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# NATIONAL ENERGY EFFICIENCY AND CONSERVATION POLICIES AND PROGRAMS IN DEVELOPED COUNTRIES AND MIDDLE EAST

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## ABSTRACT

The world's economies should endeavour to ultimately reduce their energy consumption, rather than simply adjusting or optimizing their energy utilisation. The implementation of intelligent strategies, designed to manage human activities which are highly dependant on energy, should be the preferred solution to develop and achieve a sustainable and secure economy.

This paper describes policies for energy conservation adopted by developed industrialized countries such as Japan, Germany, France, Britain and the US, as well as developing countries in the Middle East such as Qatar, Kuwait, Syria and the United Arab Emirates. The aim of this document will be to identify and clarify the major factors that drive the creation and implementation of energy policies, as well as the strength and weakness of each of the adopted strategies of energy conservation, including the associated risks and opportunities.

The conclusion of this study will offer recommendations for the most suitable framework for determining the best practices to develop sustainable societies in Middle East region, which in turn will equip these countries to respond more efficiently to the implementation of the latest international standards, which are mandatory in order to succeed in the global business field.

## INTRODUCTION

For centuries, energy production and sufficient supply were the primary focus during the evolution and survival of mankind. It is only during the last few decades that the world has started to realize the detrimental impact on the natural environment caused by energy wastage and the expenditure of the world's resources, on which future survival is dependant.

According to the environmentalist Rob Watson, "Mother Nature is just chemistry, biology and physics, everything she does is just the sum of those three things. She is completely amoral. We cannot negotiate with her, and we can't spin her and we can't evade her rules. All we can do is fit in as a species. And when a species does not learn to fit with Mother Nature, it gets kicked out, it is that simple, and that's why every day we look in the mirror, we are seeing an endangered species."

A. Understanding the consequences of climate change. The African region of Darfur is a recent dramatic example of how a relatively small shift in the climate of just one area, can have a such a dramatic impact resulting in tragic human consequences. All evidence suggests that the world can expect unavoidable, significant and potentially highly dangerous changes in climate over the next few decades irrespective of what late actions we take now. Such consequences are:

- Frequent Storms and Hurricanes
- Reduction in water supply, less snowfall, fewer glaciers, more variable rainfall patterns, and more intense individual rainstorms
- More heat waves, similar in intensity to the high temperatures that hit Europe in 2003.
- Rising sea levels: as the oceans warm they expand. This effect coupled with melting glaciers is already raising sea levels all over the world.
- Reduced food production in low-latitude areas. Less water flow in some areas which may make energy supplied from hydropower less reliable.

A.1. Risk Identification *"The entire history of the human species is a chronology of exposure to misfortune and adversity and of efforts to deal with these risks"* (Vaughan 1997).

The consequences on the natural environment as a result of energy wastage and pollution have potential risks, and impacts the scale of which may not be immediately identifiable, whose quantitative estimation may be time consuming and may lead to very subjective conclusions.

The real and present danger of risks facing the world today due to a changing climate are floods, droughts and famine, resulting in large scale human suffering. In addition there are the risks of further subsequent indirect dangers associated with mass migration, and possible future national conflicts, arising out of the perceived need to compete for control of the planet's diminishing resources.

Despite the scale of the challenge and investment cost of the proposed shift to a low-carbon economy, the long term beneficial economic case for action is very clear. The Stern review estimated that if no action is taken to reduce greenhouse gas emissions, the overall costs and risks of climate change would increase and would be equivalent to losing at least 5% of global Gross Domestic Product (GDP) each year, for an indefinite period. If a wider range of risks and impacts is taken into account, the estimate of commercial damage could rise up to as much 20% of GDP or more. This conclusion is reached through the realisation that as the average global temperature increases, the increase in individual catastrophic events would have a major impact, varying in value between 5% and 20% of GDP in terms of loss of life, asset destruction and business interruption. For an example of the scale of potential economic impact, the unseasonal flooding in the UK during the summer of 2007 resulted in the financial loss to business of approximately £4.9 billion through an estimated 130,000 insurance claims.

A.2. Strategies to Manage Risks Having decided what the environmental risks are, the next stage would be to select an appropriate strategy to deal with those risks. Most risk mitigation theorists would argue that there are four key ways to deal with risk:

- Risk avoidance: For the past few decades, most scientists, politicians and economists have debated and discussed the danger of greenhouse gas emissions and climate change. It is now generally known and understood that identified risks and consequences are no longer avoidable but are rather risks to mitigate.

- Risk Transfer: In the event that it is not possible to eliminate risks to the environment then options are sometimes pursued to try to outsource or insure against the risks. However this could involve higher costs and even when the perception is in place that risk can be offset through insurance, this often comes with pre-conditions for cover, which may require communities to put in place a range of preventive measures. However in 2008 when floods occurred in the Emirate of Sharjah which damaged retail stores and offices, the owners were never compensated by insurance companies because adequate preventative measures had not been sufficiently implemented prior to the event.

- Risk retention: The option used through the continuation of activities which harm the environment without protective measures. For example countries such as the US and Australia, who are high CO2 equivalent emitters, have in the past resisted contributing to the reduction of Greenhouse gases (GHG) emissions by not ratifying the Kyoto protocol.

- Risk reduction: There are two possible approaches to risk reduction. One is to use target hardening techniques to try to reduce the likelihood of the risk, and the other is to deal with the impact. There is a range of possibilities here, which come at different costs. The amount spent on 'target hardening' or 'mitigation' does not always equate to the level of protection actually obtained. In both contexts, worldwide policies are created to establish an efficient national energy programmes.

A.3. Risk Reduction One general formula, with five important parameters, may be applied globally in order to reduce any nation's greenhouse gas (GHG) emissions in the free atmosphere:

- Plan for adaptation strategies to cope with the expected changes in the decades to come.
- Switch over to existing low carbon technologies and fund research and development for new technologies.
- Increase efficiencies and reduce power demand.
- Engage in a combination of motivating factors that include: tax incentives and penalties, nationwide or international emissions permits trading schemes, e.g. Cap and Trade.
- Set regulatory standards encouraging accurate labelling of products to reveal their

associated carbon dioxide emissions through their entire production process.

A.3.1. For Adaptation: Engineering projects will play important roles in helping to adapt to climate change by providing protection against coastal flooding , from rising sea level and increasing storm surges, and against inland flooding (because of more intense rainfall). For example the importance of accurate model prediction is adopted in UK, which helps identify the areas that are most vulnerable to likely changes or extreme events. UK spends approximately £500 million per year into their urgent program to upgrade coastal and drainage defences.

A.3.2. For switching to Low carbon Technologies and development of new technologies: No effective way of removing CO2 from atmosphere has yet been proven. Another way to take carbon dioxide directly back out of the atmosphere would be to let biology of nature to do the work as living plants grow their bodies from carbon dioxide in the atmosphere.

A.3.3. For increased efficiencies and reduction in power demand: The way energy is used in most buildings is still unnecessarily wasteful, which is unfortunately a combination of emitting greenhouse gases into the atmosphere and pouring money down the drain. How much could we cut from projected rises in emissions from buildings without commercial investment? The aim of change behaviour for 9 billion people by the middle of the century will be a challenging task.

