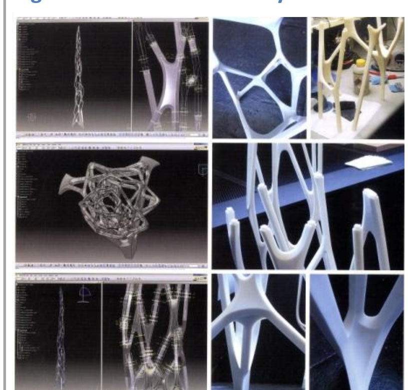


Figure 2.29: Parametric modeling tools in CATIA.

relationship with the access road, the floor area of the building on the plot has a relationship with the area of the parking places etc. and all of these relations can be described in simple rules. The general idea is that the behavior of each object is related to the behavior of its neighbor. A system of such relationships in a 3d modeling program is called parametric design. When we build the system in the game development program it displays real time behavior, and the parameters may change continuously over time. This dynamic behavioral design method is labeled Swarm Architecture [SA]. In the traditional design process these kinds of relations are usually built inside the creator's mind, but in SA they must be named, quantized and scripted. (Figure 2.30)

The truly innovative architect designs swarm architecture for an open source in real time. Building components are potential senders and receivers of information in real time, exchanging data, processing incoming data, and proposing new configurations for the outcome of the process. People communicate with people. People communicate with buildings. Buildings communicate with buildings. Building components communicate with other building components. All are members of the swarm, members of the hive. Buildings are subject to the digital revolution, and you must work with it. The innovative architect is not afraid of new media invading the built environment. The innovative architect naturally investigates and practices architecture as a real time transaction space, as a process in real time. *[Source is: http://wiki.uelceca.net/msc1011/files/Swarm+Architecture+and+the+personalized+city.pdf,Retrieved September 10, 2011.]*

Swarm Matter is an ongoing research project exploring the generation of ornamental geometries through the agent based formation of emergent hierarchies and non-liner patterns. This research project questions the contemporary understanding of component logic as elements that are subservient to a topological ordering device such as surface. Instead this exploration looks at the ability of macro order to emerge from the non-liner interaction of components at a local level. This non-liner methodology emerged from kokkugia`s ongoing research into systems of swarm intelligence and multi-agent algorithmic design. *[Source is: Contemporary Digital Architecture Design & Techniques, Jacobo Krauel. (2011)]*

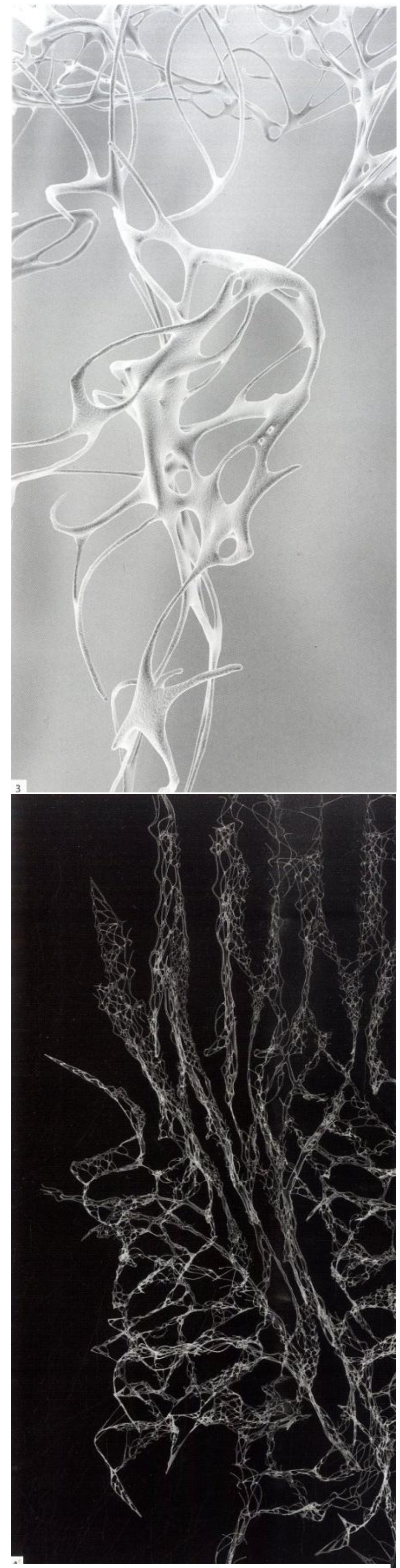


Figure 2.30: Swarm Matter in different scales (Micro, Field). *Source: [Contemporary Digital Architecture Design & Techniques, Jacobo Krauel. (2011)]*

The project is concerned both with the emergence of figure from the complex order of fields as well as the dissolution of the figure into abstraction. At a local level a component has no base state, but instead it adapts to its conditions, consequently while local moments of periodicity may occur, a definitive reading of the component is resisted through its continual negotiated transformations. Similarly symmetries while not being inherent within the system, emerge from specific interactions of components. *[Source is: Contemporary Digital Architecture Design & Techniques, Jacobo Krauel. (2011)]*

3.2 Measurement System of Performance Building:

3.2.1 LEED (America)

The United States Green Building Council (USGBC), a national non-profit entity, developed the Leadership in Energy and Environmental Design (LEED) (Figure 2.31) Green Building Rating System to rate new and existing commercial, institutional, and high-rise residential buildings according to their environmental attributes and sustainable features. The LEED system utilizes a list of 34 potential performance based “credits” worth up to 69 points, as well as 7 prerequisite criteria, divided into six categories (Figure 2.32):

1. Sustainable Sites
2. Water Efficiency
3. Energy and Atmosphere
4. Materials and Resources
5. Indoor Environmental Quality
6. Innovation & Design Process *[Source is: **The Costs and Financial Benefits of Green Buildings**, Greg Kats, Capital E. (October 2003)]*

LEED allows the project team to choose the most effective and appropriate sustainable building measures for a given location and/or project. These “points” are then tallied to determine the appropriate level of LEED certification. See Appendix A for a full list of LEED Version 2.1 prerequisites and credits. Four levels of LEED certification are possible; depending on the number of criteria met, and indicate

Figure 2.31: leed-leadership-in-energy-and-environmental-design-green-building

Figure 2.32: LEED-bubbles of concept.

Figure 2.33: LEED Certification Scorecard Breakdown

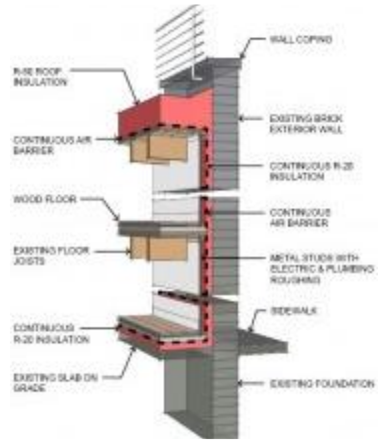


Figure 2.34: Exterior Envelope Diagram

increasingly sustainable building practices (Figure 2.33):

1. LEED Certified 26-32 points
2. LEED Silver 33-38 points
3. LEED Gold 39-51 points
4. LEED Platinum 52+ points

There is a general perception that LEED is becoming the standard for US green building design. As the industry magazine Health Facilities Management described in October 2002, "LEED has become the common benchmark for sustainability."34 Although imperfect and still evolving, LEED has rapidly become the largest and most widely recognized green building design and certification program in the US, and probably in the world. (Figure 2.37) *[Source is: **The Costs and Financial Benefits of Green Buildings**, Greg Kats, Capital E. (October 2003)]*

LEED was first introduced through a Pilot Program, and twelve buildings received version 1.0 certification in March 2000. Version 2.0 was released shortly thereafter for use as a design and certification tool. At the end of 2000, about 8 million square feet of buildings were undergoing of December 2002, of all new construction projects in the United States, an estimated 3% had applied for LEED certification, including 4% of schools, 16.5% of government buildings and 1.1% of commercial projects (Figure 2.34). In addition, many buildings use LEED as a design tool without going through the certification process.36 LEED's use and impact is therefore more pervasive than the figures suggest. All indications are that this explosive growth will continue. Despite its limitations, the strength and likely future durability of LEED and its definition of green buildings derives from several factors:

- LEED is broad and democratic in nature, currently with 3000 organizations representing all sectors of the building industry. Membership has roughly doubled annually over the last three years. (Figure 2.35)
- LEED continues to change through large, professional, voluntary committees, and a staff that is responsive to the evolving needs of its large and diverse membership. New products are being developed, including: LEED for

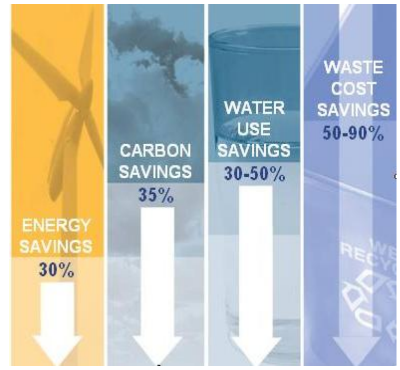


Figure 2.35: Average Savings of Green Buildings. *Source [http://nevillebarrettjr.com/2010/08/surprising-leed-certified-restaurants/, Retrieved October 14, 2011]*

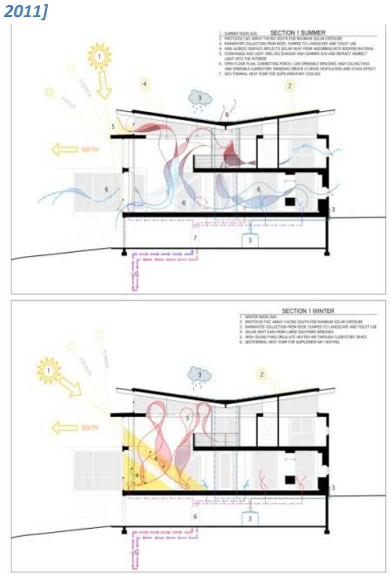


Figure 2.36: Energy & Atmosphere and Indoor Environmental Quality *Source [http://nevillebarrettjr.com/2010/08/surprising-leed-certified-restaurants/, Retrieved October 14, 2011]*

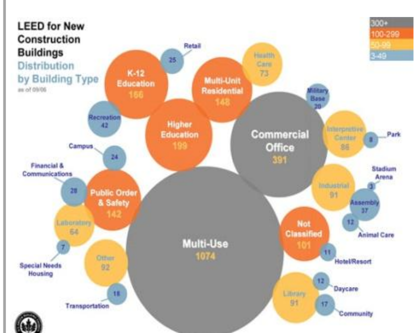


Figure 2.37: LEED for New Construction Building Distribution by Building Type. *Source[http://www.masoncontractors.org/aboutmasonry/greenbuildingsystem/greenbuildingfacts.php, Retrieved October 14, 2011]*

Existing Buildings, LEED for Commercial Interiors, LEED for Core and Shell, LEED for Homes, LEED for Neighborhood Developments, and LEED for Multiple Buildings.38 *[Source is: **The Costs and Financial Benefits of Green Buildings**, Greg Kats, Capital E. (October 2003)]*

- The USGBC spends millions of dollars each year to support LEED in a number of ways, including: an extensive training program; the LEED Accredited Professional exam; a Resource guide; LEED templates; an extensive LEED website for registered projects, technical data and scientific committees; and a growing staff of professionals dedicated to LEED. (Figure 2.36) *[Source is: **The Costs and Financial Benefits of Green Buildings**, Greg Kats, Capital E. (October 2003)]*

3.2.2 BREEAM (Britain)

Concern for the environment has grown apace over the last and yet buildings, which have very large environmental effects, are not considered. Encouraging environmentally friendlier buildings will over time substantially improve the environment. In the present climate of concern, about global warming for instance, it is of advantage to make visible that one building is environmentally better than another.

BREEAM (Building Research Establishment Environmental Assessment Method) (Figure 2.38) is currently the only established method of assessing the environmental quality of buildings. The first version of the scheme, BREEAM 1/90, was developed for assessing new offices at the design stage and was published in 1990. A revised version of the scheme for new office design, BREEAM 1/93, extending the scope of the environmental effects covered by the assessment, was published earlier in 1993. Since the publication of the scheme in 1990 about 25% of the new office stock designed since its launch has been assessed. Versions of the scheme have also been published for three other building types: BREEAM 2/91 covers superstores and supermarkets, BREEAM 3/91 new homes and BREEAM 4/93 existing offices. (Figure 2.41) *[Source is: **Environmental handbook for building and civil engineering projects Design and Specification**, construction industry research and*

breeam

Figure 2.38: BREEAM (Building Research Establishment Environmental Assessment Method) logo
Source[http://londonoffices.com/news/tag/breeam-status-awarded-to-charles-darwin-house, Retrieved October 14, 2011]

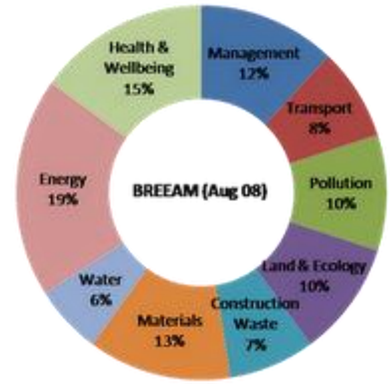


Figure 2.39: credit weightings.
Source[http://www.thegreenworkplace.com/2008/08/breeam-uk-equivalent-to-leed-toughens.html, Retrieved October 14, 2011]

Figure 2.40: BREEAM Diagram

BREEAM	
Site Selection and ecology	20.5%
Water	2.5%
Energy	33%
Materials	13.5%
Indoor Environmental Quality	13%
Innovation	6.5%
Facility management	12%

Figure 2.41: Rating systems *Source http://www.carboun.com/sustainable-development/sustainable-design/comparing-estidama%E2%80%99s-pearls-rating-method-to-leed-and-breeam/, Retrieved October 16, 2011]*

information association. (1994)]

The scheme uses independent assessors to evaluate the environmental effects of the building. At the completion of an independent assessment a certificate is issued which confirms the areas of environmental concern and criteria the building design has satisfied. Carrying out an assessment at the design stage allows improvements to be incorporated before the design is fixed. A credit on the certificate would indicate that the building will perform better environmentally than normal practice (Figure 2.39). A summary rating of fair, good, very good or excellent is included in the certificate based on a minimum number of credits achieved overall and in each of the following board categories. (Figure 2.40) *[Source is: **Environmental handbook for building and civil engineering projects Design and Specification**, construction industry research and information association. (1994)]*

The environmental issues concerned in the scheme are grouped into the global, neighborhood (or local) and indoor environments. The issues covered in each version of the scheme are slightly different, but broadly follow the environmental concerns set out below:

Global issues:

- Rainforest destruction
- Resource depletion
- Global warming
- Ozone depletion

Neighborhood or local issues:

- Limiting air pollution
- Limiting noise effects
- Legionnaires disease
- Local wind effects
- Site ecological value
- Limiting overshadowing
- Water economy
- Re- use of existing sites

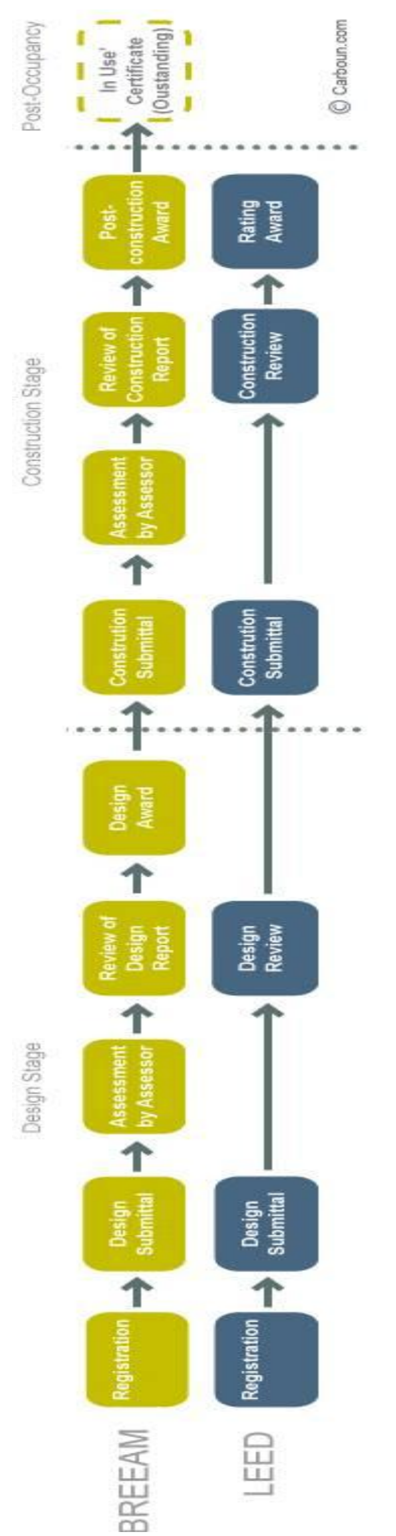


Figure 2.42: Certification Processes of BREEAM and LEED. *Source http://www.carboun.com/sustainable-development/sustainable-design/comparing-estidama%E2%80%99s-pearls-rating-method-to-leed-and-breeam/, Retrieved October 16, 2011]*

Indoor issues:

- Hazardous materials
- Lighting
- Ventilation
- Safety and security
- Indoor air quality
- Indoor pollutants

It is intended that other issues will be included in future versions of the scheme as more evidence becomes available, further matters being considered for inclusion are life cycle energy costs, combined heat and power, manageability, location, microclimate, volatile solvents, ventilation effectiveness, thermal comfort and sick building syndrome. (Figure 2.42) *[Source is: **Environmental handbook for building and civil engineering projects Design and Specification**, construction industry research and information association. (1994)]*

3.2.3 CASBEE (Japan)

Promotion of sustainability is one of the great challenges facing humankind. Since the building industry started to move toward the promotion of sustainable building in the latter half of the 1980s, various techniques to evaluate the environmental performance of buildings have been developed.*[Source is: **http://www.ibec.or.jp/CASBEE/english/download.htm**, Retrieved October 14, 2011.]*

In Japan, a joint industrial/government/academic project was initiated with the support of the Housing Bureau, **ministry of land, infrastructure and transport** (**MLIT**), in April 2001, which led to the establishment of a new organization, the **Japan Green Build Council** (**JaGBC**) / **Japan Sustainable Building Consortium** (**JSBC**), with its secretariat administered by the Institute for Building Environment and Energy Conservation. JSBC and a subcommittee under it are together working on R&D of the **Comprehensive Assessment System for Building Environmental Efficiency** (**CASBEE**) (Figure 2.43). Today, the enhancement and diffusion of CASBEE are being promoted under MLIT environment action plan (June 2004) and the Kyoto Protocol target achievement plan (approved by the cabinet on April 28, 2005). In recent years, several local

Figure 2.43: (CASBEE) Comprehensive Assessment System for Building Environmental Efficiency Logo.

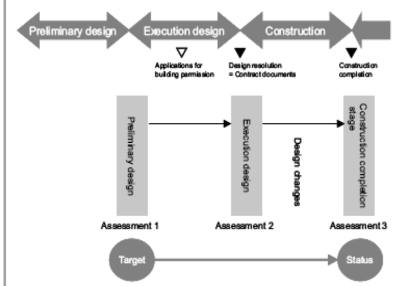


Figure 2.44: Assessment Stages of CASBEE for New Construction *Source http://www.carboun.com/sustainable-development/sustainable-design/comparing-estidama%E2%80%99s-pearls-rating-method-to-leed-and-breeam/, Retrieved October 17, 2011]*

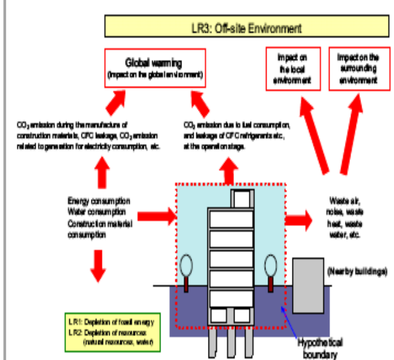


Figure 2.45: Positioning of Climate Change and Other Assessment Items within LR.

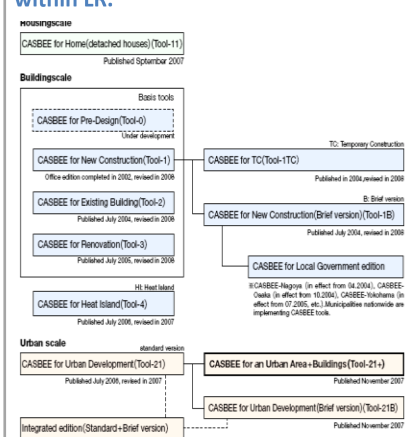


Figure 2.46: Structure of the CASBEE family. *Source http://www.carboun.com/sustainable-development/sustainable-design/comparing-estidama%E2%80%99s-pearls-rating-method-to-leed-and-breeam/, Retrieved October 17, 2011]*

authorities introduced CASBEE into their building administration. Consequently environmental performance assessment of buildings is now carried out in many buildings in Japan. (Figure 2.45)

CASBEE is a method for assessing and rating the environmental performance of buildings, ranked in five grades:

excellent (S), very good (A), good (B+), fairly poor (B-) and poor (C). The first assessment tool (Figure 2.44) , CASBEE for office, was completed in 2002, followed by CASBEE for new construction in July 2003, CASBEE for existing building in July 2004 and CASBEE for renovation in July 2005, CASBEE is unique to Japan for its introduction of an innovative concept (Figure 2.47): it evaluates a building from the two viewpoints of environmental quality and performance (Q = quality) and environmental load on the external environment (L = load) when evaluating the environmental performance of the building and define a new comprehensive assessment indicator, the building environmental efficiency (BEE) (Figure 2.48), by Q/L. CASBEE comprises the four basis tools, tailored to the building lifecycle, and expanded tools for specific purposes (Japan Sustainable Building Consortium). These are called collectively as the "CASBEE Family" (Figure 2.46). Under CASBEE, these two factors are defined below as Q and L, the main assessment categories, and evaluated separately:

Q (Quality): Building Environmental Quality & Performance: Evaluates "improvement in living amenity for the building users, within the hypothetical enclosed space (the private property)." (Figure 2.49)

L (Loadings): Building Environmental Loadings: Evaluates "negative aspects of environmental impact which go beyond the hypothetical enclosed space to the outside (the public property)." (Figure 2.50)

CASBEE covers the following four assessment fields: (1) Energy efficiency (2) Resource efficiency (3) Local environment (4) Indoor environment These four fields are largely the same as the target fields for the existing assessment tools described above in Japan and abroad, but they do not necessarily represent the same concepts, so it is difficult to deal

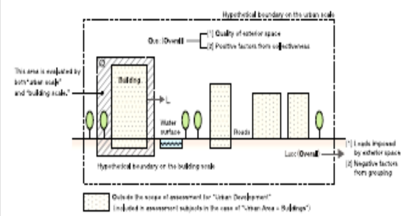


Figure 2.47: Concept of assessment subjects for CASBEE for Urban Development. *Source http://www.ibec.or.jp/CASBEE/english/download.htm, Retrieved October 17, 2011]*

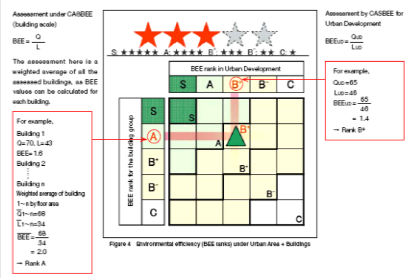


Figure 2.48: Environmental efficiency (BEE ranks) under Urban Area + Buildings. *Source http://www.ibec.or.jp/CASBEE/english/download.htm, Retrieved October 17, 2011]*

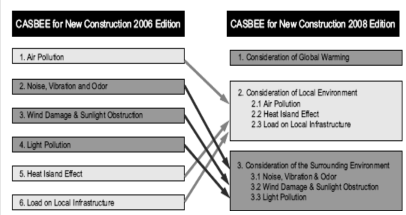


Figure 2.49: Reorganization of Medium-level Items under LR3 Off-site Environment. *Source http://www.ibec.or.jp/CASBEE/english/download.htm, Retrieved October 17, 2011]*

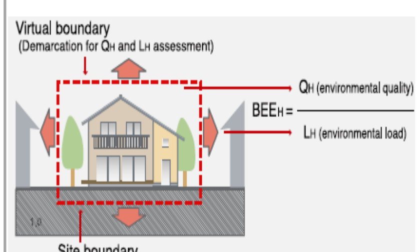


Figure 2.50: CASBEE sets a virtual boundary around the assessment site that is defined by the boundary of the site. Based on this concept, BEEH (building Environmental Efficiency Home) is an indicator for assessing the environmental efficiency of a home in terms of the environmental quality (Q) and environmental (L). *Source http://www.ibec.or.jp/CASBEE/english/download.htm, Retrieved October 17, 2011]*

with them on the same basis. *[Source is: **http://www.ibec.or.jp/CASBEE/english/download.htm**, Retrieved October 14, 2011.]*

Therefore the assessment categories contained within these four fields had to be examined and reorganized. As a result, the assessment categories were classified into BEE numerator Q (Building environmental quality and performance) and BEE denominator L (Reduction of building environmental loadings). Q is further divided into three items for assessment: Q1 Indoor environment, Q2 Quality of services and Q3 Outdoor environment on site. Similarly, L is divided into L1 Energy, L2 Resources & Materials and L3 Off-site Environment.

In assessment tools up to the 2006 edition of CASBEE, efforts which contribute to reducing CO2 emissions, such as those below, were evaluated individually:

- Efforts to reduce operating energy, which is a contributing factor in climate change
- Use of existing structural skeletons and recycled construction materials, which contribute to reduction of the embodied CO2 related to the manufacture of construction materials.
- Lifespan-extension efforts to contribute to LCCO2 reduction

We have decided to replace the above efforts with LCCO2 as a quantitative indicator for the purpose of assessment. Assessment should be performed using an emission rate (%) relative to the LCCO2 (kg CO2/year-m2) of a hypothetical reference building having level 3 for all items other than this one. (Figure 2.51)*[Source is: **http://www.ibec.or.jp/CASBEE/english/download.htm**, Retrieved October 14, 2011.]*

3.2.4 The Green Pyramid Rating System (GPRS) (Egypt)

Climate change is possibly the greatest challenge facing humanity, and research appears to show that the phenomenon is a result of the increased levels of greenhouse gas emissions resulting from human activity. In spite of Egypt's relatively low levels of greenhouse gas emissions, the Nation is considered to be one of the countries of the world most 'at risk' from climate change, making this a key issue for national policy.

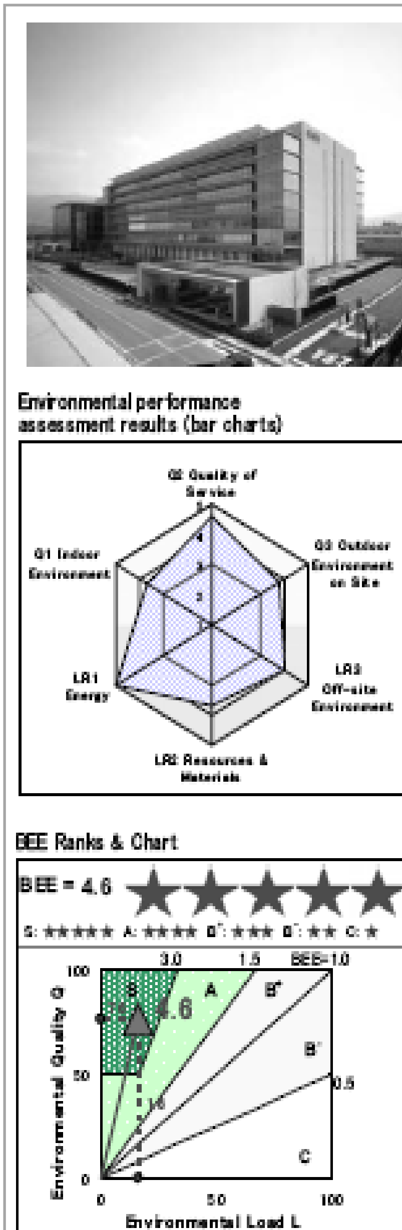


Figure 2.51: Building outline Case Study

Building type: Office (Laboratory)

Location: Shiojiri city, Nagano Pref.

Site area: 29,525 m2

Total floor area: 53,372 m2

Floors: +7

Completion: Feb. 2006

*Source **http://www.ibec.or.jp/CASBEE/english/download.htm**, Retrieved October 17, 2011]*

Given that around half of total carbon-related emissions come from buildings and their use, sustainable building development and green building, should be recognised to be of crucial importance. The government of the Arab Republic of Egypt, represented in the Ministry of Housing, Utilities and Urban Development has an interest in promoting green building as part of the Ministry's overall sustainable development policies. Green building should reduce pollution and enhance the efficiency of energy and water use. Furthermore, green buildings are designed and constructed in such a way that the activities of their occupiers and users do not endanger the environment or human health and well-being. Green building, with its use of renewable energy, recycling and reduction of pollution and waste involves more responsible, rational and sustainable use of land, raw materials, energy and water. This in turn should lead to a healthier more comfortable environment and a stronger economy.*[Source is:* **http://www.hbrc.edu.eg/files/GPRS-202011.pdf**, *Retrieved October 14, 2011.]* (Figure 2.52)

The concept of green building observes important criteria which secure the attainment of the required quality and efficiency of buildings. It covers guidance, location preparation and careful study, consideration of optimal methods for water consumption including recycling of used water for other industrial and agricultural purposes, studies on lighting, air conditioning, natural ventilation and the renewable energy sources such as the solar and wind energy systems. These technologies now exist, but it is crucial that they are promoted. (Figure 2.53)

The aims of the Green Pyramid Rating System are:

- To provide a benchmark for good practice that enables buildings in Egypt to be assessed for their green credentials through a credible, challenging and transparent environmental rating system.
- To enable building designers, constructors and developers to make reasoned choices based upon the environmental impact of their decisions.
- To stimulate awareness of, and demand for sustainable green buildings.
- To allow informed dialogue with interested parties and contribute to wider debate on Green Building in Egypt over the coming years. (Figure 2.54)
- To encourage the design and construction of sustainable

Figure 2.52: Green Pyramid Rating System (GPRS) (Egypt) logo. *Source http://www.hbrc.edu.eg/files/GPRS-202011.pdf, Retrieved October 17, 2011]*

Figure 2.53: The Housing and Building National Research Center. *Source http://www.hbrc.edu.eg/files/GPRS-202011.pdf, Retrieved October 17, 2011]*

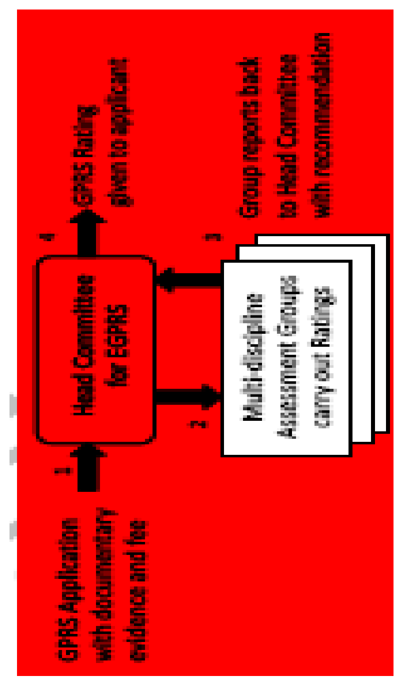


Figure 2.54: assessment and rating process. *Source http://www.hbrc.edu.eg/files/GPRS-202011.pdf, Retrieved October 17, 2011]*

green buildings, and contribute significantly to a better, more sustainable building stock for the Nation.

- In order to achieve these aims, the following objectives have been set.
- To produce rating criteria that reinforce and enhance National standard regulations.
- To promote a rating system that is understandable and achievable yet challenging.
- To raise awareness of resource scarcity and ways to mitigate demand for these resources.
- To raise awareness of best environmental practice in the design, construction and use of buildings.
- To minimise the environmental impact of buildings whilst maintaining their function and the comfort, health and well-being of their occupants and of the community.
- To encourage innovative solutions that minimise environmental impact.
- To raise the awareness of the benefits of buildings with reduced impact on the environment.

Green Pyramid Category Weightings are as follows:

1. Sustainable Site, Accessibility, Ecology. (15%)
2. Energy Efficiency. (25%)
3. Water Efficiency.(30%)
4.Materials and Resources.(10%)
5.Indoor Environmental Quality.(10%)
6. Management.(10%)
7. Innovation and added Value.(Bouns)

To earn Green Pyramid certification a project must satisfy all the stated Mandatory Minimum Requirements and may obtain Credit Points by meeting certain criteria. Projects will be rated, based on Credit Points accumulated, according to the following rating system (Figure 2.55):

- GPRS Certified: 40–49 credits
- Silver Pyramid: 50–59 credits
- Gold Pyramid: 60–79 credits
- Green Pyramid: 80 credits and above

Projects with less than 40 credits will be classified as 'Uncertified')*[Source is:* **http://www.hbrc.edu.eg/files/GPRS-202011.pdf**, *Retrieved October 14, 2011.]*

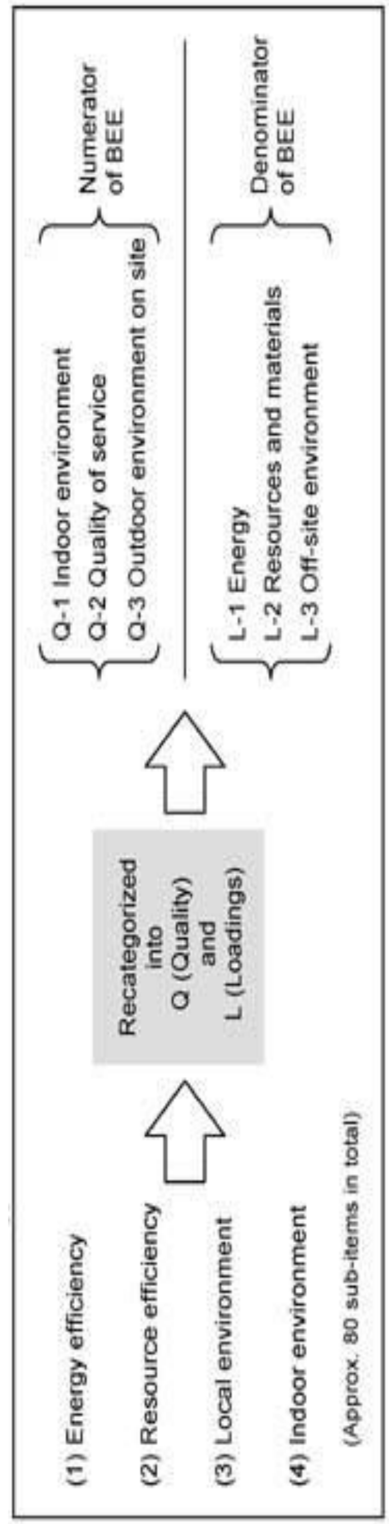


Figure 2.55: assessment and rating Outline. *Source http://www.hbrc.edu.eg/files/GPRS-202011.pdf, Retrieved October 17, 2011]*

Chapter Four: Climatic Strategies

4.1 Climatic Design.

4.1.1 Renewable Resources:

Renewable Resources uses energy sources that are continually replenished by nature-the sun, the wind, water, the Earth's heat, and plants. Renewable energy technologies turn these fuels into usable forms of energy-most often electricity, but also heat, chemicals, or mechanical power. (Figure 2.56)

Why Use Renewable Energy? Today we primarily use fossil fuels to heat and power our homes and fuel our cars. It's convenient to use coal, oil, and natural gas for meeting our energy needs, but we have a limited supply of these fuels on the Earth. We're using them much more rapidly than they are being created. Eventually, they will run out. And because of safety concerns and waste disposal problems, the United States will retire much of its nuclear capacity by 2020. In the meantime, the nation's energy needs are expected to grow by 33 percent during the next 20 years. Renewable energy can help fill the gap. (Figure 2.57) *[Source is: **Renewable Energy: An Overview**, **CADDET Renewable Energy,** Web site: www.caddet-re.org. (2001)]*

Even if we had an unlimited supply of fossil fuels, using renewable energy is better for the environment. We often call renewable energy technologies "clean" or "green" because they produce few if any pollutants (Figure 2.58). Burning fossil fuels, however, sends greenhouse gases into the atmosphere, trapping the sun's heat and contributing to global warming. Climate scientists generally agree that the Earth's average temperature has risen in the past century. If this trend continues, sea levels will rise, and scientists predict that floods, heat waves, droughts, and other extreme weather conditions could occur more often. Other pollutants are released into the air, soil, and water when fossil fuels are burned. These pollutants take a dramatic toll on the environment-and on humans. Air pollution contributes to diseases like asthma. Acid rain from sulfur dioxide and nitrogen oxides harms plants and fish. Nitrogen oxides also contribute to smog.

It is a truism that we cannot continue forever consuming the earth's finite energy resources. In the long term, the world's energy system will be supplied completely by renewable

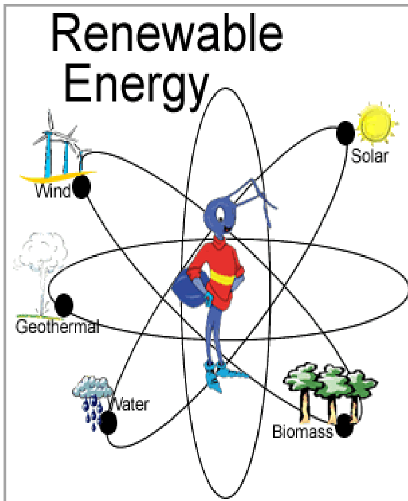


Figure 2.56: Renewable Energy. *Source http://www.ryancanderson.com/naturalresources-infographic.php, Retrieved October 20, 2011]*

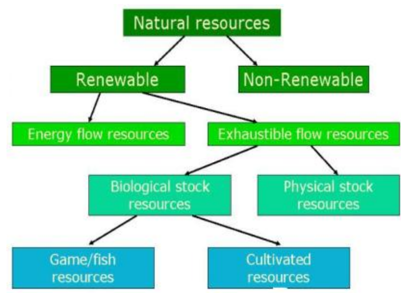


Figure 2.57: Natural Resources. *Source http://www.ryancanderson.com/naturalresources-infographic.php, Retrieved October 20, 2011]*

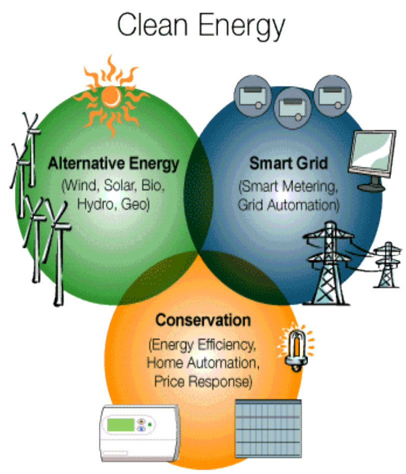


Figure 2.58: Elements of Clean Energy. *Source:http://onlinescienceallthetime.blogspot.com/2010/08/types-of-natural-resources.html, Retrieved October 20, 2011]*

energy sources. Unfortunately 'in the long term' isn't good enough. Although the renewable energy sector is growing rapidly, the climate change imperative dictates that we begin the wholesale transformation of our energy system now, if we are to have any possibility of avoiding the worst of dangerous climate change by keeping global mean temperature rise well below 2° C above preindustrial levels. (Figure 2.59)

In today's world, there are many other reasons to support a massive uptake of renewable energy and to move away from conventional fossil fuel and nuclear sources:

- Air pollution from the transport and power sectors has made our cities hazardous to our health, particularly to our children's. (Figure 2.60)
- A distributed system of generation from a variety of renewable sources provides a much more robust energy system much less susceptible to interruptions of supply.
- Relying on largely indigenous renewable sources of energy can protect local economies from the massive economic disruptions caused by speculation-driven swings on global commodities markets.
- A dispersed system of renewable generating systems is much more physically secure from attack.
- As the growing industry has demonstrated, the sector is a fast-growing supplier of high quality jobs, much more so than the capital-intensive conventional energy sector.

The renewable energy industry is booming worldwide, attracting almost 40 billion USD in investment in 2005, with most technologies growing at double-digit rates. Total installed electrical generation capacity passed 180 GW by the end of 2005, with nearly half of that in the developing world. The REN21 Global Status Report estimates that at least 85 renewable energy companies or divisions have market valuations greater than USD 40 million, up from 60 companies or divisions in 2004. (Figure 2.61) *[Source is: http://www.greenpeace.org/raw/content/international/press/reports/renewable-energy-and-climate.pdf, Retrieved October 23, 2011.]*

Renewable energy will also help us develop energy independence and security (Figure 2.62). The United States imports more than 50 percent of its oil, up from 34 percent in 1973. Replacing some of our petroleum with fuels made from

Figure 1.59: Visualizing Natural Resources Solar Panels.
Source:[http://www.repreverenewables.com/about-biomass.html, Retrieved October 23, 2011]

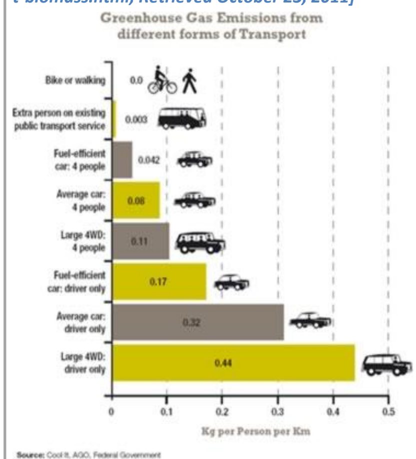


Figure 2.60: Greenhouse Gas Emissions from different forms of Transport.
Source:[http://www.deakin.edu.au/travelsmart/benefits.php, Retrieved October 23, 2011]

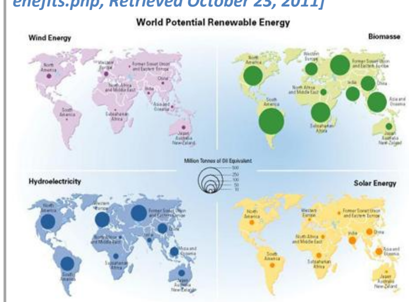


Figure 2.61: World Potential Renewable Energy. *Source:[http://www.deakin.edu.au/travelsmart/benefits.php, Retrieved October 23, 2011]*

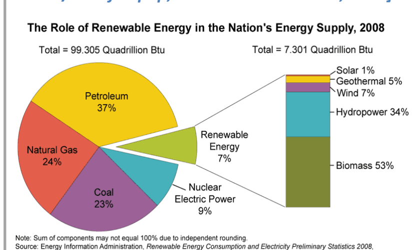


Figure 2.62: Role of Renewable Energy in the Nation's Energy Supply 2008.
Source:[http://www.repreverenewables.com/about-biomass.html, Retrieved October 23, 2011]

plant matter, for example, could save money and strengthen our energy security. Renewable energy is plentiful, and the technologies are improving all the time. There are many ways to use renewable energy. Most of us already use renewable energy in our daily lives. *[Source is: **Renewable Energy: An Overview**, **CADDET Renewable Energy,** Web site: www.caddet-re.org. (2001)]*

4.1.1.A Clean Energy.

Clean Energy Technology reduces CO2 emissions by increasing energy efficiency and enabling alternative sources like solar, wind and biomass (Figure 2.63). It is not energy use per se that causes global warming. It is the emission of CO2 that results from burning fossil fuels to generate energy. Solutions should therefore be sought not only in reducing primary energy demand but in alternative sources that do not emit CO2. In the 450 Policy scenario energy efficiency must result in a 16% reduction in total energy use relative to the reference scenario and renewable energy supply must increase by 42% – both by 2030. Clean Energy Technology enables both. (Figure 2.62)

Energy efficiency is the most cost-effective way to reduce CO2 emissions. Simply put, using less energy not only saves fossil fuel but money. Thus the investments needed are offset by lower energy bills that result from lesser volumes and lower prices (due to falling demand). Clean Energy Technology contributes to energy efficiency by enabling, for example, low-energy lighting, better insulation and more effective energy storage.

Solar, wind and biomass sources do not cause CO2 emissions. Solar and wind can be used to generate heat and electricity, and biomass has the additional advantage that it contains molecules that can be converted to liquid form to replace fossil-based transport fuels. Clean Energy Technology enables these solutions by developing solar cells and wind turbines, electric cars and biofuels. (Figure 2.64) *[Source is: http://www.second-street.com/PortfolioCleanEnergy.html, Retrieved October 23, 2011.]*

Clean Energy Technology therefore is defined as those technologies that contribute directly to reducing CO2 emissions. There are other technologies that are equally necessary and valuable, such as the recycling of fossil-based materials, material efficiency and carbon capture and storage. These, however, affect CO2 emissions only indirectly or in the

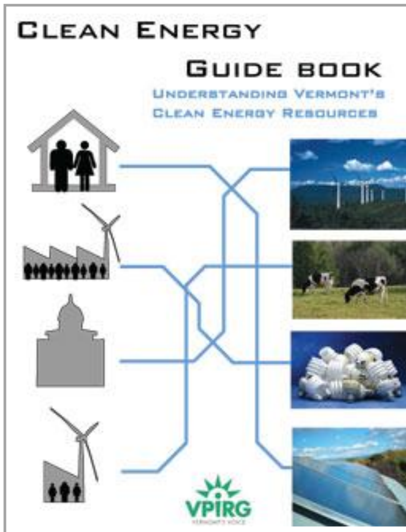


Figure 2.63: Clean Energy. *Source:[http://www.secondstreet.com/PortfolioCleanEnergy.html, Retrieved October 23, 2011]*

Figure 2.64: Solar, Wind and Biomass types of Clean Energy. *Source:[http://www.secondstreet.com/PortfolioCleanEnergy.html, Retrieved October 23, 2011]*

Figure 2.65: biomass-natural-production-cycle. *Source:[http://www.repreverenewables.com/about-biomass.html, Retrieved October 23, 2011]*

case of CCS, only present a solution after CO_2 has been created (end of pipe).