A.3.4. To engage a combination of motivating factors: Although this approach may work successfully in fossil fuel importing countries, tax reductions would not be suitable or workable in some Middle East countries.

A.4. Conclusion The costs of tackling climate change, whilst significant, will be lower in the long run if we act now. However the costs will continue to rise steeply if action is delayed. The International Energy Agency (IEA) World Energy Outlook (2009) estimates that each year of delay before moving to a more sustainable emissions path would add up to $500 billion to the global investment cost of delivering the required energy revolution, beyond the investment which would be needed simply to renew our existing energy systems.

B. Energy Efficiency and Conservation Policies in Developed Countries

B.1. History of Worldwide Strategies and Policies in Reducing GHG Emissions The World Environmental Conference held in Japan in 1995 for the “Kyoto Protocol” resulted in legally binding both developing and developed countries into ratifying its protocol. At the G8 Summit in Japan in June 2008, G8 nations committed to consider and adopt the goal of achieving at least 50% reduction of global emissions by 2050. Earlier in January 2008, the EU had also upped its climate ante, promising that by 2020, the EU would have cut its greenhouse emissions by **20%**, and would be producing **20%** of its energy from renewable sources, and would have increased energy efficiency by **20%**: **20:20:20 by 2020**.

| Country | Emissions target for 2020 | Base year |
|---|---|---|
| Australia | –5% up to –15% or –25% | 2000 |
| Canada | –17%, to be aligned with final economy-wide emissions target of the United States in enacted legislation. | 2005 |
| EU | –20%–30% | 1990 |
| Japan | –25% | 1990 |
| USA | In the range of -17% in line with anticipated U.S. legislation. The pathway set out in pending legislation would entail a 30% reduction in 2025 and a 42% reduction in 2030, in line with the goal to reduce emissions 83% by 2050 | 2005 |
| Russian Federation | –15% to –25% | 1990 |

**Table 1 COP 15 Countries targets for 2020**

In December 2009, while The Copenhagen conference did not agree everything set out between the leading countries, the Accord however committed the world to limiting temperature increases to two degrees Celsius (2˚C) and contained plans for financing reaching a hundred billion dollars a year by 2020. Since Copenhagen, over 100 countries have associated themselves with the Accord and as a result of the targets and actions put forward around 80% of emissions are covered by the agreement.

Tackling climate change will require the cooperation of the entire world, but inevitably some countries will play a greater role than others. The Copenhagen conference did cap a year of tremendous progress which saw commitments to reduce emissions from Japan, Australia, China, India, Brazil, Indonesia, the US, and the EU as well as many others. They all recognized that the challenge of climate change requires a permanent change in the way societies should think and work. This ideal can only be solved through concerted international action. If we compare COP 15 Country target for 2020 in Table 1, to Kyoto Protocol, the later has emission targets based on year 1990 which are more stringent; one reason is the difference in targets years and sometimes, in base year. Refer to Appendix A, Table A-1.

B.2. Current Policies and Programs in Developed Countries

B.2.1. Japan

➢ Energy production and cutting of GHG emissions: It is known that Japan has no oil reserves. The first "Oil Shock" led Japanese companies to avoid the high dependence on energy and focus on the improvement of its own technologies. In 1973 the environmental element of the social movements and political activism of the 1960s and early 1970s were manifested most strongly in Japan by local citizen groups that pressured the government to pass some of the world's strictest pollution laws.
Japan has relatively low emissions per head mainly because much of its electricity comes from nuclear power, and its industries are some of the most energy efficient in the world.

➢ Innovative Industry and research and development: Japan is the world biggest investor in solar photovoltaic systems, for example SHARP announced in April 2010 that they have improved efficiency of PV panels to 31.4 % through innovative technology. Also Japan is developing techniques to make hydrogen gas from water.

➢ Non Governmental Organisations (NGO) and building environmental assessment tools*:* Many NGOs and consumers monitor Japanese companies: 'Environmental ratings' are issued by NGO's each year to help clarify consumer's choices. The "Comprehensive Assessment System for Building Environmental Efficiency" (CASBEE), are a green building rating system developed by the Japanese Sustainable Building Consortium to assess the "environmental efficiency" of buildings. The CASBEE-NC assessment tool draws a virtual boundary between a building and its environment, and compares the environmental quality and performance delivered by the building, **Q**, against its environmental loading in terms of energy, resources and materials, and environmental impact, **L**.

The buildings with the highest Building Environmental Efficiency (BEE) are those in the upper left quadrant that have a high **Q**, but low **L**. Each of these areas are broken down into greater detail, and ranked in order, from Excellent (S), Very Good (A), Good (B+), Fairly Poor (B-) and Poor (C), according to the CASBEE 2008 Technical Manual for new construction.

➢ Incentives and Awards*:* Since 1998, Japan has been implementing the Top Runner Program to set energy conservation standards for home and office appliances and a fuel economy standard for automobiles. In many countries, the energy efficiency of electrical appliances are enhanced by Minimum Efficiency Performance Standards (MEPS). Japan however followed a different strategy. Instead of setting MEPS, its Top Runner Program searched for the most efficient model on the market and then stipulated that the efficiency of this top runner model should become the standard within a certain number of years. By the target year, each manufacturer had to ensure that the weighted average of the efficiency of all its products in that particular category are at least equal to that of the top runner model. This approach eliminates the need to ban specific inefficient models from the market. At the same time, manufacturers are made accountable and, perhaps most important, they are motivated to voluntarily develop products with an even higher efficiency than the top runner model.

To further promote energy efficient products, an energy efficient product retailer assessment system was introduced in 2003 to give recognition to retailers who actively promote energy-efficient products or provide appropriate energy conservation information. In addition, for commercial buildings there are programs to promote high efficiency boilers, air-conditioning systems, and energy management utilizing information technology. Finally, the government provides partial subsidies, or low interest loans, to

private enterprises or local governments in setting up Energy Service Companies.

- Labelling Program: An energy saving labelling system has been introduced to inform consumers of the energy efficiency of various home appliances, and to promote energy-efficient products. As of April 2005, labelling has been applied to 13 products: air conditioners, refrigerators, freezers, fluorescent lights, televisions, space heaters, gas cooking appliances, gas or oil water heaters, electric toilet seats, computers, magnetic disks, and transformers.

- Awareness Campaigns: In 2005, the Japanese governments "cool biz campaign" encouraged civil servants to set their office air conditioners to a minimum 28 C. Thousands of workers agreed to remove their suit jackets and ties, and switch to short-sleeved shirts for summer. The campaign has since become an annual event.

B.2.2. France

- Energy Production and cutting off GHG Emissions: France shut down its last coal mine in 2004 and now generates some 80 percent of its electricity from nuclear power, which has ensured that France has one of the lowest per capita emissions rates in the industrialized world.

- Innovative Industry and Research and development: To achieve its cuts, France has focused on new technologies, especially bio fuels in the transport sector, and on strategies to make big improvements in efficiency.

The French market in solar thermal energy is the fastest growing in Europe with growth of 131% between 2005 and 2006, associated with strong growth in renewable energy equipment manufacturing.