Clean Energy Technologies, thus defined, are urgently needed to cut CO_2 emissions, limit global warming and protect crucial ecosystems (Figure 2.65). The market is responding. The next chapter analyzes the size and growth of Clean Energy Technology markets and the leading countries therein. *[Source is: http://www.second-street.com/PortfolioCleanEnergy.html, Retrieved October 23, 2011.]*

Urgently need a clean energy system based on the efficient use of renewable energy sources, which has at its heart protecting us from climate change, the protection of the environment and the delivery of sustainable development. We need an energy system, which does not render our cities uninhabitable; increase the radioactive burden for future generations; and which does not lead to the proliferation of nuclear weapons.

Seek a world in which the manifest benefits of energy services, such as light, heat, power and transport are equitably available for all: north and south, rich and poor. Only in this way can we create true energy security, as well as the conditions for true human security. *[Source is: http://www.greenpeace.org/raw/content/international/press/reports/renewable-energy-and-climate.pdf, Retrieved October 23, 2011.]*

The technology to reverse global warming already exists; it just needs to be implemented. There are clean energy solutions that could replace coal power, which is the number one source of carbon dioxide. These clean energy solutions include such things as solar, wind, and hydroelectric power. However, no single form of clean energy can provide for all the world's energy needs, since many locations lack sufficient wind, while others lack an adequate water source for hydroelectric power, and so on. Clean energy solutions work by pairing the proper mode of energy production with the location where it will be used. (Figure 2.67)

There are also cleaner fuel sources on the horizon, such as hydrogen, ethanol, and biodiesel. These sources are not only cleaner, but also renewable, meaning they come from sources that can never be depleted, such as corn in the case of ethanol. In contrast, fossil fuels not only pollute, but they are also; when the world's supply of coal, natural gas, and gasoline is gone, it will be gone forever. This is because fossil fuels, as their name

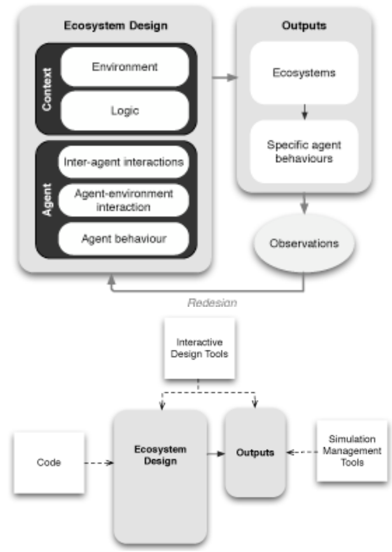


Figure 2.66: Ecosystems Design. *Source:[http://diotima.infotech.monash.edu.au/~jonmc/sa/research/creative-ecosystems/, Retrieved October 23, 2011]*

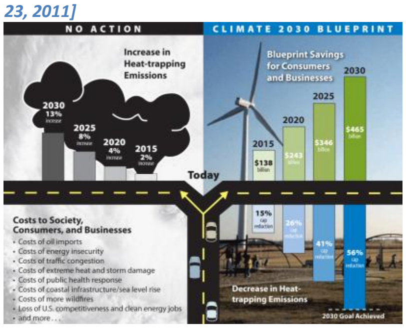


Figure 2.67: clean energy and global warming. *Source:[http://www.ucsusa.org/global_warming/solutions/big_picture_solutions/global_warming_crossroads.html, Retrieved October 23, 2011]*

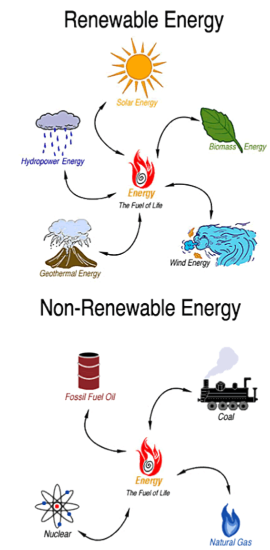


Figure 2.68: energy-resources-renewable-nonrenewable

suggests, take millions of years to form underground. But these clean energy solutions will not solve the problem of global warming overnight. It will also require a change in energy policy. Clean energy solutions already exist; they just aren't being utilized. According to the U.S. Department of Energy, 85% of all the energy consumed in the United States still comes from burning fossil fuels. The main obstacle facing clean energy solutions is not a lack of technology, but a lack of economic feasibility. Unfortunately, most countries in the developed world depend largely on fossil fuels to keep their economies running. The technology to stop global warming is already here, now it must be put into action. (Figure 2.68) *[Source is: http://www.toowarm.org/globalwarming/cleanenergy/ , Retrieved October 23, 2011.]*

4.1.1.B Solar Power.

A photovoltaic system is based on the ability of certain materials to convert the radiant energy of the sun into electrical energy. The total amount of solar energy that lights a given area is known as irradiance (G) and it is measured in watts per square meter (W/m2). The instantaneous values are normally averaged over a period of time, so it is common to talk about total irradiance per hour, day or month. (Figure 2.69)

Solar technologies tap directly into the infinite power of the sun and use that energy to produce heat, light, and power.

Passive Solar Lighting and Heating (Figure 2.70)**,** People have used the sun to heat and light their homes for centuries. Ancient Native Americans built their dwellings directly into south-facing cliff walls because they knew the sun travels low across the southern sky in the Northern Hemisphere during the winter. They also knew the massive rock of the cliff would absorb heat in winter and protect against wind and snow. At the same time, the cliff welling design blocked sunlight during the summer, when the sun is higher in the sky, keeping their dwellings cool. The modern version of this sun-welcoming design is called *passive solar* because no pumps, fans, or other mechanical devices are used. Its most basic features include large, south-facing windows that fill the home with natural sunlight, and dark tile or brick floors that store the sun's heat and release it back into the home at night. In the summer, when the sun is higher in the sky, window overhangs block direct sunlight, which keeps the house cool (Figure 2.71). Tile and brick floors also remain cool during the summer. Passive solar design combined with energy efficiency will go

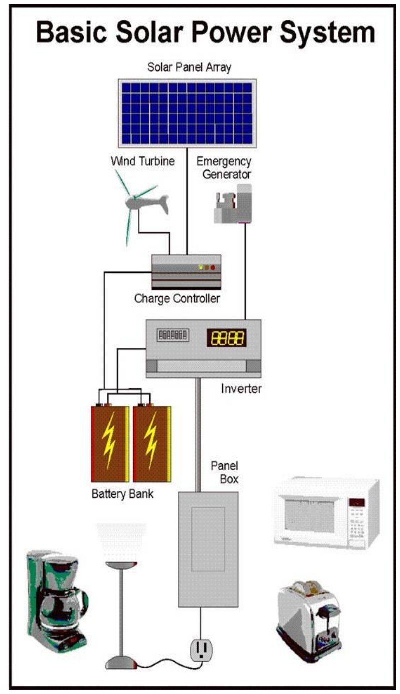


Figure 2.69: Basic Solar Power System. *Source:[http://picture7412.myblog.it/archive/2011/06/25/solar-power-system.html?googleresim, Retrieved October 23, 2011]*

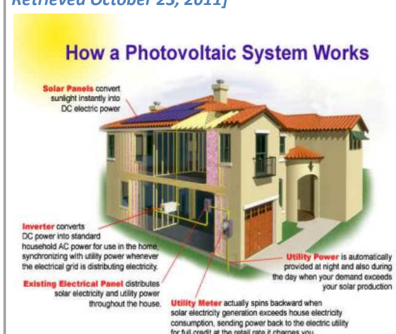


Figure 2.70: How Photovoltaic System Works. *Source:[http://www.solarexpert.com/solar-electric-how-it-works.html, Retrieved October 23, 2011]*

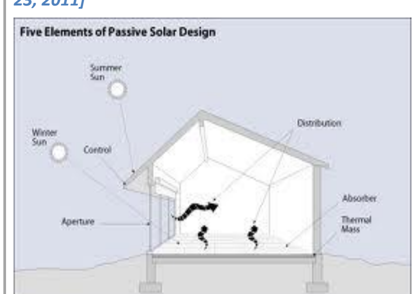


Figure 2.71: Five Elements of Passive Solar Design. *Source:[http://www.ucsusa.org/global_warming/solutions/big_picture_solutions/global_warming_crossroads.html, Retrieved October 23, 2011]*

even further. Energy-efficient features such as energy saving windows and appliances, along with good insulation and weather stripping, can make a huge difference in energy and cost savings. (Figure 2.72) *[Source is: **Renewable Energy: An Overview**, **CADDET Renewable Energy**, Web site: www.caddet-re.org. (2001)]*

Solar Water Heating (Figure 2.73)**,** Solar energy can be used to heat water for your home or your swimming pool. Most solar water-heating systems consist of a solar collector and a water storage tank. Solar water-heating systems use collectors, generally mounted on a south-facing roof, to heat either water or a heat-transfer fluid, such as a nontoxic antifreeze. The heated water is then stored in a water tank similar to one used in a conventional gas or electric water-heating system. There are basically three types of solar collectors for heating water: flat plate, evacuatedtube, and concentrating. The most common type, *a flat-plate collector*, is an insulated, weatherproof box containing a dark absorber plate under a transparent cover. *Evacuated- tube collectors* are made up of rows of parallel, transparent glass tubes. Each tube consists of a glass outer tube and an inner tube, or absorber, covered with a coating that absorbs solar energy but inhibits heat loss. *Concentrating collectors* for residential applications are usually parabolic-shaped mirrors (like a trough) that concentrate the sun's energy on an absorber tube called a receiver that runs along the axis of the mirrored trough and contains a heat-transfer fluid. All three types of collectors heat water by circulating household water or a heat-transfer fluid such as a nontoxic antifreeze from the collector to the water storage tanks. Collectors do this either passively or actively. Passive solar water-heating systems use natural convection or household water pressure to circulate water through a solar collector to a storage tank. They have no electric components that could break, a feature that generally makes them more reliable, easier to maintain, and possibly longer lasting than active systems. An *active* system uses an electric pump to circulate water or nontoxic antifreeze through the system. Active systems are usually more expensive than passive systems, but they are also more efficient. Active systems also can be easier to retrofit than passive systems because their storage tanks do not need to be installed above or close to the collectors. Also, the moving water in the system will not freeze in cold climates. But because these systems use electricity, they will not function in a power outage. That's why many active solar-electric panel to power the pump. The amount of hot water a solar water heater produces depends on the type and size of the system, the amount of sun available at

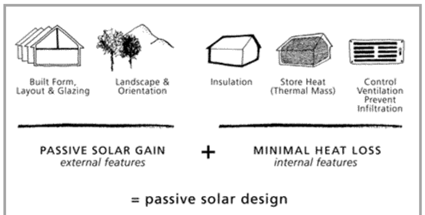


Figure 2.72: Passive Solar Design. *Source:[http://scambs.jdi consult.net/ldf/readdoc.php?docid=202&chapter=13, Retrieved October 23, 2011]*

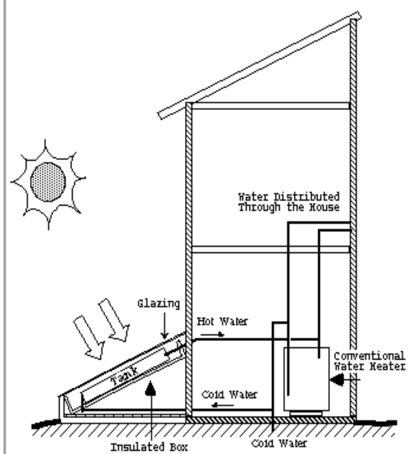


Figure 2.73: Solar Water Heating. *Source:[http://solarheatcool.sustainablesources.com/, Retrieved October 23, 2011]*

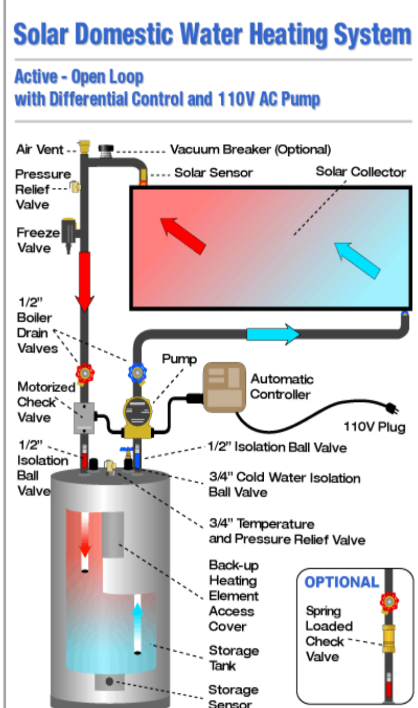


Figure 2.74: Solar Domestic Water Heating System. *Source:[http://www.solardirect.com/swh/active/open/active-open.htm, Retrieved October 23, 2011]*

the site, proper installation, and the tilt angle and orientation of the collectors. But if you're currently using electric water heater, solar water heating is a cost-effective alternative. If you own a swimming pool, heating the water with solar collectors can also save you money. (Figure 2.74) *[Source is: **Renewable Energy: An Overview**, **CADDET Renewable Energy,** Web site: www.caddet-re.org. (2001)]*

Solar Electricity (Figure 2.75)**,** Solar electricity or photovoltaic (PV) technology converts sunlight directly into electricity. Solar electricity has been a prime source of power for space vehicles since the inception of the space program. It has also been used to power small electronics and rural and agricultural applications for three decades. During the last decade, a strong solar electric market has emerged for powering urban grid-connected homes and buildings as a result of advances in solar technology along with global changes in electric industry restructuring (Figure 2.76). Although many types of solar electric systems are available today, they all consist of basically three main items: *modules* that convert sunlight into electricity; *inverters* that convert that electricity into alternating current so it can be used by most household appliances; and possibly or sometimes *batteries* that store excess electricity produced by the system (Figure 2.77). The remainder of the system comprises equipment such as wiring, circuit breakers, and support structures. Today's modules can be built into glass skylights and walls. Some modules resemble traditional roof shingles, but they generate electricity, and some come with built-in inverters. The solar modules available today are more efficient and versatile than ever before. In over 30 states, any additional power produced by a PV system, which is not being used by a home or building, can be fed back to the electric grid through a process known as *net metering.* Net metering allows electricity customers to pay only for their "net" electricity, or the amount of power consumed from their utility minus the power generated by their PV system. This metering arrangement allows consumers to realize full retail value for 100 percent of the PV energy produced by their systems. Grid-connected PV systems do not require batteries. However, some grid connected systems use them for emergency backup power. And of course in remote areas, solar electricity is often a economic alternative to expensive distribution line extensions incurred by a customer first connecting to the utility grid. Electricity produced by solar electric systems in remote locations is stored in batteries. Batteries will usually store electricity produced by a solar electric system for up to three days. What type of system to purchase will depend on the

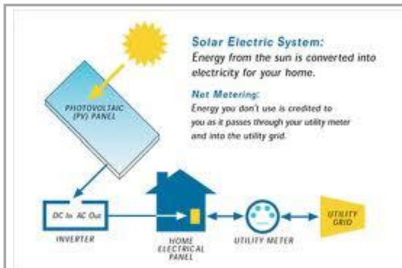


Figure 2.75: Solar Electric System. *Source:[http://www.solar-green-wind.com/archives/tag/solar-power-systems, Retrieved October 26, 2011]*

Figure 2.76: Visualizing Natural Resources. *Source:[http://www.solar-green-wind.com/archives/tag/solar-power-systems, Retrieved October 26, 2011]*

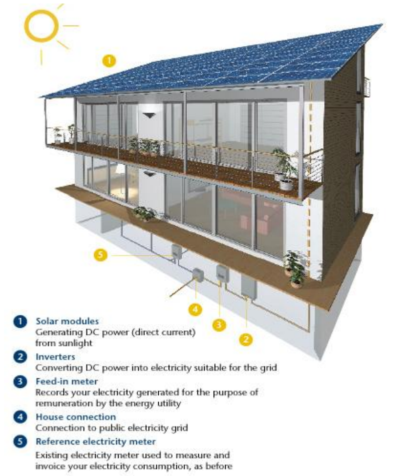


Figure 2.77: Solar Works on Home. *Source:[http://abacusenergypartners.com/products/residential/solar-pv-electricity/how-solar-works-on-your-home/, Retrieved October 26, 2011]*

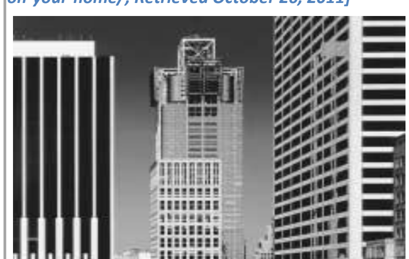


Figure 2.78: The Four Times Square Building in New York City uses thin-film PV panels to reduce the building's power load from the utility grid.

energy-efficiency of your home, your home's location, and your budget. Before you size your system, try reducing energy demand through energy efficient measures. Purchasing energy-saving appliances and lights, for example, will reduce your electrical demand and allow you to purchase a smaller solar-electric system to meet your energy needs or get more value from a larger system. Energy efficiency allows you to start small and then add on as your energy needs increase. (Figure 2.78) *[Source is: **Renewable Energy: An Overview**, **CADDET Renewable Energy,** Web site: www.caddet-re.org. (2001)]*

Solar Thermal Electricity (Figure 2.79)**,** Unlike solar-electric systems that convert sunlight into electricity, solar thermal electric systems convert the sun's heat into electricity. This technology is used primarily in large-scale power plants for powering cities and communities, especially in the Southwest where consistent hours of sunlight are greater than other parts of the United States. Concentrating solar power (Figure 2.80) (CSP) technologies convert solar energy into electricity by using mirrors to focus sunlight onto a component called a receiver. The receiver transfers the heat to a conventional engine-generator—such as a steam turbine—that generates electricity. There are three types of CSP systems: power towers (central receivers), parabolic troughs, and dish/engine systems. A *power tower system* uses a large field of mirrors to concentrate sunlight onto the top of a tower, where a receiver sits. Molten salt flowing through the receiver is heated by the concentrated sunlight. The salt's heat is turned into electricity by a conventional steam generator. *Parabolic trough systems* concentrate the sun's energy through long, parabolic-shaped mirrors. Sunlight is focused on a pipe filled with oil that runs down the axis of the trough. When the oil gets hot, it is used to boil water in a conventional steam generator to produce electricity. A uses a mirrored dish (similar in size to a large satellite dish). The dish-shaped surface focuses and concentrates the sun's heat onto a receiver at the focal point of the dish (above and center of the collectors). The receiver absorbs the sun's heat and transfers it to a fluid within an engine, where the heat causes the fluid to expand against a piston to produce mechanical power. The mechanical power is then used to run a generator or alternator to produce electricity. Concentrating solar technologies can be used to generate electricity for a variety of applications, ranging from remote power systems as small as a few kilowatts (kW) up to grid-connected applications of 200 MW or more. A354-MW power plant in , which consists of nine trough power plants, meets the energy needs of more than 350,000 people and is the world's

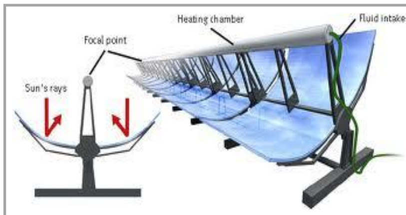


Figure 2.79: Solar Thermal Electricity.

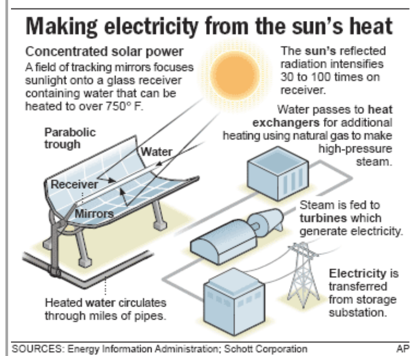


Figure 2.80: Concentrating Solar Power.

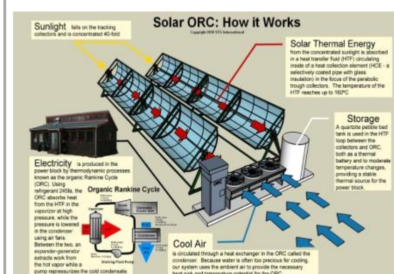


Figure 2.81: Solar ORC technology has three main components: the parabolic troughs, the organic Rankine cycle (ORC) engine, and the electrical control system

Figure 2.82: California Utility Agrees to Buy 553 Megawatts of Solar Power.
Source:[http://apps1.eere.energy.gov/news/news_detail.cfm/news_id=11132, Retrieved October 26, 2011]

largest solar energy power plant. (Figure 2.82) *[Source is: **Renewable Energy: An Overview**, **CADDET Renewable Energy,** Web site: www.caddet-re.org. (2001)]*

4.1.1.C Green Power.

Green Power is Energy produced from renewable or non-polluting and non-hazardous technologies such as windmills, geothermal power plants, and solar-cells. (Figure 2.83)

Renewable energy is derived from natural sources that replenish themselves over short periods of time. These resources include the sun, wind, moving water, organic plant and waste material (biomass), and the earth's heat (geothermal). This renewable energy can be used to generate electricity as well as for other applications. For example, biomass may be used as boiler fuel to generate steam heat; solar energy may be used to heat water or for passive space heating; and landfill methane gas can be used for heating or cooking. (Figure 2.84)

Although the environmental impacts of renewable energy are generally minimal, these power sources still do have some effect on the environment. For example, biomass resources are converted to electricity through combustion, which emits some air pollutants. Hydro electric dams can flood the surrounding land and impede the passage of fish. Compared with conventional power, however, renewable power generally avoids, or at least significantly reduces, the adverse environmental impacts of conventional electricity generation.

The term green power is used in a number of different ways. In the broadest sense, green power refers to environmentally preferable energy and energy technologies, both electric and thermal. This definition of green power includes many things, from solar photovoltaic systems to wind turbines to fuel cells for automobiles. *[Source is: http://pdf.wri.org/guide_purchase_green.pdf, Retrieved October 28, 2011.]*

Although renewable resources do more than generate electricity, green power is most commonly used in a narrower, marketing, sense to refer specifically to *electricity* from renewable resources? Green power includes the following three products:

- "Renewable electricity" is generated using renewable energy resources and is delivered through the utility grid. (Figure 2.85)

Figure 2.83: Green Power Logos. *Source:[http://green-power-clean.com/, Retrieved October 26, 2011]*

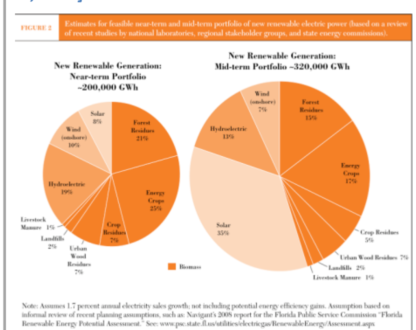


Figure 2.84: Renewable Resources Generation. *Source:[http://solarheatcool.sustainablesources.com/, Retrieved October 28, 2011]*

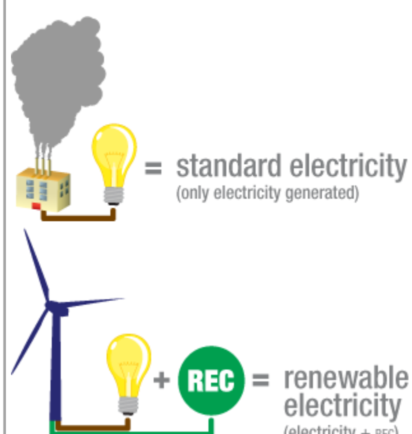


Figure 2.85: Renewable Electricity and Renewable Electricity Certificates "RECs". *Source:[http://solarheatcool.sustainablesources.com/, Retrieved October 28, 2011]*

- "Renewable Energy Certificates" (RECs) represent the environmental, social, and other positive attributes of power generated by renewable resources. (Figure 2.86)

- "On-site renewable generation" refers to electricity generated using renewable energy resources at the end-user's facility. (Figure 2.87)

Green power can help many organizations meet environmental, financial, stakeholder relations, economic development, and national security objectives. *[Source is: http://pdf.wri.org/guide_purchase_green.pdf, Retrieved October 28, 2011.]*

- **Environmental:** Avoid environmental impacts. Green power and renewable energy avoid most of the environmental impacts associated with traditional power generation, helping protect human health and the health of the environment.

- **Financial:** Fuel supply disruptions. On-site renewable generation can reduce the risk of disruptions in fuel supplies resulting from transportation difficulties or international conflict.

- **Financial:** Additional environmental regulation. To address global climate change and regional air quality issues, federal and state regulations have been proposed that would effectively increase the price of conventional electricity. But green power would be largely unaffected by these regulations, resulting in more stable prices over the long run.

On-site renewable energy technologies for power generation include photovoltaic panels, wind turbines, fuel cells, and biomass combustion. Large facilities sited near a municipal landfill or sewage treatment plant may be able to use recovered methane gas for on-site electricity and/or heat production. The following describes each of these options in more detail:

- Solar. Photovoltaic (PV) cells (Figure 2.88) and modules can be configured to almost any size from a few kilowatts up to more than one megawatt. On-site photovoltaic cells may be situated on schools, homes, community facilities, and commercial buildings. Photovoltaic cells can be made part of a

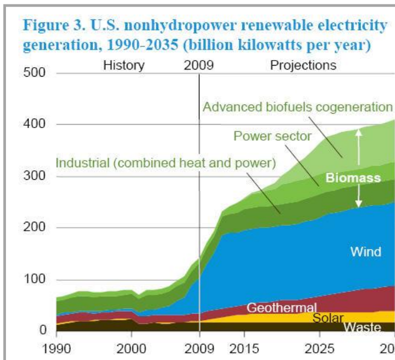


Figure 2.86: Renewable Electricity.
Source:[http://solarheatcool.sustainablesources.com/, Retrieved October 28, 2011]

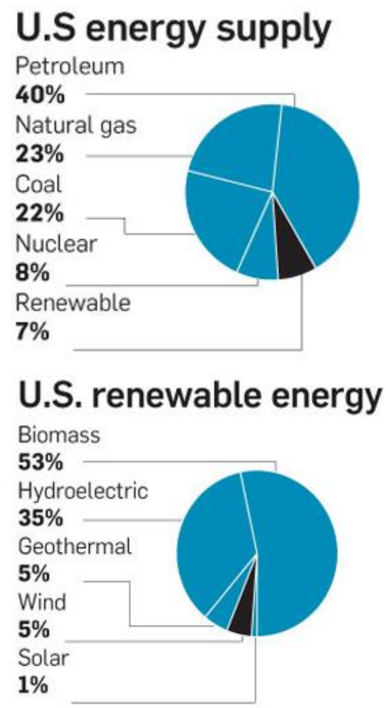


Figure 2.87: Energy Breakdowns.
Source:[http://sunhome.mst.edu/2011/10/, Retrieved October 28, 2011]

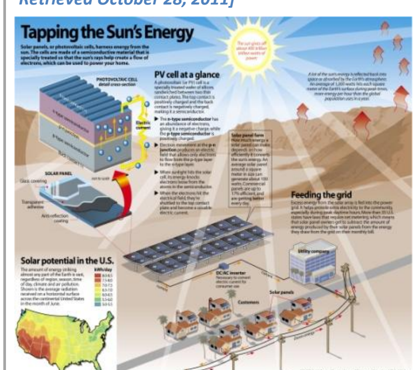


Figure 2.88: Solar Photovoltaic Cells.
Source:[http://www.greentechnolog.com/photovoltaics/, Retrieved October 28, 2011]

building, displacing other building material costs, for example, roofing shingles or car park shading.

- Wind turbines vary in size. A typical small unit provides fewer than 25 kW, whereas large turbines range from 500 kW to more than 3 MW. On-site applications are usually only possible in nonurban areas, and often require zoning permits to exceed 35-foot height restrictions (a tower for a 250 kW turbine is 130 feet high with a blade sweep of 98 feet). Such installations usually require approximately one acre of land per turbine and wind speeds that average 15 mph at a 50-meter height. In addition, placing turbines near tall buildings is inadvisable because the building may create wind turbulence that can disrupt the turbines' performance.*[Sourceis:http://pdf.wri.org/guide_purchase_green.pdf,Retrieved October 28, 2011.]* (Figure 2.89)
- Landfill and sewage methane gas. Methane gas derive from landfills or sewage treatment plants may be used to generate electricity. Methane gas also may be generated using digesters that operate on manure or agricultural wastes. The methane gas is then converted to electricity using an internal combustion engine, gas turbine (depending on the quality and quantity of the gas), direct combustion boiler and steam turbine generator set, micro turbine unit, or other power conversion technology. Most methane gas projects produce from 0.5 to 4 MW of electrical output. (Figure 2.90)

- Biomass is plant material burned in a boiler to drive a steam turbine to produce electricity. This system is good for producing combined heat and power (CHP) at facilities with large thermal loads. Biomass projects are best suited to locations with abundant biomass resources (often using waste products from the forest industry or agriculture). (Figure 2.91)

- Fuel cells are another way of producing power. They emit essentially no air pollution and are more efficient than other forms of generation. But they cannot be considered a renewable resource unless they operate on a renewably generated fuel, such as digester gas or hydrogen derived from PV or wind power. (Figure 2.92)

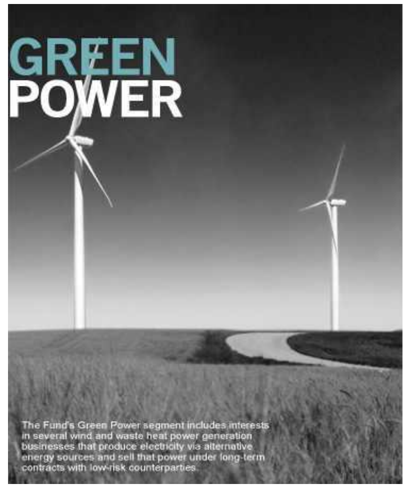


Figure 2.89: Wind Turbines. *Source:[http://solarheatcool.sustainablesources.com/, Retrieved October 28, 2011]*

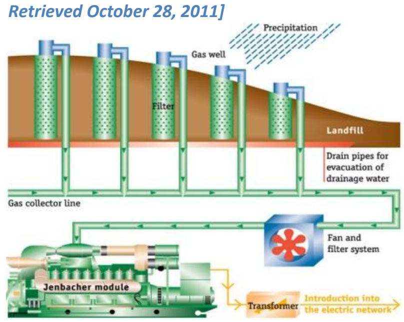


Figure 2.90: Landfill and sewage methane gas. *Source:[http://solarheatcool.sustainablesources.com/, Retrieved October 28, 2011]*

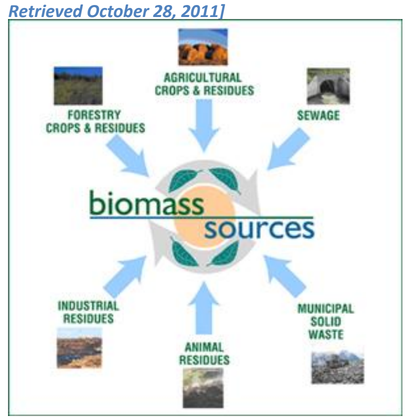


Figure 2.91: Biomass Sources.

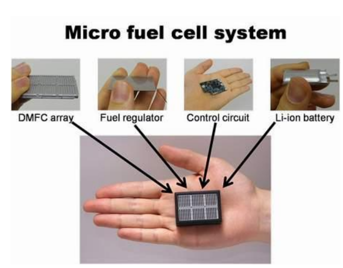


Figure 2.92: Micro Fuel Cell System.

4.1.2 The Contemporary design Context.

Orthographic projection in architectural representation inherently privileges the surface. When the three-dimensional world is sliced to fit into a two-dimensional representation, the physical objects of a building appear as flat planes. Regardless of the third dimension of these planes, we recognize that the eventual occupant will rarely see anything other than the surface planes behind which the structure and systems are hidden. While the common mantra is that architects design space the reality is that architects make (draw) surfaces. This privileging of the surface drives the use of materials in two profound ways. First is that the material is identified as the surface: the visual understanding of architecture is determined by the visual qualities of the material. Second is that because architecture is synonymous with surface – and materials are that surface – we essentially think of materials as planar. The result is that we tend to consider materials in large two-dimensional swaths: exterior cladding, interior sheathing. Many of the materials that we do not see, such as insulation or vapor barriers, are still imagined and configured as sheet products. Even materials that form the three-dimensional infrastructure of the building, such as structural steel or concrete, can easily be represented through a two-dimensional picture plane as we tend to imagine them as continuous or monolithic entities. Most current attempts to implement smart materials in architectural design maintain the vocabulary of the two dimensional surface or continuous entity and simply propose smart materials as replacements or substitutes for more conventional materials. For example, there have been many proposals to replace standard curtain wall glazing with an electrochromic glass that would completely wrap the building facade. The reconsideration of smart material implementation through another paradigm of material deployment has yet to fall under scrutiny. (Figure 2.93) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

One major constraint that limits our current thinking about materials is the accepted belief that the spatial envelope behaves like a boundary. We conceive of a room as a container of ambient air and light that is bounded or differentiated by its surfaces; we consider the building envelope to demarcate and separate the exterior environment from the interior environment (Figure 2.94). The presumption that the physical boundaries are one and the same as the spatial boundaries has led to a focus on highly integrated, multifunctional systems for facades as well

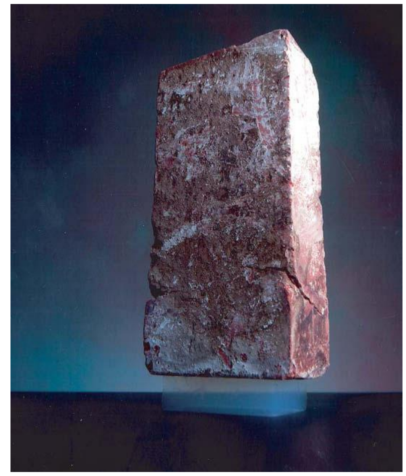


Figure 2.93: Aerogel has a density only three times that of air, but it can support significant weights and is a superb insulator. Aerogels were discovered in 1931 but were not explored until the 1970s. (NASA)

Figure 2.94: Aerogel. *Source:[http://stardust.jpl.nasa.gov/photo/posters.html, Retrieved October 28, 2011]*

Figure 2.95: the 'heat' chair that uses thermochromic paint to provide a marker of where and when the body rested on the surface. (Courtesy of Juergen Mayer H)

as for many interior partitions such as ceilings and floors. In 1981, Mike Davies popularized the term ‘polyvalent wall’, which described a facade that could protect from the sun, wind and rain, as well as provide insulation, ventilation and daylight. His image of a wall section sandwiching photovoltaic grids, sensor layers, radiating sheets, micropore membranes and weather skins has influenced many architects and engineers into pursuing the ‘super facade’ as evidenced by the burgeoning use of double skin systems. This pursuit has also led to a quest for a ‘super-material’ that can integrate together the many diverse functions required by the newly complex facade. Aerogel (Figure 2.95) has emerged as one of these new dream materials for architects: it insulates well yet still transmits light; it is extremely lightweight yet can maintain its shape. Many national energy agencies are counting on Aerogel to be a linchpin for their future building energy conservation strategies, notwithstanding its prohibitive cost, micro-structural brittleness and the problematic of its high insulating value, which is only advantageous for part of the year and can be quite detrimental at other times. *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

4.1.3 Smart System.

Smart Buildings (Figure 2.96)**,** or at least discussion of the concept, originated in the early 1980s. In 1984, for instance, a New York Times article described real estate developers creating “a new generation of buildings that almost think for themselves . . . called **intelligent buildings**.” (Figure 2.97) Such a building was defined as “a marriage of two technologies-old-fashioned building management and telecommunications.”

Smart buildings are not just about installing and operating technology or technology advancements. Technology and the systems in buildings are simply enablers, a means to an end. The technology allows us to operate the building more efficiently; to construct the buildings in a more efficient way, to provide productive and healthy spaces for the occupants and visitors, to provide a safe environment, to provide an energy-efficient and sustainable environment (Figure 2.98), and to differentiate and improve the marketability of the building. (Figure 2.99) *[Source is: **Smart Building Systems for Architects, Owners, and Builders**, James Sinopoli. (2010)]*

A smart building involves the installation and use of advanced and integrated building technology systems. These

Figure 2.96: Smart Home Design. *Source:[http://www.deakin.edu.au/travelsmart/benefits.php, Retrieved October 28, 2011]*

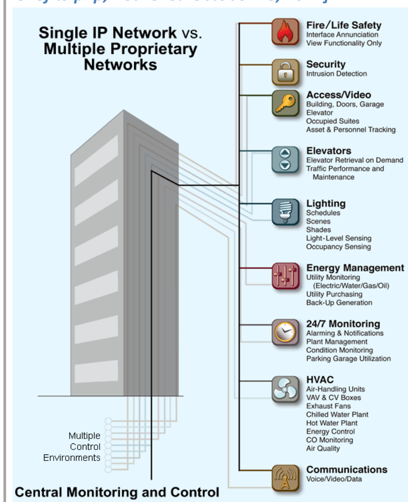


Figure 2.97: Intelligent Buildings Systems. *Source:[http://www.automatedbuildings.com/news/dec07/articles/sinopoli/071129114606sinopoli.htm, Retrieved October 30, 2011]*

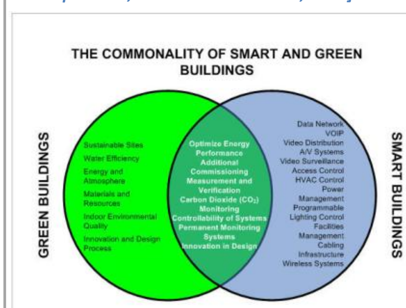


Figure 2.98: the commonality of smart and green buildings. *Source:[http://www.buildings.com/tabid/3334/ArticleID/5736/Default.aspx Retrieved October 30, 2011]*

Figure 2.99: Smart Systems.

systems include building automation, life safety, telecommunications, user systems, and facility management systems. Smart buildings recognize and reflect the technological advancements and convergence of building systems, the common elements of the systems and the additional functionality that integrated systems provide. Smart buildings provide actionable information about a building or space within a building to allow the building owner or occupant to manage the building or space. *[Source is: **Smart Building Systems for Architects, Owners, and Builders**, James Sinopoli. (2010)]*

Smart buildings provide the most cost effective approach to the design and the deployment of building technology systems. The traditional way to design and construct a building is to design, install, and operate each system separately (Figure 2.100). The smart building takes a different approach to designing the systems. Essentially, one designer designs or coordinates the design of all the building technology systems into a unified and consistent construction document. The construction document specifies each system and addresses the common system elements or integration foundation for the systems. These include cabling, cable pathways, equipment rooms, system databases, and communications protocols between devices. The one consolidated design is then installed by a contractor, referred to as a Technology Contractor or as a Master System Integrator.

This process reduces the inefficiencies in the design and construction process saving time and money. During the operation of the building, the building technology systems are integrated horizontally among all subsystems as well as vertically-that is subsystems to facility management systems to business systems-allowing information and data about the building's operation to be used by multiple individuals occupying and managing the building. (Figure 2.101)

Smart buildings are also a critical component regarding energy usage and sustainability of buildings and the smart electrical grid. The building automation systems, such as HVAC control, lighting control, power management, and metering play a major role in determining the operational energy efficiency of a building. The smart electrical grid is dependent on smart buildings. (Figure 2.102) *[Source is: **Smart Building Systems for Architects, Owners, and Builders**, James Sinopoli. (2010)]*

In order for a building to be classified as smart building, it should possess a group of features that help sense, decide and

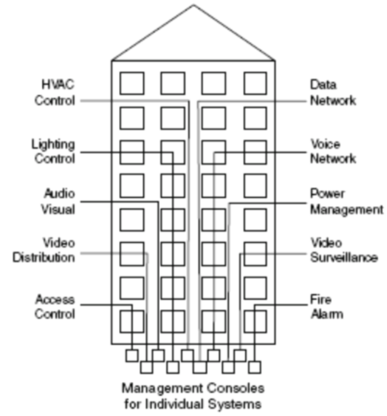


Figure 2.100: Multiple proprietary building systems.

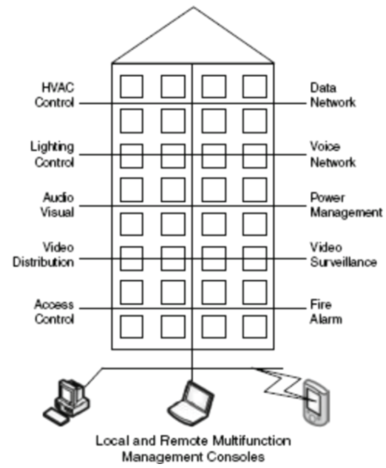


Figure 2.101: Integrated building systems.

Figure 2.102: Smart Buildings Component and energy building System.
*Source:[**http://www.buildings.com/tabid/3334/ArticleID/5736/Default.aspx**, Retrieved October 30, 2011]*

control the different elements and areas of a building. Most of the following features should be included:

Building Management Systems (BMS), it is the central processing unit of the system, "the brain" that receives all the information from all the sensors and determines the appropriate control function or procedure to be followed in response. It should be able to control all passive and active systems of the building in order to produce the best conditions for the internal environment. (Figure 2.103)

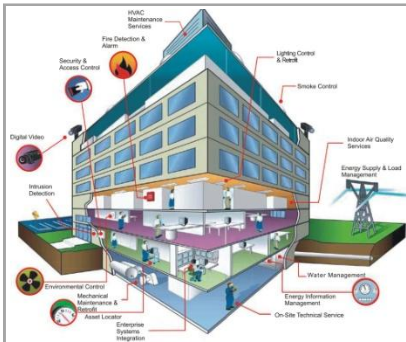


Figure 2.103: Building Management Systems (BMS). *Source:[http://www.cems.ro/building-management-systems/, Retrieved October 30, 2011]*

Learning Ability, smart system should be able to learn and anticipate different weather conditions built on historic logging of information. It should be also able to learn assess the impact of control strategies and their final outcome on the indoor environment.

Environmental Data, real time measurements of outdoor weather data should be available in order interact accordingly. This data should include temperatures, wind speed, humidity and daylighting values. Indoor climate and lighting conditions should also be monitored and measured. Different kinds of sensors are used for such systems. They include (fire and smoke detection, photo optics, access, acceleration, shock and vibration, motion and human presence, temperature, humidity, solar radiation, pressure, light, flow of liquids and gases, air content, moisture, chemical measurement, structural system monitoring, mechanical system monitoring of HVAC system. (Figure 2.104)

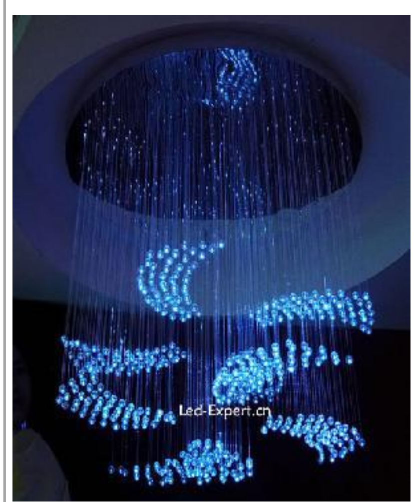


Figure 2.104: fire and smoke detection and photo optics from environment data. *Source:[http://www.traderscity.com/board/products-1/offers-to-sell-and-export-1/china-optical-fibre-fibers-optics-wholesale-factory-supply-111357/, Retrieved October 30, 2011]*

Responsive Artificial Lighting, an effective daylighting strategy incorporates such a system in order to dim lights automatically in order to maximize the use of natural daylight, and to compensate for the deficit in natural light by the appropriate amount of light needed it supply the required lighting level according to the type of activity. Dimming of individual lights could generate a lot more saving in energy consumption.