France has also the most generous tax incentives in Europe for research and development (R&D Industry Clusters). Environment focused clusters, such as Axelera and CapEnergie, have gained significant funding and recognition since the Grenelle Environment Policy. The Axelera vision is to boost progress towards a state-of-the-art, environmentally friendly chemistry industry integrating an eco-design approach, and it is currently working on the cutting edge of environmentally useful materials, systems, and catalysts.

- NGOs and building environmental assessment tools: The Haute Qualité Environnementale or (High Quality Environmental standard HQE) is a standard for green building in France, based on the principles of sustainable development first set out at the 1992 Earth Summit. The standard is controlled by the Paris based Association pour la Haute Qualité Environnementale (ASSOHQE).

HQU emphasizes on nine major aspects of building construction: environmentally conscious construction, low environmental impact, energy and water control, waste management, low maintenance construction, and thermal energy control, acoustic control and visual comfort, odour control and sanitary quality, air and water pollution control.

- Awareness, renovation of existing buildings and associated incentives: The government requested the renovation of 40 million buildings built prior to 1975. In phases, the target was to renovate 400,000 units annually starting with 800,000 public housing units.

Grenelle Environment Policy specialists suggested that 50 million windows needed to be replaced in order to increase energy savings and achieve lower emissions. 85% of French homes were built before 1975 and almost all are environmentally inefficient. Also, included in the current tax credits are large incentives for buying more insulation.

- Labelling Program: The Axelera competitiveness cluster labels various types of projects: innovative, collaborative research and development projects, innovation projects, development projects, which respond to one of the three technological topics of the cluster (materials, catalysis, processes), and, take into account the 5 selection criteria of the cluster (technological innovation, research/industry partnership, scientific originality, environmental impact, economic impact).

- Green Buildings Targets

- By 2010-12 – All new buildings will meet "low consumption standards" (50kWk/m2/year).
- By 2020 – New buildings should be energy neutral.
- Half of all new public construction to meet new environmental standards –$350 million for 2008-2009, by increasing the use of Renewable Energy & Green Building Construction.

- Reduce energy usage (Immediate), 20% Commercial and 12% for residential next 5 years

B.2.3. Germany

➢ Energy supply and cutting GHG Emissions*:* Germany is one of the first European countries to fully introduce wide spread deployments of wind and solar power systems. In 1999 the '100,000' roof program, offered favourable loans to households to install solar panels, and since then Germany has now the largest installed capacity of solar energy. However, half of the country's electricity still comes from coal, which is the most polluting of all the fossil fuels.

➢ Renewable Energy: Germany adopted feed-in tariff (FIT) markets, and Spain, Italy, France, Greece, Portugal and UK; also adopted a very similar feed-in tariff. In addition Germany imposed portfolio standards for wind power on utilities providers, requiring them to produce certain amounts each year and offering long term subsidies, making them the world leader in terms of installed wind capacity, amounting to 13,512 MW in October 2003 (nearly 40 % of the global capacity). Some economists have predicted that renewable energy could outstrip car manufacture as the country's most important export industry. The positive Renewable Energy Sources Act (Erneuerbare-Energien-Gesetz, EEGRES) development in Germany can be explained by conducting key promotion measures which serve as a subsidy for the operational costs, several promotion programs, which supported Renewable Energy Source (RES) through investment subsidies (in the form of grants or soft loans), tax exemptions (within the scope of the Environmental Tax Reform) or in a more indirect way, through the decision to phase out nuclear energy.

➢ Biomass: In Berlin during the year 2009, the National Biomass Action Plan was approved supporting the EU Commission which, in its Biomass Action Plan published in 2005, called upon the EU member states to draw up national action plans for the energy use of biomass. Theoretically speaking, national resources for bio-energy would suffice to reach the targets and double the share of bio-energy in Germany by 2020. In this context it must be avoided that the expansion of biomass production for energy use comes into conflict with food security, the right to food and the protection of the environment and nature.

➢ Hydropower*:* In 2007 approximately 20.7 billion kilowatt hours of hydroelectricity were generated. That accounts for a 3.4% share in electricity generation, a 23.6% share in electricity generation from renewable energy sources and a reduction of CO2 emissions by 22.6 million tonnes. 20% of the large power stations in Germany are storage power stations, 80% are run-of-river plants.

➢ Green Buildings Targets*:* The Energy Policies of IEA Countries – Germany - 2007 Review recorded that, Germany continued to reform its electricity and natural gas markets, to set a timetable to phase out coal subsidies, to meet key climate and environmental targets. In addition Germany brought energy efficiency and environment to the top of the world agenda during its presidencies of both the G8 and European Union.

The planned phase-out of nuclear power over the coming years would have major impacts on the country's energy mix, raising concerns about energy security, economic efficiency and environmental sustainability for the country and for Europe as a whole. Finally, the country's environmental policies, though helping meet ambitious goals, are expensive.

➢ NGOs and building environmental assessment tools: Energy Conservation policies seem to be mainly driven by governmental and federal decisions rather than other non-profit associations. The German Sustainable building council (Deutsche Gesellschaft für Nachhaltiges Bauen), was established to assess Green Buildings in Germany.

B.2.4. United Kingdom

➢ Energy Production: The UK has a small coal reserve along with a significant, but continuously oil and gas reserves. Over 400 million tonnes of proven coal reserves have been identified in the UK in 2004, while the total UK coal consumption (including imports) was 61 million tonnes, allowing the UK to be self sufficient in coal for just over 6.5 years, although at present extraction rates, it would take probably around 20 years to mine. An alternative to coal-fired electricity generation is underground coal gasification (UCG). UGC involves injecting steam and oxygen down a borehole, which extracts gas

from the coal and draws the mixture to the surface - a potentially very low carbon method of exploiting coal. The identified onshore areas that have the potential for UGC amount to between 7 billion tonnes and 16 billion tonnes. Based on current UK coal consumption, these volumes represent reserves that could last between 200 and 400 years.

- Cutting greenhouse gas emissions: The UK is committed to delivering its share of the EU target for 20% of energy from renewable sources by 2020. UK's renewable energy strategy could provide £100 billion worth of investment opportunities and up to half a million jobs in the renewable energy sector. The British Government is committed to tackling climate change and maintaining security of their energy supply.

The former Minister of State for the Department of Energy and climate change explained that the low carbon transition plan set out the UK strategy to reduce carbon dioxide emissions, whilst exploiting the opportunities of the green economy. The plan encouraged householders and communities to play their part by installing small scale low carbon and renewable onsite energy technologies.

- Renewable Energy: The "**energy cash back**" plan will play a significant part in delivering increased numbers of installations to move from a niche to mass market. Feed-in Tariffs (FITs) became available in Great Britain on 1st April 2010. The excellent opportunity exists for plumbing, heating and electrical engineers to provide installation services for solar PV panels, solar thermal, micro wind, biomass, heat pumps and the range of micro-generation technologies. But those who want solar power to supply a high proportion of the electricity used by the United Kingdom encounter two basic problems: as there isn't enough sun and it shines at the wrong time of year.

Working through the Office for Nuclear Development the government is working to facilitate the building of new nuclear power stations by taking action to streamline the planning and regulatory approvals process.