Daylight Controllers, the maximization of the use of daylight- as previously mentioned – is a main objective of smart building. Thus, mechanically and electrically controlled light guiding, reflecting and shading devices are employed. These depend on different light sensors that detect solar intensity and angle. (Figure 2.105) *[Source is: **Intelligent skins, Architectural press, Oxford**, Michael Wigginton et al. (2003)]*

Sun Controllers, sun tracking solar energy collectors and devices are employed. The unwanted effects of the sun, such as overheating and glare, are accounted for by controllable, louver, overhangs, internal and external blinds and shading devices. They have ability to be opened, closed and tilted. (Figure 2.106)

Occupant Control, it is proven that the occupants perform better if they feel they have control over their internal environment. Hence, occupant control should be provided, yet to a limit, as it might lead to compromising other areas of control and performance in the building. Thus occupant control should be within a limited range, if exceeded, the system either warns them, or takes over and does not allow for manual override. *[Source is: **Intelligent skins, Architectural press, Oxford**, Michael Wigginton et al. (2003)*

Electricity Generators, photovoltaic generated electricity, wind turbines and solar heating and cooling are features that can be incorporated to achieve electrical autonomy. (Figure 2.107)

Ventilation Controllers, such as retractable roofs, motorized windows and pneumatic dampers are used in order to obtain naturally induced ventilation and air changes. They are automatically operated according to varying internal and external conditions such as wind speed, temperature and noise levels. They maximize the use of natural ventilation. However, if not efficient enough, most systems include additional mechanical ventilation techniques to make up for the deficit.

Cooling Devices, in addition to using passive cooling techniques, after hours natural ventilation can be employed to pre-cool the building`s thermal mass.

The Double Skin, it is a system that incorporates the use of a second layer of glass or a similar material, in order to increase the use of daylight and natural ventilation. (Figure 2.108) *[Source is: **Intelligent skins, Architectural press, Oxford**, Michael Wigginton et al. (2003)]*

4.1.4 Media of Smart System.

Building information modeling (BIM) is the process of generating and managing building data during its life cycle. BIM involves representing a design as objects – vague and undefined, generic or product-specific, solid shapes or void-

Figure 2.105: Daylight Controllers.

Figure 2.106: Louver from Sun Controllers

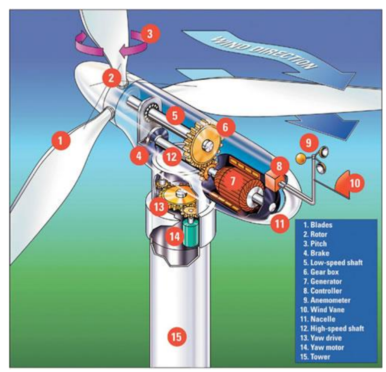


Figure 2.107: Wind Turbines from Electricity generators

Figure 2.108: Double Skin.

space oriented (like the shape of a room), that carry their geometry, relations and attributes. BIM design tools allow for extracting different views from a building model for drawing production and other uses. These different views are automatically consistent – in the sense that the objects are all of a consistent size, location, specification – since each object instance is defined only once, just as in reality. Drawing consistency eliminates many errors. Typically it uses three-dimensional, real-time, dynamic building modeling software to increase productivity in building design and construction. The process produces the Building Information Model (also abbreviated BIM), which encompasses building geometry, spatial relationships, geographic information, and quantities and properties of building components. Pieces can carry attributes for selecting and ordering them automatically, providing cost estimates and well as material tracking and ordering. This method of management is more practical and efficient. It eliminates many of the uncertainties found during the construction phase since they can be found during the design phase of the project and fixed so they do not occur during the actual construction phase. Also, any changes during construction will be automatically updated to BIM and those changes will be made in the model. Modern BIM design tools go further. They define objects parametrically. That is, the objects are defined as parameters and relations to other objects, so that if a related object changes, this one will also. (Figure 2.109) *[Source is: http://Building information modeling - Wikipedia, the free encyclopedia.mht, Retrieved November 04, 2011.]*

Building information modeling covers geometry, spatial relationships, light analysis, geographic information, quantities and properties of building components (for example manufacturers' details). BIM can be used to demonstrate the entire building life cycle, including the processes of construction and facility operation. Quantities and shared properties of materials can be extracted easily. Scopes of work can be isolated and defined. Systems, assemblies and sequences can be shown in a relative scale with the entire facility or group of facilities. Dynamic information of the building, such as sensor measurements and control signals from the building systems, can also be incorporated within BIM to support analysis of building operation and maintenance. (Figure 2.110)

Under the guidance of a **virtual design and construction project manager** (**VDC**) BIM can be seen as a companion to **Product Lifecycle Management** (**PLM**), since it goes beyond geometry and addresses issues such as **cost**

Figure 2.109: Building Information Modeling (BIM) Elements. *Source:[http://www.scia-online.com/en/bim-building-information-modeling-software.html, Retrieved October 30, 2011]*

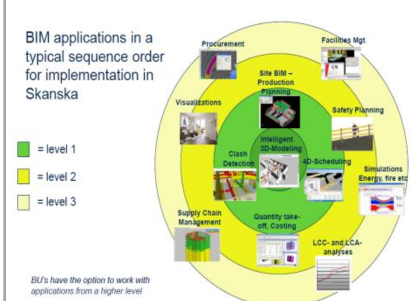


Figure 2.110: BIM applications. *Source:[http://www.scia-online.com/en/bim-building-information-modeling-software.html, Retrieved October 30, 2011]*

management, Project Management and provides a way to work concurrently on most aspects of building life cycle processes. BIM goes far beyond switching to new software. It requires changes to the definition of traditional architectural phases and more data sharing than most architects and engineers are used to. (Figure 2.111) *[Source is: http://Building information modeling - Wikipedia, the free encyclopedia.mht, Retrieved November 04, 2011.]*

BIM is able to achieve such improvements by modeling representations of the actual parts and pieces being used to build a building. This is a substantial shift from the traditional computer aided drafting method of drawing with vector file-based lines that combine to represent objects.

The interoperability requirements of construction documents include the drawings, procurement details, environmental conditions, submittal processes and other specifications for building quality. It is anticipated by proponents that VDC utilizing BIM can bridge the information loss associated with handing a project from design team, to construction team and to building owner/operator, by allowing each group to add to and reference back to all information they acquire during their period of contribution to the BIM model. (Figure 2.112) *[Source is: http://Building information modeling - Wikipedia, the free encyclopedia.mht, Retrieved November 04, 2011.]*

The American Institute of Architects has further defined BIM as "a model-based technology linked with a database of project information", and this reflects the general reliance on database technology as the foundation. In the future, structured text documents such as specifications may be able to be searched and linked to regional, national, and international standards. (Figure 2.113)

A building information model can be used for the following purposes:

- Visualization: 3D renderings can be easily generated in-house with little additional effort.
- Fabrication/shop drawings: it is easy to generate shop drawings for various building systems, for example, the sheet metal ductwork shop drawing can be quickly produced once the model is complete.
- Code reviews: fire departments and other officials may use these models for their review of building projects.
- Forensic analysis: a building information model can easily be adapted to graphically illustrate potential

Figure 2.111: BIM Components. *Source:[http://www.scia-online.com/en/bim-building-information-modeling-software.html, Retrieved October 30, 2011]*

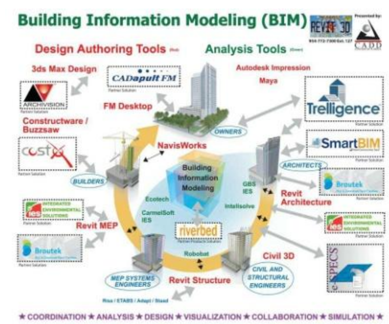


Figure 2.112: Many Type of Building Information Modeling (Revit Architecture, Smart BIM)

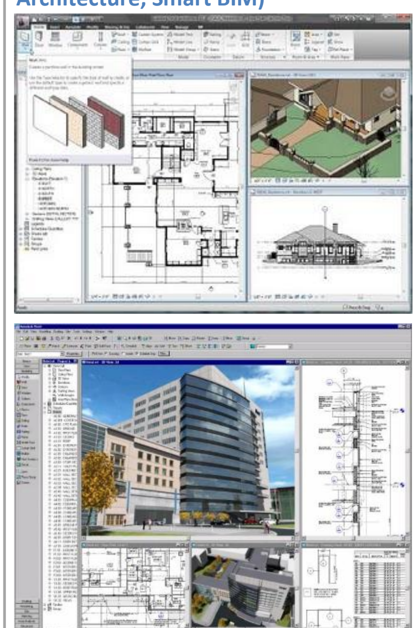


Figure 2.113: Interface of Revit Program and how it works. *Source:[http://www.bluentcad.com/services/revit-bim-services.html, Retrieved October 30, 2011]*

failures, leaks, evacuation plans, etc.

- Facilities management: facilities management departments can use BIM for renovations, space planning, and maintenance operations.
- Cost estimating: BIM software(s) have built-in cost estimating features. Material quantities are automatically extracted and changed when any changes are made in the model.
- Construction sequencing: a building information model can be effectively used to create material ordering, fabrication, and delivery schedules for all building components.
- Conflict, interference and collision detection: because BIM models are created, to scale, in 3D space, all major systems can be visually checked for interferences. This process can verify that piping does not intersect with steel beams, ducts or walls. (Figure 2.116) *[Source is: http://Building information modeling - Wikipedia, the free encyclopedia.mht, Retrieved November 04, 2011.]*

The key benefit of BIM is its accurate geometrical representation of the parts of a building in an integrated data environment. Other related benefits are (Figure 2.114):

- Faster and more effective processes – information is more easily shared, can be value-added and reused.
- Better design – building proposals can be rigorously analyzed, simulations can be performed quickly and performance benchmarked, enabling improved and innovative solutions.
- Controlled whole-life costs and environmental data – environmental performance is more predictable, lifecycle costs are better understood.
- Better production quality – documentation output is flexible and exploits automation.
- Automated assembly – digital product data can be exploited in downstream processes and be used for manufacturing/assembling of structural systems.
- Better customer service – proposals are better understood through accurate visualization.
- Lifecycle data – requirements, design, construction and operational information can be used in facilities management.

Figure 2.114: Benefits of BIM Process. *Source:[http://www.cowieassociates.com/2010/heres-something-new-about-boma/, Retrieved November 04, 2011]*

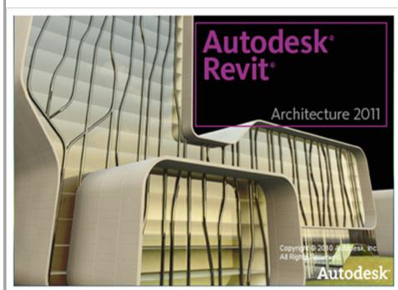


Figure 2.115: Autodesk Revit. *Source:[http://www.cowieassociates.com/2010/heres-something-new-about-boma/, Retrieved November 04, 2011]*

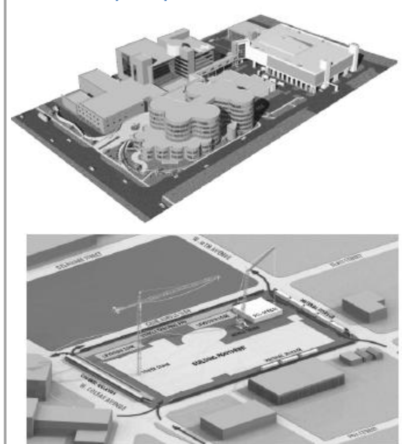


Figure 2.116: 3D Architectural Model and Site Logistic Planning Model

Figure 2.117: Revit Final Project. *Source:[http://bimboom.blogspot.com/, Retrieved November 04, 2011]*

Autodesk **Revit Architecture** (Figure 2.115) often referred to as simply **Revit** is a **Building Information Modeling** software developed by Autodesk. Revit Architecture, for architects and building designers (formerly *Revit Building*). The AutoCAD Revit Architecture Suite includes Revit Architecture, AutoCAD, and AutoCAD Architecture. An AutoCAD Revit Architecture Visualization Suite also adds 3ds Max Design and Navisworks Review. (Figure 2.117) *[Source is: http://Building information modeling - Wikipedia, the free encyclopedia.mht, Retrieved November 04, 2011.]*

4.2 Smart Materials.

4.2.1 Materials and architecture

The relationship between architecture and materials had been fairly straightforward until the Industrial Revolution. Materials were chosen either pragmatically – for their utility and availability – or they were chosen formally – for their appearance and ornamental qualities. Locally available stone formed foundations and walls, and high-quality marbles often appeared as thin veneers covering the rough construction. Decisions about building and architecture determined the material choice, and as such, we can consider the pre-19th century use of materials in design to have been subordinate to issues in function and form. Furthermore, materials were not standardized, so builders and architects were forced to rely on an extrinsic understanding of their properties and performance. In essence, knowledge of materials was gained through experience and observation. Master builders were those who had acquired that knowledge and the skills necessary for working with available materials, often through disastrous trial and error. (Figure 2.118) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

Figure 2.118: Several examples of how nanoscale materials are currently being used. Applications include many optical films for light, color, or thermal control; light-emitting devices (QLEDs); surfaces that are self-cleaning, antibacterial, or self-healing and that aid pollution reduction; nanofoams and nanogels for thermal insulation; solar cells; and a host of applications related to the strength and stiffness of members

The role of materials changed dramatically with the advent of the Industrial Revolution. Rather than depending on an intuitive and empirical understanding of material properties and performance, architects began to be confronted with engineered materials. Indeed, the history of modern architecture can almost be viewed through the lens of the history of architectural materials. Beginning in the 19th century with the widespread introduction of steel, leading to the emergence of long-span and high-rise building forms, materials transitioned from their pre-modern role of being subordinate to architectural needs into a means to expand functional performance and open up new formal responses. The industrialization of glass-making coupled with developments in environmental systems enabled the 'international style' in which a transparent architecture could be sited in any climate and in any context. The broad proliferation of curtain wall systems allowed the disconnection of the facade material from the building's structure and infrastructure, freeing the material choice from utilitarian functions so that the facade could become a purely formal element. Through advancements in CAD/CAM (Computer Aided Design/Computer Aided Manufacturing) technologies, engineering materials such as aluminum and titanium can now be efficiently and easily employed as building skins, allowing an unprecedented range of building facades and forms. Materials have progressively emerged as providing the most immediately visible and thus most appropriable manifestation of a building's representation, both interior and exterior. As a result, today's architects often think of materials as part of a design palette from which materials can be chosen and applied as compositional and visual surfaces. *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

It is in this spirit that many have approached the use of smart materials. Smart materials are often considered to be a logical extension of the trajectory in materials development toward more selective and specialized performance. For many centuries one had to accept and work with the properties of a standard material such as wood or stone, designing to accommodate the material's limitations, whereas during the 20th century one could begin to select or engineer the properties of a high performance material to meet a specifically defined need. Smart materials allow even a further specificity – their properties are changeable and thus responsive to transient needs. For example, photochromic materials change their color (the property of spectral transmissivity) when exposed to light: the more intense the incident light, the darker the surface. This ability to respond to multiple states rather than being optimized for a single state has rendered smart materials a seductive addition to the design palette since buildings are always confronted with changing conditions. As a result, we are beginning to see many proposals speculating on how smart materials could begin to replace more conventional building materials. (Figure 2.119)

Figure 2.119: 'Hyposurface' installation combines position sensors with conventional actuators to create a responsive surface. Images courtesy of Marc Goulthorpe and DeCOI Architects

Cost and availability have, on the whole, restricted widespread replacement of conventional building materials with smart materials, but the stages of implementation are tending to follow the model by which 'new' materials have traditionally been introduced into architecture: initially through highly visible showpieces (such as thermochromic chair backs and electrochromic toilet stall doors) and later through high profile 'demonstration' projects such as Diller and Scofidio's Brasserie Restaurant on the ground floor of Mies van der Rohe's seminal Seagram's Building. Many architects further imagine building surfaces, walls and fac¸ades composed entirely of smart materials, perhaps automatically enhancing their design from a pedestrian box to an interactive arcade. Indeed, terms like interactivity and transformability have already become standard parts of the architect's vocabulary even insofar as the necessary materials and technologies are far beyond the economic and practical reality of most building projects.

Rather than waiting for the cost to come down and for the material production to shift from lots weighing pounds to those weighing tons, we should step back and ask if we are ignoring some of the most important characteristics of these materials. Architects have conceptually been trying to fit smart materials into their normative practice alongside conventional building materials. Smart materials, however, represent a radical departure from the more normative building materials. Whereas standard building materials are static in that they are intended to withstand building forces, smart materials are dynamic in that they behave in response to energy fields. This is an important distinction as our normal means of representation in architectural design privileges the static material: the plan, section and elevation drawings of orthographic projection fix in location and in view the physical components of a building. One often designs with the intention of establishing an image or multiple sequential images. With a smart material, however, we should be focusing on what we want it do, not on how we want it to look. The understanding of smart materials must then reach back further than simply the understanding of material properties; one must also be cognizant of the fundamental physics and chemistry of the material's interactions with its surrounding environment. The purpose of this book is thus two-fold: the development of a basic familiarity with the characteristics that distinguish smart materials from the more commonly used architectural materials, and speculation into the potential of these characteristics when deployed in architectural design. (Figure 2.120) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

Figure 2.120: Dichroic light field from James Carpenter Design Associates. To animate a blank, brick fac¸ade, a field of 216 dichroic fins was attached perpendicularly to a large plane of semi-reflective glass.

4.2.2 Characteristics of smart materials

We have been liberally using the term ‘smart materials’ without precisely defining what we mean. Creating a precise definition, however, is surprisingly difficult. The term is already in wide use, but there is no general agreement about what it actually means. A quick review of the literature indicates that terms like ‘smart’ and ‘intelligent’ are used almost interchangeably by many in relation to materials and systems, while others draw sharp distinctions about which qualities or capabilities are implied. NASA defines smart materials as ‘materials that ‘‘remember’’ configurations and can conform to them when given a specific stimulus’, a definition that clearly gives an indication as to how NASA intends to investigate and apply them. A more sweeping definition comes from the Encyclopedia of Chemical Technology: ‘smart materials and structures are those objects that sense environmental events, process that sensory information, and then act on the environment’.4 Even though these two definitions seem to be referring to the same type of behavior, they are poles apart. The first definition refers to materials as substances, and as such, we would think of elements, alloys or even compounds, but all would be identifiable and quantifiable by their molecular structure. The second definition refers to materials as a series of actions. Are they then composite as well as singular, or assemblies of many materials, or, even further removed from an identifiable molecular structure, an assembly of many systems? (Figure 2.121)

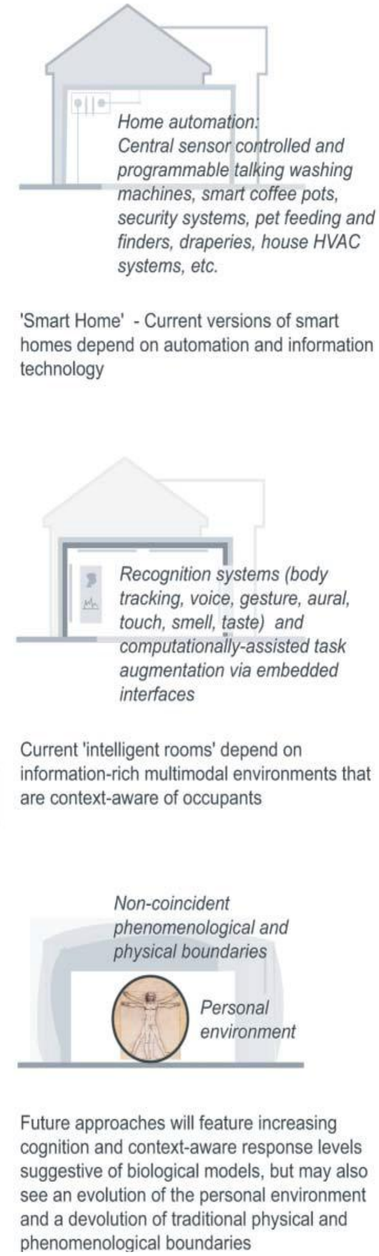


Figure 2.121: Current smart room and intelligent room paradigms, with a glimpse into the future

If we step back and look at the words ‘smart’ and ‘intelligent’ by themselves we may find some cues to help us begin to conceptualize a working definition of ‘smart materials’ that would be relevant for designers. ‘Smart’ implies notions of an informed or knowledgeable response, with associated qualities of alertness and quickness. In common usage, there is also frequently an association with shrewdness, connoting an intuitive or intrinsic response. Intelligent is the ability to acquire knowledge, demonstrate good judgment and possess quickness in understanding. . (Figure 2.122) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

Figure 2.122: Monsanto’s ‘House of the Future’ opened at Disneyland in 1957. The house, and all its furnishings, were fabricated of plastic

Interestingly, these descriptions are fairly suggestive of the qualities of many of the smart materials that are of interest to us. Common uses of the term ‘smart materials’ do indeed suggest materials that have intrinsic or embedded quick response capabilities, and, while one would not commonly think about a material as shrewd, the implied notions of cleverness and discernment in response are not without interest. The idea of discernment, for example, leads one to thinking about the inherent power of using smart materials selectively and strategically. Indeed, this idea of a strategic use is quite new to architecture, as materials in our field are rarely thought of as performing in a direct or local role. Furthermore, selective use hints at a discrete response – a singular action but not necessarily a singular material. Underlying, then, the concept of the intelligent and designed response is a seamless quickness – immediate action for a specific and transient stimulus. *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

Does 'smartness', then, require special materials and advanced technologies? Most probably no, as there is nothing a smart material can do that a conventional system can't. A photochromic window that changes its transparency in relation to the amount of incident solar radiation could be replaced by a globe thermometer in a feedback control loop sending signals to a motor that through mechanical linkages repositions louvers on the surface of the glazing, thus changing the net transparency. Unwieldy, yes, but nevertheless feasible and possible to achieve with commonly used technology and materials. (Indeed, many buildings currently use such a system.) So perhaps the most unique aspects of these materials and technologies are the underlying concepts that can be gleaned from their behavior. (Figure 2.123)

Whether a molecule, a material, a composite, an assembly, or a system, 'smart materials and technologies' will exhibit the following characteristics:

- Immediacy – they respond in real-time.
- Transiency – they respond to more than one environmental state.
- Self-actuation – intelligence is internal to rather than external to the 'material'.
- Selectivity – their response is discrete and predictable.
  Directness – the response is local to the 'activating' event. *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

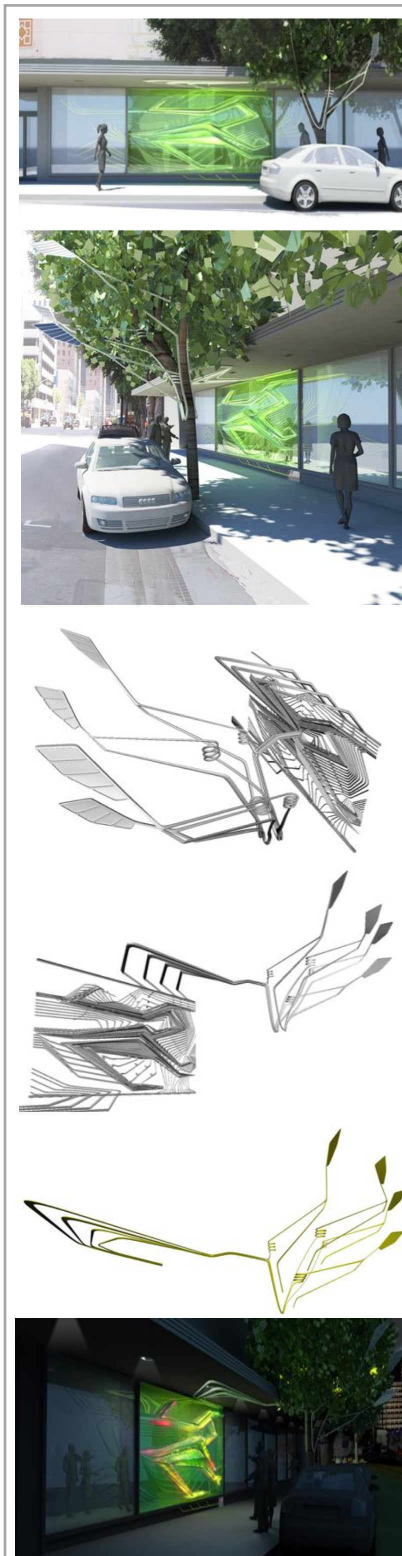


Figure 2.123: Flower Street BioReactor, Location: Department of Culture and the arts, LA Los Angeles, USA, 2009 Design by: Tom Wiscombe, Bin Lu, Ryan.

4.2.3 Examples of Smart Materials

FACADE SYSTEMS

THE SMART WINDOW:

The term ‘smart window’ has been applied to any system that purports to have an interactive or switchable surface, regardless of whether that surface is a real or virtual window, interior or exterior. For the purposes of this book, we will consider the virtual windows to fall into the category of large panel displays, and concentrate our discussion on exterior glazing and interior partitions. (Figure 2.124)

‘Smart’ windows will typically possess one or more of the following functions:

- Control of optical transmittance. A shift in the transparency (the optical density) of the material may be used to manage the incident solar radiation, particularly in the visual and near ultraviolet wavelengths. The window would vary from high density (opaque or translucent) for the prevention of direct sun penetration and its associated glare to low density (transparent) as incident light loses intensity.

- Control of thermal transmittance. This is a similar function to that above, but the wavelengths of interest extend into the near infrared region of the spectrum. Heat transmission by radiation can be minimized when appropriate (summer) and maximized for other conditions. (Figure 2.125) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

- Control of thermal absorption. Transparency and conductivity tend to correlate with each other, but are relatively independent of the incident radiation. Whenever the inside temperature is higher than the outside temperature, a bidirectional heat flow is established: radiant energy transfers in, while thermal energy transfers out. Altering the absorption of the glazing will ultimately affect the net conductivity, and thus can shift the balance in favor of one or the other direction.

- Control of view. The use of switchable materials to

Figure 2.124: Design experiment: the patterns in this wall study vary with changing temperature and with the on–off state of the LCD panel. (Yun Hsueh)

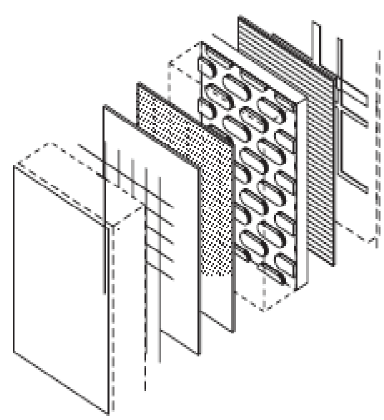


Figure 2.125: Schematic representation of Mike Davies’ polyvalent wall. He proposed that the exterior wall could be a thin system with layers of weather skin, sensors and actuators, and photoelectric

control view is currently the fastest growing application of smart materials in a building. Interior panels and partitions that switch from transparent to translucent allow light to transmit, but are able to moderate the view by altering the specularity of the material. Exterior store fronts can reveal merchandise in windows selectively, perhaps only when the store is open. A specular material will transmit intact images, whereas a diffuse material will obscure the image.

Figure 2.126: Fiber-optics, dichroic glasses and LEDs were used by James Carpenter Design Associates in this lobby installation for Bear Stearns in New York. The green zone is produced with fiber-optics and dichroic glass, it serves as a soft contrast to the moving blue LED information screens.

LIGHTING SYSTEMS

FIBER-OPTIC LIGHTING:

The use of fiber-optics for illumination, however, demands a radical shift in the way one thinks about lighting. Each optical cable will emit a fraction of the light emitted from a more typical lamp, but the light can be more productive. Ambient lighting systems fall prey to inverse square losses, the intensity drops off with the square of the distance. The light-emitting end of the fiber-optic can be placed almost anywhere, and thus can be quite close to the object or surface being illuminated. The tiny amount of light emitted may deliver the same lumens to the desired location as light being emitted from a ceiling fixture at more than an order of magnitude greater intensity. Contrast can also be locally and directly controlled. As we can see, then, fiber-optic lighting possesses two of the important characteristics of smart materials – they are direct and selective. (Figure 2.126) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

Fiber-optic lighting offers other advantages over conventional systems. The source of light is remote in comparison to where it is delivered. As a result, the heat from the source is also remote. Lighting, as an inefficient process, produces more heat than light such that about one-third of a building's air-conditioning load is simply to remove the excess heat generated by the lamps. Not only does a remote source save energy, but it protects the lighted objects from heat damage and possibly even fire. Since no electrical or mechanical components are required beyond those at the source location, electrical infrastructure can be reduced and maintenance is simplified. Color control and UV/IR filtering can easily be incorporated, expanding the versatility not only of the system but of each individual cable. These advantages,

Figure 2.127: Field of Light, Bruce Munro*Source:[http://plusmood.com/2008/11/field-of-light-2-bruce-munro/, Retrieved November 04, 2011]*

particularly in regard to the heat reduction and UV control, have rendered fiber-optics the choice for museum exhibit lighting and for display case illumination. The majority of other architectural uses, however, tend to be decorative, utilizing the point of light at the emitting end of the cable as a feature rather than for illumination. Even though there are good models for the effective and efficient use of fiber-optic illumination, the paradigm of the ambiently lit interior is so pervasive that onlythose applications with critical requirements have utilized thisdiscrete approach to lighting. (Figure 2.127) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

A fiber-optic lighting systems is comprised of three majorcomponents:

- Illuminator: this houses the light supply for the fiber-optics. The source of light can be anything, from LEDs to halogen, metal halide, or even solar radiation. Key features of the source are its color and intensity; the greater the intensity, the greater the number of emitting ends, called tails, that are possible. Greater intensity also enables longer length of the tails, up to 75 feet. The light source generates a large amount of heat which then must be dissipated by heat sinks and/or fans. Reflectors and lenses will narrow the light beam as much as possible to fit within the cone of acceptance (this is determined from the critical angle of the strand medium). Light must enter the acceptance cone, so the more collimated the source, the more efficient the transformation will be. Color wheels and other filters are often included in the illuminator to create special lighting effects or eliminate unwanted UV. Electronic controls, including ballasts and dimmers, are also housed in the illuminator. (Figure 2.128) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

- Cable or harness: fiber-optics for lighting are either solid core or stranded fiber, both of which are bundled into cable form and sheathed with a protective covering. (No cladding is used.) The emitting end will most likely be split into multiple tails, each one providing distinct illumination, while the source end will be bound as a single cable and connected into a coupler, which is then connected to the illuminator. The entire cable assembly,

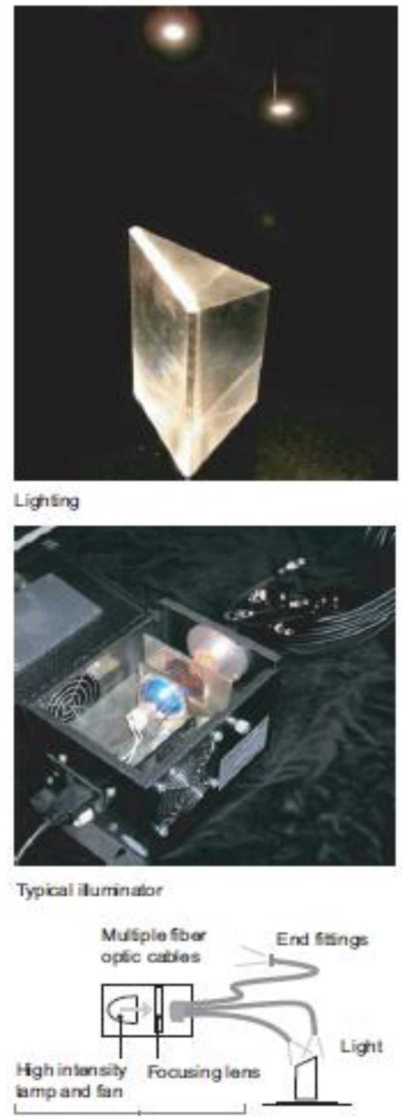


Figure 2.128: Fiber-optic lighting. Multiple cables can be served from a single lamp. The lamp heat and fan noise is removed from the object being illuminated.

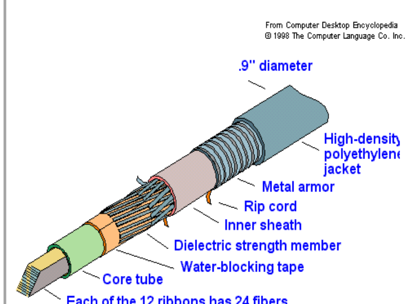


Figure 2.129: Fiber Optics. *Source:[http://encyclopedia2.thefreedictionary.com/Fiber-optic+cable, Retrieved November 04, 2011]*

including the coupler, is referred to as a harness. (Figure 2.129)

- End fittings: for end emitters, the tail ends will need to be secured or mounted in some manner, and the primary purpose of the end fittings, which are usually threaded, is to allow this. The fittings can also house individual lenses and filters so that the light emitted from each tail end can be controlled separately.

ENERGY SYSTEMS

PHOTOVOLTAICS:

Photovoltaics were essentially the provenance of NASA until about two decades ago when large-scale photovoltaic generating facilities were first built. (Figure 2.130) The high cost and low efficiency of these facilities prevented their widespread adoption as it was more effective to use the solar energy to produce steam in an intermediate step rather than to produce electricity directly. Concurrently, PVs as replacements for batteries began emerging in small products such as calculators and watches. Although PVs were commonly used in remote areas to power villages, houses and even offshore platforms without an electrical supply, they did not gain favor in grid-connected buildings until the electrical industry was deregulated. Through its 'Million Solar Roofs' initiative launched in 1997, the US Department of Energy (Figure 2.131) has been encouraging, and rewarding (through tax credits), the widespread privatization of grid-connected PVs. Relieving the utilities of the high investment burden of moving to carbonfree generation, the push for building-scale distributed PVs was also intended to speed up the transition to solar technologies. The term 'building-integrated photovoltaic (BIPV)' is now a part of every architect's vocabulary. (Figure 2.132) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

Some basic understanding about PV operation is needed before the decision is made to install a system. A typical photovoltaic cell produces about 2 watts. The cells are connected in series to form modules, and the modules are connected in parallel to form arrays. Series connection is necessary to build up to an adequate operational voltage, but it is then vulnerable to any weak link in the connection. If individual cells in the modules are unevenly illuminated,

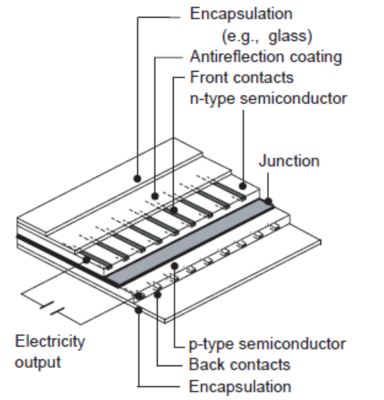


Figure 2.130: Schematic layout of a photovoltaic cell

Figure 2.131: US. Department of Energy. *Source:[http://www.nativelegalupdate.com/2011/04/articles/national-tribal-energy-summit-45-may-2011/, Retrieved November 04, 2011]*

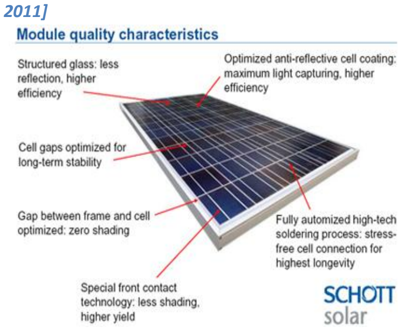


Figure 2.132: Photovoltaic Cell. *Source:[http://www.rayotec.com/solar_power/photovoltaics.php, Retrieved November 04, 2011]*

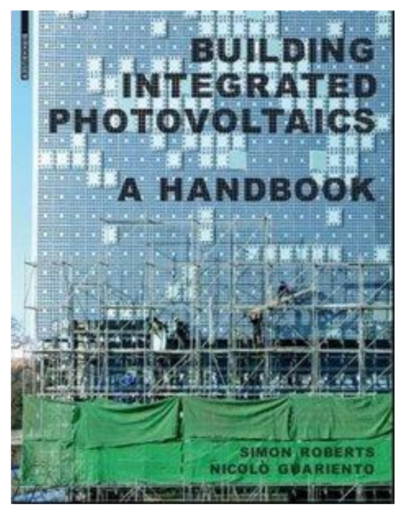


Figure 2.133: Building Integrated Photovoltaic.

perhaps due to shading from trees or dirt accumulation, the unlit cells will dissipate the power produced by the illuminated cells. Night-time causes a problem as well, blocking diodes are necessary to prevent PV systems from drawing electricity when they are not illuminated, but not without a penalty. The penalty is an output power loss. As a result, the efficiency of the module is approximately 20–25% (this is before one even takes the PV cell efficiency into account) Thin film technologies are not subject to inter-cell losses as they are manufactured directly as modules, but they still suffer the inverter and transformer losses. (Figure 2.133) (Figure 2.134) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

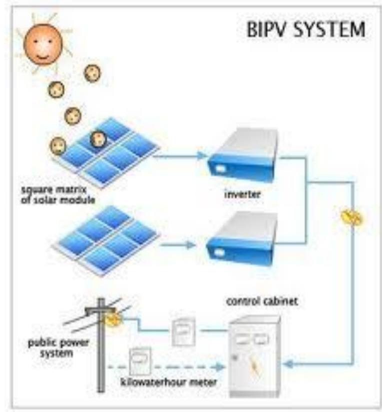
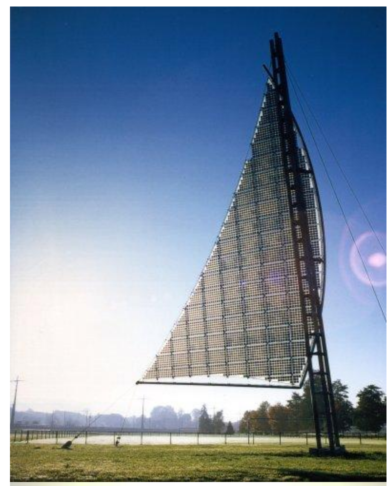


Figure 2.134: BIPV System. *Source:[http://www.rayotec.com/solar_power/photovoltaics.php, Retrieved November 04, 2011]*



Stand-alone systems store the generated power in batteries, whereas the intention of BIPVs is to interconnect with the utility grid. The appropriate matching of PV operation with the utility is known as 'balance of system'. This is not a small issue, since both are dynamic systems. There is powerconditioning equipment that manages this transfer, but it too reduces overall efficiency. Just the inverters for converting the DC power of the array to AC power for the utility operate at efficiencies between 70 and 90%. (Stand-alone systems also require 'balance of system': batteries need charge controllers to prevent overcharging and excessive discharging.) Each additional piece of equipment needed in the system reduces the overall efficiency.

The efficiency of the individual solar cell by itself has received much of the attention in research and development. While solar cell efficiencies are continuing to increase, and are now about 8% for thin film to about 18% for single crystal silicon, we must recall that the conversion of radiation to electricity is an uphill process, and thus one in which the theoretical efficiency will be limited.8 While solar energy is certainly copious, the low efficiency would not seem to be an issue with the exception of cost, but the principle of exergy tells us that energy lost due to efficiency is converted to heat. The efficiency calculation for PVs takes into consideration solar radiation that is reflected, so not all of the efficiency drop creates heat; nevertheless, 40–45% of incident solar radiationon a module does produce heat. (Figure 2.135) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

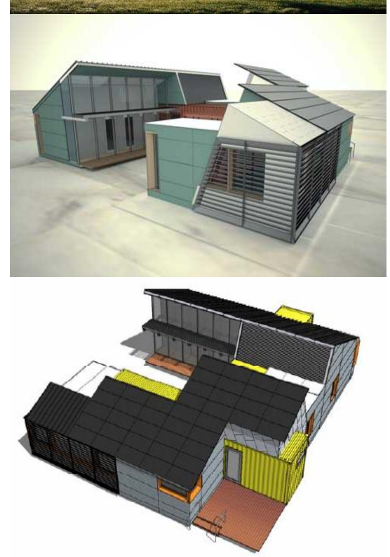


Figure 2.135: University of Colorado Solar Decathlon complete house rendering *Source:[http://solar.colorado.edu/pdf/Energy_Analysis.pdf, Retrieved November 04, 2011]*

Part Two Conclusion

This part provides a broad review of previous work in part two like the architecture trends and its goals to reach to sustainability solutions serving the environment friendly. We will find out that all of these schools aim to reducing the co2 emissions which increase the negative effects of global warming, and aim also to using clean energy in buildings and in the design methods of these schools to serve the envirnoment and substituting the electricity; the non renewable energy; which harm the envirnoment. These new techniques which depend on the renewable energy "clean", producing, and transforming it to usable energy so all the kind of buildings either residential, commercial or offices can depend on it. And also all other types, and the architrcture schools. This is answer one of the important questions which aim to answer this message:

- **How Can Nanoarchitecture reduce the global warming?**
- **What are the techniques that can reduce global warming?**

The answer of these two important questions appears through different aspects as follows:

- **First aspect:** focusing on the designing and architectural aspects and new schools which aim to using renewable "clean" energy serving the envirnoment in the primary stages of the design process so introducing new architectural trends aim to reducing the global warming effects.

- **Second aspect:** integrating "or combining" the new technologies of clean energy and its different forms in the design process and relying on it as new architectural processing techniquies providing substuiting solutions for the petrolum energy, and coal energy which harm the environment. Throug using these techniquies, it will be possible to reduce the negative effects resulting from using the petrolum energy and the coal energy.

- **Third aspect:** one of the common points between all of these schools and different techniques is reaching "or inventing" new systems like ventialion system, natural ligting system, artifical lighting system, water feeding system, water treatment, and saintary "or drainage" system and other differnet systems which consolidate the using and dependancy of clean, renewable, and carbon free energy.

- **Forth aspect:** the role of specialist entities in assessing or evaluating the building performance, effectiveness, its role in preserving the environment, its impact on the surrounding environment, its caused damages, and its clean energy usage percentage that protect the environment like leed, and … all of these organizations enjoy independency and international recognitionaim to preserve the environment and reducing the harmful gases emissions of buildings and construction sector by assessing or evaluating building performance, and the different systems in the building such as the effectiveness of the natural lighting system in reducing the use of electricity lighting, converting or transforming solar lighting produced by solar cells to clean energy, building redirecting to receive the largest sunlight amount in the interior spaces, and to store the largest sunlight amount via through the solar cells.

- **Fifth aspect:** beside to the new technologies of the clean energy, there are also the smart materials which have the ability to respond to different environmental changes. Some of these materials are for the external usage such as for external layer for the building to prevent the transmission of the harmful environmental changes inside the building. Also it can absorb all the useful environmental characteristics which could be helpful inside the building such as the smart windows which works to prevent the heat transmission into the building, harmful rays and transmit only the useful sunlight rays. All of this can be applied through its characteristics which resist the harmful rays and absorb the useful one. Also it can control the light amount entered in the space without being glare or darkness.

The introduction of a system for green building assessment and rating is considered to be one of the cornerstones of promoting sustainable green building development. For example, in 1990 the Building Research Establishment in the UK introduced the Building Research Establishment Environmental Assessment Method (BREEAM) and several years later, the United States Green Building Council launched its LEED (Leadership in Energy and Environmental Design) system. Many other countries have followed suit. There is increasing evidence from these countries that owners, investors and the public are starting to place a premium on certified green buildings. In response to the need for an Egyptian green building assessment system, and with the benefit of the experiences of early-adopters in other countries, the Housing and Building National. The concept of green building observes important criteria which secure the attainment of the required quality and efficiency of buildings. It covers guidance, location preparation and careful study, consideration of optimal methods for water consumption including recycling of used water for other industrial and agricultural purposes, studies on lighting, air conditioning, natural ventilation and the renewable energy sources such as the solar and wind energy systems. These technologies now exist, but it is crucial that they are promoted.

The change of the material properties directs us toward nanotechnology which helps in identifying and reaching the different properties of materialswhich serve our needs like in smart materials. Also the useful characteristics of materials help the building to achieve the highest effectiveness in the surrounding environment and in the interior spaces through creating internal smart environments. Also the smart material integrate with the modern systems of clean energy to reach to the highest level of building efficiency and performance which happens only through using the modern systems and smart materials to achieve the following equations:

Clean energy system + smart materials = high efficiency building

Hence, the role of nanotechnology in serving the nanoarchitecture becomes clearer in reaching to useful and smart properties of materials contributing in modern architecture; its main aim to reach to the highest level of efficiency of a friendly environment building and significantly reducing the harmful rays' emissions of the building resulting from using the old systems using petroleum and coal energy which harm the environment and substituting it with new clean techniques and systems reducing the energy consumption enhance energy saving and carbon free.

The next part or chapter will present different forms to reduce the gas emissions and facing the global warming using a package of different methods through using nanotechnology and nano-science, its importance to nanoarchitecture, and nanoarchitecture role to control this phenomenon.

Part Three: Nanoarchitecture and Global Warming Solution.