- Green Buildings Targets and Incentives: Information and quality assurance is important in UK purchasing decisions. That's why the Micro-generation Certification Scheme, known as MCS, has an important role to play to deliver quality assurance in purchasing decisions. The MCS is an internationally recognized quality assurance scheme and mark for Low and Zero Carbon Technologies (LZCT) installers and products. It was designed with input from installers and product representatives. MCS gives mark of competency and includes the following technologies: Air Source Heat Pumps, Biomass, Ground Source Heat Pumps, Micro CHP, Small Scale Hydro Turbines, Solar Photovoltaic, Solar Thermal and Wind Turbines.

Additionally, smart meters are in the process of installation, and will help people to better understand their energy use and modify their behaviour to save money on bills.

The Renewable Heat Incentive (RHI), from domestic through to industrial, offers individuals, communities, public sector and large commercial and industrial companies a financial incentive to switch from using fossil fuels for heating to using renewable sources of heat. RHI is aimed to be introduced in April 2011.

- Investing in low-carbon infrastructure: The new Government announced in their 2010 Budget their intention to establish a Green Investment Bank, which will invest in the low-carbon sector. It will consider primarily new energy and transport projects, specifically addressing the significant risk of a gap emerging in the provision of equity capital to large, complex infrastructure projects.
It is likely that the Green Investment Bank will focus initially on offshore wind electricity generation and will consider other infrastructure as and when appropriate and as the need for investment arises. The 2010 Budget also announced that the Government, subject to European state aid considerations, will be launching an open competition allowing site developers to bid for funding of up to £60 million for infrastructure for the offshore wind industry.

- NGOs and building environmental assessment tools*:* BREEAM is the UK Building Research Establishment (BRE) Environmental Assessment Method which was created in 1990. Buildings outside the UK can be assessed using BREEAM International, which is tailored to suit local circumstances. A BREEAM International assessment relies on the BRE setting up a list of criteria specifically for the project, or for

series of projects which have similar characteristics. It is carried out by an accredited assessor who then submits a report to the BRE for Quality Assurance, resulting in a rating such as; Pass, Good, Very Good, Excellent, or Outstanding together with a BREEAM certificate. In 2010 BREEAM has now over 110,000 certified buildings, most of which are residential projects. In the UK, BREEAM may be incorporated into the building regulations by 2019 in line with the push towards building and living with sustainability in mind. BREEAM assess buildings against a wide range of environmental and sustainability issues, covering a number of categories. For each issue, one or more 'credits' are available when specific levels of performance or process are achieved. Overall, the total number of points or credits obtained determines the final BREEAM score, which result in a rating, ranging from Pass to Outstanding.

B.2.5. The United States of America

- Energy Production: The United States nation's energy mix constitutes 24 % coal, 40% petroleum, 3% Hydro, 8% Nuclear and 25% Natural Gas, which equates to a total of 89% dependence on fossil fuel in providing the nation's energy.

- Cutting GHG Emissions: Two closely linked challenges shape all debates on the required path for the nation's energy policy: how to increase security by reducing the dependence on imported supplies; and how to address growing emissions of greenhouse gases. In contradiction to the Japanese policy which put Nature and the environment's protection on top of their priority list. The United States national strategy is to find solutions largely through technology and innovative designs. It is a world leader in research and development and is further driving the development of carbon capture and storage and second-generation bio-fuels, especially those extracted from corn. But so far, no Federal government policy is in place to establish as a target an absolute reduction of CO2 emissions. The resulting uncertainty risks holding back investments into new technologies and may delay projects that are urgently required. A different environmental approach was noticed when President Barak Obama participated in COP15 in December 2009; The US has finally recently demonstrated their commitments to environmental strategies, for the first time in more then three consecutives decades.
Large initiatives were also brewing from within the previous Bush administration to rejuvenate the nuclear power industry by building new power plants.

- NGOs and building environmental assessment tools: The most internationally known; Leadership in Energy and Environmental Design (LEED) Green Building Rating System was developed by the US Green Building Council (USGBC) and officially launched in 1998 in the US. The scheme has been inspired by previous schemes including BREEAM. Unless a country-specific LEED system is in place, the LEED US criteria can be used for any country in the world. The LEED Accredited Professional (LEED AP) gives support and guidance to the Design Team on LEED issues, but the LEED certification is provided by independent, third-party verification from the USGBC. All certified projects receive a LEED plaque and a certificate, with ratings awarded for Certified, Silver, Gold or Platinum status. Although the USGBC is a large organization, fewer than 2,000 buildings, (mostly commercial), have acquired LEED rating, compared to 110,000 buildings certified by BREEAM.

B.2.6. Overall Strategy in European Countries: Europe's current supply structure still bears the characteristics of the fossil-fuel powered era during which it was developed. The technologies applied are ageing and the markets supporting it are underdeveloped. However, the European cable industry, the European wind industry, European solar Industry, and the European Nuclear Industry are all world leaders in their field.

*Christian Kjaer*, from European Wind Energy Association (EWEA) said "European policy agenda favours a better electricity infrastructure, bringing more and more wind power online and driving down prices for consumers' Modern electricity infrastructure". "Over the next 12 years, Europe must use the opportunity created by the large turnover in capacity to construct a new, *modern power system capable* of meeting the energy and climate challenges of the 21rst century. Grids need to be interconnected which create corridors of trade in electricity in Europe that will bring down prices for consumers", he said. *A smarter management* needs to be introduced, he added, of the electricity sector adjusting the

rules and regulations on the supply side to meet the needs of wind energy. This must include shorter gate closure times so that the providers of wind energy can give two hours notice instead of two days notice of the amount of power they will supply.

B.3. Conclusion In developed countries, policies and programs for investment in energy efficiency and renewable energy sources are reducing oil and gas import bills, and are securing energy by reducing reliance on these more price volatile energy sources. They are also ensuring the best use of free energy produced directly from wind, sun, water and waste.

Effective government strategies, coupled with monitored and controlled implementation are certainly improving construction standards and are modifying end users behaviours.
NGOs are creating awareness and are testing practices which would be enforced as regulations at later stages. Moreover, they are responsible in increasing the competitiveness in many industries, specifically manufacturing industry and construction industry.

The IEA World Energy Outlook (2009) estimates that over half of the reduction in emissions in the energy industry could be carried out by increasing efficiency in both the generation and use of power. It estimates that by increasing efficiency, energy bills in transport, buildings and industry could be reduced by over £5,400 billion ($8,600 billion) globally over the period 2010-2030 and by £10,700 billion ($17,100 billion) over the lifetime of the investments.

C. Middle East Countries

C.1. Current Policies in Energy Conservation: In his article published in October 2009, Mohammed Redha Qader concluded in his study that GCC countries emit considerable amounts of CO2 from the combustion of fossil fuels, the main source for that emission being the energy sector, which includes the energy extraction and the energy conversion sectors: only the later has been considered in his study. As he concluded, at present, the only measures taken to curb energy consumption in domestic uses in most of GCC countries consist in government-sponsored campaigns advising consumers to reduce their electricity consumption.