Introduction…

Chapter Five: Nanotechnology Solution

5.1 Nanotechnology and Nanoscience as future Solution:

5.1.1 Environmental Benefits and Impacts.

5.1.2. Reduction of pollution in the production of materials.

5.1.3. Reduction of pollution in construction, use and demolition.

5.2 Futures Solutions:

5.2.1. Materials for Global Warming.

5.2.2. Sensors and Smart Electronic.

5.2.3. How Recycling can help stop Global Warming.

5.2.4. Nanotechnology centers in the Arab world.

Chapter Six: Futuristic Thinking

6.1 Architecture Applications:

6.1.1. Nano House.

6.1.2. Nano Studio.

6.1.3. Carbon Tower.

6.1.4 Bahrain World Trade Center.

6.2 Futuristic thinking of zero carbon urban settlement:

(zero carbon infrastructure and architecture)

6.2.1. Masder city.

6.2.2. Energy Island.

6.3 Futuristic thinking Nano zero carbon settlement:

(nano zero carbon infrastructure and architecture)

6.3.1. Nano-city India.

6.3.2. Nano-Polis China.

6.4 Case Study (Reading Area in Bibliotheca Alexandrina)

6.4.1. Background of Case Study.

6.4.2. Concept of Study.

6.4.3. Analysis of Case Study

6.4.4. New Design with Nanomaterials.

Part Three Conclusion.

Part Three: Nanoarchitecture and Global Warming Solution.

Introduction…

Based on the previously part mentioned addressed the Contemporary architecture trends to minimize the damaging effects resulting building sector through different directions which its main purpose to reduce the causes of the global warming, its benefits for the surrounding environment, and building emissions rates. As well as the friendly buildings measurement systems of different environment which has strict standards to maximize the effiency of the buildings without maximize its harmful emissions. This part will introduce the nanotechnology and nanoscience solution for global warming. (Figure 3.1) (Figure 3.2)

The strategy of cleaner production is one of the latest findings of the environmental thought in the last two decades, extending this strategy to reduce consumption of resources significant reduction, to avoid the use of hazardous substances are highly toxic or harmful to the environment as possible, and raise the efficiency of product design and production methods to achieve these goals , then the reduction of greenhouse gas emissions and discharges and waste during the production process and recycling of waste, and has caused a Nanotech tremendous progress in cleaner production technology represented by the reduction of industrial waste and then dispose of industrial pollution.*[Source is: http://drkhaledkassem.blogspot.com/2011/05/blog-post_12.html , Retrieved 20 November, 2011.]*

The work in this part consists of two chapters:

- First it deals mainly with Nanotechnology and Nanoscience solution for global warming by explain Environmental Benefits and Impacts of using nanomaterials in building construction, the way of Reduction of pollution in the production of materials and Reduction of pollution in construction, use and demolition.3- Smart Materials. After that we review the future solutions like Materials for Global Warming, Sensors and Smart Electronic. At the end of this chapter

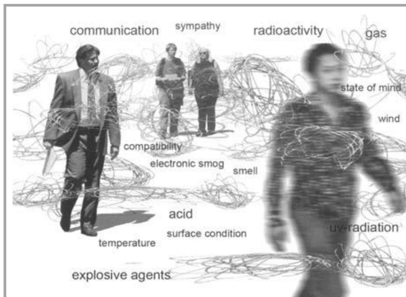


Figure 3.1: Nanoscience in every where around us. ***Source: [Nano Materials in Architecture, Interior Architecture and Design, Sylvia Leydecker, 2008]***

Figure 3.2: This is how nano is represented mathematically. Ten to the negative 9th equals one billionth or 1/1,000,000,000.

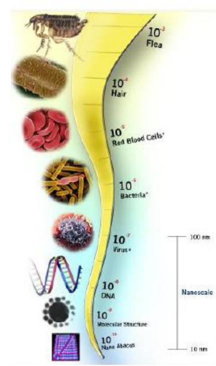


Figure 3.3: Images by Dennis kunnel Microscopy, Inc. to show Nanoscale area.

Unit	Abbreviation	Description
meter	m	approximately three feet or one yard
centimeter	cm	1/100 of a meter, about half of an inch
millimeter	mm	1/1,000 of a meter
micrometer	µm	1/1,000,000 of a meter, often called a micron — most integrated circuits are at this scale
nanometer	nm	1/1,000,000,000 of a meter, the size of a single molecule

Figure 3.4: List of metric measures

we will discuss How Recycling can help stop Global Warming. All this trial for answering important questions: How Nanoarchitecture can reduce the global warming? Why Nanomaterials is helpful than micro? What is the techniques which can reduce global warming? (Figure 3.3) (Figure 3.4) It seems like more and more Arab countries acknowledge the importance and potential of nanotechnology to address the three most fundamental development challenges facing the Arab world, which include: ensuring adequate supplies of water ,energy, and food .Thus, there is no wonder that that two first major environmental projects applying nanotechnology have to do with desalination and purification of water. This acknowledgment of the importance of nanotechnology to the Arab world will, most probably, result in more research centers established in all the Arab countries and in more environment projects launched using nanotechnology. In order to cover the knowledge gap with the West, joint nanotechnology research centers and projects have been launched in collaboration with foreign companies and research centers, which already have the needed knowledge in nanotechnology. *[Source is: http://translate.google.com.eg/translate,nanotechnology-and-the-environment-in-the-arab-world,Retrieved 20 November, 2011.]*

- Second it summarizes the Nanoarchitecture and Global Warming Solution in three points, first point is Global Warming Problem. Second point is Problem Negative Effect on human and environment. Third point is Urban Society in Europe. At the end of this chapter we will discuss Example of Europe Solution like Energy Island, Zero Carbon City, Fibro City and Tianjin Eco- City. (Figure 3.5, 3.6, 3.7, 3.8, 3.9)

- Finally, we will find the conclusion of part Three which we reach after first and second part and explain relationship between Part Three and Four.

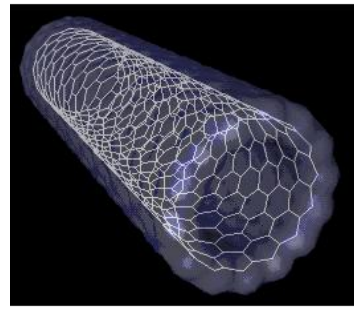


Figure 3.5: Image of Carbon Nanotube.

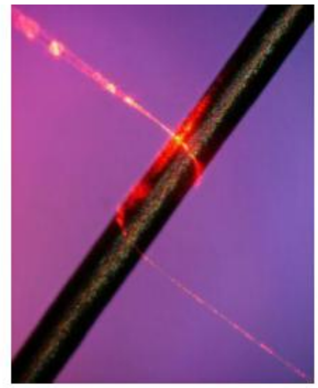


Figure 3.6: Image of Nanowires.

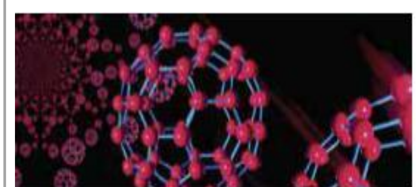


Figure 3.7: Image of C 60/Fullerenes.

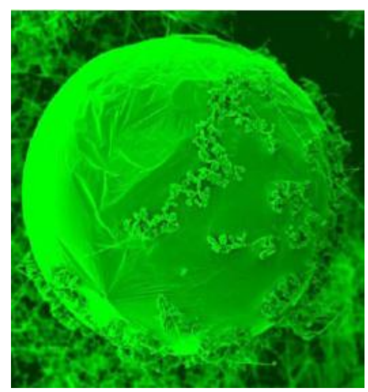


Figure 3.8: Image of Nanoparticle.

Figure 3.9: Image of geodesic domes by C 60/ fullerenes.

Chapter Five:

5.1 Nanotechnology and Nanoscience as future Solution.

5.1.1 Environmental Benefits and Impacts.

Our environment has long suffered from harmful effects produced by myriad pollutant-generating sources. Industrialized processes, oil or chemical spills, pesticides, fertilizers, and emissions from vehicles have caused pollution in our air, water, and earth environments. The need to achieve clean air, water, and soil environments is a challenge facing societies throughout the world. It is well known that human health can be directly affected by these issues, as can the health of whole ecological systems. The role of nanomaterials in relation to these environmental issues has been reasonably raised many times—by the scientific research community, by concerned public groups, and by regulatory agencies. A surprisingly large body of literature already exists on the subject, perhaps because it is so controversial. (Figure 3.10)

Figure 3.10: ***Developing a way to store energy-rich gases can help our energy systems. Metal organic frameworks (MOFs) are highly porous organic matrix substances that can store hydrogen or natural gas. The cubical nanostructures consist of an "organometallic" framework, whereas the interior of the cube contains numerous nanometersize pores in an interconnected structure. The nanopores have high surface area. These structures might also be used for energy sources for many devices, such as laptops. Tiny fuel cells could serve as a rechargable storage medium. (Courtesy of BASF.)***

On one hand, there is every reason to believe that nano-based technologies offer real opportunities for helping to achieve positive environmental objectives through improvements in technologies that might help reduce our dependency on fossil fuels, such as fuel cells or solar cells-a way of storing energy, directly help purify air and water supplies through the use of nanoporous materials. On the other hand, many point out that the very characteristics that are attractive in nanomaterials may have significant adverse health and environmental consequences. These concerns stem from their very small sizes and corresponding transport and penetration abilities as well as their high relative surface areas, which naturally increase surface reactivities. Direct fears include the envisioned prospect of tiny irreducible particles working their way into not only the air environment but into water supplies and soils as well—and hence even into our food supplies. (Figure 3.11) *[Source is: **Nanomaterials, Nanotechnologies And Design**, Mike Ashby, Paulo Ferreira and Daniel Schodek, (2009)]*

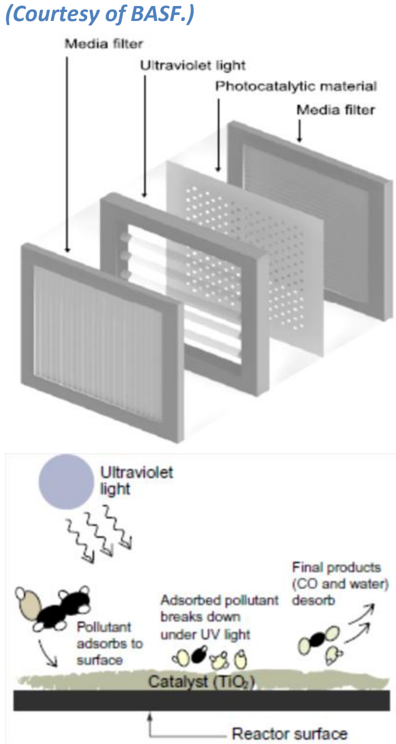


Figure 3.11: Typical photocatalytic air purifier.

It was observed that human health undoubtedly can and will benefit enormously from the use of nanomaterials in medicine and the general field of treatment, including pharmaceutical applications, but at the same time it was clear that if wrongly used, health risks can develop. Certainly it is well known that there are problematic health effects associated with tiny particulates in the air that are associated with air pollution, and that nanoparticulates can be even smaller. Findings of whether deleterious effects occur because of skin penetration were noted as being less clear. Caution, careful use, and further testing were advised. *[Source is: **Nanomaterials, Nanotechnologies And Design**, Mike Ashby, Paulo Ferreira and Daniel Schodek, (2009)]*

Some Reducing Environmental Impacts:

- **General Source Reductions**
- **General Remediation and Treatment**
- **Environmental Monitoring**
- **Water Cleaning and Purification** (Figure 3.12,13)
- **Air Cleaning and Purification**
- **Soil Remediation**

The benefits of improved production processes can be very high. A case in point that has attracted considerable interest is the use of nanoparticles in concrete mixes used in massive quantities in construction. It has been found that the production of cement accounts for between 5% and 10% of the world's total carbon dioxide emissions, a figure that will probably surprise most readers. A research team observed that concrete's strength and durability lie in the way that particles in concrete are organized, thus opening the potential for using materials other than conventional cement to achieve strength and durability but with lower carbon dioxide emission levels. The idea is still in its infancy, but prospects are intriguing.

Source reductions can also occur in ways that are not commonly thought about. Our society spends an enormous amount of not only effort but direct energy as well in keeping products clean. Washing clothing, for example, is among the most common of society's activities and consumes huge energy resources. Some cleaning processes also use chemicals that can have potentially harmful environmental effects. Decreasing the need for constant cleaning could have a significant environmental benefit; how much, of course, is unclear, since little work has been done in assessing benefits. (Figure 3.14)

Though the opportunities seem high, there is currently

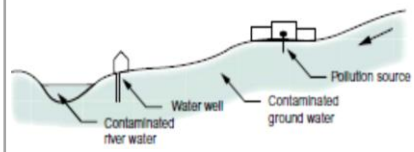


Figure 3.12: Pollutants can find their way into ground water in many ways, including accidental discharges, and be carried to sources of drinking water, rivers, and lakes. (Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. 2009)

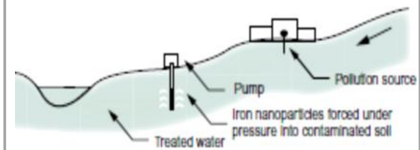


Figure 3.13: Experiments have been conducted with dispersing reactive nanoparticles in slurries into contaminated groundwater zones. The nanoparticles react with certain pollutants and render them benign. (Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. 2009)

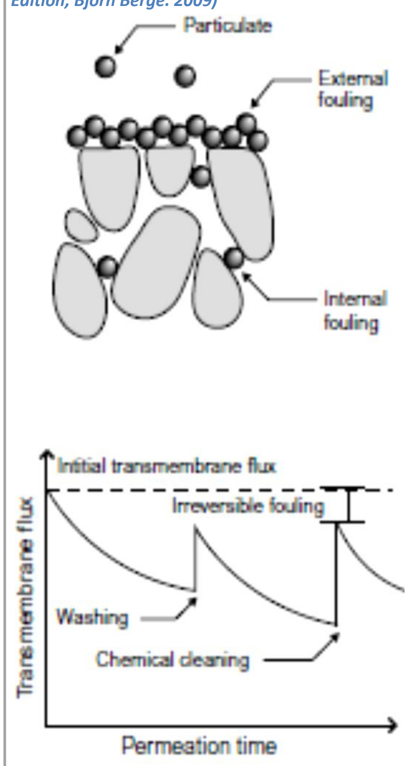


Figure 3.14: a) Cross-section of a porous membrane showing fouling and the effect of fouling on membrane performance. (b) Effect of fouling on membrane performance. (Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. 2009)

little understanding of the overall impacts that nanomaterials might have in improving processing methods as a way of reducing negative environmental impacts associated with society's huge production industries. In the list of common drivers to all industries noted in the opening of this section, the ones related to environmental impacts and the use of environmentally benign materials, energy use, health and safety, and costs stand out as very important basic concerns. Achieving good-quality indoor thermal and lighting environments is a primary driver, as is providing buildings that are healthy for occupants (Figure 3.15). Improved work and task environments are always important. The quality of use experiences that stem from either interesting features or spatial compositions or simply good functional designs remain fundamental as well. Needs or desires to differentiate buildings from one another, in many sectors, remain highly important (witness the success of designs from the office of Frank Gehry, an architect well known for his unusual buildings). Specific material or technological innovations that relate to color, movement, and interactivity are hungrily seized on. (Figure 3.16) *[Source is: **Nanomaterials, Nanotechnologies And Design**, Mike Ashby, Paulo Ferreira and Daniel Schodek, (2009)]*

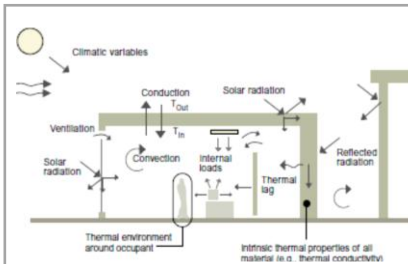


Figure 3.15: ***Considerations in designing spatial thermal environments. All the factors noted in the text affect the nature of the thermal environment as perceived by an occupant.*** *(Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. 2009)*

Figure 3.16: Frank Gehry and Dancing House in Prague example for his work. *Sourceishttp://en.wikipedia.org/wiki/Frank_Gehry ,Retrieved 12 November, 2011]*

5.1.2 Reduction of pollution in the production of materials.

Naturally, pollution from the building industry depends on the amount of resources used. Reductions are therefore a primary strategy. *[Source is: **The Ecology of Building Materials Second Edition**, Bjorn Berge. (2009)]*

- **Substitution to non-fossil energy sources for extraction of raw materials and production processes**. The possibilities of using renewable energy sources such as solar, wind, hydropower and biomass should be investigated, and priority given to manufacturing processes and materials which put these principles into practice. (Figure 3.17)
- **Reduced use of toxic chemicals**. Preference to materials that are not based on hazardous ingredients or additives.
- **Careful utilization of natural resources**. An increased use of materials that involve less environmentally-damaging methods of extraction and production would entail an increased use of renewable resources and

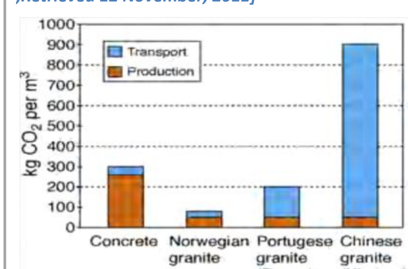


Figure 3.17: Climate impacts of paving slabs made in concrete and in granite, for use in Norway. The production of granite slabs has much less impact than the production of concrete slabs. But when importing granite from China the emissions of carbon dioxide from transport will quickly offset this advantage. Today China is the dominating producer of granite slabs for the European market (Berge, 2005).

recycled materials.

- **Efficient purification of industrial processes**. There are plenty of possibilities in this area. It is even possible, in some cases, to reprocess waste for the manufacture of new products.

5.1.3 Reduction of pollution in construction, use and demolition.

The pollution created in construction, use and demolition of buildings I closely connected to the amount of resources used, e.g. the size of the house. In addition, the following are important:

- **Reduced use of products that are responsible for larger emissions of greenhouse gases and other pollutants during production.** There is a large potential in switching to materials with less environmental impact. This will often mean choosing materials based on biological resources.
- **Reduced use of products that emit harmful gases, dust or radiation.** Alternative materials are available.
- **Avoiding organic materials in moist situations**. Hazardous substances can be emitted while decaying as well as mould being formed which can emit my cotoxins and other indoor irritants.
- **Increased use of timber and other biotic resources in long-term products.** Products made from plants function as storage of carbon and should be chosen where possible. *[Source is: **The Ecology of Building Materials Second Edition**, Bjorn Berge. (2009)]*

Building materials are the source of various kinds of pollution inside completed buildings. Many organic materials, as well as mineral materials with organic additives, are apt to host fungal growth when exposed to continuous humidity. These can emit my cotoxins and other serious irritants. A wide range of common building materials emit particles and gases that carry a variety of health risks. Examples are volatile organic compounds such as solvents in paints. In such cases, emissions will be greatest during the first weeks or months. In other cases, the emissions are persistent, as from plasticizers in

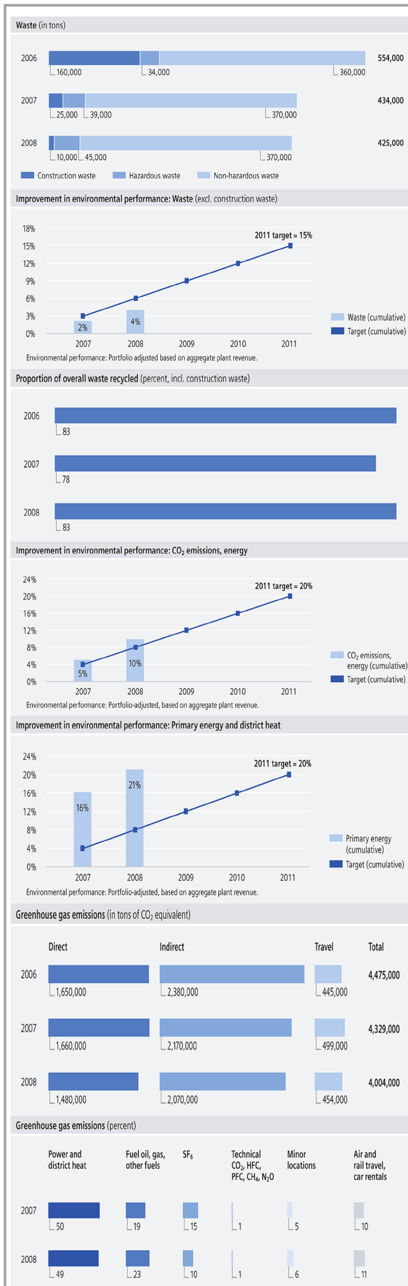


Figure 3.18: Sustainability Report 2008 by Siemens include Studies and statistics for Environmental performance, Energy consumption, Greenhouse gas emissions, Waste. A- Waste (in ton) B-improvement in environmental performance: Waste. c- improvement in environmental performance: CO2 emission, energy. D- properties of overall recycling. E- Greenhouse gas emission. F- improvement in environmental performance: primary energy and district heat ***[Sourceishttp://en.wikipedia.org/wiki/Frank_Gehry,Retrieved 12 November, 2011]***

soft plastic flooring. In yet other cases, emissions may increase later as material ages or is exposed to excessive temperature or humidity. These emissions are most often the cause of respiratory problems, whilst many may increase susceptibility to asthma and allergies, and in some cases they include highly toxic and carcinogenic substances. (Figure 3.18) *[Source is: **The Ecology of Building Materials Second Edition**, Bjorn Berge. (2009)]*

Energy source	CO_2	CO	NO_x	SO_2	Heavy metals	Dust	Aromatic hydrocarbons	Radioactivity
Sun								
Water/wind/waves								
Geothermal								
Biomass burning	(x)[2]	x				x	(x)[3]	
Biogas/bioethanol burning	(x)[2]	x					(x)[3]	
Natural gas burning	x	x	x				x	
Oil burning	x	x	x	x	x	x	x	
Coal burning	x	x	x	x	x	x	x	
Nuclear power								x

[1] Emissions originating from the transportation of fuels and the construction of the generation plants are not included.
[2] Considered neutral since emissions are equal to initial uptake through photosynthesis.
[3] Small amounts by effective combustion.

Table 3.1: Energy sources and pollution. *(Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009))*

1		2a	2b	2c	3	4	5
Material		*Global warming potential GWP*			*Acidification potential AP*	*Poisons and ozone depleting substances*	*Waste category*
		Basic impact	*Negative modifyers*	*Positive modifyers*		*[See Table 2.5]*	
		[g CO_2-equ./kg]	*[g CO_2/kg]*	*[gCO_2/kg]*	*[g SO_2-equ/kg]*		
Cast iron	From ore	750	–	–	6	53-52-12-94	D
Steel	Recycled	1000	–	–	3	94-30-21-9-53	D
	Galvanized from ore	2200	–	–	10	5-8-94-30-21-53	D
	Stainless from ore	2200	–	–	10	5-8-30-21-64-53	D
Aluminium	From ore	15000	–	–	>60	12-53	D
	85% recycled	3100	–	–		12-53	D
Copper	From ore	6000	–	–	140	32-9-85	C
Lead	From ore	1130	–	–	10	56-85	E
Concrete with Portland cement	Structure, reinforced	180	−20	–	0.6	78-30-85	C
	Roof tiles	180	−40	–	0.6	78-30-85	C
	Fibre reinforced slabs	400	−80	–	2	78-30-85	C
	Terrazzo	120	−40	–		78-30-85	C
	Mortar and plaster	200	−40	–	0.8	78-30-85	C
Areated concrete	Blocks and prefab units	270	−20	–	1.2	78-30-85	C
Light aggregate concrete	Blocks and prefab units	330	−20	–	2.3	78-30-85-53	C
Lime sandstone		150	−5	–	0.7	78	C
Lime mortar and plaster		190	−120	–	0.2	–	C
Calcium silicate sheeting		140	−5	–	1	78	C
Plasterboard		250	–	–	2	6	D
Perlite expanded		500	–	–	2	–	C
	With silicone	500	–	+10	2.3	80-6-23-26	D
Glass		700	–	–	44	53-9	C

Table 3.2: Effects of pollution. *(Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009))*

	With tinoxide layer	700	–	–		53-9-89	D
Foam glass	Slabs	1250	–	–	8	–	C
Mineral wool	Glasswool	1700	–	+100	9	62-72-45-15-78	D
	Rockwool	1740	–	+50	10	62-72-45-52	D
Stone	Structural	10	–	–	0	78	C
	Slates	15	–	–	0	78	C
Earth	Compressed, structural	20	–	–	0.1	–	C
	Loam plaster	20	–	–	0.1	–	C
Fired clay	Well-fired bricks, massive	190	–	–	1	53-78	C
	Well-fired bricks, perforated	190	–	–	1	53-78	C
	Roof tiles	190	–	–	1	53-78	C
Ceramic tiles		570	–	–		53-78	C
Expanded clay pellets		350	–	–	2.5	53-78	C
Bitumen		400	–	+3000	4	12	B/D
	Sheeting	430	–	+2000	4	12	B/D
Polyethylene (PE)		1600	–	+3200	9	43-72-6	B/D
Polypropylene (PP)		1650	–	+3200	7	72-6	B/D
Polystyrene, foamed	EPS	3500	–	+3550	27	81-72-6-17-11-46	B/D
	XPS foamed with CO_2	3700	–	+3550	25	81-72-6-17-11-46	B/D
	XPS foamed with HCFC's	21500	–	+3550	29	81-50-72-6-17-11-46	B/D
Polyurethane, foamed (PUR)		14500	–	+2200	55	54-73-72-50-24-17-37-39-2-45-89	B/D
Polyvinyl chloride (PVC)		3000	–	+1450	13	92-71-27-36-8-5-49-14-21	D
Timber	Untreated, air dried	300	−850	–	0.5	–	A/D
	Untreated, kiln dried	550	−850	–	0.8	–	A/D
	Laminated	700	−825	+50	3	45-72-79	B/D
Cork	Untreated porous boards	600	−825	–	3	–	A/D
Wood shavings	Loose fill	300	−825	–	2	–	A/D
Wood fibre	Loose fill	600	−825	–		15	A/D
	Matting with starch glue	1000	−825	–		–	A/D
	Matting glued with polyolefines	1000	−775	+300		43	B/D

1		*2a*	*2b*	*2c*	*3*	*4*	*5*
Material		*Global warming potential GWP*			*Acidification potential AP*	*Poisons and ozone depleting substances*	*Waste category*
		Basic impact	*Negative modifyers*	*Positive modifyers*		*[See Table 2.5]*	
		[g CO_2 -equ./kg]	*[g CO_2 /kg]*	*[gCO_2/kg]*	*[g SO_2-equ/kg]*		
	Porous boards, wet process	1600	−825	–	9	–	A/D
	Porous boards, dry process	1300	−775	+90	4	54-73-6	B/D
	Porous boards with bitumen	1400	−775	+300	10	12	B/D
	Hard boards	1500	−825	–	5	72-31	A/D
Woodwool cement slabs		1600	−400	–	5	78-30-85	D
Chipboard		700	−775	+200	2.5	72-45	B/D
Plywood		750	−825	+100	0.5	72-45	B/D
Flax fibre	Matting glued with polyolefin/ polyester fibres	1650	−700	+450	11	15-43	B/D
Linoleum		1020	−400	–	1.5	94	B/D
Hemp fibre	Matting glued with polyolefin/polyester	1400	−775	+300	13	43	B/D
Straw bales		5	−800	–		–	A/D
Cellulose	Loose fill 100% recycled	230	−800	–	2.2	45	D
	Matting from fresh fibre, glued with polyolefin/polyester	1600	−775	+300	12	43	B/D
	Building paper, 98% recycled	300	−825	–	0.3	–	A/D
	Building paper with bitumen	320	−750	+600		12	B/D
Cardboard sheeting	Laminated with polyvinyl acetate	400	−775	+100		–	B/D
Wool	Matting glued with polyester	500		+300	5.5	43-15-77	B/D
Recycled textiles	Matting glued with polyester	1320	−325	+300	3	43	B/D

Note: The table is compiled and based on many sources, a.o. Kohler et al., 1994; Weibel et al., 1995; Fossdal, 1995; Gielen, 1997; Mötzl et al., 2000; Krogh et al., 2001; Pommer et al., 2001; Thormark, 2001; Nemry, 2001; Fossdal, 2003; Buschmann, 2003; Jochem et al., 2004; IBO, 2006; Mühlethaler et al., 2006; Hammond et al., 2006; Schmidt, 2006.

Table 3.2: Effects of pollution (Continued) *(Source is: The Ecology of Building Materials Second Edition, Bjorn Berge. (2009))*

5.2 Futures Solutions.

5.2.1 Materials for Global Warming.

The increase in threats from global warming due to the consumption of fossil fuels requires our planet to adopt new strategies to harness the inexhaustible sources of energy. The current stars of the nano-world are another variety of the fullerenes known as carbon nanotubes (CNT), or simply nanotubes for short, and were discovered in 1991 by Professor Sumio lijima at the electronics concern NEC in Tsukuba, Japan.

Nanotubes consist of single-walled (SWNTs) or multi-walle (MWNTs) carbon tubes of rolled layers of graphite. They have a diameter of between one and a few nanometres and can be several nanometres long. They have a tensile strength far in excess of steel, yet are flexible and lighter. Their thermal conductivity is also higher than any other known material, exceeding that of diamond. Their key properties - great strength coupled with low weight - are predestined for use in future composite materials. Nanotubes can act as semiconductors or as conductors. Their electric conductivity is excellent, and as such nanowires are of great interest for electronic applications such as minute circuits and a generally more efficient use of electricity. The mechanical properties described are, however, only attained when the atomic structure of the nanotubes is faultless. Any defects result in impaired performance. A particularly ingenious variant developed for certain applications are filled nanotubes. (Figure 3.19) *[Source is: **Nanomaterials, Nanotechnologies And Design**, Mike Ashby, Paulo Ferreira and Daniel Schodek, (2009)]*

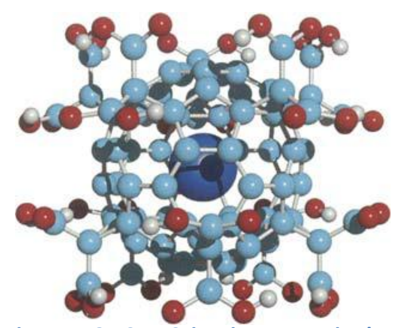


Figure 3.19: Scientists manipulate nanotubes at minute dimensions. A revolutionary class of contrast agents for magnetic resonance screening was developed in 2005. A single gadolinium atom is placed within the cage of a buckyball. Carboxylic groups are attached to the exterior of the buckyball, simultaneously making the material soluble and improving its efficiency as a contrast agent.

Extremely stable, lightweight and conductive – ideal properties for a perfect raw material for the future. New application areas are constantly being discussed in the sciences and breakthroughs and new discoveries occur regularly. Nanotubes are always mixed with other materials or applied to surfaces. The company Hyperion Catalysis International, for example, mixes small quantities of electrically conductive nanotubes into plastics to facilitate electrostatic discharge. Plastics are likewise mixed with nanotubes to improve their mechanical properties considerably. (Figure 3.20) (Figure 3.21)

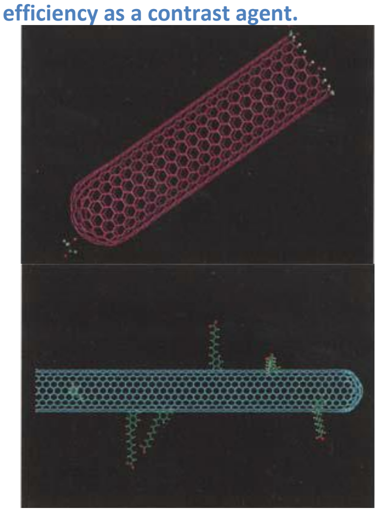


Figure 3.20: One way in which chemists manipulate carbon nanotubes is by creating nanotube derivative nanotubes that are decorated with extra molecules that give the tubes unique properties or act as chemical "handles" for further manipulation.

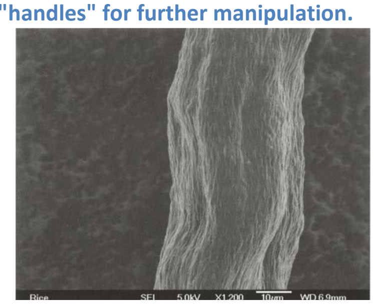


Figure 3.21: Single-walled carbon nanotubes can be extruded to form macroscopic fibres.

The development of nanotubes is continually being optimised. The cost for their production has fallen significantly since the initial high cost of manufacture. The company Carbon Nanotechnologies Inc., founded by Richard Smalley, one of the discoverers of the buckyball, produces nanotubes in large quantities. The Frontier Carbon Corporation

FCC, founded in 2001 in Tokyo, produces fullerenes including nanotubes in vast quantities (1500 t per annum). With the development of the so-called "Baytubes" method (developed in 2005 by Bayer MaterialScience AG in cooperation with Bayer Technology Services GmbH in Germany), high-quality nanotubes can now be produced much more cheaply and in large quantities. Similarly, the NASA recently developed a method for the cost-effective mass production of nanotubes. (Figure 3. 21) *[Source is: **Nanomaterials, Nanotechnologies And Design**, Mike Ashby, Paulo Ferreira and Daniel Schodek, (2009)]*

Although nanotubes can now be produced comparatively economically, they are still too expensive for use in large quantities, for example as additives for concrete. In order to be practical for the mass market, it is essential that they are to be obtained not only at a consistently high quality and secured availability but also at a sufficiently low price. Before the production of nanotubes can become feasible for the mass market, it must also overcome some hurdles with regard to purity. Nevertheless, it seems as if it is only a matter of time before these problems will be overcome. From then on, the way is paved for highly stable materials for the construction of bridges (e.g. ultra-strong concrete) or of skyscrapers (Figure 3. 24). The NASA is using nanotubes in its research for a truly visionary project - an elevator into outer space! (Figure 3. 22)

Other nano raw materials, The chemical industry, which sits at the beginning of the chain as a supplier of raw materials for further processing, uses various raw materials. Nanoparticles can be produced from different substances. The most common nano raw materials include polymer emulsions, aerogels and zeolites, carbon black, dendrimers, nanosilica and metallic nanoparticles, titanium dioxide, ceroxide and aluminium oxide. The proportion of nanoparticles in a composite material or coating is comparatively small, so typically only small quantities are required. For example, the nano raw material is mixed into another raw material and then processed further, or a coating that contains nanoparticles is applied using conventional methods such as dipping or spraying using techniques such as CVD (chemical vapour deposition). (Figure 3.23) *[Source is: **Nanomaterials, Nanotechnologies And Design**, Mike Ashby, Paulo Ferreira and Daniel Schodek, (2009)]*

Hydrogen is an energy carrier which holds tremendous promise as a new renewable and clean energy option. Hydrogen is a convenient, safe, versatile fuel source that can be easily converted to a desired form of energy without releasing harmful emissions. Hydrogen is the ideal fuel for the future since it

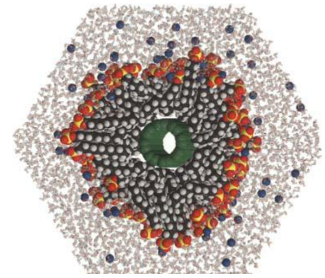


Figure 3.22: This image shows a single carbon nanotube isolated and enclosed In a molecule. Under particular conditions carbon nanotubes have been found to exhibit fluorescent properties. In the near-infrared range, light is absorbed and emitted.

Figure 3.23: The largest nanotube model in the world was produced by a team at Rice University in Houston, Texas.

Figure 3.24: The pattern of the building shell of the Watercube, the National Swimming Centre for the 2008 Olympic Games in Beijing, China, resembles oversized buckybails, but has otherwise nothing in common with nanotechnology.

significantly reduces the greenhouse gas emissions, reduces the global dependence on fossil fuels, and increases the efficiency of the energy conversion process for both internal combustion engines and proton exchange membrane fuel cells. Hydrogen used in the fuel cell directly converts the chemical energy of hydrogen into water, electricity, and heat as represented by

$$H_2 + \frac{1}{2}O_2 \longrightarrow H_2O + \text{Electricity} + \text{Heat.}$$

Hydrogen storage cuts across both hydrogen production and hydrogen applications and thus assumes a critical role in initiating a hydrogen economy. For catering today's fuel cell cars, the onboard hydrogen storage is inevitable and an integral part of the system to be reengineered. The critical properties of the hydrogen storage materials to be evaluated for automotive applications are (i) light weight, (ii) cost and availability, (iii) high volumetric and gravimetric density of hydrogen, (iv) fast kinetics, (v) ease of activation, (vi) low temperature of dissociation or decomposition, (vii) appropriate thermodynamic properties, (viii) long-term cycling stability, and (ix) high degree of reversibility. (Figure 3. 25) *[Source is: **Nanomaterials for Hydrogen Storage Applications: A Review**, Michael U. Niemann,1 Sesha S. Srinivasan,1 Ayala R. Phani,2 Ashok Kumar,1 D. Yogi Goswami,1 and Elias K. Stefanakos1, (2008)]*

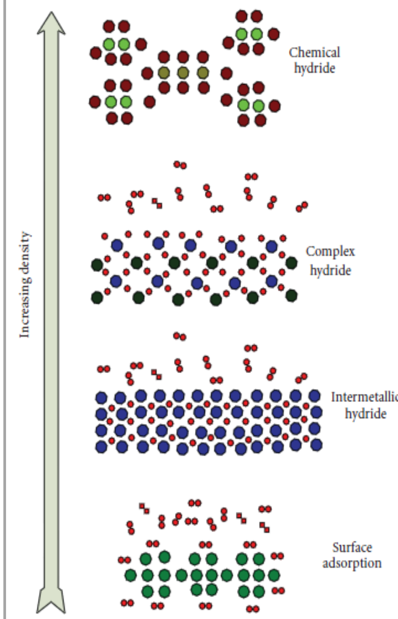


Figure 3.25: Hydrogen storage density in physisorbed materials, metal/complex, and chemical hydrides.

5.2.2 Sensors and Smart Electronic.

Sensors and transducers are closely related to one another since both involve energy exchange. A transducer is normally a device that converts energy from one form to another, e.g., mechanical energy into electrical energy, although a transducer can also transfer energy in the same form. Transducers are normally used for the purpose of transmitting, monitoring or controlling energy. By contrast, sensors – which also involve energy exchange – interact directly with and respond to the surrounding stimulus field. (Figure 3. 26) *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

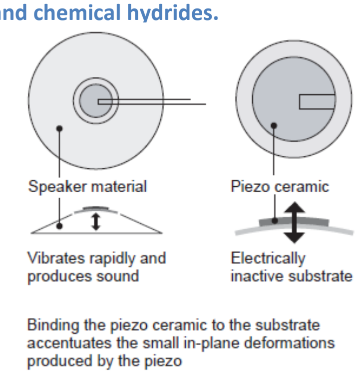


Figure 3.26: A common small piezoelectric speaker. It is based on the actuation capabilities of piezoelectric materials.

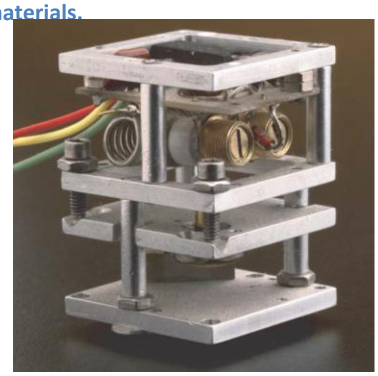


Figure 3.27: This microseismometer is capable of sensing accelerations. Thus, it can be used for sensing vibrations. (NASA)

As usually used, the term detector refers to an assembly consisting of a sensor and the needed electronics that convert the basic signal from the sensor into a usable or understandable form. An instrument is a device for measuring, recording or controlling something. An actuator is a device that converts input energy in the form of a signal into a mechanical or chemical action. This term typically refers a device that moves or controls something; most frequently, an actuator produces a mechanical action or movement in response to an input voltage. *[Source is: **Smart Materials and New Technologies For***

the architecture and design professions, *D. Michelle Addington Daniel L. Schodek. (2005)]*

In an actuator, an external stimulus in the form of an input signal (such as a voltage) produces an action of one type or another. In a sensor, an external stimulus (such as a mechanical deformation) produces an output signal, often in the form of a voltage. The signal, in turn, can be used to control many other system elements or behaviors. We will see that in many cases the same device that serves as a sensor can also be reconfigured to serve as an actuator. This is certainly the case, for example, with the piezoelectric devices discussed earlier. *[Source is:* ***Smart Materials and New Technologies For the architecture and design professions***, *D. Michelle Addington Daniel L. Schodek. (2005)]*

There are many different types of sensors and transducers. A basic way of thinking about the different types is via the energy form that is initially used – mechanical, thermal, electrical, magnetic, radiant or chemical. Sensors and trans-ducers can be based on any of these energy states. Another way of thinking about the different types that exist is based on their expected usage, e.g., proximity sensors or sound sensors (Figure 3. 29). Some of these basic types those are particularly relevant to design applications:

- **Light sensors.**
- **Sound sensors.**
- **Thermal sensors.**
- **Humidity sensors.**
- **Touch sensors.** (Figure 3. 28)
- **Position sensors.**
- **Proximity sensors.**
- **Motion sensors.** (Figure 3. 27)
- **Chemical, magnetic and other basic sensors.**
- **Environmental sensors.**
- **Biosensors.**
- **Swarms (smart dust).** (Figure 3. 30)

Object tracking and identification systems, while not really sensors in the normal meaning of the word, there are several technologies that serve sensor-like functions which are used for determining the presence of objects, as well as identifying and tracking them. Radio Frequency Identification (RFID) tags have become widespread and almost ubiquitous. These tags listen for a radio query and respond by transmitting an identifiable code. A typical RFID system consists of a central transceiver connected to a computer-based processing

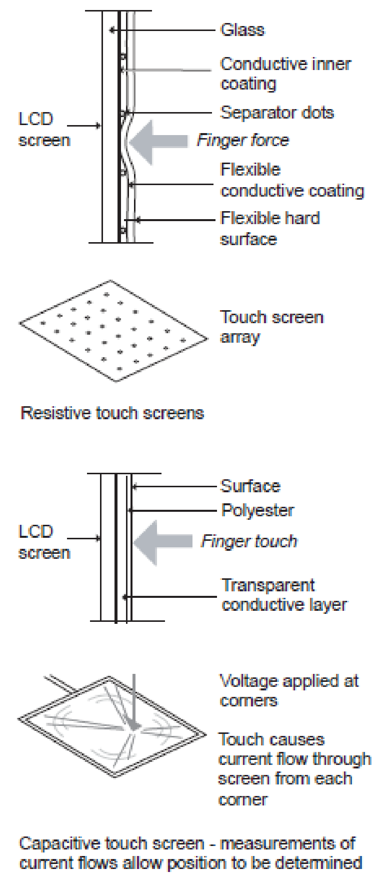


Figure 3.28: Touch screens: two common technologies for touch screens are shown. Other technologies are possible as well

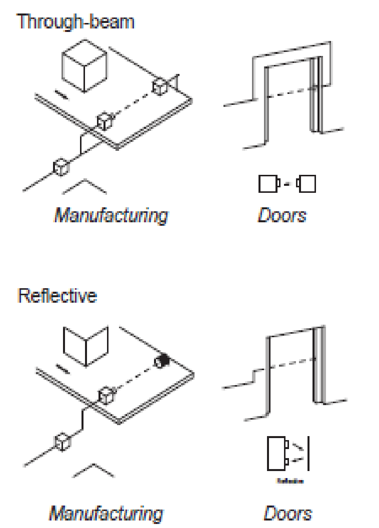


Figure 3.29: Applications of different sensors in manufacturing and other contexts (detection of presence, counting, etc.)

device and a transponder, or tag on the object that is being tracked. The transponder contains a small integrated circuit that picks up radio signals and responds with identification data. Typically, the latter need not contain batteries. High frequency RFID systems can transmit fairly long distances. Problems include common radio technology problems such as interference, absorption (e.g., by water or human bodies at certain wavelengths), and available bandwidth. (Figure 3. 31)

RFID tags are inexpensive and can be placed virtually anywhere. Hence, they find wide application in everything from inventory control applications, counting and charging (e.g., for automobile tolls), process applications (e.g., stages in manufacturing) and so forth. Since RFID tags depend on radio technologies, they obviate the need of other tracking systems, such as the all-familiar bar coding, for line-of-sight readings. *[Source is: **Smart Materials and New Technologies For the architecture and design professions**, D. Michelle Addington Daniel L. Schodek. (2005)]*

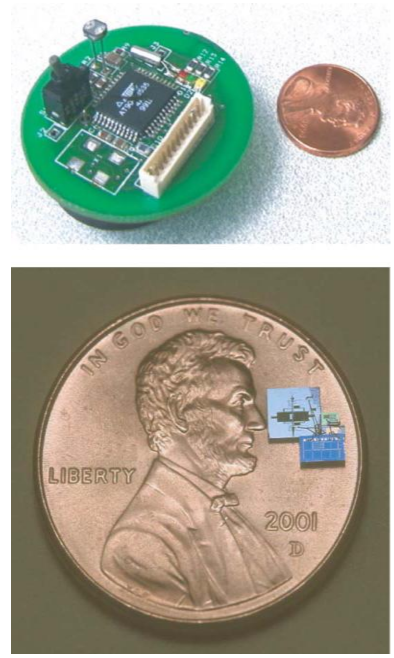


Figure 3.30: Smart dust. The visions for smart dust presume that it will be relatively undetectable by the human eye. Current research efforts have dramatically brought down the size of the dust. (Berkeley)

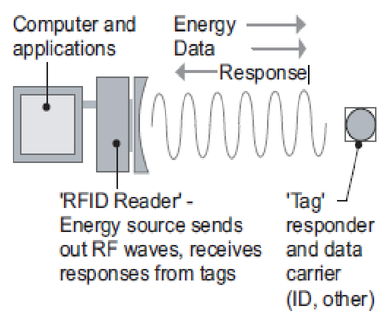


Figure 3.31: RFID Tags

Figure 3.32: Right, Recycle Aluminum Left, Recycle Steel "Tin" Cans. *[Source is http://www.help-stop-global warming.com/global-warming-recycling.html, Retrieved 20 November, 2011]*

5.2.3 How Recycling can help stop Global Warming.

As an avid recycler, we do our best to also take actions in my life that will help stop global warming. Because landfills filled with our garbage produce a dangerous greenhouse gas called methane, recycling is a great way to get started fighting global warming.

These simple actions can make a big difference in fighting global warming with recycling and reducing the garbage accumulating in landfills:

- **Recycle Aluminum - Recycling one aluminum can saves enough energy to run a TV for three hours** -- or the equivalent of a half a gallon of gasoline. It takes 95% less energy to recycle aluminum than it does to make it from raw materials. (Figure 3. 32)
- **Recycle Steel "Tin" Cans** - A 60-watt light bulb can be run for over a day on the amount of energy saved by recycling 1 pound of steel. In one year in the United States, the recycling of steel saves enough energy to heat and light 18,000,000 homes! It takes 60% less energy to recycle steel

than it does to make it from raw materials. (Figure 3. 32)

- **Recycle Paper** - Each ton (2000 pounds) of recycled paper can save 17 trees, 380 gallons of oil, three cubic yards of landfill space, 4000 kilowatts of energy, and 7000 gallons of water. This represents a 64% energy savings, a 58% water savings, and 60 pounds less of air pollution! The 17 trees saved can absorb a total of 250 pounds of carbon dioxide from the air each year. Burning that same ton of paper would *create* 1500 pounds of carbon dioxide. It takes 40% less energy to recycle newspaper than it does to make it from raw materials. (Figure 3. 33)
- **Recycle Plastic** - Recycling plastic saves twice as much energy as burning it in an incinerator. It takes 70% less energy to recycle plastics than it does to make it from raw materials. (Figure 3. 34)
- **Recycle Glass** - The energy saved from recycling one glass bottle can run a 100-watt light bulb for four hours. It also causes 20% less air pollution and 50% less water pollution than when a new bottle is made from raw materials. It takes 40% less energy to recycle glass than it does to make it from raw materials. (Figure 3. 35)
- **Recycle Used Motor Oil** - Two gallons of used motor oil can generate enough electricity to power the average home for one day, cook 48 meals in a microwave oven, blow-dry a person's hair at least 216 times, vacuum a house for 15 months or watch television for 7 and a half days straight! (Figure 3. 36)
- **Use Recycled Paper** - Using 100% post-consumer recycled paper for your printer or copy machine keeps 5 pounds of carbon dioxide out of our atmosphere per ream of paper. (Figure 3. 37)
- **Reuse and/or Recycle Your Grocery Bags** - When 1 ton of plastic bags is reused or recycled, the energy equivalent of 11 barrels of oil are saved.
- **Use a Reusable Cloth, Hemp or Mesh Shopping**

Figure 3.33: Recycle Paper.

Figure 3.34: Recycle Plastic.

Figure 3.35: Recycle Glass.

Figure 3.36: Recycle Used Motor Oil.

Figure 3.37: Use Recycled Paper. *[Source is **http://www.help-stop-global warming.com/global-warming-recycling.html**, Retrieved 20 November, 2011]*

Bag - A sturdy, reusable bag needs only be used 11 times to have a lower environmental impact than using 11 disposable plastic bags. (Figure 3. 38)

- **Buy Products with the Least Amount of Packaging** - Reducing trash by purchasing products with minimal packaging saves 1000 pounds of carbon dioxide from entering our atmosphere. (Figure 3. 39)

In 2000, recycling resulted in an annual energy savings equal to the amount of energy used in 6 million homes (over 660 trillion BTUs).

In 2005, recycling is conservatively projected to save the amount of energy used in 9 million homes (900 trillion BTUs).

A of 30% reduces greenhouse gas emissions as much as removing nearly 25 million cars from the road. (Figure 3. 40) *[Sourceis:http://www.help-stop-globalwarming.com/global-warming-recycling.html, Retrieved 20 November, 2011.]*

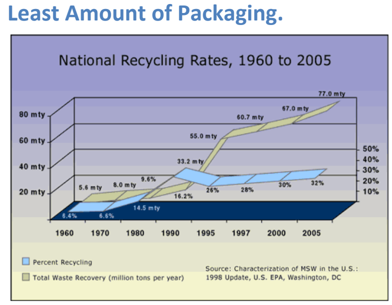
5.2.4 Nanotechnology centers in the Arab world.

On February 20, 2010, Mohamed HA Hassan, executive director of TWAS, the academy of sciences for the developing world, and President of the African Academy of Sciences, said that "Nanotechnology could aid the future of development of the Arab region .”He said that at a panel session called “Re-emergence of Science, Technology and Education as Priorities in the Arab World”, taking place at the AAAS's annual meeting in San Diego .He further said that “the Arab region, home to some 300 million people, faces a host of daunting development challenges .Three of the most fundamental involve ensuring adequate supplies of water, energy and food .”Advances in nanotechnology could help achieve progress by helping to address each of these challenges” *[Source is: http://translate.google.com.eg/translate,nanotechnology-and-the-environment-in-the-arab-world, Retrieved 20 November, 2011.]*

The development of nanotechnology research throughout the Arab world is a very recent phenomenon, which started to

Figure 3.38: Use a Reusable Cloth, Hemp or Mesh Shopping Bag. *[Source is http://www.help-stop-globalwarming.com/global-warming-recycling.html, Retrieved 20 November, 2011]*

Figure 3.39: Buy Products with the Least Amount of Packaging.



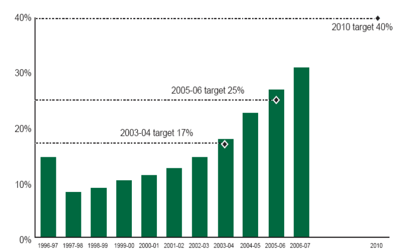


Figure 3.40: National Recycling Rates from 1960 to 2010. *[Source is http://www.help-stop-globalwarming.com/global-warming-recycling.html, Retrieved 20 November, 2011]*

take place only two years ago in Saudi Arabia and since then has spread to other Arab countries .(Figure 3. 41)

It is not surprising that the pioneer in acknowledging the importance of nanotechnology is Saudi Arabia .Indeed, as part of the six members of the Gulf Cooperation Council's strategy to transform their industries from petroleum production to knowledge-based industries using nanotechnology and biotechnology, research centers have been established recently in Saudi Arabia as well as in the UAE in order to provide the human resources, innovation and pioneering technology needed for its implementation. (Figure 3. 42)

The agreement on the establishment of the first such research center was signed in Riyadh on February 26, 2008 between the King Abdulaziz City for Science and Technology (KACST), the Saudi Arabian national research and development organization, and IBM Research . The research center is called the Nanotechnology Centre of Excellence .Its aim is to seek key innovations, and explore and develop breakthroughs in applying molecular-scale engineering to critical energy and sustainable resource issues . Under this agreement, Saudi scientists and engineers will work side by side with IBM scientists and engineers on advanced nano-science and nano-technology programs in the fields of solar energy, water desalination and petrochemical applications such as recyclable materials .The work will be conducted between teams working at IBM laboratories in Zurich ,Switzerland; Almaden, California; Yorktown Heights, New York; and the KACST/IBM Nanotechnology Centre of Excellence in Riyadh, Saudi Arabia .(Figure 3. 43)

It should be mentioned that IBM is one of the leading global technology companies and the world's largest nanotechnology research institution .*[Source is: http://translate.google.com.eg/translate,nanotechnology-and-the-environment-in-the-arab-world, Retrieved 20 November, 2011.*

The joint research work in solar energy will include a focus on novel materials for the direct conversion of sunlight to electricity, known as photovoltaics .The water treatment research will focus on the use of new nano-membrane materials for reverse osmosis seawater desalination .The research on efficient organic catalysts builds on IBM's advance materials expertise to develop synthetic methods for recycling of plastic

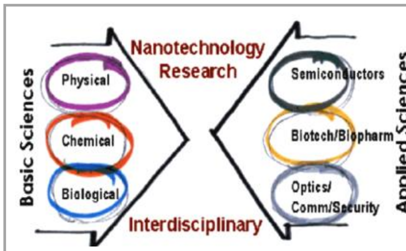


Figure 3.41: ***Nanotechnology research brings together the basic and applied sciences.*** *[Source is http://www.google.com.eg/search Nanotechnolog world, Retrieved 20 November, 2011]*

Figure 3.42: The National Institute of Standards and Technology (NIST) Advanced Measurement Laboratory was designed by HDR Architecture Inc. Gaithersburg, Maryland. *[Source is http://www.help-stop-globalwarming.com/global-warming-recycling.html, Retrieved 20 November, 2011]*

Figure 3.43: ***The Birck Nanotechnology Center Purdue University.*** *[Source is **http://www.google.com.eg/search Nanotechnolog world**, Retrieved 20 November, 2011]*

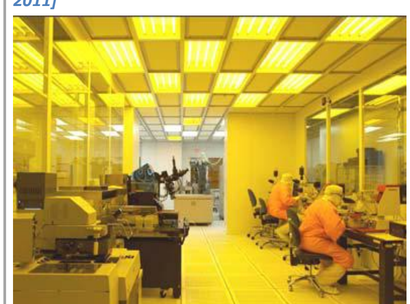


Figure 3.44: ***The (BNC) Nanofabrication Cleanroom.*** *[Source is http://www.help-stop-globalwarming.com/global-warming-recycling.html, Retrieved 20 November, 2011]*

materials .(Figure 3. 44)

King Abdullah of Saudi Arabia donated US$9.6 million to establish further nanotechnology institutes at universities around Saudi Arabia, to promote education and research in nanotechnology .The US$3.2 million King Abdullah Institute for Nanotechnology was opened in mid-2008 at the King Saud University in Riyadh .Two other nanotechnology institutes are also planned, for King Abdul Aziz University in Jeddah and the King Fahd University for Petroleum and Minerals in Riyadh, at a cost of US$3.2 million each .(Figure 3. 45)

On April 28, 2009, Intel and King Abdulaziz City for Science and Technology signed a collaborative research agreement to establish CENA, Center of Excellence in Nano-manufacturing Applications .The focus of CENA is to conduct leading-edge research on advanced nano-processing and fabrication technology, nano-sensors/network, nano-devices, and synthesis and deposition of nano-structures .CENA will commence its activities in October 2010 .(Figure 3. 46)

A nanotechnology research center was also established in the UAE .On November 16, 2008, the Khalifa University of Science, Technology and Research (KUSTAR) in Abu Dhabi announced that it would set up a nanotechnology research center in collaboration with the Asian Nano Forum .The announcement was made during the Fifth Asian Nano Forum Summit which started at that day in Abu Dhabi .

According to its website, the aim of the KUSTAR's nanotechnology center is "to play a leading role in the establishment of nanotechnology research, development, and industry in Abu Dhabi and the UAE .The centre will be dedicated to research on theoretical and experimental nanotechnology with strong emphasis on education and training."*[Source is: http://translate.google.com.eg/translate,nanotechnology-and-the-environment-in-the-arab-world, Retrieved 20 November, 2011.]*

The interest in nanotechnology in the Arab world is not limited only to Saudi Arabia and the Gulf countries .Scientists in North African countries are increasingly interested in nanotechnology .In January 2009, Egypt launched the first North African nanotechnology and nanoscience research center in Cairo that aims to be world-class, with support from IBM Research .Egypt's Information Technology Industry

Figure 3.45: NIST's experimental Molecular Measuring Machine for ultraprecise two dimensional measurements in one of the AML's underground metrology wings. The instrument is designed to be operated by remote control from the adjoining room to minimize environmental disturbances. The instrument is used to draw lines on silicon as small as 10 nanometers wide and 4 nanometers high. It can also measure the placement of nanometer-scale features with subnanometer resolution. *[Source is **http://www.google.com.eg/search Nanotechnolog world**, Retrieved 20 November, 2011]*

Figure 3.46: Ultraprecise electrical measurements require extremely stable temperature, humidity, and vibration control. Here, a NIST physicist in one of the AML's metrology laboratories prepares to measure the international standard for resistance— the quantum Hall Effect
[Source is http://www.help-stop-globalwarming.com/global-warming-recycling.html, Retrieved 20 November, 2011]

Development Agency (ITIDA) and Science and Technological Development Fund (STDF (signed the three-year partnership agreement with IBM on September 18 .2008 ,Joint investments will be in the region of US$30 million .Partners in the Center, Cairo University, Nile University and IBM will collaborate in the areas of simulation and modeling software, alternative energy sources (thin film silicon photovoltaics) and energy recovery for desalination .(Figure 3. 47)

More recently, Algeria launched several joint research projects with Iranian scientists in nanotechnology applications in environment and water management .But most of this research is yet to be applied, partly because of limited funding .

And, even more recently, the Jordanian Higher Council for Science and Technology decided on August 17, 2009 to establish the National Nanotechnology Centre of Jordan (NANCEJ .(The Centre started to be officially active in early February .2010 Its aim is to build the "scientific capacity in the field of nanotechnology in the Kingdom through programming and coordinating scientific research and development activities in this field nationwide, making the necessary financial support available for them, and networking Jordanian researchers with their counterparts abroad .The centre will establish an advanced specialized research laboratory capable of implementing the wide range of R&D and production ."… *[Source is: http://translate.google.com.eg/translate,nanotechnology-and-the-environment-in-the-arab-world, Retrieved 20 November, 2011.]*

In Israel, the care of a lot to the development and production of nanotechnology; where he founded the "Research Institute of Nanotechnology," at a cost of $ 88 million, and "Israel Institute of Technology" in the city of Haifa, with a capital of $ 4 million, which mobilized 200 scientists from all disciplines. Also have set up in 2003, "the research nanostructures," spotted at the end of last year, nearly $ 90 million, in addition to support of this body by the United States, the equivalent of $ 250 million, was established nearly 80 trap him in the entity , of the total 820 companies around the world, for the production and marketing of nanotechnology products, and is expected to reach production of "Israel" in this sector to a trillion dollars in 2015. (Figure 3. 48) (Figure 3. 49)

Figure 3.47: ***Clean room cabin for Precision measuring tools.*** *[Source is* ***http://www.google.com.eg/search Nanotechnolog world****, Retrieved 20 November, 2011]*

Figure 3.48: ***Humans are a major source of particles inside a cleanroom.*** *[Source is* ***http://www.google.com.eg/search Nanotechnolog world****, Retrieved 20 November, 2011]*

Figure 3.49: Cleanroom furniture is designed to produce a minimum of particles and to be easy to clean. *[Source is* ***http://www.google.com.eg/search Nanotechnolog world****, Retrieved 20 November, 2011]*

Chapter Six:

6.1. Architecture Applications:

6.1.1 NanoHouse, Australia.

Nanohouse brings nanotechnology home. Australia has no formal national nanotechnology initiative, though a series of national networks and programs have been established to bring together relevant research. There is significant government investment in Australian nanotechnology research from the Australian Research Council and the Commonwealth Scientific and Industrial Research Organization as well as funding from state governments. Over 50 Australian companies claim to be working in 'nanotechnology'.

CSIRO and the University of Technology Sydney (UTS) have developed a model house that shows how new materials, products and processes that are emerging from nanotechnology research and development might be applied to our living environment. (Figure 3.50)

Figure 3.50: Marquettes of the nanoHOUSE quoted by the University of Technology Sydney.

The NanoHouse™ Initiative, by Dr Carl Masens at the Institute for Nanoscale Technology and visualized and implemented by architect James Muir, has proven a successful method of explaining what nanotechnologies are and how they work; for example, how the latest technology windows clean themselves, how tiles might resist build up of soap scum, or timber surfaces resist UV damage. In the building industry, nanotechnology provides a whole new palette of materials that could potentially have profound effects on building design. (Figure 3.51)


Figure 3.51: The white walls of the nanoHOUSE absorbs light and harvests solar energy.

The NanoHouse has a radiative cooling paint as the outer surface of some of the roofing material. A metal roof coated with this paint will become a cooling element in a building rather than a source of unwanted heat gain. Other features are self-cleaning glass, cold lighting systems and the dye solar cell – a photovoltaic cell based on titanium dioxide rather than silicon. For instance, glass can be used more liberally if it is optically tuned to block heat and UV. It would be possible to construct a building with many more, larger windows than is currently viable, since heat can be kept out and UV photodamage prevented. Reduction of the solar heat gain through windows reduces the need for cooling via air conditioning, saving electricity. In certain parts of a building, solar thermal radiation is welcome, such as the exterior surface of a thermal mass. (Figure 3.52)

Even if it's surrounded with glass walls, the NanoHouse doesn't need any curtains. [This] glass can be made almost opaque at the flick of a switch with SPD (suspended particle device) glass. It can be done manually with a switch, or automatically by attaching a sensing device and a controller, in much the same way street lights go on when it becomes overcast. The technology uses particles dispersed in a liquid or in droplets encapsulated in a thin plastic film. (Figure 3.53)

The particles align, allowing light to pass through when a charge is applied to a coating of electrically conductive transparent material. The particles return to random positions and block light when there is no charge. SPD glass can be used as substitute curtain for privacy. Other glass technologies are available to fill the insulation role of curtains. (Figure 3.54)

Some of the types of technologies under consideration for inclusion in the house include:

- UV/IR filtering and reflecting windows for control of unwanted solar heat gain.
- Self-cleaning TiO2 coated glass.
- Protective coatings for furniture offering UV protection.
- Bottles, food containers etc. with tuned optical. properties for the enhancement of shelf life of both containers and contents .
- Cold lighting systems for the harvesting of daylight during the day and use with ultra efficient bright white LED light sources.
- Water quality control systems that remove pollutants from water, and clean effluent water .
- Light colored paints without glare and dark

Figure 3.52: ***Computer generated images for the proposed NanoHOUSE***

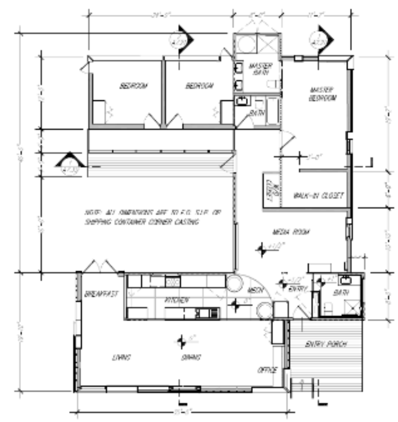


Figure 3.53: Solar Decathlon complete house floor plan.

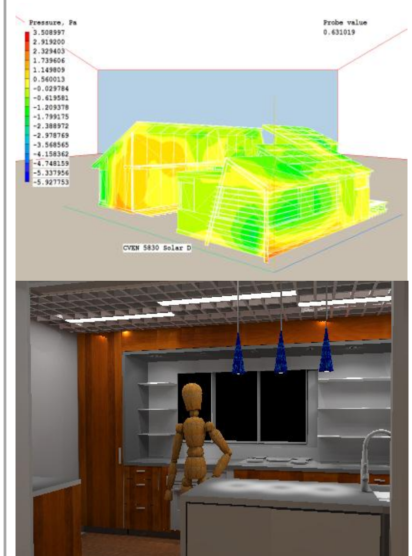


Figure 3.54: Pressure contours on CU building surfaces.

pigments for paints that do not retain heat.

6.1.2 Nano Studio.

How will nanotechnology affect the way we design, make, and inhabit buildings?

In the NanoStudio, interdisciplinary groups of students from Ball University, and Illinois Institute of Technology are exploring nanotechnology‘s potential impact on the built environment, as well as social, ethical and environmental issues it raises. Together they are designing buildings using nanomaterials including carbon nanotubes, quantum dot displays, and nanosensors to create new kinds of environments not limited by the constrains of traditional materials. Aware that these radical materials fundamentally after the relationship between buildings, users, and the environment, we are integrating a detailed examination of the social, ethical, and environmental side-effects of nanotechnology into the investigation. The results they hope, will be a proactive contribution to the social discussion on this rapidly developing supertechnology. (Figure 3.55)

The students‘ palette of materials included nanomaterials already developed in laboratories that are now working their way to market. These include transparent carbon nanotubes 100 times stronger than steel, nanosensors small enough to embed not only in building components but their users as well, and quantum dot lighting able to change the color and opacity of walls and ceilings. But this was no mere "house-of-the-future" fantasy. Students also addressed the social and environmental concerns raised by nanotechnology, from toxicity (nanoparticles are so tiny they can pass through cell membranes) to privacy (who controls the data gathered by embedded nanosensors?) (Figure 3.56)

6.1.3 Carbon Tower.

Architects Peter Testa and Sheila Kennedy have very different practices, but both navigate the uncharted waters of innovative design through collaboration with manufacturers, multidisciplinary interaction, and the adaptation of nascent technologies. "The complexity of contemporary buildings is an

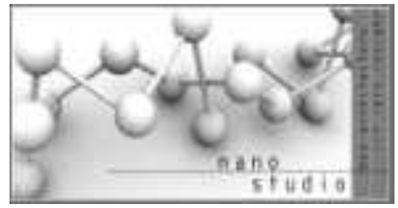


Figure 3.55: ***Using carbon nanotubes in a multistory building (Image courtesy of image Adam Buente + Elizabeth Boone/nanoSTUDIO)***

Figure 3.56: ***The nanoStudio website, provides lots of innovative ideas for the use of nanotechnology in buildings made by students.***

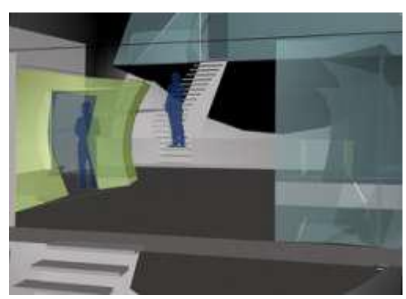


Figure 3.57: ***Architcture students of Ball university are exploring new ways of architecture at the nanoStudio***

enormous achievement, but we need to question how we cam to the point of building with such complexity. We believe we need to rethink how we assemble buildings." These might seem like strange words coming from architect Peter Testa, who, with his partner, Devyn Weiser, has designed a carbon-fiber tower, a complex undertaking that proposes to build a high-rise tower out of composite materials. According to Testa, whose firm, Peter Testa Architects, is located in Santa Monica, California, the willingness to use complex computer modeling tools will allow the design of new buildings, materials, and products that just might transform the building industry. (Figure 3.58)

Testa and Weiser are pursuing, in partnership with industry, a systemic examination of intermediate-level building systems. Manufacturers are the most willing to shoulder risk; they stand to profit from reasonable investment. The lure for many manufacturers is scale, an advantage not lost on Testa. The carbon tower project was envisioned with that strategic thinking. "Tshe [construction] industry isn't completely fixed. If one finds applications for materials that are provocative and at a big enough scale, it is possible to engender new divisions of industry," says Testa. (Figure 3.59) "We are interested in things that are realizable. We are trying to reach different actors and trying to create something the industry can understand and rally around." The ultimate measure of an innovation is when it becomes a reality. (Figure 3.60)

Sheila Kennedy, AIA, principal and founder with partner Frano Violich, AIA, of Kennedy & Violich Architecture (KVA) in Boston believes there is an exciting horizon for architects to return to the design of materials. One of the main missions of KVA, its materials research unit, is to expand the diminishing role of architects. Its goal is to forge a new relationship with materials, one that will draw on mass customization. "We have always taken existing materials and products and expanded the palette beyond their usual use. Research with new materials is an extension of what we have been doing all along," she says. Kennedy describes two main "design drivers" that she believes are changing how space is made and organized. The first is the advance in solid-state technology; the second is the wireless and hardwire distributionand integration of information infrastructure.*[Source is:http://archrecord.construction.com/inTheCause/0602ArchiFuture/archiFuture.asp., Retrieved November 04, 2011.]*

Figure 3.58: ***A perceptional 3D image of the proposed carbon tower by Peter Testa***

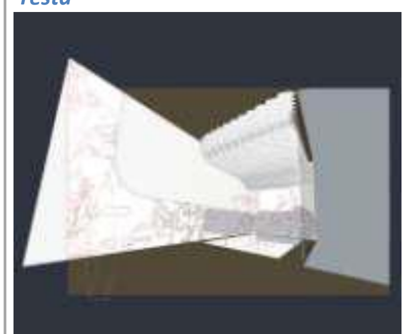


Figure 3.59: ***For a shop in Hollywood, Testa designed a structure using textile based composites. 2 carbon-fiber frames support a woven mesh of Kevlar cables spanning 110 feet. A double façade of Kevlar panels is suspended from this framework.***

Figure 3.60: ***interior computer generated perspectives of the Tower.***
Source:[http://solar.colorado.edu/pdf/Energy_Analysis.pdf, Retrieved November 04, 2011]

Innovators look for opportunities and mine for ideas. A seemingly unlikely arena for innovation is work commissioned for public agencies. For New York City, however, KVA is designing seven ferry landings along the Harlem and East River waterfronts in Manhattan. The work includes intermodal passenger shelters, commuter ferry boat docking facilities, site improvements, and community amenities. The technology also allows for rapid prototyping, which is especially useful in a multisite project. Although this kind of technology is becoming more common in the construction industry, Kennedy says they have often gone outside of the construction industry to metal fabricators or set builders who are more familiar with it. (Figure 3.61)

In the spring of 2001, Kennedy began to work with DuPont on an initiative to incorporate solid-state technologies with translucent and transparent materials. "Internal and external market research supported the idea of integrating solid-state lighting with surface materials where we had good brands," explains Tom O'Brien, portfolio manager for DuPont Ventures, who had heard Kennedy speak about the subject at a conference. "However, it also called for a prototype that would demonstrate validity." (Figure 3.62) *[Source is: http://archrecord.construction.com/inTheCause/0602ArchiFuture/archiFuture.asp., Retrieved November 04, 2011.]*

The KVA and DuPont teams focused on two DuPont products: Corian and SentryGlas Plus protective glass. They developed concept demonstrations-a combination of materials, solidstate lighting, and product information to stimulate discussion about applications. Although he can't talk too specifically about the results, O'Brien says the goal was to make the DuPont products smarter by integrating technology without compromising the integrity or features that have made them successful. O'Brien is now working with three DuPont businesses to turn these concept demonstrations into possible offerings.The nature and methods of KVA's work involves risk, but Sheila Kennedy considers herself one of the architects who wouldn't enjoy her work if she couldn't affect cultural production.*[Sourceis:http://archrecord.construction.com/inTheCause/0602ArchiFuture/archiFuture.asp., Retrieved November 04, 2011.]*

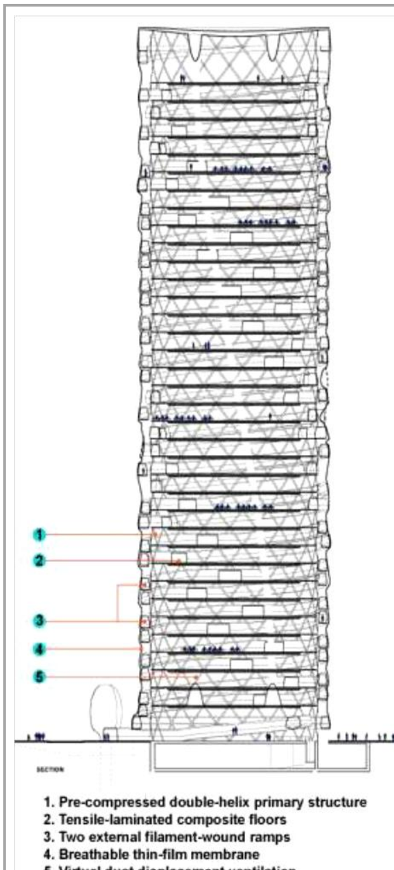


Figure 3.61: ***A longitudinal section of the Carbon Tower.***

Figure 3.62: ***Exterior and interior computer generated perspectives of the Tower.***
Source:[http://news.cnet.com/Photos-Weaving-high-tech-fabrics-of-the-future---page-14/2009-1008_3-5667576-14.html, Retrieved November 04, 2011]

6.1.4 Bahrain World Trade Center.

Design:

Is an extension to the existing five-star Sheraton Hotel complex and comprises two 50-storey sail-shaped commercial office towers, which taper to a height of 240m and support three 29m diameter horizontal-axis wind turbines. The towers are integrated on top of a three-storey podium which accommodates a new 9,600m² MODA shopping centre, fine restaurants, food court, hotel space for the Sheraton, business centre and car parking. *[Source is: http://en.wikipedia.org/wiki/Bahrain_World_Trade_Center#cite_note-wan-, Retrieved November 04, 2011.]* (Figure 3.63)

Figure 3.63: ***Bahrain World Trade Center.*** *Source:[http://news.cnet.com/Photos-Weaving-high-tech-fabrics-of-the-future---page-14/2009-1008_3-5667576-14.html, Retrieved November 04, 2011]*

Environmental Features:

The two towers are linked via three sky bridges, each holding a 225KW wind turbine, totaling to 675kW of wind power production. Each of these turbines measure 29 m (95 ft) in diameter, and is aligned north, which is the direction from which air from the Persian Gulf blows in.

The wind turbines are expected to provide 11% to 15% of the towers' total power consumption, or approximately 1.1 to 1.3 GWh a year. (Generating between 1,100MWh and 1,300MWh a year) and will operate for 50% of the time with full power being generated at a wind speed of 15 to 20m/s. This is equivalent to providing the lighting for about 300 homes annually. *[Source is: http://en.wikipedia.org/wiki/Bahrain_World_Trade_Center#cite_note-wan-, Retrieved November 04, 2011.]* (Figure 3.64)

Figure 3.64: ***The three turbines.*** *Source:[http://news.cnet.com/Photos-Weaving-high-tech-fabrics-of-the-future---page-14/2009-1008_3-5667576-14.html, Retrieved November 04, 2011]*

The three turbines were turned on for the first time on the 8th of April, 2008.They are expected to operate 50% of the time on an average day. (Figure 3.65)

Figure 3.65: ***Turbine images***

Why Zero:

This was confirmed by wind tunnel tests, which showed that the buildings create an S-shaped flow, ensuring that any wind coming within a 45° angle to either side of the central axis will create a wind stream that remains perpendicular to the turbines; this significantly increases their potential to generate electricity.

6.2 Futuristic thinking of zero carbon urban settlement:

(zero carbon infrastructure and architecture)

6.2.1. Masder City (Zero Carbon City).

	Masder City
Architect	Norman Foster
Location	Abu Dhabi – U.E.A
Date	2016
Type	Zero Carbon City.
Technologies Used	Photovoltaic Farms – Solar Power – Pod Car -Renewable Energy.
CO2 Emissions	Strategy is to reach zero emission.

Figure 3.66: Masdar City (Zero Carbon City) *Source:[http://en.wikipedia.org/wiki/masdercity,Retrieved 22 November, 2011.]*

An extraordinary ecological city of the future is being built in the United Arab Emirates, outside of the capital Abu Dhabi. The work force will soon reach 40,000. Situated in the desert, Masdar is a small city that will be 6 square kilometers (2.3 m2). It is designed to house 40,000 people, 1500 businesses and accommodate up to 50,000 commuters. The blazing sun, the ultimate clean power source will power the city. Masdar's solar farm, which is the largest in the Middle East, is already built. No skyscrapers or cars will be allowed and the streets are designed for pedestrians. Boundary walls prevent urban sprawl and on the narrow streets, buildings are so closely aligned that they shade each other. (Figure 3. 66) *[Source is: http://en.wikipedia.org/wiki/masdercity, Retrieved 22 November, 2011]*

Masdar has 5 integrated units:

1. **Masdar City:** A living city that will house around 1,500 Clean tech companies with 40,000 residents and 50,000 commuters, and provide a research and test base for its technologies.
2. **Masdar Institute of Science and Technology:** Developed in cooperation with the Massachusetts Institute of Technology (MIT), The Masdar Institute will eventually host 800 students and 200 faculty members.

3. **Utilities and Asset Management:** The Utilities team is a renewable energy project developer focusing on concentrated solar power (CSP), photovoltaic (PV), wind, and waste-to-energy both locally and internationally. A hydrogen fi red power plant in Abu Dhabi will be the world's first and produce over 500MW of power...

4. **Carbon Management:** Aims to drive the progress of low carbon economies around the world while capitalising on monetizing carbon emission reduction projects. The Carbon Management Unit is also developing a carbon capture and storage network within the Emirate of Abu Dhabi.

5. **Industries:** Developing large-scale, strategic clean energy projects locally and internationally including a PV production facility in Germany and Abu Dhabi and a 4 sq km solar manufacturing cluster also in Abu Dhabi. (Figure 3. 67) *[Source is:* http://en.wikipedia.org/wiki/masder*city, Retrieved 22 November, 2011]*

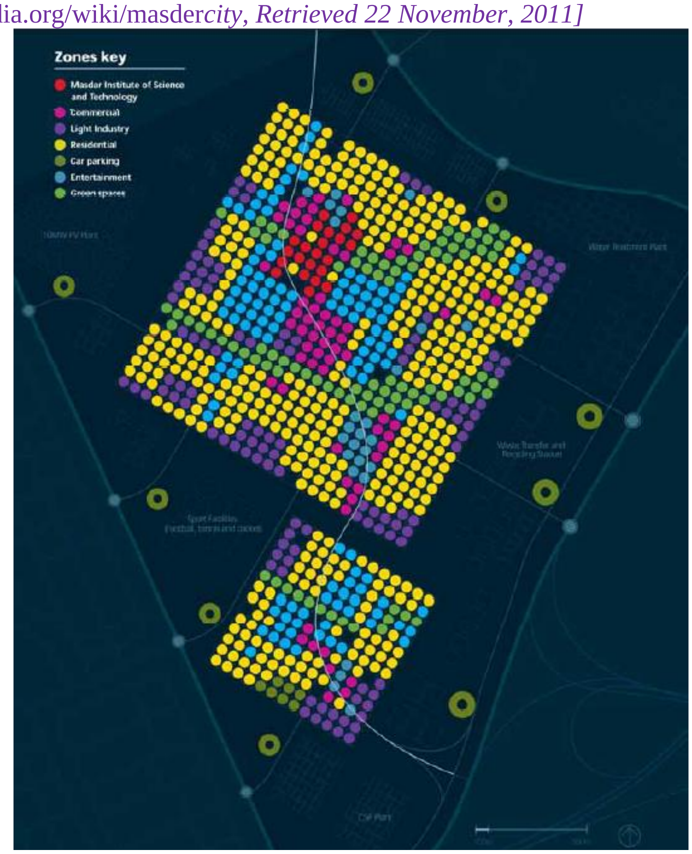


Figure 3.67: master plan design diagram. *Source:[* ***http://en.wikipedia.org/wiki/masder****city,****Retrieved 22 November, 2011****.]*

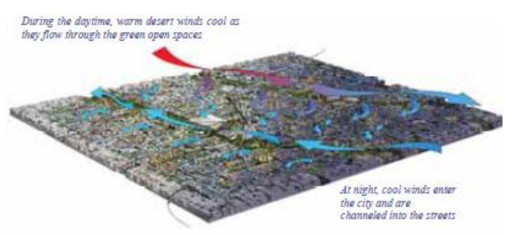
Environmental Features:

Responsive to the culture and spirit of Abu Dhabi, the design of the city is inspired by the traditional Arabic architecture and urban planning of the region and includes many examples of where traditional design techniques help to reduce energy Consumption and to improve the quality of the Environment.

Shaded walkways and narrow streets reduce glare and solar gain, and create pleasant and attractive outside green spaces. (Figure 3. 68)

The diagonal orientation of the streets and public spaces makes best use of the cooling night breezes and lessens the effect of hot daytime winds, whilst further reducing the effects of direct sunlight. Traditional passive features such as wind towers and blinds and solar shades help to further improve comfort levels. *[Source is:* http://en.wikipedia.org/wiki/masder*city, Retrieved 22 November, 2011]*

The buildings in the city are amongst the most advanced in the world. Intelligent design of residential and commercial spaces reduces the need for artificial lighting and air conditioning.



All buildings will surpass the highest standards currently set by internationally recognized organizations and Masdar City is a key partner in the *Estidama* programme which sets new benchmarks in planning, design and building within cities.

A 40 to 60 watt solar power plant built by the German firm Conergy supplies power for construction work. A larger solar power plant will

Figure 3.68: Masder City Analysis. *Source:[http://en.wikipedia.org/wiki/masdercity,Retrieved 22 November, 2011.]*

follow and, together with photovoltaic modules on rooftops, 130 megawatts of solar power is expected to be generated. A solar powered desalination plant will generate the city's fresh water ~80% of the water will be recycled. Water usage in Madar will be one half that typical of comparably sized small cities. Wind farms will be built on Masdar's outskirts with a designed power output of 20 megawatts. The world's largest hydrogen power plant is planned and there are geothermal sources to be exploited.

Exceptional energy efficiency and reduction in energy footprint at Masdar will be achieved through the integration of several important, almost zero footprint, alternative energy technologies. High fences installed around the city will reduce the impact of hot blowing winds from the desert. Building units use solar glass whose composition is new materials that further reduce the heat burden. Building complexes have high efficiency cooling towers. Fountains and trees will be grown as an additional cooling device. Huge umbrellas unfold during the day and close up at night as shown in these photos. Architects and engineers are projecting that Masdar's average temperature will be 20 degrees lower than the surrounding desert.

Waste can be reduced to near zero. Biological waste will be used to create a nutrient rich soil (and fertilizer), and some could be burned via waste incineration for power. Industrial wastes such as plastics will be recycled and/or reduced and reused.

Final deployment of the PRT will utilize 3,000 pod cars that make 130,000 trips per day on a passenger network that has 85 stations. A trip around Masdar City will take about 10 minutes.

The Freight Rapid Transit System (FRT) will run on a dedicated guide way in the undercroft, an artificial basement that can be created by raising the pedestrian level. The FRT system will make 5,000 trips/day using vehicles with two pallets and maximum payload of 1600 kg. (Figure 3. 69) *[Source is:* http://en.wikipedia.org/wiki/masder*city, Retrieved 22 November, 2011]*

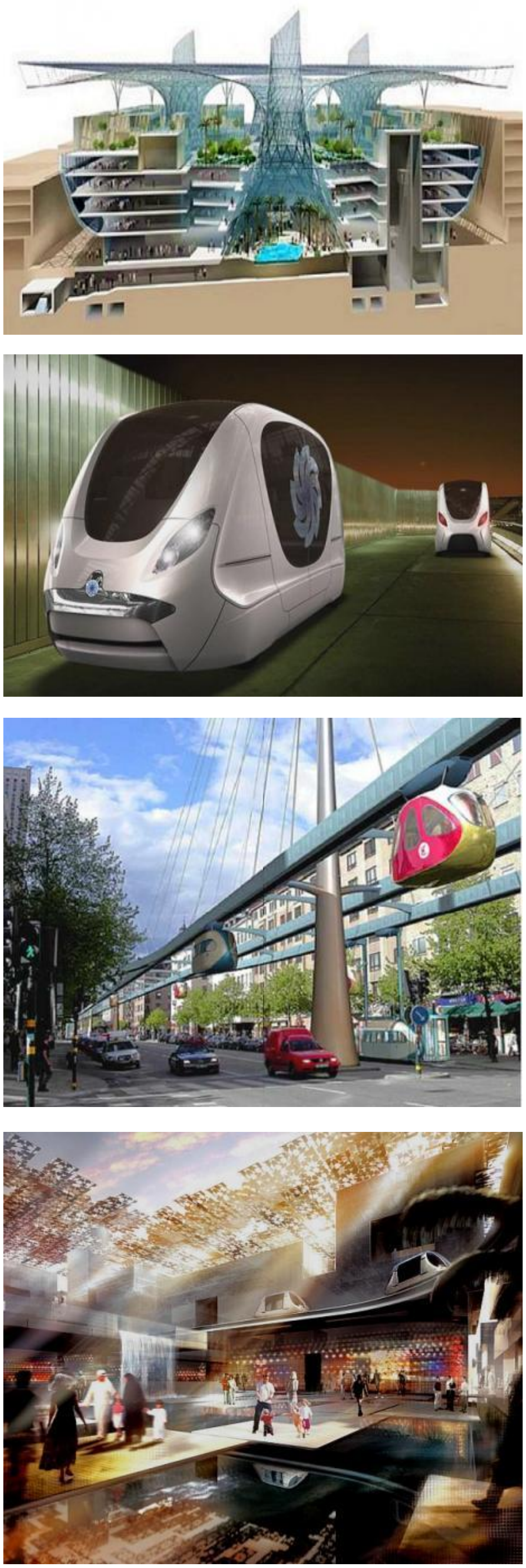


Figure 3.69: Many View of Masder City. *Source:[**http://en.wikipedia.org/wiki/masder**city,**Retrieved 22 November, 2011**.]*

6.2.2. Energy Island.

	Energy Islnd
Architect	Dominic Michaelis and specialist research groups from University of Southampton
Location	United Kingdom
Date	In Future
Type	Single Floating Structure
Technologies Used	Photovoltaic Farms - Wind Turbines - Renewable Energy.
CO2 Emissions	Strategy is to Maximize the Energy Production Available from the Diverse Sources Available

The Energy Island concept is to bring together on a single floating structure a variety of renewable energy conversion systems to maximize the energy production available from the diverse sources available, so that the interrelated systems can assist each other to reach greater efficiencies of conversion. The basic island could be of hexagonal plan, so that it could readily be joined to other units to form cluster or linear plans as required. A hexagon made up of 6 equilateral triangles of 300 meter long sides would have a longest cross distance of 600 meters and a shortest cross distance of 520 meters. Its area would be 234 000 m(2), or 23,4 hectares. It's size would guarantee it's stability in heavy seas. (Figure 3. 70) *[Source is:* http://en.wikipedia.org/wiki/energyisland*, Retrieved 22 November, 2011]*

Figure 3.70: Main Perspective of Energy Island. *Source:[* ***http://en.wikipedia.org/wiki/Energy****island,****Retrieved 22 November, 2011****.]*

The Energy Island would act as a platform to maximize collection and conversion of the diverse renewable energy sources available.