C.2. Worldwide Electricity Consumption: For comparison purposes, this paper refers to Table 2. The Kingdom of Saudi Arabia consumes an equivalent kWhr energy 38% of energy consumed by United Kingdom, and equivalent 3.5% of energy consumed by United States. The United Arab Emirates consumes an equivalent kWhr energy 11% of energy consumed in United Kingdom, and equivalent 1 % of energy consumed by United States.

Qatar consumes equivalent kWhr energy 3% of energy consumed by United Kingdom, and equivalent 0.25 % of energy consumed by United States.

| Rank | Country | Electricity consumption (kWh) |
|---|---|---|
| **1** | United States | 3,660,000,000,000 |
| **2** | China | 1,630,000,000,000 |
| **3** | Japan | 971,000,000,000 |
| **4** | Russia | 894,300,000,000 |
| **5** | Germany | 519,500,000,000 |
| **6** | India | 510,100,000,000 |
| **8** | France | 414,700,000,000 |
| **10** | United Kingdom | 337,400,000,000 |
| **20** | Saudi Arabia | 128,500,000,000 |
| **33** | Egypt | 75,580,000,000 |
| **48** | United Arab Emirates | 36,510,000,000 |
| **58** | Kuwait | 30,160,000,000 |
| **60** | Syria | 24,320,000,000 |
| **78** | Oman | 9,792,000,000 |
| **79** | Qatar | 9,046,000,000 |
| **82** | Lebanon | 8,591,000,000 |
| **86** | Jordan | 7,094,000,000 |

**http://www.mapsofworld.com/world-map.html**

**Table 2 Electricity Consumption Worldwide**

Analysing the large difference between power utilisation and consumption rates, factors that could drive Middle East countries to use and develop renewable energies and energy conservation, are certainly different from the driving factors urging developed countries to invest in Green Technologies. Middle East would perhaps consider such energy production and conservation alternatives, because of desalination plants for much of its potable water rely on fossil fuelled energy. Besides being conscious about environment, Middle East countries should be seeking for those alternatives to secure continuous supply of potable water.

It is important to mention that if we consider CO2 emission per population as another indicator for comparison, consulting Table A-1 and Table D-1 in Appendixes A and D respectively, results can be contradicting with power consumption results. Based on year 2004, GCC countries are among the highest CO2 emitters! Qatar emission per person is 189% greater then USA per capita emissions (almost 3 times), and 414% greater then UK CO2 per Capita Emissions (more then 5 times). UAE as well as Kuwait emit each 113% per Capita CO2 greater then USA, and 247% greater than UK per capita CO2 emissions. It is not the subject of these papers to calculate carbon emissions resulting from Oil production or extraction, or to verify carbon reduction resulting from the use of renewable energy: the mentioned percentages are for reference only and the analysis will not account for this indicator.

C.3. The use of Energy in Buildings The electricity power production serves more than 50% to commercial and residential buildings in GCC countries, which approximate 70% of its production, is used only to cool buildings in summers and assure acceptable indoor environment conditions.

The two emirates Sharjah, Ajman and Ras Al Khaimah in UAE experience frequent, long and severe power short supply, especially during summer. On the other side, Kuwait utilizes the media to send messages to its communities to reduce power load by minimising the use of electrical appliances and air conditioning equipments at domiciles.

C.4. Understanding Energy Efficient Design in ME Countries In the aim to evaluate the understanding and perception of Green building codes in ME, two hundred professional in different sectors in construction industry were invited to participate in taking an electronic survey, titled Green Building, in April 2010, using www.surveymonkey.com. Only 51 professional have completed the survey as of end of May 2010, equivalent to a percentage of responders that equals 25%.The survey results are listed in Appendix B.

C.4.1. Interpretation and Analysis of Results

- Sustainability of Construction Businesses: Construction companies operating in the ME acknowledge the importance to create and implement Green policies or environmental strategies, in the purpose to sustain their business in the new construction market's requirements and in response to Governments Campaigns. Only 16% of companies operating in ME have no plan to pursue any environmental strategies.
- Professional Awareness about Green Building Assessment Tools: The result positively reflects awareness of multiple Green Building assessment tools. However, it may be surprising to have better or fairly equal knowledge in LEED rather than local guidelines and codes. Although late LEED assessment were not compatible to international application, local codes and guidelines might have failed to attract key players because of many reasons; failed to influence international investors to gain their trust, failed to prove effectiveness of their codes, or initially, they did not communicate properly or educate enough professional and industrial key players about the correctness and reliability of their practices.

- Perception about eco-friendly Building*:* Candidates are divided over the cost of designing and building eco-friendly buildings: It is obvious that cost is not clear to a major number of professionals. While we know that cost of a design and construction of green buildings may result in increase to between 5% and 10% from original costs in USA and Europe, the actual cost in ME is still unknown. Actually it may be higher than 10%, considering many factors including the need to outsource accredited designers from international companies who do jobs for higher fees than local markets fee charges. Another interesting result that is consistent with results in sustainability of construction business, approximate 17% of candidates do not agree to make green buildings codes mandatory.

The last result of 79% of candidates believing that is possible to achieve green buildings goals in the ME, is a positive indicator, showing clearly that professional engineers accept to implement energy efficient policies dictated by authorities.

- Opinions on subsidy vary between for and against: For social reasons they would encourage to subsidy utilities, but should however also subsidy "green technology" as well. It is encouraged because "The utilities distributor may instead be a facilitator for improving the utilization effectiveness across the spectrum, through awareness campaigns and encouraging energy performance contracts by acting as regulators and mediators between the end user and the

service providers". On the opposite side, some of them think that work is still to be done prior reaching this level, most particularly at architectural certification and design. Someone adds "more clients will be willing to follow the Green Building Concept if the government will provide subsidies for making greener building". "Utilities are currently being subsidized in Oman. This can be done in a different form which supports the cause".

- Incentives A total of 62% candidate find incentives to be very important in achieving goals in eco-friendly and energy efficient designs. It is important to note that non monetary incentives are the most wanted ways of incentives, 76% request for awards, marketing and good publicity. The least important incentives are buyers' tax reduction or tax credits 23% followed by density bonus 17%. The first result can be associated with the absence of direct taxes mainly in GCC countries that constitutes 86 % of candidates. The low percentage recorded in density bonus rate could be associated to the relatively low percentage (10%) of developers participating in the survey and who usually wish to get high density bonuses and efficient use of their built up areas and lands.

C.4.2. Survey Conclusion The analysis concludes that professional communities in ME are highly aware of Green codes and assessment tools. They acknowledge the need to shift to better way of designing buildings, using sustainable practices which have lower impact on environment. On the other side, information about the liability of implementing local promoted energy efficiency measures is yet to be proven, in terms of cost and benefits. International investors prefer to adopt proven and tested international green codes, so in order to save time and efforts, and to avoid confusion and perhaps conflicts; authorities are urged to standardize local green codes and craft national energy efficiency policies and programs in buildings. Any forward step towards innovation and renewable energy is highly embraced by the Middle Eastern professional communities; however, authorities have to offer tangible rewards and assurance.

C.5. ME Independent Green Building Assessors

C.5.1. United Arab Emirates

- The Emirates Green Building Council (EGBC) is a non-profit organisation, formed in 2006, and was at the time the 8th green building council in the world, with the goal of advancing green building principles for protecting the environment and ensuring sustainability in the United Arab Emirates.

UAE has the highest number of registered projects in GCC under LEED in USGBC directories as of May 2010: 44 projects in Abu Dhabi, 462 projects in Dubai, one project in Sharjah, one project in Al Ain, totalizing 504 registered projects, compared to 27 projects in Doha, 6 projects in the Sultanate of Oman, one project in Kuwait, 14 projects in Beirut, two projects in Bahrain, and 3 projects in Cairo.

- Estidama, is also a locally tailored assessment tool, lead by a sustainable design committee, addressing the harsh climatic conditions within Abu Dhabi and including the impacts associated with the production and use of desalinated water. The program has been initiated by a group of government agencies and developers, UPC (Abu Dhabi Urban Planning Council), EAD (Environment Agency-Abu Dhabi), ADM (Department of Municipalities & Agricultures), and Masdar: Masdar has initiated building the Worlds First Carbon Neutral, Zero Waste City.

The Estidama program as a whole is made of three key projects:

1. Estidama New Building Guidelines launched May 2008
2. Estidama Community Guidelines
3. and upcoming Estidama Existing Building Guidelines

C.5.2. Qatar The Qatar Green Building Council started its establishment role in June 2008 with the help of volunteers. In July 2009, sponsored by the Qatar Foundation, the council was established under the auspices of Her Highness Sheikha Moza Al Thani. The council is a non-profit, private organization of public benefit with a vision to provide leadership and collaboration for Qatar in guiding businesses to adopt environmentally sustainable practices for green building design and development. The main goals of QGBC are to help developing and promoting the sustainable design and development of buildings in Qatar.

C.5.3. Lebanon The Lebanon Green Building Council (LGBC) was officially launched in 2009, its mission to provide stewardship towards a sustainable built

environment. It promotes, spreads and helps implement high performance construction concepts that are environmentally responsible, healthy and profitable. LGBC is a coalition of corporations, contractors, engineers, universities, and non-profit organizations working together.

C.5.4. Comparison in Green Standard
Appendix C presents a comparison table between Green Building rating systems adopted by US Green Building Council, Estidama and Indian Green Building Council. It is obvious that water efficiency weighting factor constitutes 30% of total rating of Estidama ratings, higher than water efficiency weighting factor in USA 7% or India 9%. While energy use is given approximately similar weighting factor: 25% as per USGB ratings and IGBC ratings, and 20% as per Estidama ratings.

C.6. Power Production's Road Maps: It is obvious that Qatar, United Arab Emirate and Kuwait are having clear road maps to build new energy production plants acknowledging that forecasts indicate that demand for utilities (electricity and water) in these countries will increase by 12 per cent and 14 per cent per annum until 2020, fuelled by high population growth and high per capita income.

C.7. CO2 Emission in ME Countries: In GCC countries, electricity is generated mostly by fossil fuels (oil or gas) power plants. As tabulated in Appendix D Table D1, the highest emitter of CO2 per kWhr from electricity and heat regeneration from **Oil** is Bahrain followed by United Arab Emirates. The highest emitter of CO2 per kWhr from electricity and heat regeneration from **Gas** is Bahrain too, followed by United Arab Emirates and Oman.

C.8. Energy Security
C.8.1. Kuwait In the absence of energy conservation policies, Kuwait is seeking to import 500 megaWatts from Qatar in order to secure electricity, until energy production program's implementation gets achieved.

In January 2010, World Nuclear News wrote, Kuwait and France have signed an agreement on nuclear cooperation amid suggestions that the Gulf state is interested in buying a stake in a French nuclear company. The agreement ensures developing nuclear cooperation and exchanging expertise. The deal covers the peaceful use of nuclear energy both for electricity generation and for the provision of clean water.

C.8.2. Qatar

- Energy Production. Qatar fully depends on its Natural Gas to produce Energy. Current electricity production capacity is 4,200 megawatts, according to official figures. Qatar plan is to raise power capacity to 9,000 megawatts, and may export power once it gets a 'suitable offer'. The country's energy minister said in May 2010. "Once we receive a real offer, Qatar will be ready to discuss exporting power; we haven't received a serious offer." With new plants online, Qatar will have a surplus that will be used for projects which depend on energy in their production, such as aluminium factory.

- Gas in Qatar: Qatar is the world's top exporter of liquefied natural gas and has the world's third-largest LNG reserves, after Russia and Iran. One of the largest energy projects "Gas to Liquid" GLT is in Qatar. Qatar sits on one of the biggest natural gas fields on the planet, but it is far away from the big consumer markets, so it is too costly to build pipelines to move it out to consumers. Qatar in conjunction with large companies is putting on big push to convert its natural gas into petroleum liquids like diesel fuel, and the transport the products to markets around the world via tankers. The $7billion project in Qatar is slated to start delivering 154,000 barrel per day, to Western markets by 2011.

- Empower Neighbourhood

*Kuwait*
Plans exist to transport 500 MegaWatts to Kuwait.

*Oman*
Qatar is awaiting a decision on building a power plant in the sultanate of Oman.

*Syria*
The Qatar Electricity and Water Company (QEWC) have signed a Principles of Agreement with Syrian Qatari Holding (SQH) for jointly developing, constructing, financing and operating two power plants in Syria. The power plants, to be commissioned by June 2013, will be located in the north eastern region of Syria. Agreement would go a long way in developing two 450mw gas-propelled power stations in Syria and will use environmental-friendly combined cycle technology for their operations. The plants are expected to cost over 1bn US dollars. A long-term Fuel Supply Agreement (FSA) has been

reached with the Syrian ministry of petroleum and natural mineral resources to facilitate the supply of gas to the two plants. The power generated from the two plants would be transferred to the Syrian national grid through a long-term Power Purchase Agreement (PPA) or an energy conversion agreement (ECA), both of which have the same duration as the FSA.

- Powering desalination plants in Qatar : The setting up of a desalination plant to run on solar power will solve many of Qatar's problems related to its low and expensive agricultural production, said the Chairman of Qatar National Food Security Program (QNFSP). QNFSP was engaged in conducting comprehensive researches in association with Qatar Foundation, Qatar University, Qatar Science and Technology Park as well as Texas A & M University to make Qatar self-sufficient in food production.

Responding to a query as to how Qatar plan to tackle the cost of production, which was often higher than the actual value of the produce, QNFSP confirmed that by using innovative technologies such as the solar power, Qatar would be able to irrigate farms at a lower cost, protect environment and secure employment to people, which would do much more than just compensate for the heavy cost of farm production."

- Empower manufacturing in Qatar: Qatar Solar Technologies (QST) will establish a production facility for poly-silicon. Partners are the Qatar Foundation (70%) and the Qatar Development Bank (1%) and a foreign company (29%). Qatar Solar Technologies are willing to invest a total of more than 500 million US dollars in the construction of the new production facility with a planned annual capacity of around 3,600 tons of high-purity poly-silicon in its first stage of expansion. Start of production is planned for the third quarter of 2012.