These would include :-

- **WIND ENERGY** Wind Energy varies from site to site, but is generally more plentiful at sea, without the interference of land features. In these conditions, to maximise wind energy collection, aerogenerators would be mounted on height adjustable hydraulic masts allowing collection at different heights where one mill would be in the lee of another. On a 600 meter wide platform, it is proposed to place 3 low level 70 meter diameter mills and 3 high level diameter mills, each capable of generating 3 MW (el). The total peak output is 18 MW peak.
- **SEA CURRENT ENERGY** Sea current Energy is very site dependent, but it is assumed that a cowled turbine assembly 500 meters across perpendicular to a constant current flow can generate 2MW / 100 meters, or a total of 10 MW.
- **WAVE ENERGY** Although in tropical waters, the average wave energy profile is far from the 50 kW / meter average of the North Sea, a figure of 15 kW / meter can be expected. Since one of the problems of OTEC systems lies in the vast volumes of water that need to be shifted, wave energy could be used directly to induce these flows without going through the inefficiencies of electricity generation. With a 600 meter long front, a 9 MW resource is achieved, of which it is assumed that 2/3 can be transferred to usable hydraulic power, a 6 MW contribution.
- **SOLAR ENERGY** Many different solar collector systems can be considered over the 22 hectare platform, ranging from PV arrays to concentrating thermal systems. The hexagonal plan lends itself particularly well to "Power Tower" systems in tropical latitudes. The highest collection efficiencies, around 75%, are achieved by such high temperature "Power Tower" type concentrators, which, at 800°C, allow a secondary conversion ratio to electricity of 40%, an overall efficiency of 30%.(Figure 3. 71) *[Source is:* http://en.wikipedia.org/wiki/energyisland, *Retrieved 22 November, 2011]*

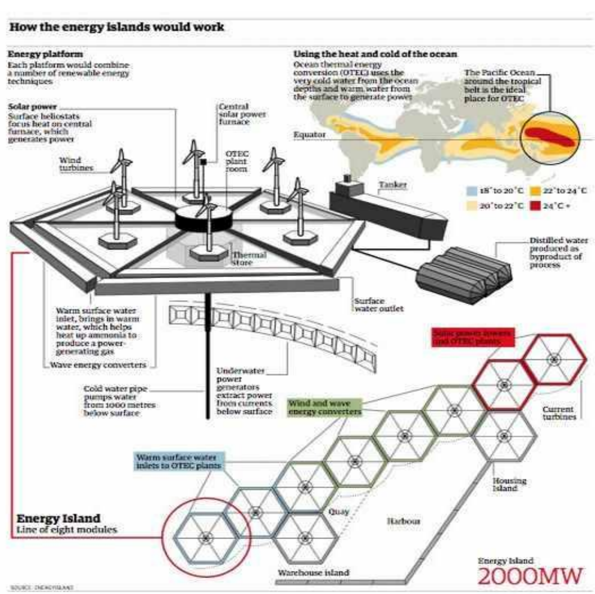


Figure 3.71: How the Energy Islands Would Work. *Source:[* ***http://en.wikipedia.org/wiki/Energy****island,**Retrieved 22 November, 2011**.]*

The 0,9 kW / sq m radiation at sea level would produce, from 20 hectares, a thermal input to the focus of 135 MW and an electrical output of 54 MW (e) peak. In tropical waters, the cosine losses being low during the three hours around solar midday, it can be assumed that the Power Tower will operate at full regime during 6 hours a day, the losses being made up during the remaining hours. This would be equivalent to a 13,5 MW continuous output. But, the 81 MW (thermal) peak remaining can be used totally by the OTEC system to boost its efficiency, that is a contribution of 20,25 MW (thermal) continuous. The high efficiency of collection at high temperatures could be of great benefit to OTEC systems, since by gradual dilution of high grade "waste" heat to low grade heat, the effective benefits could raise the OTEC temperature differential to increase Carnot efficiencies, a number of "cascade" generation subsystems being possibly introduced. (Figure 3. 72)

The total peak contribution from wind, wave, current and solar sources amount to a 47,5 MW electric, 6 MW hydraulic and 20,25 MW relatively high grade thermal energy, a total of 73,75 MW. (Figure 3. 73) *[Source is:* http://en.wikipedia.org/wiki/energyisland, *Retrieved 22 November, 2011]*

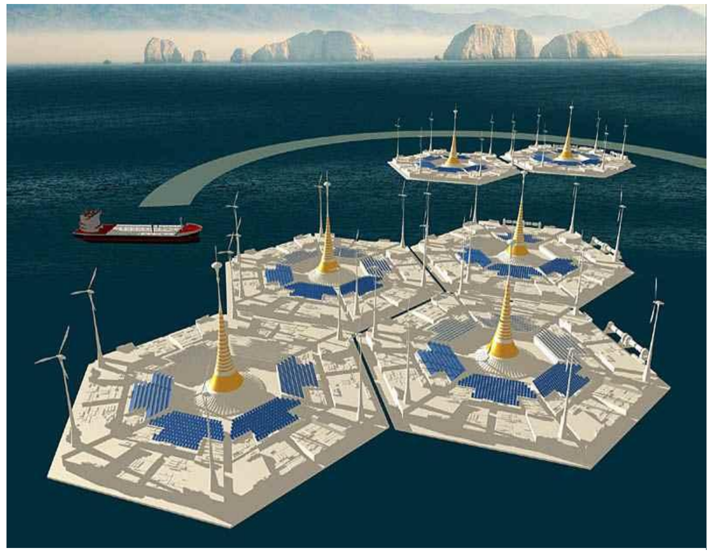


Figure 3.72: Modeling Design.
*Source:[**http://en.wikipedia.org/wiki/Energy**island,**Retrieved 22 November, 2011**.]*

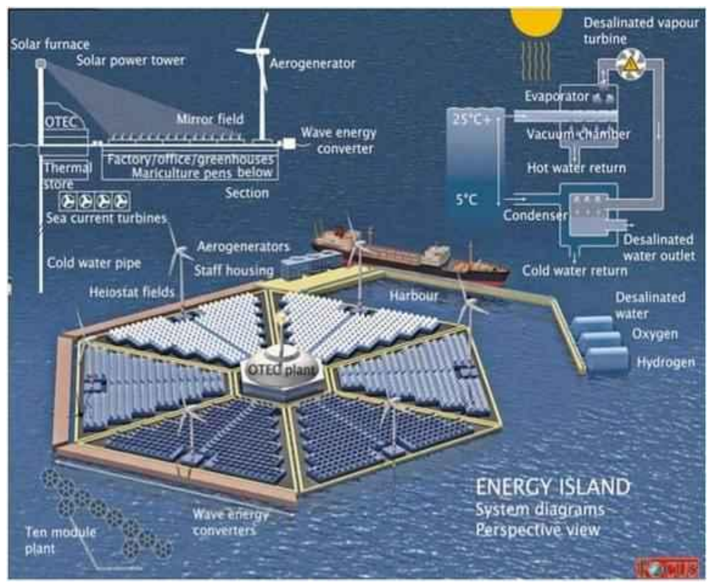


Figure 3.73: Modeling Analysis.
*Source:[**http://en.wikipedia.org/wiki/Energy**island,**Retrieved 22 November, 2011**.]*

	Masder City	Energy Island
Facts	Architect : Norman Foster Location : Abu Dhabi – U.E.A.	Architect: Dominic Michaelis and specialist research groups from University of Southampton. Location: United Kingdom.
Purpose	All buildings will surpass the highest standards currently set by internationally recognized organizations and Masdar City is a key partner in the *Estidama* programme which sets new benchmarks in planning, design and building within cities.	The Energy Island concept is to bring together on a single floating structure a variety of renewable energy conversion systems to maximize the energy production available from the diverse sources available, so that the interrelated systems can assist each other to reach greater efficiencies of conversion.
Objectives	Traditional design techniques help to reduce energy Consumption and to improve the quality of the Environment in traditional Arabic architecture and urban planning of the region.	Maximize the energy production available from the diverse sources available, so that the interrelated systems can assist each other to reach greater efficiencies of conversion.
Strategies	Strategy is to reach zero emission.	Strategy is to Maximize the Energy Production Available from the Diverse Sources Available.
Planning And Design Concept	An extraordinary ecological city of the future is being built in the United Arab Emirates, outside of the capital Abu Dhabi. The work force will soon reach 40,000. Situated in the desert, Masdar is a small city that will be 6 square kilometers (2.3 m2). It is designed to house 40,000 people, 1500 businesses and accommodate up to 50,000 commuters.	The basic island could be of hexagonal plan, so that it could readily be joined to other units to form cluster or linear plans as required. A hexagon made up of 6 equilateral triangles of 300 meter long sides would have a longest cross distance of 600 meters and a shortest cross distance of 520 meters. Its area would be 234 000 m2, or 23,4 hectares. It's size would guarantee it's stability in heavy seas
Nanotechnology Implementation	Not exist.	Not exist.

Table 3.4: Comparison between Masder City and Energy Island

6.3 Futuristic thinking Nano zero carbon settlement:

(nano zero carbon infrastructure and architecture)

6.3.1. Nano-city India.

	Nano-city India
Architect	Berkeley Group for Architecture&Planning (Prof. Nezar Al Syyad).
Location	Panchakula district of Haryana, 25 Km from Chandigarh, India.
Date	In Future.
Type	Nano-zero-energy city.
Technologies Used	Half of the energy used in the city will come from **Renewable sources**, such as **windmills** and **photovoltaic technologies**. **Energy efficient** infrastructure, equipped with carbon capture **solar paneling** and sensitive lighting systems.
CO_2 Emissions	80% reduction in total energy costs for the city and its inhabitants to reach zero emission.

Global warming and climate change make the contemporary urban agenda a global one. The first step in building environmentally intelligent urban space is preserving the naturally existing resources of the land. NanoCity will take advantage of these limited resources by integrating site-specific hydrology and agricultural patterns into the greater design scheme. During the annual monsoon season, water will be harvested from underground sources for retention and use throughout the year. The seasonal rivers that border the city will become part of the perennial public waterway. These naturally existing rivers will not only beautify the city, but will provide a local, sustainable solution to offset India national water shortages. The water reclaimed from these rivers and other natural sources will undergo intensive bioremediation to make it safe for consumption. The water from the rivulets will also be used for district and passive cooling strategies, local crop cultivation and the production of bio-energy. The city will be outfitted with a dual distribution piped water system to separate drinking water from reclaimed greywater used for non-potable purposes. In addition, Living Machine technology will provide NanoCity with the capacity to convert all wastewater into chemical and odor-free drinking water. (Figure 3. 74)

Figure 3.74: Master Plan Design of Nano City. *Source:[http://www.ced.berkeley.edu/~nanocity/,Retrieved 22 November, 2011.]*

Half of the energy used in the city will come from renewable sources, such as windmills and photovoltaic technologies. Energy efficient infrastructure, equipped with carbon capture solar paneling and sensitive lighting systems, will use half the energy required by conventional buildings. The result will be an 80% reduction in total energy costs for the city and its inhabitants. Buildings will also utilize climate responsive design techniques, such as sun shading, cross ventilation and direct evaporative cooling, to reduce the need for air-conditioning. (Figure 3. 75) (Figure 3. 76) *[Source is:* http://www.ced.berkeley.edu/~nanocity/, *Retrieved 22 November, 2011]*

Figure 3.75: Main section in NanoCity. *Source:[* ***http://www.ced.berkeley.edu/~nanocity/,Retrieved 22 November, 2011****.]*

At least 70% of the city waste will be recycled or composted. The residents of NanoCity are estimated to consume 20 times less resources than those living in other cities, and the city will have the smallest per capita carbon footprint in all of India. NanoCity implementation of environmentally sustainable measures will serve as a testament to the financial feasibility of these efforts, and will demonstrate the broad benefits such living can have for all of society. (Figure 3. 77) (Figure 3. 78)

Figure 3.76: View expert living. *Source:[* ***http://www.ced.berkeley.edu/~nanocity/,Retrieved 22 November, 2011****.]*

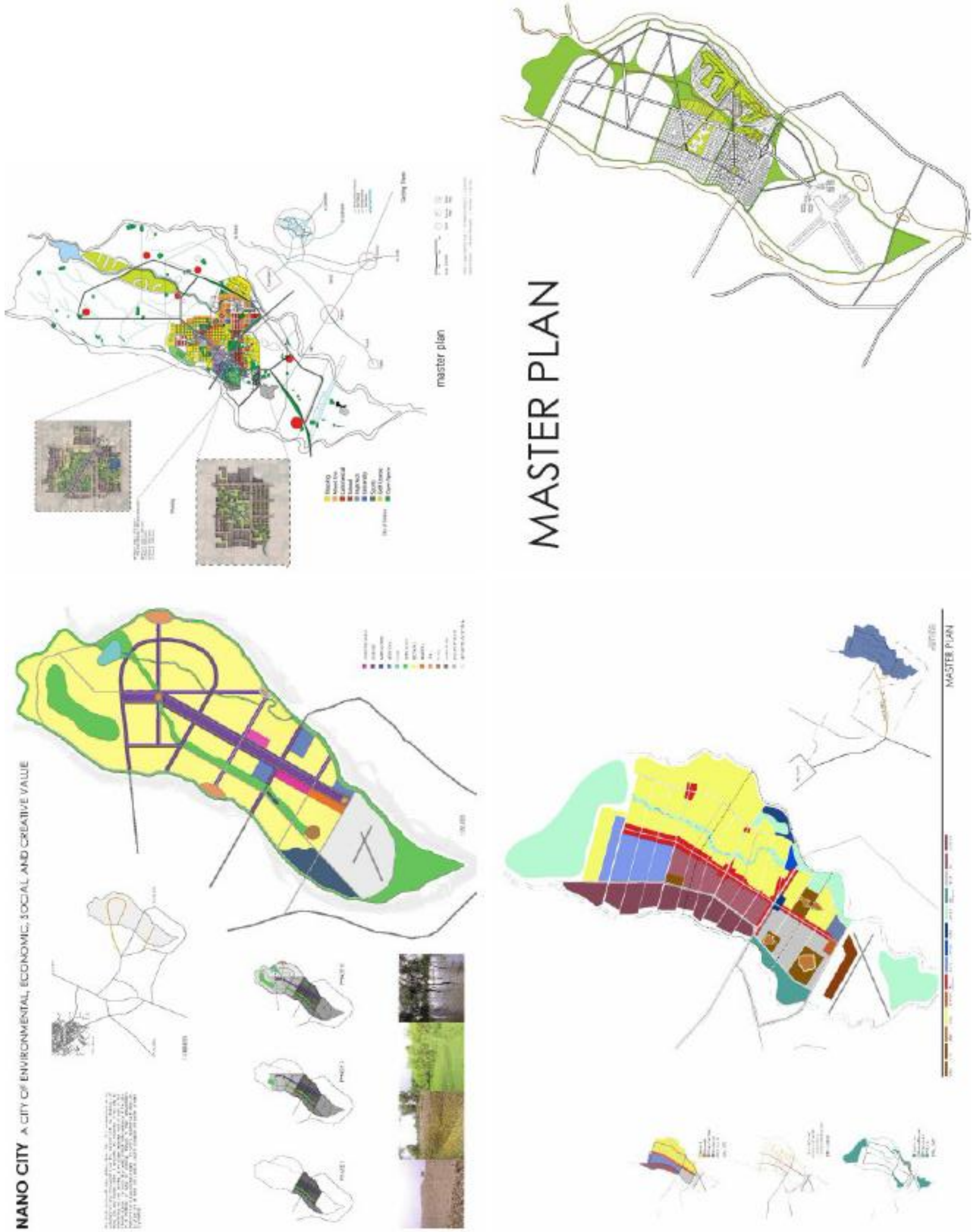


Figure 3.77: NanCity Master Plan. *Source:[**http://www.ced.berkeley.edu/~nanocity/,Retrieved** 22 **November, 2011**.]*

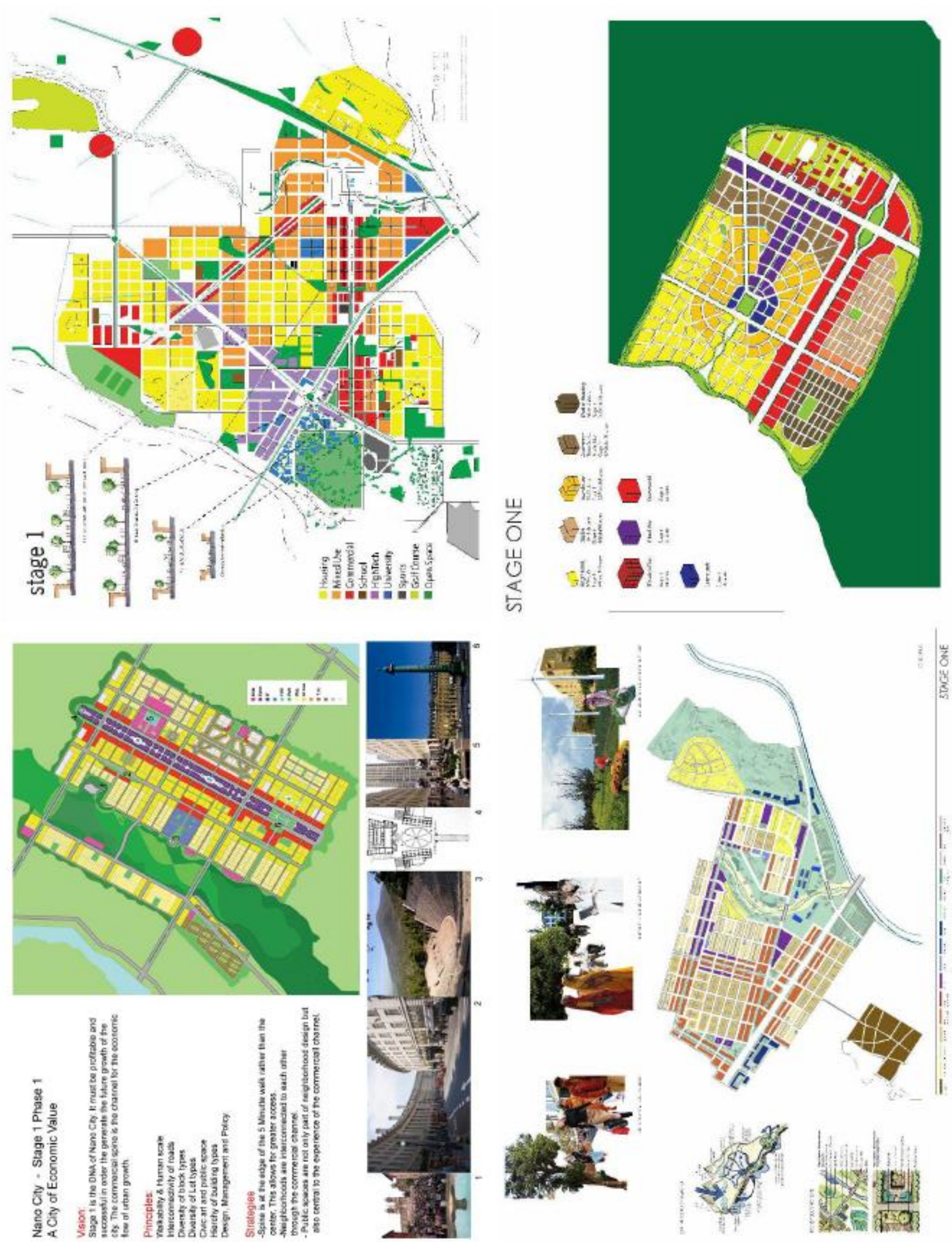


Figure 1.78: NanoCity Vision – Stage – Phase 1 *Source:[* ***http://www.ced.berkeley.edu/~nanocity/,Retrieved 22 November, 2011****.]*

6.3.2. Nano-Polis China.

	Nano-Polis China
Architect	HENN Architekten.
Location	Suzhou, China
Date	In Future.
Type	Nano-zero-energy city.
Technologies Used	**Nanotechnology** is the **primary** focus of the development, the arrangement and planning of the building mass was done with consideration to scale and fractal logic.
CO_2 Emissions	**Innovative technologies** such as **solar harvesting** and **rainwater collection** work together with simple strategies of pedestrian access and public transportation to decrease energy consumption while creating a comfortable place to live and work with Zero Carbon.

The concept for Nano-Polis, a Nanotech Research and Development Park in the city of Suzhou drew its inspiration from both traditional Chinese Urban Planning as well as modern science. (Figure 3. 79)

Since nanotechnology is the primary focus of the development, the arrangement and planning of the building mass was done with consideration to scale and fractal logic. The programmatic needs of the site are divided into sizes S, M, L, and XL, which are further subdivided and arranged according to specific functions. This scalar logic integrates various scales from urban to nano and provides opportunities for the buildings to interact with the users at an intimate human scale as well as creating large iconic landmarks within the site. (Figure 3. 80) *[Source is: http://www.masterpolisnanocity/, Retrieved 22 November, 2011]*

Figure 3.79: Competition-winning design for the new 'Nano-Polis Master Plan' in Suzhou, China by HENN ARCHITEKTEN. *Source:[**http://www.masterpolisnanocity/,Retrieved 22 November, 2011**.]*

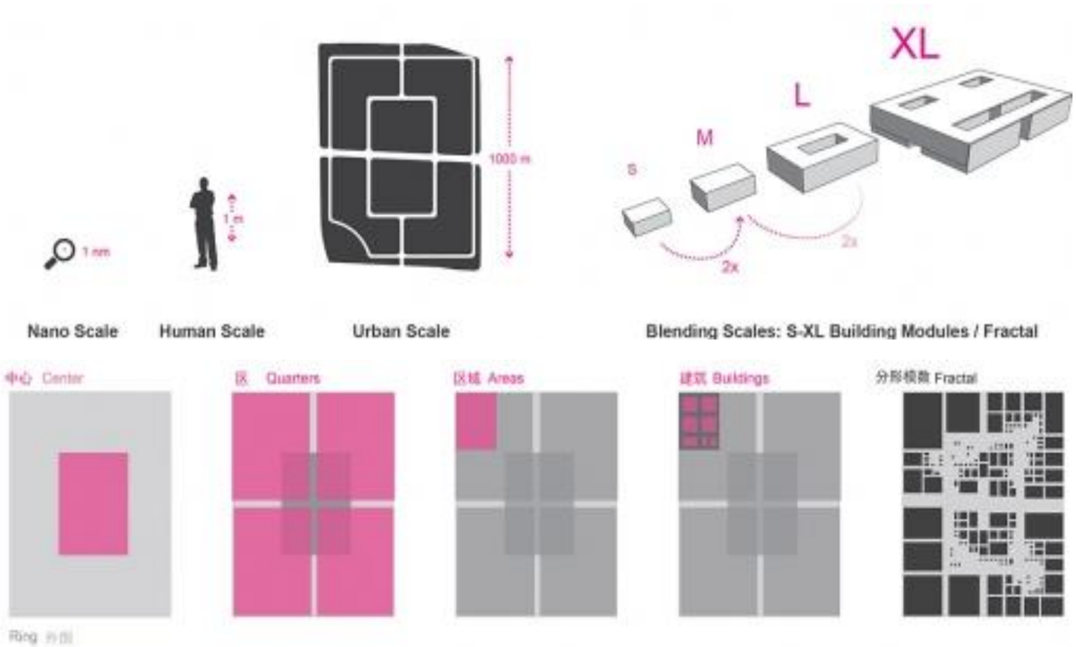


Figure 3.80: Conceptual diagram. *Source:[**http://www.masterpolisnanocity/,Retrieved 22 November, 2011**.]*

Figure 3.81: Conceptual diagram 2. *Source:[**http://www.masterpolisnanocity/,Retrieved 22 November, 2011**.]*

Like most traditional Chinese cities, Nano-Polis assumes a rectilinear shape with a clearly defined border and staggered internal connections. Also the Idea of the fractal can be found in traditional Chinese cities that are assembled in recursive logic by blocks, areas, districts, quarters and boroughs, from S to XL respectively. (Figure 3. 81) (Figure 3. 82) *[Source is: http://www.masterpolisnanocity/, Retrieved 22 November, 2011]*

Figure 3.82: View expert living. *Source:[http://www.masterpolisnanocity/,Retrieved 22 November, 2011.]*

Figure 3.83: Master Plan. *Source:[http://www.masterpolisnanocity/,Retrieved 22 November, 2011.]*

The overall development includes a cluster of high and medium-rise buildings surrounding a central plaza. This area houses most of the administrative, exhibition, conference and public areas as well as temporary housing facilities. This iconic centre is surrounded by a transitional "green belt" which references the traditional Chinese gardens that Suzhou is known for. A natural river flows east to west through the site which feeds a series of ponds, canals, and water features throughout this zone. This green buffer zone connects by a series of shared roof scapes, courtyards and galleries to the outer ring: The entire complex is defined by a dense belt of research and production facilities that create a defined urban edge to the surrounding context. (Figure 3. 83) *[Source is: http://www.masterpolisnanocity/, Retrieved 22 November, 2011]*

Figure 3.84: View internal. *Source:[* ***http://www.masterpolisnanocity/,Retrieved** 22* ***November, 2011****.]*

The design of Nano-Polis employs a variety of environmentally responsible systems into its planning. Innovative technologies such as solar harvesting and rainwater collection work together with simple strategies of pedestrian access and public transportation to decrease energy consumption while creating a comfortable place to live and work. (Figure 3. 84) (Figure 3. 85) *[Source is: http://www.masterpolisnanocity/, Retrieved 22 November, 2011]*

Figure 3.85: View center. *Source:[* ***http://www.masterpolisnanocity/,Retrieved** 22* ***November, 2011****.]*

	NanoCity - India	Nano-Polis China.
Facts	Location: India Area: 44.5 km2	Location: China Area: 1.65 km2
Purpose	It is modeled on Silicon Valley. It will deal in nanotechnology, biosciences, software product development, next generation Internet products, materials research and energy.	Nano-Polis is a Nanotech Research and Development Park. It includes R&D, Production, Office, Conference Center, Exhibition Center, Hotel, Restaurants, Shopping, Housing, and Sports Facilities.
Objectives	The aim is to be the place where learning (Nano) and lifestyle (City) become one, beside develop a sustainable city to create an ecosystem for innovation leading to economy, ecology and social cohesion.	Nanopolis will push forward the development of new emerging industries led by nano-technology and strive to forge a core engine for the development of nano-based industries.
Strategies	The city will accomplish this goal by providing sustainable and efficient infrastructure from the outset, so the residents and future generations of the city can thrive and focus on fostering a lively knowledge economy.	The design of Nano-Polis employs a variety of environmentally responsible systems into its planning. Innovative technologies decrease energy consumption while creating a comfortable place to live and work.
Planning And Design Concept	Nanocity has been designed on three main principles: greencity, flex city and complex city. city design is responsive to changing needs and patterns of growth over time and offer a dynamic sequence of unique neighborhoods and public spaces.	The molecular theory has a reflection on the planning concept. the site are divided into sizes S, M, L, and XL, which are further subdivided and arranged according to specific functions.
Nanotechnology Implementation	Not exist.	Molecular theory has a reflection on the planning concept.

Table 3.4: Comparison between Nanocity India and Nano-Polis China

Part Three Conclusion

We are at a time where there is, global warming and where the earth is overwhelmed with its population which is more than 7 billion people, and where polar mountains are melting and the Ozone hole is getting bigger, and where forest areas destroyed by man are increasing and green areas are decreasing, and where our consumption of electricity is increasing in addition to wasting water. Under all these circumstances, we should think of new ways to limit the negative mark which human beings have left on nature and all its components. This could be done through using new technologies like Nano technology, new techniques and smart materials which work on reducing the energy consumed in heating and cooling. All this should be done in a form of a complete system to result into a clean environment free of harmful substances. This is clarified at part three where is an answer to the questions which we aim to answer through this thesis like these questions:

- **How Nanoarchitecture can reduce the global warming?**
- **Why Nanomaterials is helpful than micro?**
- **How we can reach the clean energy inside the building?**

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

Aspect One:

The nanomaterials and nanotechnology importance appear through discovering new materials working on two axes. First axis is s participation and contribution in forming different clean energy systems due to their small size. It is used as important component in developing the solar cells, windmills turbines, and many other clean energy systems. These materials aim to find new natural resources and new clean energy sources to gradually phasing out the non renewable energy sources threatening to run out after long time of consumption and usage. The second axis is to entering this technology. The nanotechnology measurement is to form and find new materials can be used in architectural and construction aspect. The characteristics of these materials should be environment friendly and not harmful. Also it should be as co-factor or workable factor in not transferring the harmful aspects of the external environment into the buildings to create healthy, comfortable, and livable environment.

Aspect Two:

To reduce the resulted pollution from construction and buildings sector, there is an important stage or phase to focus on when starting the construction process which is production of materials. This stage is causing and contributing to a high portion of the pollution resulting from the construction and buildings sector. The benefit of nanotechnology and using nanomaterials appear in the production stage whereas it is carbon free materials, and its production stages don’t contain any form of pollution. This material production phase result in producing material can be used in construction and building process to construct the optimal architectural unit in the constructed building. This unit is environment friendly, healthy, and compatible or adapting to the surrounding environment.

Aspect Three:

The Smart sensors systems; which are an important component of the integrated system aiming to reduce the negative effects of the global warming, and reducing energy consumption inside or within one unit. This is basic function of the smart sensors systems which work to reduce the wastes resulting from energy misusing such as electrical lighting turned on after working hours ends, “leaving the water taps open after using “or water waste resulting from not closing or sealing water taps, or air conditioners used for long periods of time even after reaching the required programmed temperature. Such systems should be used in houses, public buildings, and different types of buildings as it works to reduce energy consumption and energy wasting inside the building, and also storing it, and reusing. These systems are developed continuously and quickly as it is composed as result of using nanotechnology and using smart nanomaterials which are significantly contributing in its continuous development, and improving its performance or efficiency.

Aspect Four:

The importance of various material recycling; this process contributes in reducing the negative effects of global warming, saving high percentage of consumed or used energy in the various materials production which is used on a daily bases and considered a huge burden on the communities in the form of wastes must be disposed of or get rid of. Thus various materials recycling provide great benefits to the environment.

Aspect Five:

Mentioning many examples of the news cities beginning to appear in various countries which show new architecture trends aiming to reach clean environment and carbon free through using new technologies such as nanotechnology, nanomaterials, smart materials, and smarts sensor systems. Also in addition to the infrastructure of these cities which its primary objective or goal is linking all of these cities’ elements together, continuous and smart controlling of energy consumption, and depending on clean energy producing renewable energy such as solar energy, wind energy, tide and energy and other forms of clean energy to replace non renewable energy . One of the Arabian examples of such cities is “Masdar” city in Dubai which demonstrate the Arab governments interests in this trend whereas there will be much depending on such cities in the near future. These cities will facilitates all the human being needs in different comfortable means including the basic human needs. It connects them together with different networks in these cities infrastructure, and transferring electricity from generators to all units and buildings. It also provides different non-exhaust transportation means depending on clean energy such as electrical cars. Also electric-powered trains, and metros, solar-power bikes, and many other transportation means.

At the end of this part showing the different governments, and the international interest in this architecture trend, and such city type such as India, china, UAE, USA, Bahrain, and Qatar that are interested in this trend that obviously appear in different cities designs, this is considered real seeds of an architectural trend will benefit the human beings and the environment alike without any harms.

Aspect Six:

It seems like more and more Arab countries acknowledge the importance and potential of nanotechnology to address the three most fundamental development challenges facing the Arab world, which include: ensuring adequate supplies of water, clean energy, food and renewable energy. Thus, there is no wonder that that two first major environmental projects applying nanotechnology have to do with desalination and purification of water.

This acknowledgment of the importance of nanotechnology to the Arab world will, most probably, result in more research centers established in all the Arab countries and in more environment projects launched using nanotechnology.

In order to cover the knowledge gap with the West, joint nanotechnology research centers and projects have been launched in collaboration with foreign companies and research centers, who already have the needed knowledge in nanotechnology.

Facing the challenges of lack of water, energy, and food is a need common to all the countries located in the Middle East and North Africa. This need might also bring the Arab countries to collaborate with each other and even to collaborate with Israel, which has the knowhow in this field. *[Source is: http://gc-research.org/Nanotechnology_and_the_Environment_in_the_Arab_World/ , Retrieved 22 November, 2011]*

Part Four: Application.

Introduction

Chapter Seven: Application (Bibliotheca Alexandrina)

7.1 Case Study (Reading Area in Bibliotheca Alexandrina)

7.1.1. Background of Case Study.

7.1.2. Concept & Analysis of Case Study

7.1.3. Recommendations.

Part Four Conclusion.

Overall Conclusions and Recommendations

References.

ملخص الرسالة بالعربية

Part Four: Application.

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 differentiated 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. (Figure 4.1) *[Source is: http:// annual report 09-10 for Egypt Electricity Company.pdf, Retrieved 22 February ,2012]*

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 combustion 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

	2009/2010	2009/2008	Develop %
steamy	53520	56165	4.7
gaseous	11429	2767	313
Combined cycle	46627	42966	8.5
Total thermal	111576	101898	9.5
aqueous	12863	14682	12.4
Wind (el zafrana)	1133	931	21.7
Total network	125572	117511	6.9
Non-Connected station	218	271	19.6
Purchased from industrial companies	26	17	53
Generator from boot	13148	13241	0.4
Total	129000	121040	6.1

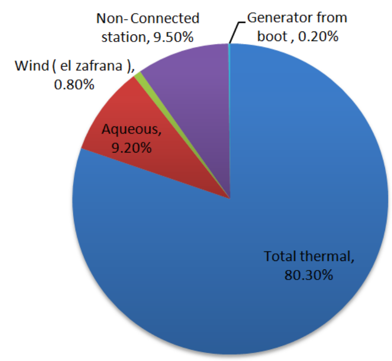


Figure 4.1: Distribution of power generated according to the type of generation *Source:[http:// annual report 09-10 for Egypt Electricity Company.pdf, Retrieved 22 February ,2012]*

Power generated G.W.H	Company
27862	Cairo
19997	East Delta
25969	Central Delta
19085	West Delta
18663	Upper Area
12863	Hydro Station
124439	Total Companies
14561	Generated from the private sector (Non-bound, purchased)
139000	Total

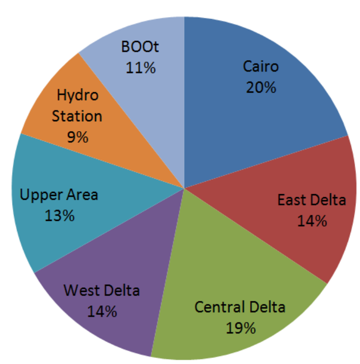


Figure 4.2: Energy generated and purchased in a company-wide
Source:[http:// annual report 09-10 for Egypt Electricity Company.pdf, Retrieved 22 February ,2012]

cooperation with several friendly countries in the implementation of projects and programs aimed at developing the use of new and renewable energies, green building and capacity development, and policy development of environmental action in Egypt. (Figure 4.2) *[Source is: http:// annual report 09-10 for Egypt Electricity Company.pdf, Retrieved 22 February, 2012]*

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. Egypt is well aware of the importance of cooperation with the international community in addressing the dangers of climate change has therefore taken the initiative to establish a national commission for clean development mechanism, which committed a number of activities since its inception in 2005, has been approved for implementation of 38 projects in various sectors - some port actually the ground, and Avoid carbon reduction certificates, and contribute to solving the problem of global warming And government of Egypt is also promoting the use and production of clean energy, especially the new and renewable energy in addition to improving energy efficiency has been the establishment of the Supreme Council of Energy to oversee the development and organization of this important sector in the country. (Figure 4.3)

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. (Figure 4.4) *[Source is: http:// annual report 09-10 for Egypt Electricity Company.pdf, Retrieved 22 February ,2012]*

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

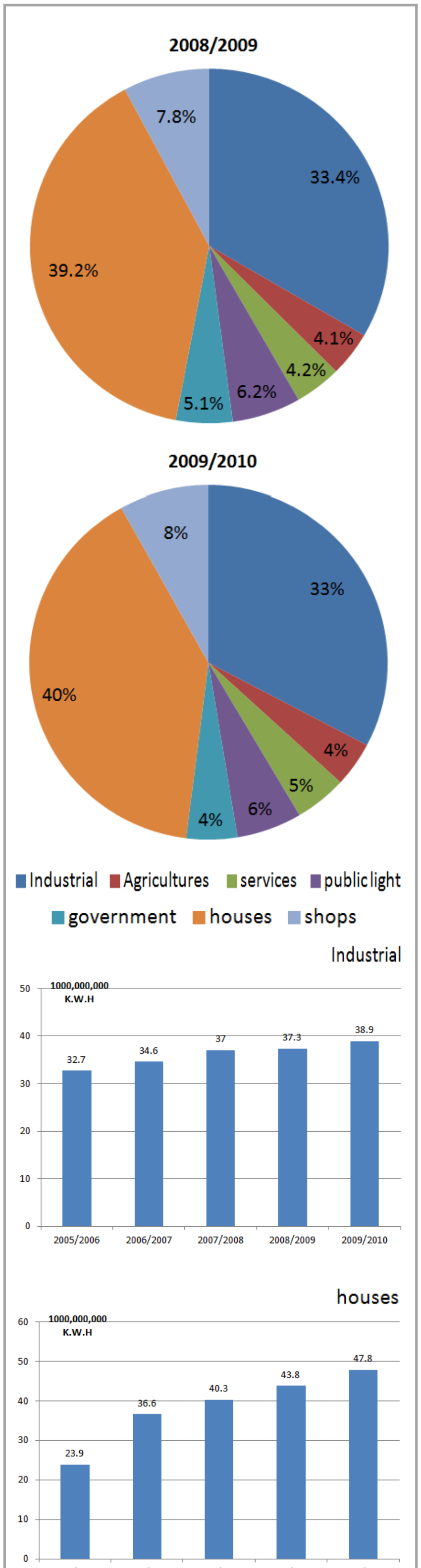
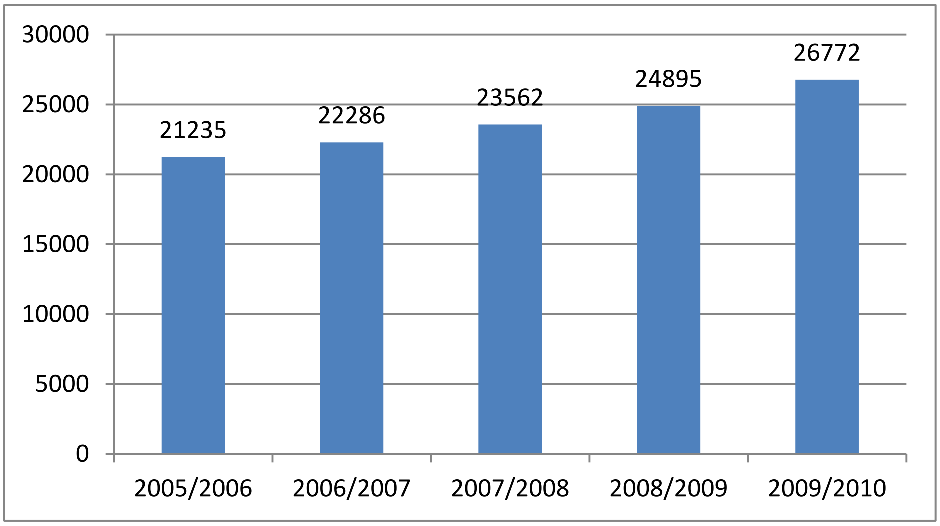


Figure 4.3: Energy sold, distributed for the purposes. *Source:[http:// annual report 09-10 for Egypt Electricity Company.pdf, Retrieved 22 February ,2012]*

Subject	09/10	08/09	Develop %
Mazot 1000 ton	5929	5321	11.4
Gas 1,000,000 m3	24314	23013	5.7
Regular Solar 1000 ton	4.4	5.1	13.7
Special Solar 1000 ton	170.81	116	47.3
Total 1000 ton.m2	36772	24895	7.5



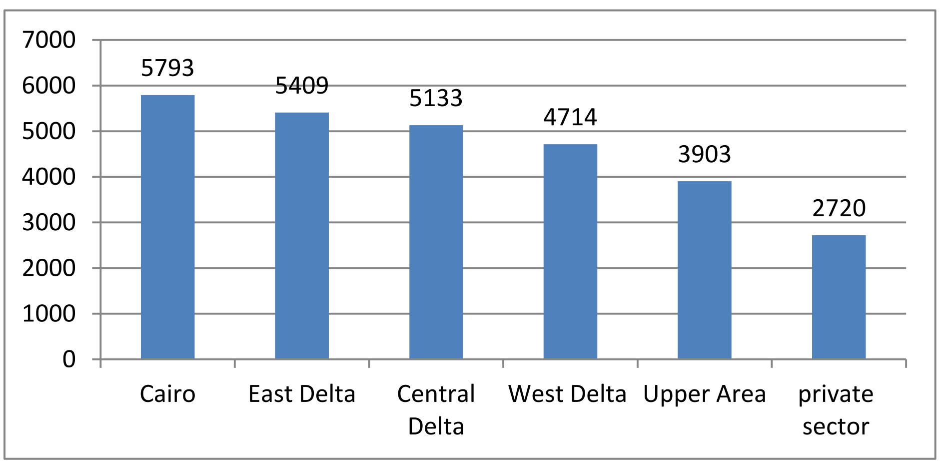


Figure 4.4: Spent fuel by type and the evolution of average. *Source:[http:// annual report 09-10 for Egypt Electricity Company.pdf, Retrieved 22 February ,2012]*

This Part provides a broad review of pervious work done in the field of renewable technology particularly in building sector. First, it deals with preface of the problem and literature review of background of case study. Second, it summarizes the Concept & Analysis of Case Study (Bibliotheca Alexandrina). Finally, we will find recommendations of case study.

Chapter Seven: Application (Bibliotheca Alexandrina)

7.1 Case Study (Reading Area in Bibliotheca Alexandrina)

7.1.1. Background of Case Study.

	Bibliotheca Alexandrina
Architect	Norwegian architectural firm Snohetta
Location	Alexandria , Egypt
Date	2002
Area	80,000 m2.
Client	UNISCO, Arab Republic of Egypt.
Cost	212,000,000 US$

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. (Figure 4.5)

Figure 4.5: Bibliotheca Alexandrina (Arial View) *Source:[http://en.wikipedia.org/wiki/Bibliotheca_Alexandrina, Retrieved 22 February ,2012]*

The dimensions of the project 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 people, and for children; four museums; four art galleries for temporary exhibitions; 15 permanent exhibitions; a planetarium; and a manuscript restoration laboratory. The library's architecture 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. (Figure 4.6) (Figure 4.8) (Figure 4.9) *[Source ishttp://en.wikipedia.org/wiki/Bibliotheca_Alexandrina, Retrieved 22 February, 2012]*

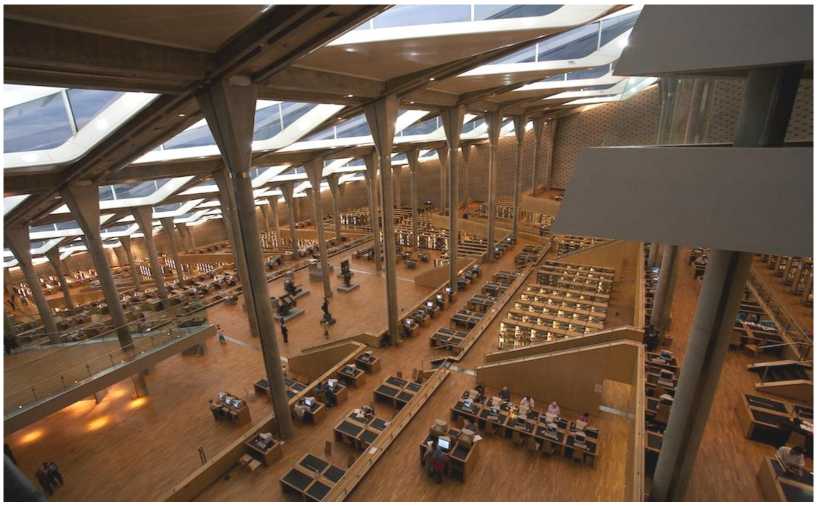


Figure 4.6: Bibliotheca Alexandrina (Internal View)

The BA is completing its eighth year and is getting ready to approach its first decade of existence. This past year has seen us expand our activities: 1.4 million visitors and over 700 events; in addition to about a million hits per day on our various websites. We continue to do cutting-edge work in each of our eight research institutes, and we have successfully integrated a super-computer (capable of doing 10,000,000,000,000 calculations per second) into our arsenal of analytical tools. We have developed critical tools for librarianship in Arabic, and we have been the recipient of the largest book donation in history: 500,000 volumes of French books donated to the BA by the Banff. (Figure 4.7)

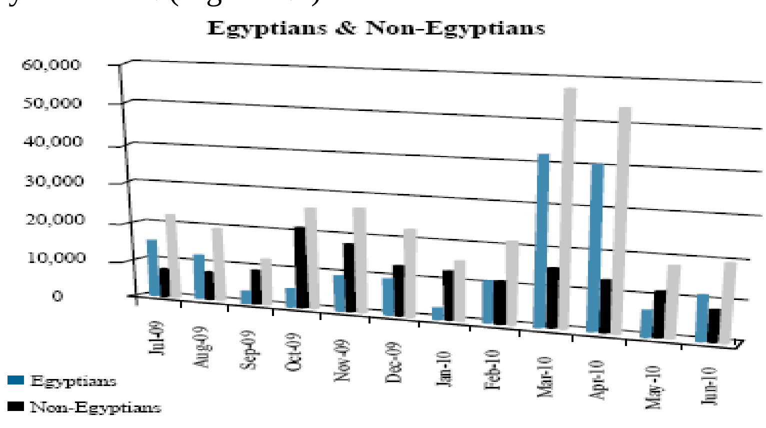


Figure 4.7: Bibliotheca Alexandrina Visitors

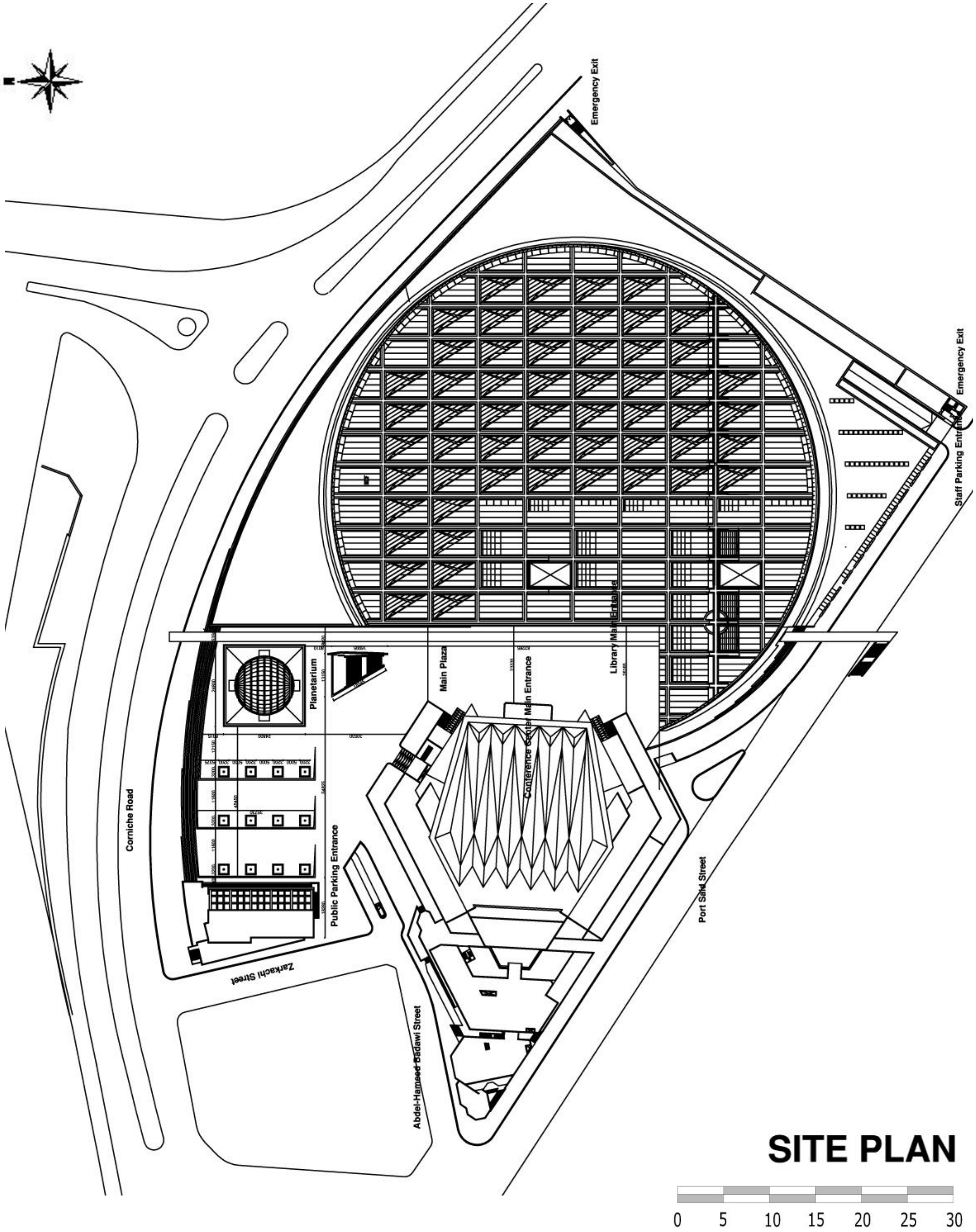


Figure 4.8: Site Plan.