C.8.3. United Arab Emirates

- Energy Production: The production and supply of one kW of electricity costs around AED 2,500. According to an official forecast, annual peak demand for electricity in the UAE are likely to rise to more than 40,000 MW by 2020-considering an annual growth rate of nine per cent. A recent government study said known volumes of natural gas were insufficient to meet that demand and burning oil liquids are seen as environmentally unfriendly. UAE have signed a Memorandum of Understanding on nuclear energy with France, US, UK and Japan. UAE have pledged 10 million US dollars towards an International Atomic Energy Authority administered low-enriched uranium fuel bank to ensure nuclear fuel supply.

"Living planet Report (World Wildlife Federation, 2006) had assigned UAE the highest Ecological Footprint ECF (11.9) on the basis of 2003 data, mostly from carbon dioxide emissions. The water withdrawal rates (1,533% of total resources) are also among the highest in the world.

- Energy Conservation: In response to Governmental decrees and leaders' visions, UAE have started implementing energy conservation policies since 2004 with the help of local and international experts. Insulating external walls is mandatory in all new constructed buildings, as well as minimum heat transfer U values of building's envelope should be verified to be conform to local standards.

The risk of shortage in Electricity supply from one side, and the environment protection from other side are driving the construction industry to reduce electric loads on existing grids. As mentioned previously, NGOs are very active in UAE and developers are very conscious about sustainable development.

C.8.4. Syria

- Renewable Energy: Syria is working on investing and developing solar and wind energy to meet the increasing demand on energy in light of the population growth and the economic, industrial and agricultural expansion.

- Research and Development: Syrian Ministry of Higher Education has launched many programs on renewable energy to be studied at the faculties of electrical, mechanical and technical engineering and in the institutes and postgraduate programs. Research and training energy centres have been established in Damascus, Aleppo, Tishreen and al-Baath universities. Syrian institutes and research centres have conducted many studies on new types of renewable energies and the required infrastructure to invest them. In a statement to SANA, the Head of the Higher Institute for Applied Sciences and Technology said "we conducted research on producing biodiesel from consumed frying oil and the results were good. Now we are studying the possibility of

carrying out this project." The Institute worked on drawing a sunlight map in cooperation with Armenia. The project aims at linking the sunlight map in Syria and Armenia to invest solar power and use it in heating and cooling water. He added that an international conference on renewable energy would be held regularly every two years to exchange scientific researches and experiences.

- Exploring Wind Energy: Syria is rich in natural resources that could be invested to generate new types of energy. Syrian national wind energy companies' in Syria and the largest Wind Energy Company in the world in Denmark have signed strategic partnership to develop wind energy in Syria.

The partnership includes the submittal of a joint pre-qualification to the Public Establishment for Electricity Generation and Transmission for the development of the first wind energy project in Syria.

The project includes the construction and operation of a wind farm with generation capacity of 50-100 MW at two sites. Syria has a considerable wind energy potential in a variety of locations promising to offer clean energy needed to meet the increasing demand for electricity in Syria in an environmentally friendly manner in line with the Syrian government strategic vision as to achieve sustainable development in Syria.

C.9. Ranking of ME Countries. UAE is the top country in the Middle East for using technology to create a better economic and social environment, according to a new report published by the World Economic Forum. The Global Information Technology Report 2009-2010 ranks the UAE as the 23rd best country out of 133 survey on how it uses information technology to create a "more economically, environmentally and socially sustainable world in the aftermath of one of the most serious economic crises in decades". Globally, Sweden came out on top, followed by Singapore and Denmark. In the Gulf region, the UAE was placed six places above Bahrain, which edged Qatar into 29th place. Saudi Arabia was ranked at number 38 while Oman was rated the 50th most ICT prepared country. Kuwait was the lowest ranked GCC nation at number 76.

It is noticed recently that the Emirate of Qatar might advance ahead of all listed Arab countries. With minimal focus on energy conservation, Qatar is preparing a strong platform for renewable energy production and supply, covering the whole supply chain, from solar panels manufacturing up to electronic smart meters at the end-users side, inside Qatar and outside. Politically Qatar could be a strong player in the future influencing decisions in Arab countries as well as abroad: its development is believed to be steady and well mitigated.

C.10. CHALLENGES: Strategies cannot be proven right until successfully implemented and tested. It is obvious to see that ME countries are investing in building new energy plants using gas as primary fuel sources, or solar energy, or nuclear energy (Wind and Hydraulic excluded from all countries strategies except Syria). The energy will feed developing agriculture and manufacturing industries, water desalination plants and domestic buildings. But still, rigid conservation policies do not exist except in UAE.

C.10.1. In Solar energy. Solar Energy is readily available in these countries, for long hours and continuously throughout the year. Challenges may rise in maintaining efficiencies of solar panels under harsh, hot and dusty environmental conditions.

- Cleaning of surfaces: Large volume of water, that could be estimated to reach 5% of water usage of any glass building, is used to clean its external glass facades. When efficiency of PV panels or solar tubes are directly affected by the clearness of exposed surfaces, any design or installation should consider maintenance cost associated with cleaning, which is usually negligible in countries with relatively moderate weather.

- Installation areas: Due to the low efficiency of solar panels, their installation consumes large areas. Building central stations in remote isolated areas could be a solution, however, the cost of transporting the power could add to the power infrastructure requirements. Installing solar roofs could offer some advantage, but regulation should be set to facilitate and control those installations.

- Electricity Storage: Batteries are perfect storage of power when it is not readily used or fed back to the grid. Sizing a cooling and ventilation system requires a good understanding of the amount of heat produced by the batteries and UPS systems contained in

enclosed spaces, and also proper maintenance schedule is essential in maintaining batteries life which efficiency may dramatically deteriorate when exposed to high temperature and high humidity.

- High temperature: In one of the running project using solar water heating for domestic use in Dubai, consultant had to add extra heat exchanger to reduce the high temperature of the closed hydraulic system; high temperature had caused vacuum tubes to crack. Particular tubes specifications should be well tailored to accommodate GCC countries' weather conditions.

C.10.2. In Nuclear Energy

- Radiation and Waste: Nuclear radiation and waste were always big concerns in producing nuclear energy. At the end of uranium processing, the product could constitute one essential element of the primary materials in manufacturing nuclear weapons. With all security measures, waste should be properly processed or disposed.

- Site Selection: Proper site selection is important: habitats at proximity to operating plants have to bear a large risk in case of incidents like nuclear leak or radiations. Furthermore, the challenges in cooling generators may lead to increase sea water's temperature, and may cause dramatic irreversible maritime consequences and dangerous effects on bio-diversity. Few lessons could be learned from Ukrainian Chernobyl catastrophe (1986).

- Severe environment conditions: factors to consider in designing nuclear power generating plants are humidity and temperature. Sensitivity of sensors can be easily deteriorated by major changes in conditions (dust, humidity, high wet bulb temperature, and high dry bulb temperature, high daily temperature difference).

C.10.3. In Natural Gas Power Generation GHG emissions will not be totally omitted but minimised; it is still reliable and relatively cheap to install and operate.

C.10.4. In Coastal Development While studies conducted by International energy Agency (IEA), confirm that sea levels will rise in 2050 by at least 500mm, and floods are likely to occur frequently, developers in GCC countries insist to build artificial islands on coasts or in the sea. Coastal and drainage defences could be studied and commissioned by engineering universities in order to develop a comprehensive tool, simulating climate changes and environmental disasters.