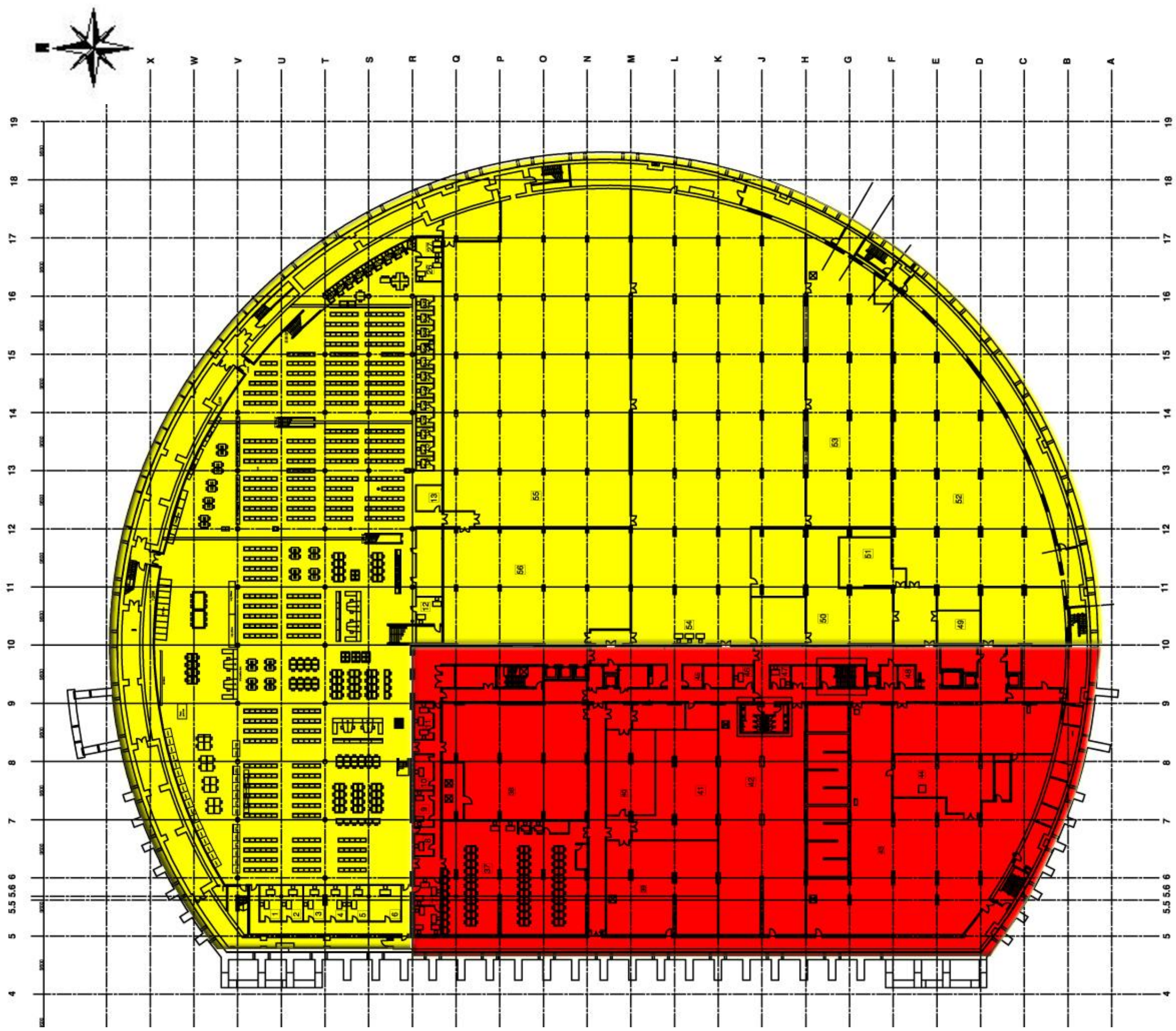


Figure 4.9: Bibliotheca Alexandrina Reading Area Percentage

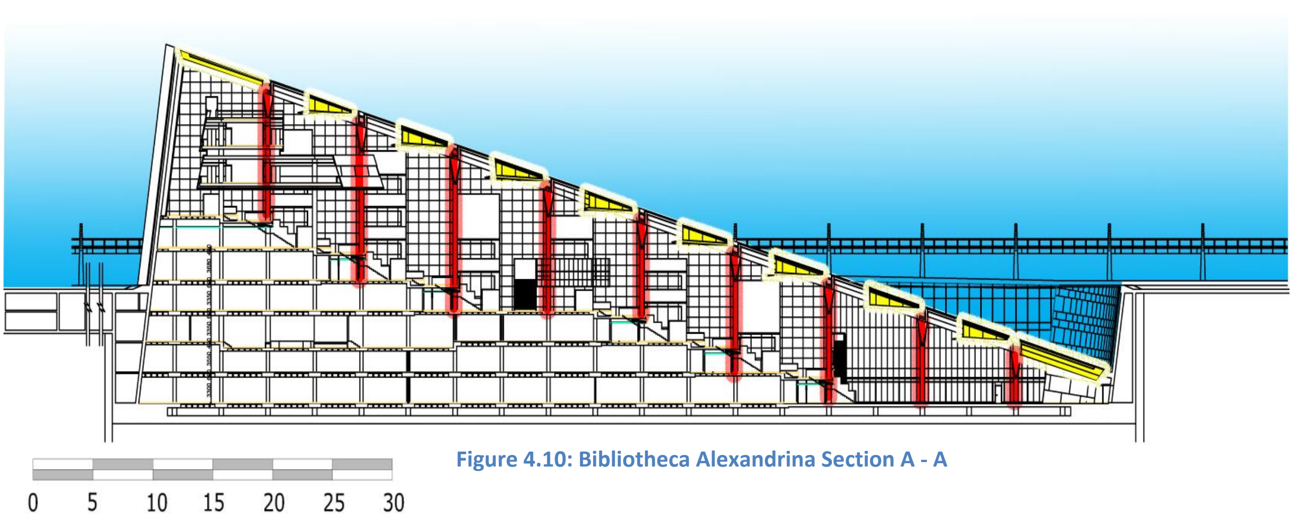


Figure 4.10: Bibliotheca Alexandrina Section A - A

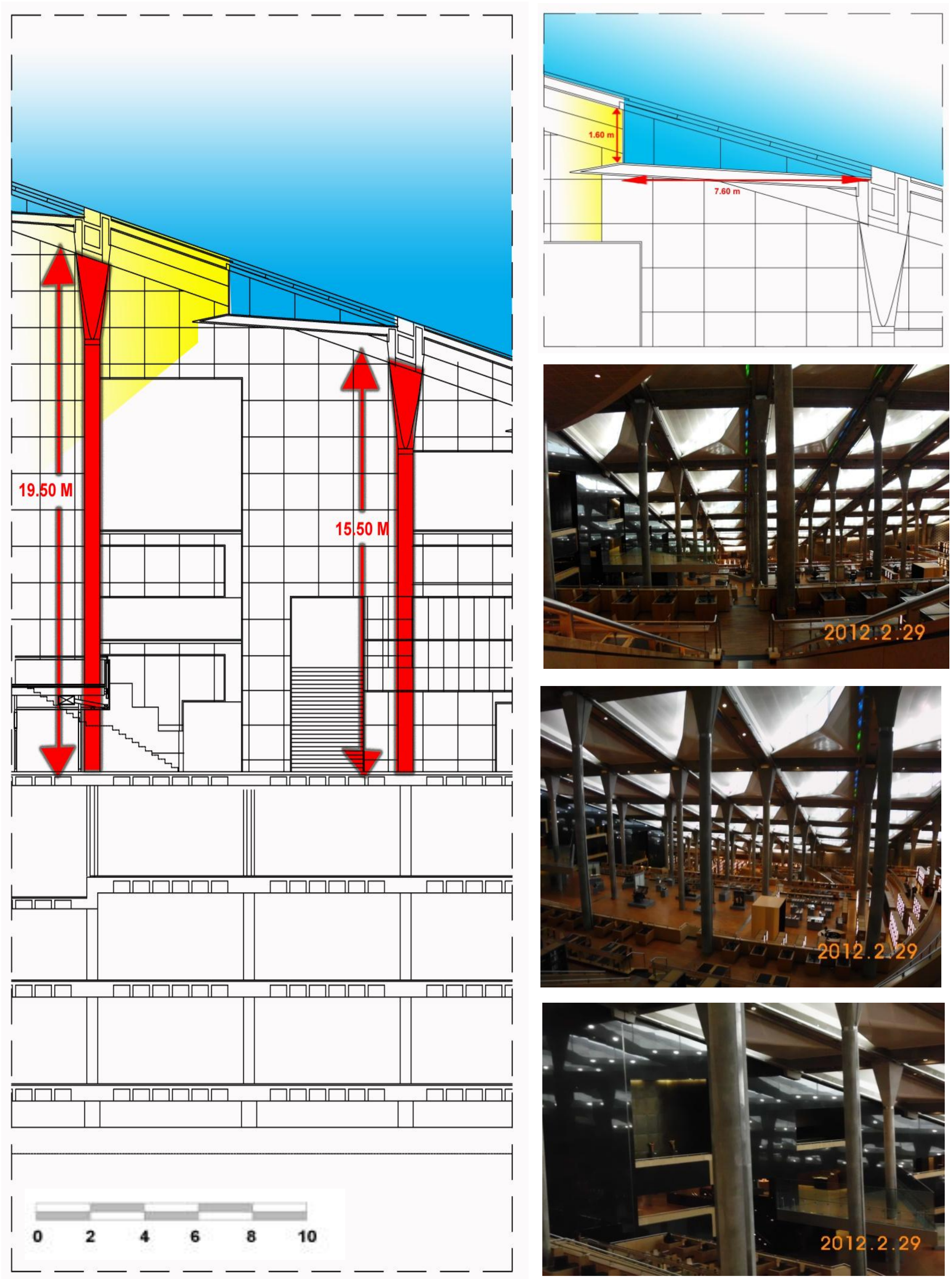


Figure 4.11: Drawing for Section Details (High of Internal Column) and Internal Picture

Should also be emphasized that through the drawing, it's clear that the interior high of columns be 20 m to 30 m, which certainly affect the arrival of daylighting for the reading area so as to distance and large reading area as the vertical glass panel (8m *4m), which means that the daylighting factor is so small for public buildings which must be **DF=1**. (Figure 4.10) (Figure 4.11)

The composition of vertical glass roof lights is exterior 8mm toughened clear glass with coating Sunex 66/38. 16 mm gap filled with Argon gas + the bounding material is Thiokol. Interior 2*6 mm float clear glasses with inserted Trosifol protective film of 0.76 mm thickness.

Light Qualities	Required	Reality
Light transmission index	Minimum 50%	62%
Shading coefficient	Even or lower than 45%	44%
Reflection	Max. 10 %	9%
Total solar radiant heat transmission factor	Max. 40%	38%
Colour rendition	96	91
The deviation of the planckian locus towards green not to exceed more than 0.02 on the chromaticity 7-co-ordinte.	——	——
UV- reduction - factor	Minimum 85%	85.5%
U value for this glazing	1.35(W/m2k)	1.35

Table 4.1: Composition of vertical glass rooflight.

Figure 4.12: Vertical glass rooflight (external view)

We can see that the glass and aluminum panels and gray Aswan granite be as the external finishing , but the internal finishing is wooding in floor, double black granite, concrete in column, also the most furniture in reading area from wood and aluminum sheet. All that materials had its reflection factor which affect in internal environment by absorption the energy and transferred the heat from outside to inside which make a large heavy burden on HVAC inside the reading area. (Table 4.1) (Figure 4.12) (Figure 4.13) (Figure 4.14)

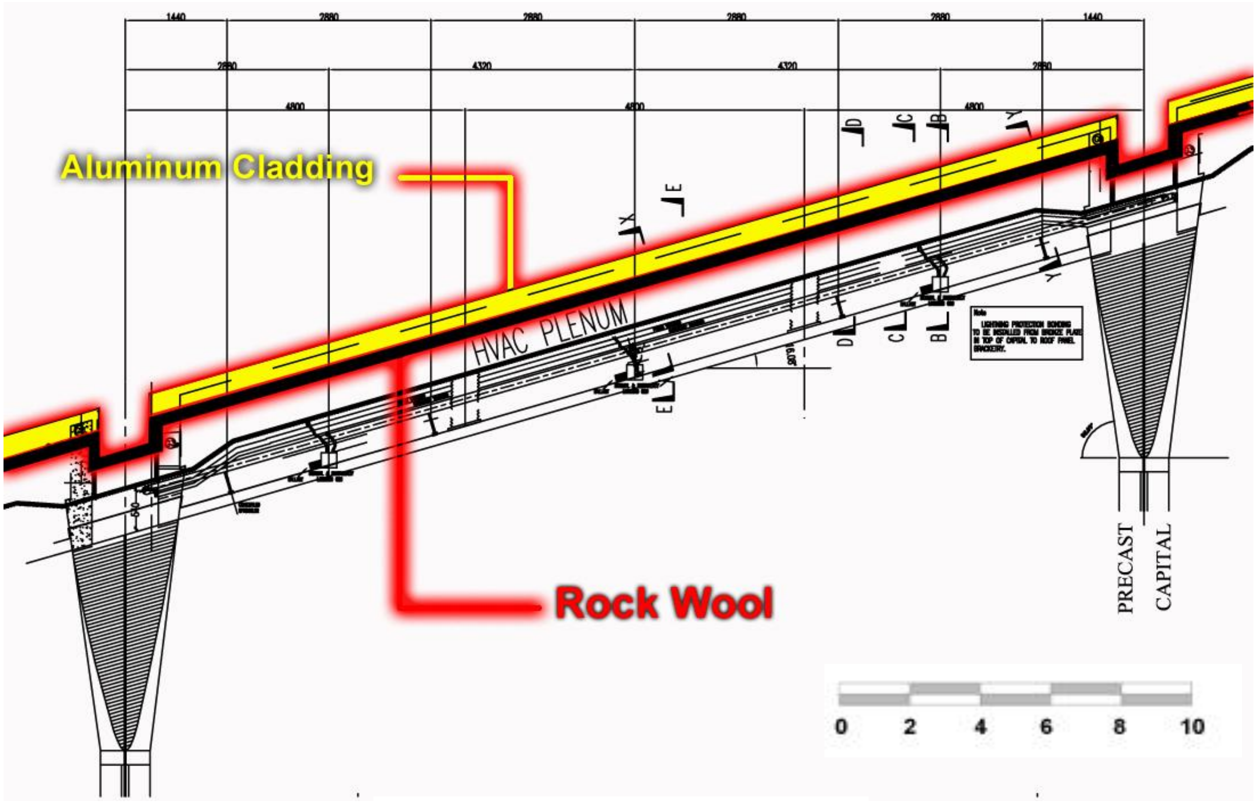


Figure 4.13: Section Details G-G in Roof section.

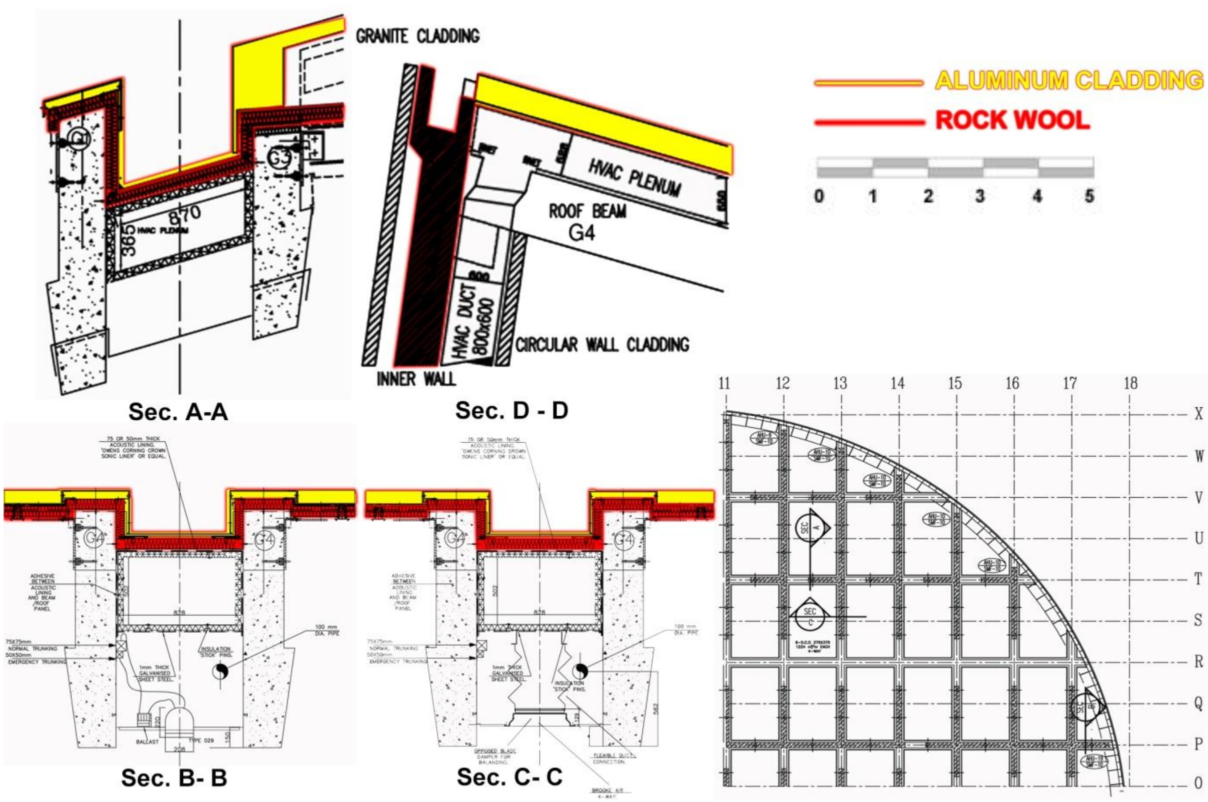
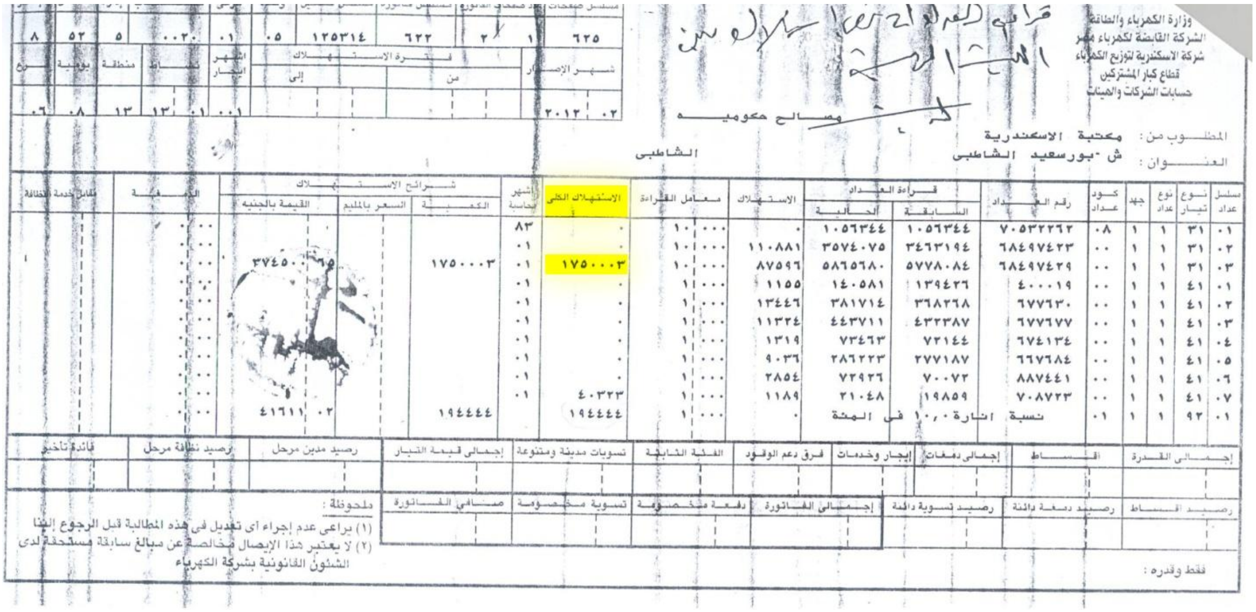


Figure 4.14: Sections Diagrams



وزارة الكهرباء والطاقة
الشركة القابضة لكهرباء مصر
شركة الاسكندرية لتوزيع الكهرباء
قطاع كبار المشتركين
حسابات الشركات والهيئات

مصالح حكوميه

المطلوب من : مكتبة الاسكندرية
العنوان : ش -بورسعيد الشاطبى الشاطبى

شهر الإصدار: ٠٢ ٢٠١٣

مسلسل عداد	نوع تيار	نوع عداد	جهد	كود عداد	رقم العداد	قراءة العداد السابقة	قراءة العداد الحالية	الاستهلاك	معامل القراءة	الاستهلاك الكلى	أشهر محاسبة	شرائح الاستهلاك الكمية	السعر بالمليم	القيمة بالجنيه	الدمغة	مقابل خدمة النظافة
٠١	٣١	١	١	٠٨	٧٠٥٣٢٢٦٢	١٠٥٦٣٤٤	١٠٥٦٣٤٤	٠	١٠ ٠٠٠	٠	٨٣				٠ ٠٠	
٠٢	٣١	١	١	٠٠	٦٨٤٩٧٤٢٣	٣٤٦٣١٩٤	٣٥٧٤٠٧٥	١١٠٨٨١	١٠ ٠٠٠	٠	٠١				٠ ٠٠	
٠٣	٣١	١	١	٠٠	٦٨٤٩٧٤٢٩	٥٧٧٨٠٨٤	٥٨٦٥٦٨٠	٨٧٥٩٦	١٠ ٠٠٠	١٧٥٠٠٠٣	٠١	١٧٥٠٠٠٣		٣٧٤٥٠ ٦٥	٠ ٠٠	١
٠١	٤١	١	١	٠٠	٤٠٠٠١٩	١٣٩٤٢٦	١٤٠٥٨١	١١٥٥	١ ٠٠٠	٠	٠١				٠ ٠٠	
٠٢	٤١	١	١	٠٠	٦٧٧٦٣٠	٣٦٨٢٦٨	٣٨١٧١٤	١٣٤٤٦	١ ٠٠٠	٠	٠١				٠ ٠٠	
٠٣	٤١	١	١	٠٠	٦٧٧٦٧٧	٤٣٢٣٨٧	٤٤٣٧١١	١١٣٢٤	١ ٠٠٠	٠	٠١				٠ ٠٠	
٠٤	٤١	١	١	٠٠	٦٧٤١٣٤	٧٢١٤٤	٧٣٤٦٣	١٣١٩	١ ٠٠٠	٠	٠١				٠ ٠٠	
٠٥	٤١	١	١	٠٠	٦٦٧٦٨٤	٢٧٧١٨٧	٢٨٦٢٢٣	٩٠٣٦	١ ٠٠٠	٠	٠١				٠ ٠٠	
٠٦	٤١	١	١	٠٠	٨٨٧٤٤١	٧٠٠٧٢	٧٢٩٢٦	٢٨٥٤	١ ٠٠٠	٠	٠١				٠ ٠٠	
٠٧	٤١	١	١	٠٠	٧٠٨٧٢٣	١٩٨٥٩	٢١٠٤٨	١١٨٩	١ ٠٠٠	٤٠٣٢٣	٠١				٠ ٠٠	
٠١	٩٢	١	١	٠١	نسبة انارة ١٠,٠ فى المئة			٠	١ ٠٠٠	١٩٤٤٤٤		١٩٤٤٤٤		٤١٦١١ ٠٢	٠ ٠٠	

إجمالى القدرة | اقساط | إجمالى دمغات | إيجار وخدمات | فرق دعم الوقود | الفئة الثابتة | تسويات مدينة ومتنوعة | إجمالى قيمة التيار | رصيد مدين مرحل | رصيد نظافة مرحل | فائدة تأخير

رصيد اقساط | رصيد دفعة دائنة | رصيد تسوية دائنة | إجمالى الفاتورة | دفعة مخصوصة | تسوية مخصوصة | صافى الفاتورة

ملحوظة :
(١) يراعى عدم إجراء اى تعديل فى هذه المطالبة قبل الرجوع إلينا
(٢) لا يعتبر هذا الإيصال مخالصة عن مبالغ سابقة مستحقة لدى الشئون القانونية بشركة الكهرباء

فقط وقدره :

Figure 4.15: Statement of electricity consumption during the month.

Statement of electricity consumption during the month shown that the total consumption of electricity within a month of work from 9 am to 4 pm (7 hour per day) for 26 days per month is (1750 MW) (Figure 4.15) and after the breakdown of that amount is clear they are used in three sections as follows:

- First section: **Cooling consumption** used to adapt the reading area is (300 MW).
- Second section: **Services consumption** used in electricity services is (435 MW).
- Third section: **Lighting consumption** the electricity used in lighting reading area is (1015 MW). (Figure 4.16)

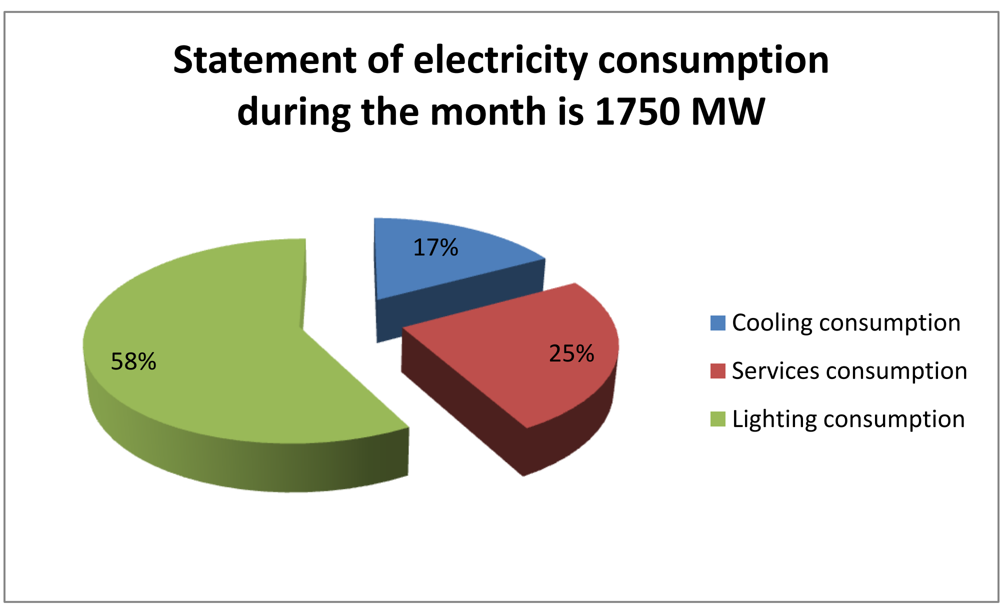


Figure 4.16: Sections of electricity consumption during the month percentage.

7.1.2. Concept & Analysis of Case Study:

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:

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.
- The warmest average max/ high temperature are 30 °C (86 °F) in July, August & September.
- The coolest average min/ low temperature are 11 °C (52 °F) in January & February.
- Alexandria receives on average 190 mm (7.5 in) of precipitation annually or 16 mm (0.6 in) each month.
- On balance there are 41 days annually on which greater than 0.1 mm (0.004 in) of precipitation (rain, sleet, snow or hail) occurs or 3 days on an average month.
- The driest weather is from June to September when on balance 0 mm (0.0 in) of rainfall (precipitation) occurs.
- The month with the wettest weather is December when on balance 59 mm (2.3 in) of rain, sleet, hail or snow falls across 10 days.
- Mean relative humidity for an average year is recorded as 69.3% and on a monthly basis it ranges from 66% in March & April to 73% in July. (Figure 4.17)

- 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. (Figure 4.18)
- On balance there are 3594 sunshine hours annually and approximately 9.8 sunlight hours for each day. (Figure 4.19)
- On balance there are 0 days annually registering frost in Alexandria and in January there are on average 0 days with frost. (Table 4.2)

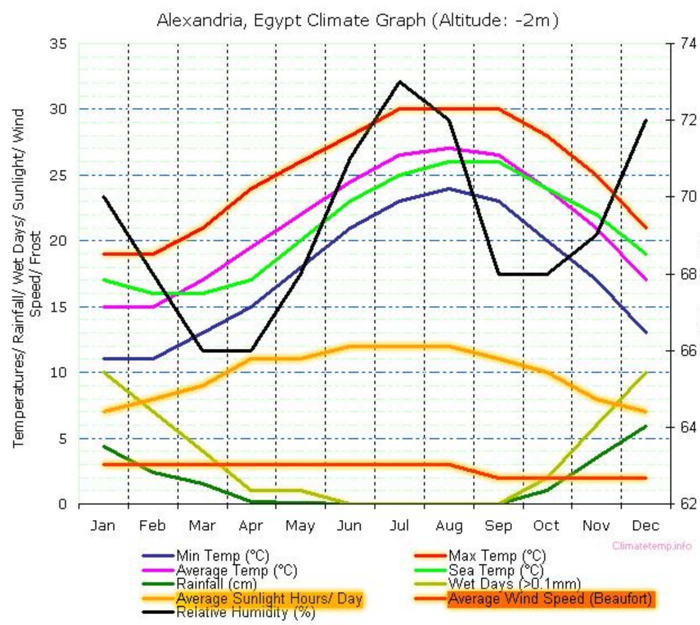


Figure 4.17: Alexandria Climate Guide ***Source:[http://www.climatetemp.info/egypt/alexandria.html, Retrieved 22 February ,2012]***

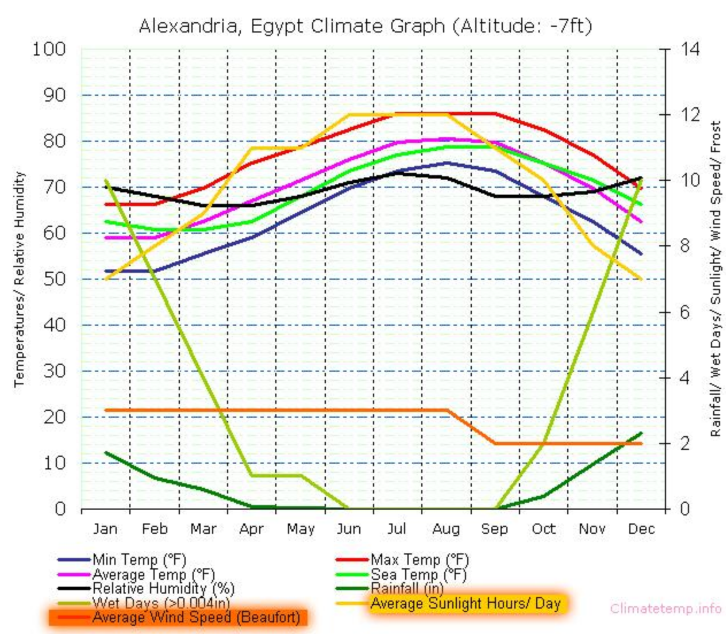


Figure 4.18: Alexandria *Climograph* ***Source:[http://www.climatetemp.info/egypt/alexandria.html, Retrieved 22 February ,2012]***

	Average Minimum Temperatures in Alexandria, Egypt (°C)	Average Maximum Temperature in Alexandria, Egypt (°C)	Alexandria Average Temperature (°C)	Average Sea Temp (°C)	Average Rainfall/ Precipitation (mm)	Wet Days (>0.1 mm)	Average Sunlight Hours / Day	Relative Humidity (%)	Average Wind Speed in Alexandria (Beaufort)	Average Number of Days with Frost	
Weather in Alexandria in January	11	19	15	17	44	10	7.0	70	3	0	Average Temperature in Alexandria in January
Weather in Alexandria in February	11	19	15	16	24	7	8.0	68	3	0	Average Temperature in Alexandria in February
Weather in Alexandria in March	13	21	17	16	15	4	9.0	66.0	3	0	Average Temperature in Alexandria in March
Weather in Alexandria in April	15	24	20	17	2	1	11.0	66	3	0	Average Temperature in Alexandria in April
Weather in Alexandria in May	18	26	22	20	1	1	11.0	68	3	0	Average Temperature in Alexandria in May
Weather in Alexandria in June	21	28	25	23	0	0	12.0	71	3	0	Average Temperature in Alexandria in June
Weather in Alexandria in July	23	30	27	25	0	0	12.0	73	3	0	Average Temperature in Alexandria in July
Weather in Alexandria in August	24	30	27	26	0	0	12.0	72	3	0	Average Temperature in Alexandria in August
Weather in Alexandria in September	23	30	27	26	0	0	11.0	68	2	0	Average Temperature in Alexandria in

											September
Weather in Alexandria in October	20	28	24	24	10	2	10.0	68	2	0	Average Temperature in Alexandria in October
Weather in Alexandria in November	17	25	21	22	35	6	8.0	69	2	0	Average Temperature in Alexandria in November
Weather in Alexandria in December	13	21	17	19	59	10	7.0	72	2	0	Average Temperature in Alexandria in December

Table 4.2: Alexandria Weather Averages *Source:[http://www.climatetemp.info/egypt/alexandria.html, Retrieved 22 February ,2012]*

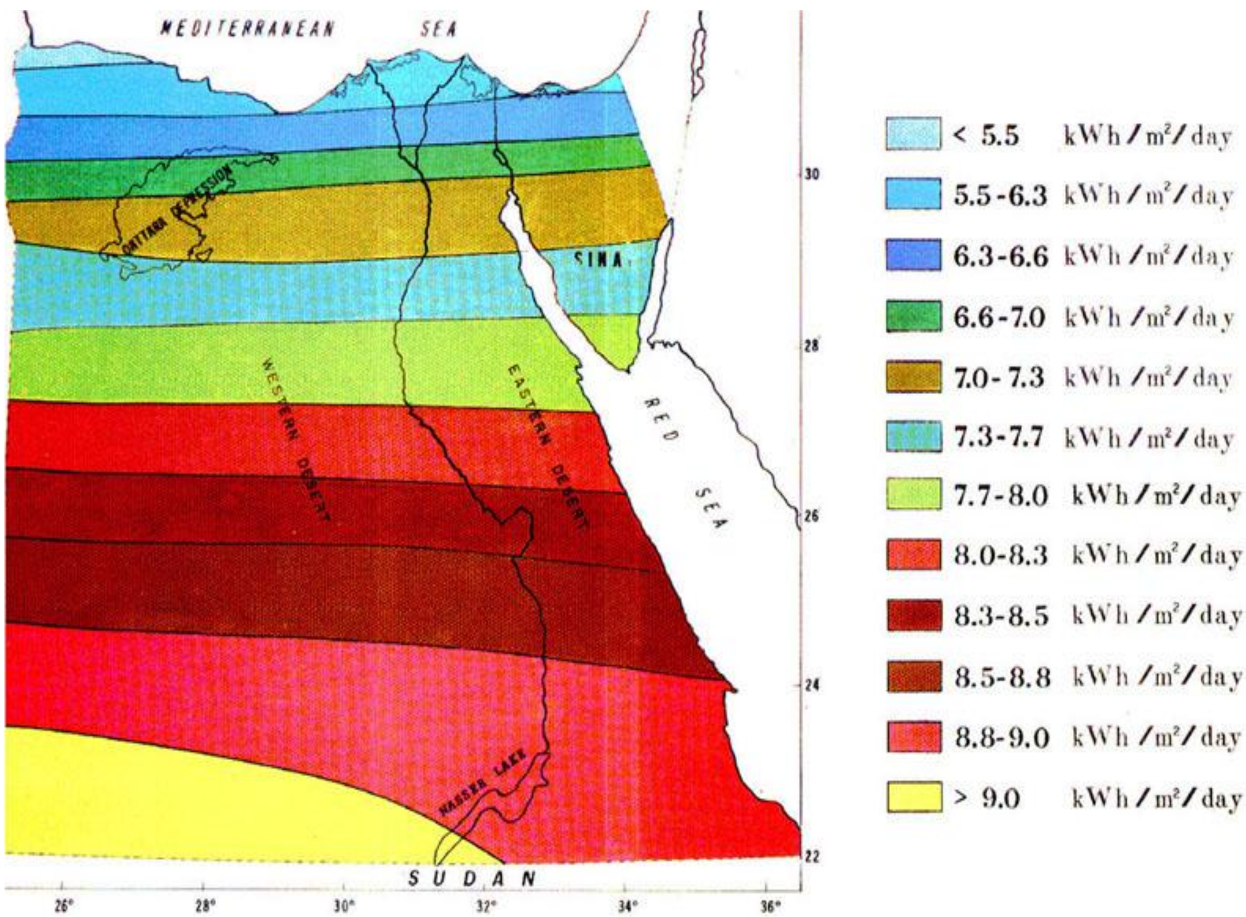


Figure 4.19: Egypt average annual sunlight per kwh/m2/day.

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 4.20):

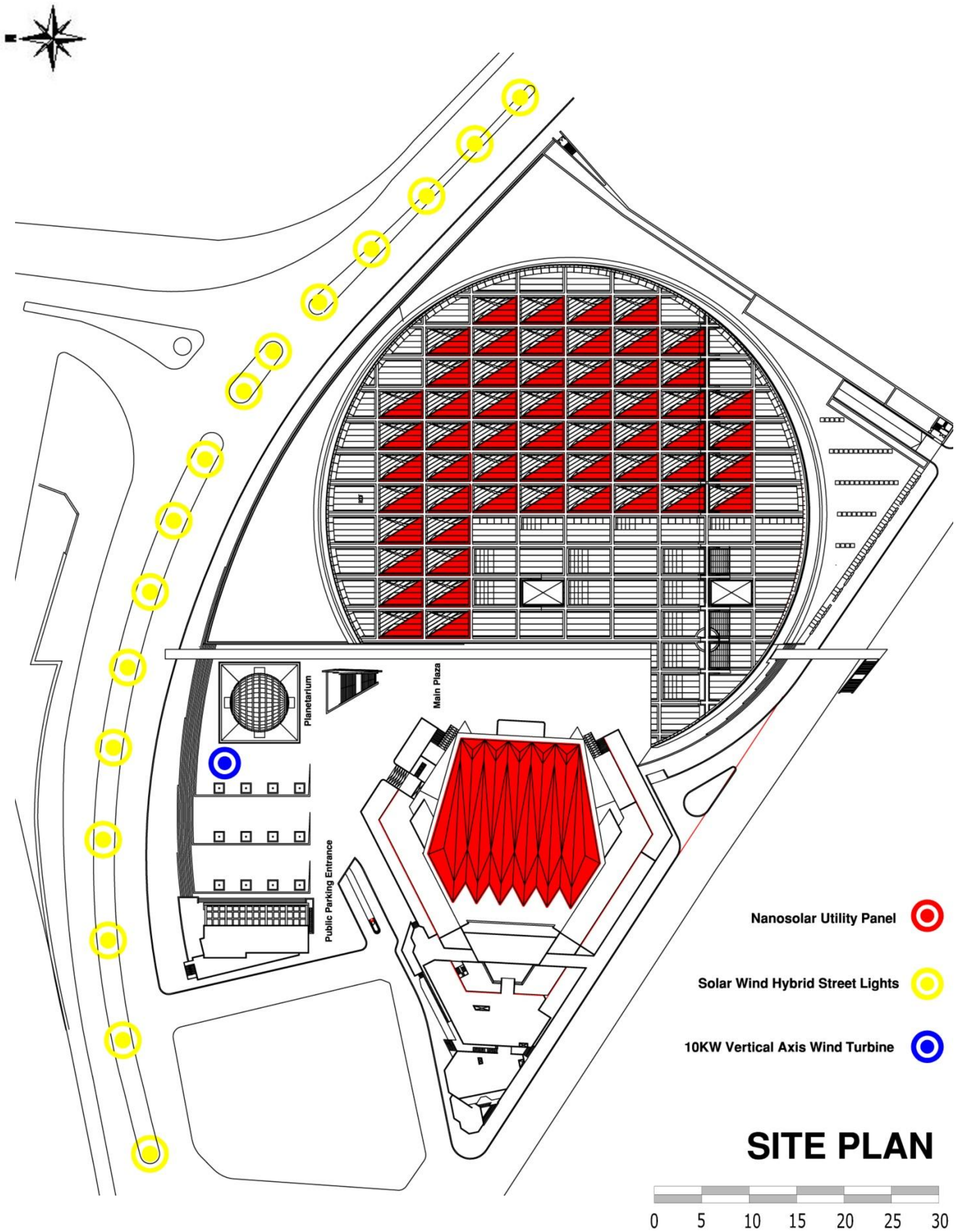


Figure 4.20: New Site plan with three elements places

1- 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. (Figure 4.21)

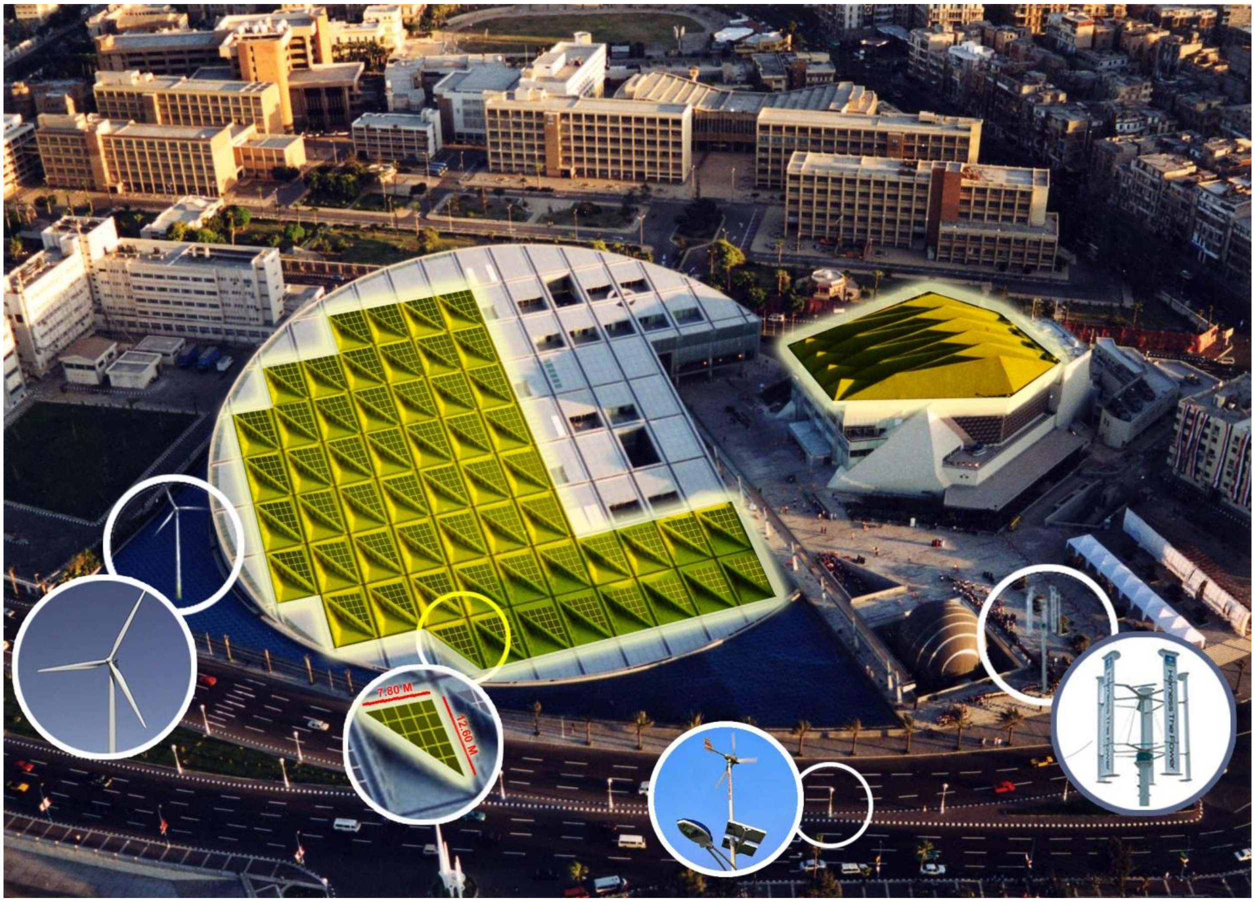
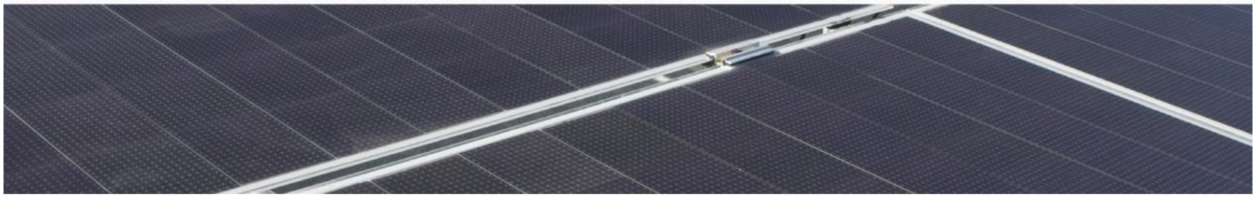


Figure 4.21: Bibliotheca Alexandrina renewable energy sources

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). (Figure 4.22)

nanosolar

Nanosolar Utility Panel



Performance

Maximum Rated Power	$220W_p – 280W_p$
Tolerance[1]	+/- 5%
Limited Warranty[1]	5 years material & workmanship 90% nominal power output for first 10 years 80% nominal power output for first 25 years

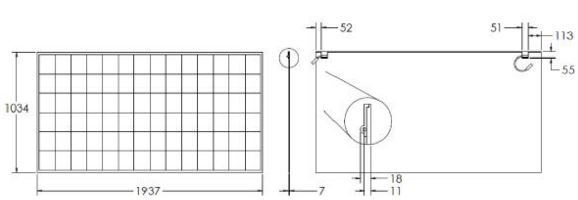
Mechanical Characteristics

Dimensions	Length: 1937 mm (76 in) Width: 1034 mm (41 in) Height: 7 mm (0.28 in)
Weight	34.7 kg (76.3 lbs)
Construction	Frameless glass/glass laminate 3 mm tempered solar glass front 3 mm tempered glass back
Solar Cells	84 MWT CIGS cells in series
Cell Layout	6 cells per string 14 strings per module
Output Cables	80 mm cable (positive) 300 mm cable (negative)
Output Terminal	MC4 compatible
Mounting Systems	4 clamps for 2400 Pa load Additional 2 rails for 5400 Pa

Shipping Quantities

Per Pallet	30
Per 40-foot ISO Container	330

Mechanical Drawing



Electrical Characteristics at STC[2]

Rated Power (W_p)	220	230	240	250	260	270	280
V_{MPP} (V)	41.4	42.7	43.3	44.7	44.4	45.6	46.9
I_{MPP} (A)	5.5	5.5	5.6	5.6	6.0	6.0	6.0
V_{OC} (V)	53.2	54.0	53.6	54.4	53.7	54.5	55.2
I_{SC} (A)	6.4	6.5	6.5	6.6	7.1	7.1	7.1
Temp Coeff of P_{MAX} (% / K)	-0.40						-0.35
Temp Coeff of V_{OC} (% / K)	-0.30						-0.27
Max System Voltage	1500V						
Max Series Circuit Fuse	25A						
Nominal Operating Cell Temperature	47°C						
Grounding	No positive or negative grounding required. Panels can be connected to transformerless inverters						

Electrical Characteristics at NOCT[3]

Rated Power (W_p)	220	230	240	250	260	270	280
V_{MPP} (V)	37.3	38.4	38.5	39.8	38.7	40.0	41.2
I_{MPP} (A)	4.4	4.5	4.6	4.6	5.0	5.0	5.1
V_{OC} (V)	49.0	50.0	49.4	50.4	49.5	50.4	51.4
I_{SC} (A)	5.2	5.2	5.2	5.3	5.7	5.7	5.7

Qualifying Test Conditions

Temperature Cycling	-40°C to +85°C, 200 cycles
Damp Heat	85% RH, 85°C, 1000 hr
Static Load Front and Back	2400 Pa (50 psf)
Hailstone Impact	25 mm diameter at 23 m/s

Quality and Safety

- IEC 61646 & 61730
- UL 1703, Fire Resistance Class A
- TUV Safety Class II up to 1500VDC

[1] Contact Nanosolar for full warranty terms
[2] Standard Test Conditions (STC): 1000 W/m², 25°C, AM1.5G
[3] NOCT Test Conditions: 800 W/m², ambient 20°C, Wind ≤1m/s

Figure 4.22: Nanosolar Cells Datasheet.

From previous Datasheet of Nanosolar panels:

(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) for Conference hall roof.

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

2- 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. (Figure 4.23)

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

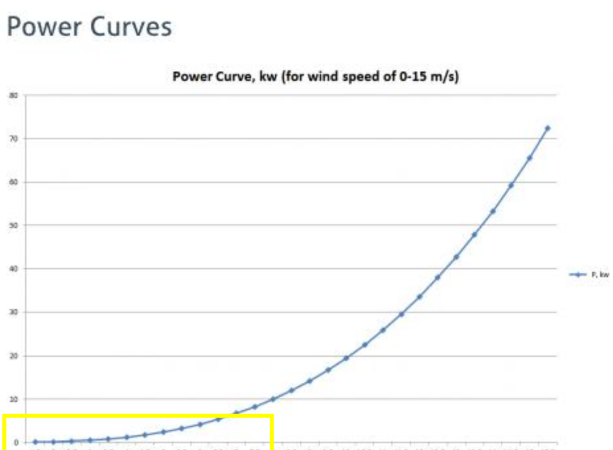


Figure 4.23: Power Curves for 10KW Vertical Axis Wind Turbine

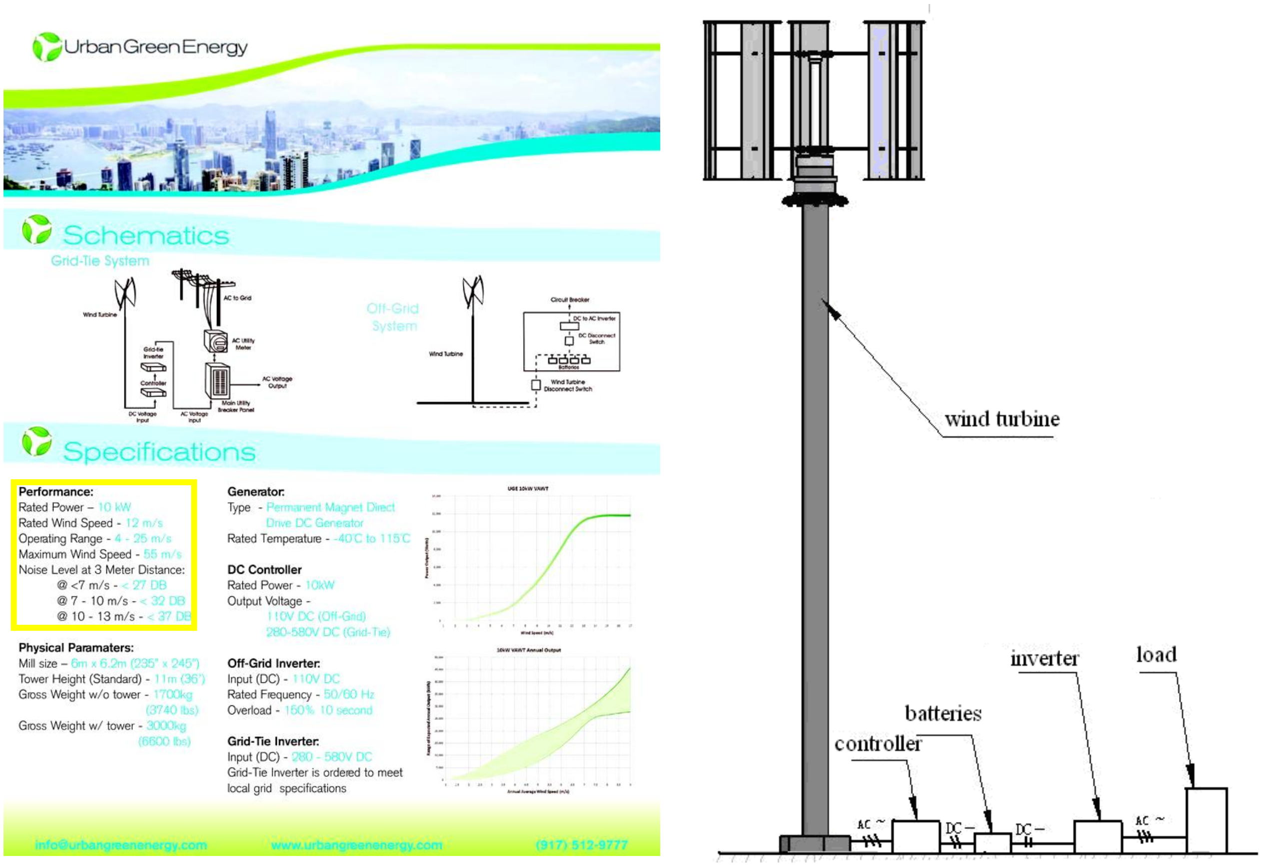


Figure 4.24: 10KW Vertical Axis Wind Turbine Data sheet and diagrams

3- Solar Wind Hybrid Street Lights:

Figure 4.25: Solar Wind Hybrid Street Lights outdoors. *Source:[http://www.climatetemp.info/egypt/alexandria.html, Retrieved 22 February ,2012]*

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 4.25)

Data Sheet:
a. Wind power: 300w
b. Solar panel: 90W. Solar panels conversion efficiency >15% and average life is at least 20years.
c. Light source: 30W low pressure sodium lamp.
d. Battery: Sealed colloid lead-acid battery. Battery capacity: 120AH/12V
e. Applied temperature: -40Deg C to +60Deg C.
f. Micro computer controller: With protection of over-charging, over-discharging, over-loading..
g. Pole: Steel plate, plastic coating after zinc-plate.
h: Pole height: 6 meter
i: Distance from ground to lamp: 4-5meter
j: Lighting time per day: 6-8 hours
k: Continuously work with 4 cloudy/rainy days. (Table 4.3)

Parts	**Spec.**	
Pole	**height**	**6M**
	material	**high quality steel plate**
	thick	**4mm**
	suface treating	**plastic coating after zinc-plate**
	fitting arm	**single arm 1.5M**
	anchor screw	**under soil**
Light Source	**power**	**30W**
	type	**Ultra-bright LED**

	voltage	12V
	lampshade	Die cast aluminum housing, Toughened safety glass, painting coating.
	warranty	1 year
PV and Wind Controller	work voltage	12V/24V auto switch
	work type	A/B individual controll, programable
	Photosensitive	9 level programable
	PWM Arithmetic	yes
	warranty	1 year
Solar Panel	type	Monocrystal silicon
	power	90W
	warranty	1 year
Battery	type	valve regulated sealed lead-acid battery（maintance free）
	capacity	120ah
	voltage	12V
	warranty	1 year
	battery box	up on the pole
Accessories	restrictive coating wire	
	stainless steel fastening piece	
Wind Turbine	300w 12V	

Table 4.3: Solar Wind Hybrid Street Lights Data Sheet. *Source:[http://www.climatetemp.info/egypt/alexandria.html, Retrieved 22 February ,2012]*

4- Other specifications:

- As part of Bibliotheca Alexandrina to reduce the consumption 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(Figure 4.26)

- .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 cooling consumption. (Figure 4.26)

Figure 4.26: Marine Chiller type and LED`s panels. *Source:[http://www.climatetemp.info/egypt/alexandria.html, 22 February ,2012]*

After what has been presented of the elements on this track, it is necessary to alert that those elements are not affected negatively on the front of elevation of Bibliotheca Alexandrina where they merge with the void of plaza and this is what appears in the external picture, which describes the heights of these elements and places in the plaza of Bibliotheca Alexandrina. (Figure 4.27) (Figure 4.28)

Figure 4.27: External Elements of renewable energy sources in plaza of Bibliotheca Alexandrina.

Figure 4.28: Nanosolar Cell on roof of Bibliotheca Alexandrina (Suggestion places)

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:

1- *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 4.29)

Figure 4.29: 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 a 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 4.30, 31) (Table 4.4)

Figure 4.30: VIP insulation must be made to measure and fitted precisely on site.

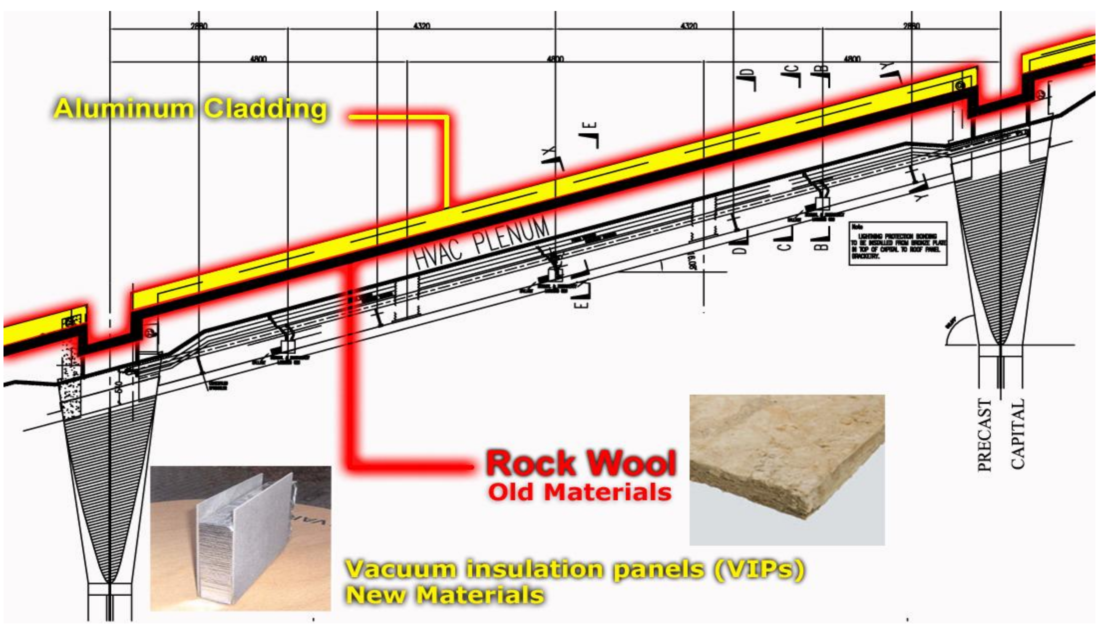


Figure 4.31: VIP insulation places in roof of Bibliotheca Alexandrina

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 • Able to be used at higher temperatures • Performance is not adversely affected from contact with water. • Non combustible	• Performance is not adversely affected from contact with water. • Non combustible. • More thermal conductivity up to 10 times lower. • Non combustible. • The thickness is small than Rock wool. • Able to be used at higher temperatures

Table 4.4: Comparison between Rock wool and VIPs thermal *insulation.*

2- *Solar protection: (KALWALL + NANOGEL)*

SOLAR PROTECTION: NO blinds necessary.
Glass darkens automatically or is switchable without the need for a constant electric current (memory effect).

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. (Figure 4.32)

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. (Figure 4.33)

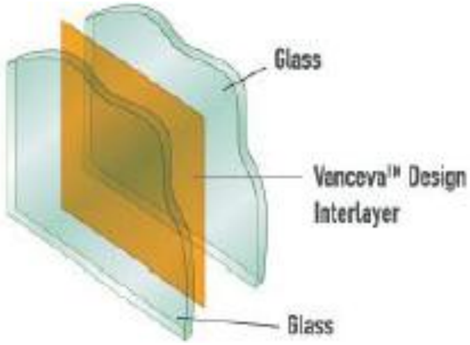


Figure 4.32: Components of Solar protection

Figure 4.33: Eiectrochromatic glass with an ultra-thin nanocoating needs only be switched once to change state, gradually changing to a darkened yet transparent state. At present the maximum dimension of glazing panels is limited.

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. (Figure 4.34)

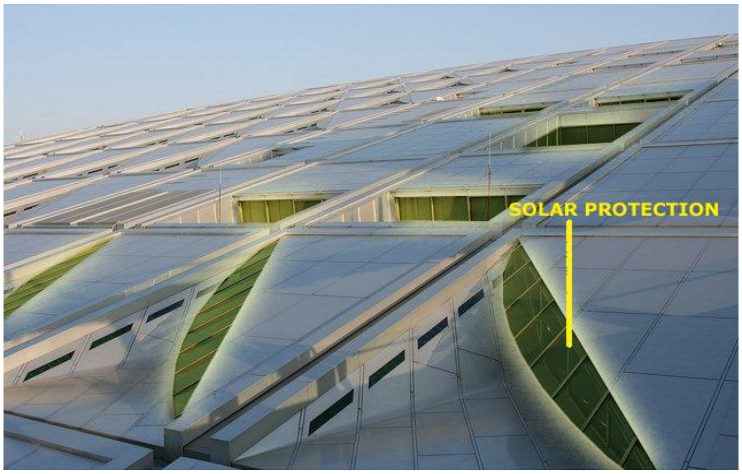


Figure 4.34: Replacing old glass with Solar protection in roof of Bibliotheca Alexandrina.

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. (Table 4.5)

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)

Table 4.5: Comparison between old material and new material.

3- *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. (Figure 4.35)

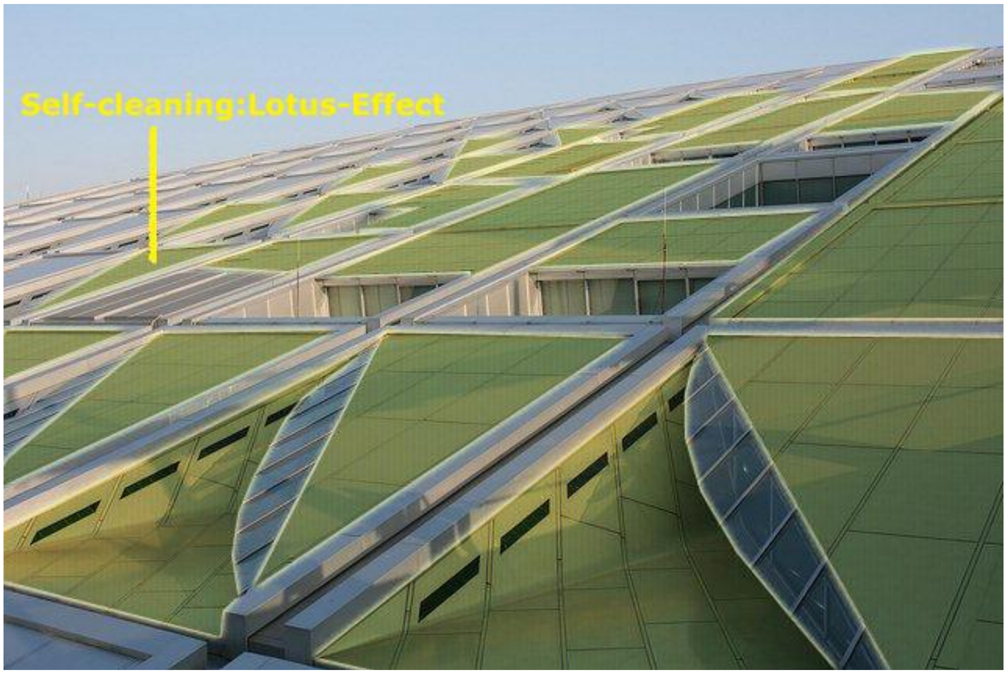


Figure 4.35: *The surface which we will put the paints coated on it.*

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 self-cleaning 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 4.36)

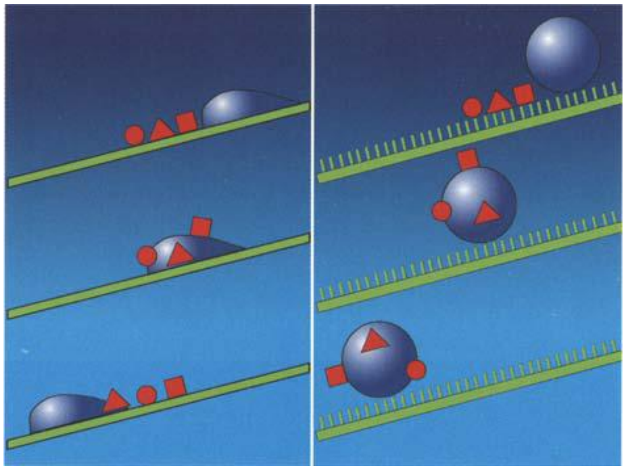


Figure 4.36: The diagrams show clearly the difference between conventional surfaces and the Lotus-Effect.

To summarise, 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 self-evident: a cleaner appearance and considerably reduced maintenance demands.

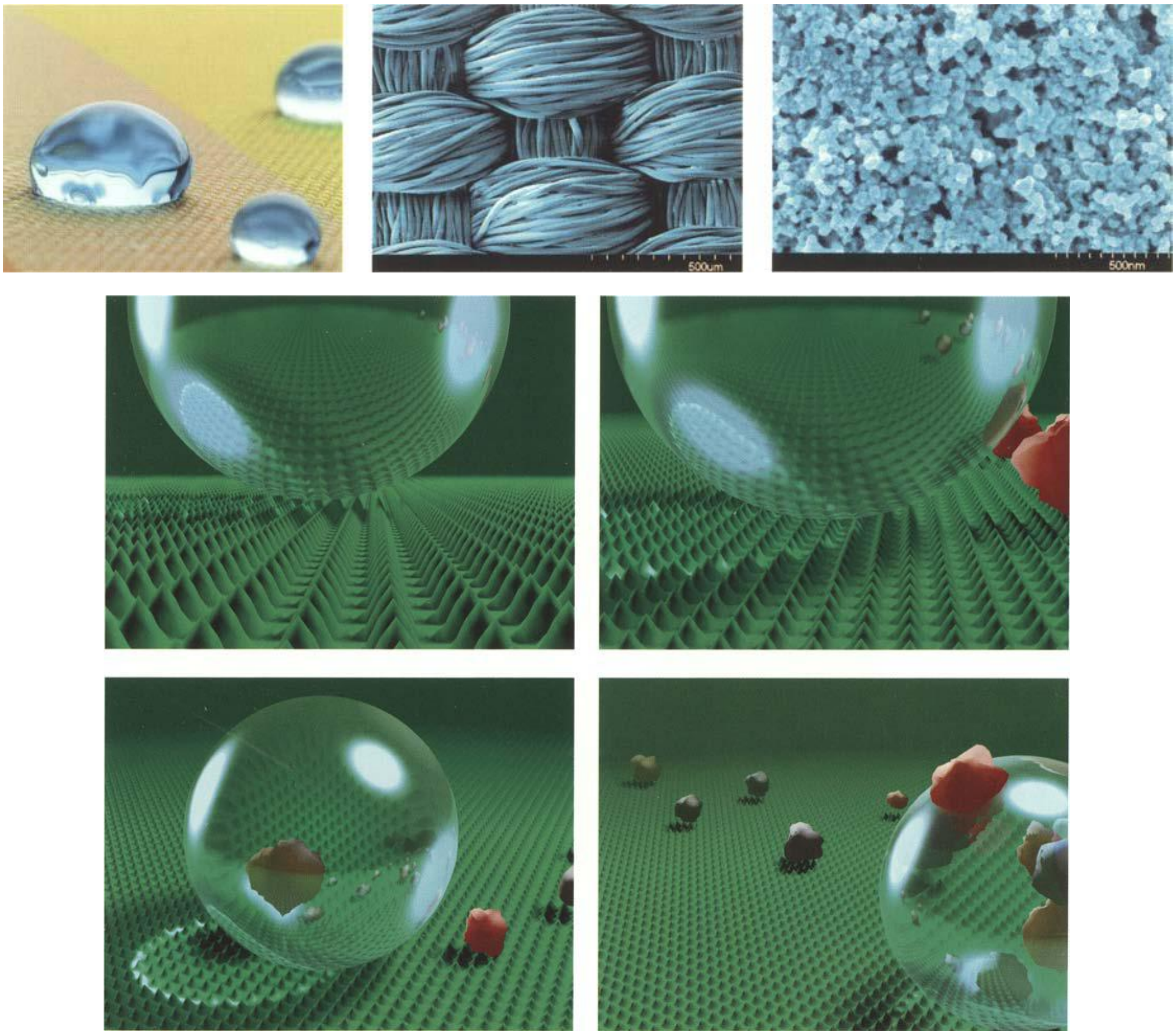


Figure 4.37: visualization illustrates how the basic principle of the Lotus-Effect works: the knobbly structure combined with reduced surface contact and low surface adhesion makes water form droplets that run off, washing away dirt deposits.

7.1.3. Recommendations:

In the end of this thesis, we recommend a number of recommendations which we believe that serves the interest of the environment by nanoarchitecture and renewable resources and their role in minimizing the negative effects of global warming, and those recommendations follows:

1- The need to guide governments for clean energy in the hunt for new sources of energy in the part near the entry into force of the world`s reserves of oil and the negative effects resulting from the burning of harmful gases to the environment.

2- The role of nanotechnology in the production of new materials with small dimensions, area and features a highly efficient and functional help to raise the operational efficiency of the building through the improvement of the environment internal to the vacuum and make it more interactive with the user through smart materials and sensor equipment that intervention in the manufacture of nanotechnology.

3- the need to enact laws, architecture and environmental requirements, which works to assess the building in stages of design the primary before the actual implementation, giving an area of change for the materials used and design that work on the optimal utilization of space available to be done in the framework of an environmental organizations, local and international so that all buildings are under the laws of those organizations.

4- To spread awareness among the architects of the impotence of nanotechnology and renewable resources and how annexation of teaching curricula for inclusion in the process design and implementation process as a prelude to creating clean environment and non-pollution cities.

5- Coordination between all institutions of society from government institutions, educational and business to increase public awareness of the importance of the trend towards nanoarchitecture because of their active role in protecting the environment and raising the standard of living of the human through the techniques and devices that enter the industry.

6- The role of housing and building national research center to focus on nanomaterials that serve the building products used in building construction, both finishing materials outside or finishing materials inside which is working to provide those materials in the local market, which will change the shape of local architecture and contribute greatly in finding nanoarchitecture into reality to address the problem of Egypt with global warming.

7- The change of construction material must be in two key sectors, namely the first part is the construction of treatment of existing buildings effectively by replacing the materials and techniques of ancient articles of modern and the second part is the construction of new building, through the introduction os such materials and new techniques in the initial stages of process design.

8- The contribution of nanotechnology in solving the problem of global warming is not limited to its contribution in the field of architecture, but extends to the field of environmental studies and various fields.

Part Four Conclusion

Through what has been presented in Part Four 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 thesis 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.

Overall Conclusions and Recommendations

Many information and studies have been presented and examined to cover all aspect of the addressed problem throughout this doctoral thesis which is “global warming, and nanotechnology”. It defines the global warming problem, its impact on the globe in general, and on Arab world and Egypt in particular. Also the construction and buildings sector effects, and role in increasing the negative effects of the global warming problem. After addressing the problem, its main causes, and its negatives impacts on the individual level, and environmental level, demonstrating different detailed studies of modern architectural trends interested in decreasing this negative impacts of this sector. This could be achieved through the architectural and philosophical trends in the design process in the unit level and urban planning of modern cities. Nanotechnology role in solving the global warming problem through providing practical solutions, and modern technologies in the present time, and in the future, it contribute significantly in minimizing damages, finding out architectural processors via depending on the nanotechnology to reduce global warming, and to create new clean, carbon free, and healthy environment.

This summary review all the findings answering many questions addressed throughout the thesis presented in nano-architecture and nanotechnology role in reducing the negative effects of global warming, and finding out architectural and theoretical standards can be assembled or collected into new architectural, philosophical, and intellectual trend to maintain human health, and environment as well.

Principle One:

The global warming problem emerged in the industry revolution which invaded all of world factories, and depended on petroleum, and burning energy for a long period of time and in different fields. This non renewable energy resulted in large amounts of oil wastes, harmful gas emissions causing ozone layer hole, black clouds, and many other damages. The major countries racing toward evolution caused significantly accelerating these negative effects harming the human beings and environment. Also the construction and buildings sector is affected through using non-friendly environment, and harmful materials consuming huge energy in its production “manufacturing” stage. The air conditioning and the lighting systems also boosted by big jump in energy consumption rates which negatively affect cities energy reserves, increasing gases wastes such as harmful gases emissions, and harmful non-recycled substances. Thus, solving these architectural problems, and finding new alternatives to reduce such gases emissions, and harmful residuals is a important necessity.

Principle Two:

An emphasis on intellectual trends and different architectural schools such as nano-architecture That provides different architectural solutions and treatments contributing significantly in finding clear solutions helping in reducing the harmful effects of non-recycled and non- renewable materials and using clean and environment friendly substitutes to produce new architecture aiming mainly to provide healthy, comfortable, and livable environment. It is important to strengthening these intellectual trends which turned to viable and applicable trends through using nanotechnology to introduce smart and carbon-free materials in order to promote and develop the architectural environment, and the used materials in building and construction via using new renewable energy systems, and merging with it to reach to the efficient performance level of the building.

Principle Three:

The necessity of activating the government institutions role in monitoring the urban planning, and construction trends to support the intellectual trends, and the architectural schools that mentioned earlier. As it supports protecting the natural resources and the urban planning trend creating clean environment, the monitoring role consist of two trends as the followings:

First trend: raising awareness of next generation of young engineers about the architectural schools maintaining the sustainability concept, and the clean environment concept, and many other concepts. There should be commitment to these concepts without any deviation because of its values contributing in maintaining the urban environment, and country's natural resources.

Second trend: the role of the government institutions presented in control authorizes monitoring the design process, enforcing necessary restrictions to maintain the designing identity and concept inside and outside the urban communities in order to continuously preserving the environment. Also enacting powerful laws to punish any violators and issuing construction permissions only after the evaluation of designs and its role in protecting environment without any harm through architect's well knowledge and full understanding of the designing standards during the designing and implementing processes. These laws should include building performance evaluation methods in pre-building stage with detailed description of building components, how to implement the design, proper supervision of the country control and monitoring authorities on implementation stage, issuing building permissions based on these authorities reports.

Principle Four:

The decreasing of petroleum reserves all over the world turns most of government toward finding new energy sources. These energy sources should have two basic conditions, to be clean energy, and to be renewable. It starts to appear in the developed countries aiming to replace the petroleum energy with new clean energy such as solar energy, wind energy, and water turbines energy and to gradually depending on it until full dependence through satisfying all the needs of energy on the building units level and new cities level. Thus the Egyptian government role is appears to be very important in this trend, many studies have proved that through producing clean and renewable energy from wind energy in different places across Egypt. Also the solar energy, storing the produced energy and converting it to a usable energy networked to the cities much in need.

Principle Five:

The nanotechnology contributes in improving the architectural product from new materials usable in the construction and building process. It directly contributes in improving the building performance, and ensure new clean architecture environment free from harms resulting from different surrounding industrial complexes. Nanotechonlogy is very important in emerging the smart sensor systems monitoring internal system performance inside the building, thermal emissions and different gases emissions high rates warnings so the user can reduce these emissions by an assisting of new useful and environment friendly materials. Beside it also updating and finding new techniques in clean energy systems used in the infrastructure of manufacturing solar cells, windmills, and many other systems contributing significantly in meeting the needs of different urban communities. Thus, the role of nanotechonolgy is an architectural environmental friendly trend using all of the capabilities to serve the environment.

Principle Six:

Reference to the key role of this study and the role of nano-technology to speed up solving the problem of global warming and that by controlling the material specifications re-installed 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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الملخص العربي:

في زمن تحتبس فيه الحرارة وتنوء الأرض بمن يعيش فوق ظهرها ويتجاوز عدد سكانها السبعة مليارات انسان وفي عصر تذوب فيه جبال الجليد القطبية ويزداد اتساع ثقب الأوزون وترتفع مساحات الغابات التي يدمرها الأنسان وتتقلص المساحات الخضراء ويزداد استهلاكنا للكهرباء واهدارنا للمياه . في ظل كل هذه الظروف يتوجب علينا التفكير في اساليب جديدة تحد من بصمة البشر السلبية على الطبيعة بكل مكوناتها وذلك من خلال استخدام التكنولوجيا الجديدة مثل تكنولوجيا النانو والتقنيات الحديثة والمواد الذكية التي تعمل على التقليل من الطاقة المستهلكة للتدفئة والتبريد .كل ذلك في صورة منظومة كاملة لتعطي بيئة نظيفة خالية من المواد الضارة . وقد زادت الحاجه الى ايجاد حلول عملية لتلك المشكلة العالمية المتمثلة في الأحتباس الحراري نتيجة للوضع البيئي والأقتصادي والأجتماعي الذي يعاني منه اغلب سكان العالم وخاصة ان هذه الأوضاع لا تنحصر في اقليم او دولة بل لها تداعيات وتأثيرات على العالم بأسره . وكما كان للعلم والتكنولوجيا دور رئيسي في الوضع البيئي الذي نعاني منه الأن فانه لا بديل عن العلم والتكنولوجيا لتصحيح واصلاح ما تم افساده . وهنا يكمن السؤال الرئيسي للبحث " **كيف يمكن لعمارة النانو ان تقلل من الأثار السلبية للأحتباس الحراري؟ والوصول الى التقنيات الحديثة التى تعمل على معالجة اضرار الأحتباس الحراري الموجودة في البيئة؟** " ومن هنا يظهر ان التكنولوجيا المختلفة مثل تكنولوجيا النانو ومواد النانو اديها المقومات لعمل تغيير شامل في العالم كله وخلق ابداعات جديدة تسهم في تكوين مستقبل افضل للعالم اجمع .

يهدف هذا البحث الى توضيح العلاقة بين الأحتباس الحراري وعمارة النانو واظهار مدى تأثير تطور تكنولوجيا النانو ومواد النانو على معالجة تلك المشكلة . ومن هذا المنطلق يحاول البحث الأجابة على عدة تساؤلات منها السؤال الرئيسي للبحث وهو " **كيف يمكن لعمارة النانو ان تقلل من الأثار السلبية للأحتباس الحراري؟** " و " **كيف يمكن ايقاف الأحتباس الحراري ؟** " و " **ما هي التقنيات الحديثة التى تعمل على معالجة اضرار الأحتباس الحراري الموجودة في البيئة؟** " و " **كيف يمكن الوصول الى الطاقة النظيفة داخل المباني وتقليل الأعتماد على طاقة حرق البترول ؟** " وبالأضافة الى محاولة الأجابة على كل تلك الأسئلة وذلك من خلال فصول الرسالة المختلفة فان هذا البحث يهدف الى المساهمة في توعية الأشخاص العاديين بالأخطار المحدقة بالبيئة التى يعيشون فيها واسباب تلك الأخطاء وتثقيف اولئك الأشخاص بالطرق المختلفة لترشيد استهلاك الطاقة والاعتماد على الطاقة النظيفة وتوعية الأشخاص باهميتها وتحقيقها للأحتياجات الخاصة بكل هؤلاء الأشخاص وتشجيع الأبحاث التى تدعم ذلك الأتجاه . ومن خلال ذلك البحث يظهر دور الحكومة المصرية في الأتجاه الى ايجاد حلول بديلة للطاقة الكهربائية وذلك من خلال تخصيص اراضي لبناء طواحين للهواء لأنتاج الطاقة النظيفة والمتجددة وحقول الخلايا الشمسية في الصحراء المصرية والى غير ذلك من الخطط التي تضع مصر من ضمن الدول الثلاثين في العالم التي بدأت خطوات جدية للتقليل من الاعتماد على الطاقة الضرة والتي تؤدي الى زيادة نسبة الانبعاثات الكربونية الضارة بالبيئة والاعتماد تدريجيا على الطاقة النظيفة المتجددة خلال فترة زمنية حتى 2030.

تم تناول هذا البحث من خلال أربعة أبواب رئيسية , كل باب يحتوي على فصلين وذلك في محاولة للأجابة على كل الأسئلة السابق ذكرها وهي كالتالي :

الباب الأول " **الاحتباس الحراري** " ويستعرض ذلك الباب فصلين , الفصل الأول ويتناول الخلفية النظرية للأحتباس الحراري وذلك من خلال الأجابة على عدة اسئلة منها " ما هو الأحتباس الحراري ؟ " و " لماذا الأحتباس الحراري ؟ " و " الأسباب المؤدية لظهور تلك المشكلة العالمية والأثار السلبية الناتجة عن الأحتباس الحراري ؟ " وفي نهاية الفصل الأول نتناول علاقة الأحتباس الحراري والعولمة في اشارة الى انها مشكلة عالمية مشترك فيها كل دول العالم . كما تناولنا في ذلك الفصل الأثار السلبية الناتجة عن قطاع الأنشاءات والناتجة عن استخدام المواد البنائية السيئة والضارة بالبيئة وكذلك الأستهلاك السيئ للطاقة واهدارها . اما الفصل الثاني فيتناول البحث عن التلوث الناتج عن الطاقة والمواد والأثار السلبية الناتجة عن قطاع المباني وناتج الأنبعاثات الضارة من استخدام المواد البنائية التى تحتوى على الكربون . وفي نهاية الفصل الثاني نتناول علاقة العمارة الحديثة بتلك المشكلة العالمية والأحتباس الحراري في التخطيط العمراني واثره على تخطيط المدن .

الباب الثاني " **الأتجاهات البيئية المعمارية المعاصرة** " ويحتوي على فصلين " الثالث والرابع " , الفصل الثالث ويستعرض الأتجاهات المعمارية البيئية مثل العمارة البيئية وعمارة " BIO Architecture " والعمارة المستدامة وعمارة النانو وذلك من حيث المبادئ والأهداف وكيفية تحقيق تلك الأهداف ورفع كفاءة المباني من حيث استهلاك الطاقة وترشيد الطاقة وكيفية التصدي لمشكلة الأحتباس الحراري من خلال تكنولوجيا النانو الجديدة والتقنيات الحديثة التى تعمل على التقليل من الأثار الضارة للأحتباس الحراري. وفي نهاية الفصل الثالث تم استعراض الأنظمة المختلفة لقياس كفاءة المباني ومدى

تأثيرها بالأيجاب والسلب للبيئة المتواجدة فيها وذلك في كل من امريكا وبريطانيا واليابان . وفي ذلك الفصل يظهر اهمية عمارة النانو وتكنولوجيا النانو في معالجة اضرار الأحتباس الحراري من خلال الأنظمة الذكية والمواد الذكية التى ترفع من مستوى اداء المباني وذلك حيث تعمل على علاج الفراغات الداخلية من الأنبعاثات الغازية داخل المباني من خلال مراقبة اداء الانظمة المختلفة داخل المبنى والتحكم في مستوى الأنبعاثات . واما الفصل الرابع فيبحث في موضوع الطاقة المتجددة ومصادر الطاقة النظيفة المختلفة مثل الطاقة الشمسية والطاقة الخضراء وطاقة الرياح كما يتحدث على الأنظمة الذكية ووسائل عرضها مثل برامج المحاكاه مثل برنامج " Revit " وبرنامج " BIM " وكذلك المواد الذكية والتى تكمل منظومة محتويات المباني من انظمة ومواد وتم سرد العديد من الأمثلة للمواد الذكية التى تساعد على ايجاد بيئات داخلية نظيفة وفي نهاية الفصل الرابع تم استعراض امثلة مثل " nanohouse " و " nanostudio " و " carbon tower " .

الباب الثالث " **عمارة النانو وحلول لمعالجة الأحتباس الحراري** " والأخير وفيه تم تناول تكنولوجيا النانو وعلوم النانو كحلول مستقبلية وما تقدمه من رؤى مستقبلية لمعالجة مشكلة الأحتباس الحراري وذلك في الفصل الخامس من الباب الثالث وايضا يقدم الباب صور لتقليل الثار السلبية الناتجة عن قطاع المباني من مراحل مبكرة تشمل مراحل تصنيع المواد التى يتم البناء بها حيث تدخل تكنولوجيا النانو في عملية الأنتاج لأنتاج مواد خالية من الكربون وتساعد على رفع كفاءة الفراغ . كما يتناول الفصل الخامس مواد جديدة مقاومة للأثارة السلبية لأحتباس الحراري وانظمة استشعار ذكية تعمل على مراقبة النبعاثات المختلفة داخل الفراغ والمحافظة على مستوى الأنبعاثات محدود وكيف ان عملة التدوير لتلك المواد تساعد على التقليل من الأحتباس الحراري . وفي الفصل السادس تم تقديم امثلة لمدن جديدة واتجاهات تخطيطية جديدة تعتمدها الحكومات الأوروبية والعربية لأيجاد مجتمعات نظيفة وخالية من الكربون بمساعدة تكنولوجيا النانو وتقنيات الطاقة النظيفة مثل مدينة مصدر في دبي وكذلك جزيرة الطاقة ومدينة النانو في الهند والأخرى التي في اليابان .

الباب الرابع " **التطبيق و هو مقترح على قاعة القراءة بمكتبة الأسكندرية** " وفيه يتم استعراض التصميم المقترح بتحويل مبنى المكتبة من مبنى مستهلك للطاقة الى مبنى صديق للبيئة ومنتج للطاقة وذلك من خلال محورين رئيسين وهما :

المحور الأول ويتمثل في اقتراح لوضع خلايا شمسية تعمل بتكنولوجيا النانو على سطح المكتبة وسطح قاعة المؤتمرات وكذلك طاحونة هواء راسية في البلازا الخاصة بالمكتبة على ارتفاع 11 متر وكذلك وضع وحدات اضاءة (تحتوي على خلايا شمسية +طاحونة هواء + وحدة اضاءة علوية) في الشوارع المحيطة بالمكتبة بحيث يتم تجميع كل الطاقة المنتجة من تلك العناصر والأستعواض بها عن الطاقة الكهربائية التى تستهلكها المكتبة وبالتالى نكون قد قللنا من استهلاك المكتبة للطاقة الكهربائية بالطاقة النظيفة والمتجددة واما داخل المكتبة فتناولنا مقترحات بتغيير وحدات الأضاءة ووحدات التكييف التى تستهلك طاقة كبيرة باخرى تستهلك طاقة اقل بكثير حيث تتدخل في تصنيعها مواد النانو وتكنولوجيا النانو .

المحور الثاني ويتمثل في اقتراح مواد جديدة تعمل بتكنولوجيا النانو ولها مميزات مواد النانو من حيث صغر الحجم والمساحة والكفاءة والجودة العالية حيث تم اقتراح مادة عازلة جديدة (مواد النانو) بدلا من ال(Rock wall) الموجود حاليا حيث يمتاز بسمك اقل وكفاءة اعلى في العزل الحراري و كذلك الزجاج الذكي بدلا من الزجاج الموجود فعلا حيث ان الزجاج الذكي (Smart Windows) يمتاز بمنعه لأنتقال الحرارة وكذلك تغيرمواصفاته حسب التغير المناخي (شدة السطوع للشمس) الخارجي والمادة الأخيرة تمتاز بصفة التنظيف الذاتي وهي خاصية جديدة في مواد النانو والتى تعمل على طرد الأتربة والماء من على سطحها ذاتيا بدون الحاجة الى التنظيف المستمر .

وفي نهاية الرسالة تم استعراض النتائج والتوصيات التى تنوه بأهمية دور تكنولوجيا النانو والتقنيات الحديثة في معالجة الأزمات التى تمر بها دول العالم كلها وكيف ان ذلك الدور الذي تلعبه التكنولوجيا الجديدة تعمل على راحة الفرد والمجتمع بما يخدم مصلحة البيئة التى يعيش فيها الأنسان والتى يجب المحافظة عليها للأجيال القادمة .

جامعـــة الأسكندريـــة
كليـة الهندســة
قسم الهندسة المعمارية

عمارة النانو و الأحتباس الحراري

رسالة مقدمة
لقسم الهندسة المعمارية – كلية الهندسة – جامعة الاسكندرية
ضمن متطلبات الحصول على درجة
دكتوراه الفلسفة
فى
الهندسة المعمارية

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2012

عمارة النانو والأحتباس الحراري

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للحصول على درجة

دكتوراه الفلسفة

فى

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