C.11. Efficient Energy Policies and Programs

C.11.1. Adaptation and Mitigation Adaptation is one of the necessary measures to take in the changing climate. It is one of the important preventive actions that ME countries should consider planning it.

Following a what-if scenario, what if the average temperature increases by 2 C, what would be the impact on existing residential and commercial buildings, heritage buildings, and business ports, what are the consequences on wild life? It is enough or satisfying to rely on data provided by foreign scientific bodies, in order to study any crisis management plan and attend catastrophes like fires and heat waves?

Often, building services design contingency for power and water supplies in most ME countries are 24 hours. A considerable continuous shut down in energy supply, more than 48 hours, due to sudden floods or excessive heat for example would certainly cause losses in millions of dollars in businesses and in lives in GCC countries. During such catastrophes, risks are high in that communication stops, building services and utilities dependent on power stop and specifically water and air conditioning, rural as well as maritime and air transportation become difficult and dangerous, risks of fire rise, food supply dependent of import decreases, personal and property security means become un-operational and inefficient, civil crimes increase, to an extreme extent that a National Security would be endangered.

Crisis and disaster management's effective procedures and coastal and floods defences are almost non-existent in ME countries environmental maps or programs. Big claims require strong support: roads in the Emirate of Sharjah disappear every year under heavy rain basins, the Sultanate of Oman is suffering since 2007 the disastrous consequences of floods caused by Guno cyclone, hospitals in the region fail to prove their preparedness and efficiency in accommodating emergency cases when heat waves hit hundreds of labours on construction sites.

C.11.2. Switch to Low Carbon Technologies and Develop new Technologies. Few countries in ME are buying and importing

renewable energy and green technologies. Leaders and investors in United Arab Emirates, Qatar, Sultanate of Oman, Bahrain, and Syria have recently started looking at the energy production more from sustainable political and economical approaches, rather than from environmental aspect. It is too early to score credits to those countries, but their visions and leadership are highly praised.

The two main sources of renewable energy that Green Peace proposes for the clean energy are solar panels and micro wind turbines. In hot countries like ME region and specifically GCC countries, electricity use peaks in the middle of a summer day, fortunately when air conditioning equipments are turned on and fully loaded. It is important to note that solar radiation intercepted by the earth is 5.450.000 EJ/yr while world wide energy use in 2005 was recorded to be only 450 EJ/yr. So, there are two good reasons to shift to produce clean energy from solar radiation: solar photovoltaic electricity power produced from panels of light-sensitive cells is un-intrusive and silent, it upsets no one. The infrastructure it requires already exists, in the form of south-facing roofs on our houses, factories and offices. It is not quite a zero-carbon technology (solar panels in Europe takes between two and four years to produce as much energy as is used in the manufacturing), but it generates far fewer emissions per watt than fossil fuel power production plants.

C.11.3. Encourage NGOs participation. Arab governments are encouraged to be flexible and help establishing NGOs. Hit by regulations and inefficient bureaucracy, many NGOs end up by not being registered in most of the cases, which make them illegally established, limiting by that fact their participation in creating awareness and promoting good energy practices in the countries where they operate. A good example about the importance of operating NGOs is the Lebanese Green Building Council (LGBC): the council's board is successful in promoting energy efficiency in buildings via preparing design and materials specification guidelines as well as in reaching the society via the media. While in other countries, such organisations have obviously failed to accomplish their missions and sustain their existence.

C.11.4. Reduce Energy Use. When optimizing may not allow the maximum reduction in energy when conducting feasibility studies, it is highly important to make sure that energy reduction has the highest weighting factor when compared to cost factor. One of the solutions to assist in paying higher capital cost resides in governmental financial helps and soft loans scheme.

Without neglecting what big roles NGOs and non-profit energy assessment organizations can offer in the purpose to promote efficiencies in building's design, it is the sole responsibility of the authorities to plan, implement, enforce and monitor energy consumption policies and programs in the attempt to reduce energy use. The process may start by preparing guidelines, testing their efficacy and applicability, revising the guidelines in line with leaders' visions and construction industry's feedback and capacities. Upon testing these guidelines, which may take between 5 to 7 years (unless they are already tested under same or similar conditions), they could be converted then into codes and regulations.

C.11.5. Create Policies for Existing Buildings. Governments sometimes pass over the advantage which existing buildings can bring in reducing energy consumption. Arab governments have yet to address energy reduction in existing building in their agenda. France plan for existing buildings constitutes an excellent example to apply in ME.

C.11.6. Tariff Scheme. Another important item on the agenda of new policies could be to change the electricity tariff scheme: many scenarios can be adapted to allow normalizing the power demand profile, especially at high peak times, which is in day time in the ME. That would encourage the design of wider ranges of technologies with lower carbon emission, e.g. thermal energy storage for cooling commercial buildings. Another scheme is TIFs under which suppliers make regular payments to householders and communities who generate their own electricity from renewable or low carbon sources such as solar electricity (PV) panels or wind turbines

C.11.7. Metering Utilities. It is proven that end users tend to reduce electricity, water and gas consumptions when they are offered to visually monitor utility meters. New smart strategies to meter utilities are encouraged to be implemented in ME countries giving better measuring results and enhanced use of energy.

C.11.8. Import and Export policies Few regulations are already implemented in transportation sector, however, for other goods and equipments, ME countries are unfortunately becoming the refusal place of home appliances, wheels tyres, plastic pipes, light fittings and cooling equipments. Importing energy efficient labelled products with full specification is highly required. An energy-saving labelling system can be created and introduced to inform consumers about the energy efficiency of various home appliances, for example, or production's ecological footprint. Policies can forbid importing non-labelled goods, like incandescent light bulbs, air conditioning equipment using ozone depleting refrigerants. They can also limit the import of unrecyclable or non-biodegradable products.

C.11.9. Engage a combination of motivating factors Governments, especially in wealthy countries, should be able to offer a range of financial products, including grants and low interest rate loans in order to motivate high energy consumers as well as ordinary residents to shift to green technologies, which are usually associated with high capital cost. Other measures could be publicity and reward in national magazines and newspapers.

C.11.10. Financial Support. Funds could be provided to finance adaptation and mitigation measures, forests protection (Lebanon and Syria), technology (Research and Development), building material (insulation, heat reflective coating, domestic solar panels, micro-wind turbines). Finance should be allocated against each country owned plans, and investment decisions should be made at the local level.

C.12. Opportunities

- Jobs' creation is one direct opportunity which will improve life and overall GDP of thousands of people living in GCC countries.

- Manufacturing: Associated with well planned raw material procurement strategies, local manufacturing of cables, batteries, aluminium and glass will be the first economy sectors to benefit.

- Trading free energy to neighbourhood, instead of selling raw fossil fuel or gas, e.g. Qatar is seen developing a new sector in trading energy.

- Reduced Capital Cost: Manufacturing solar panels or wind turbines in the region and exporting to neighbouring countries make such products accessible, requiring less delivery time, thus quicker procurement, reduced import taxes and reduced transportation's ecological footprint. Making such products cheaper to supply will definitely improve feasibility studies results.

- Reduced cost of energy production and distribution of one kW of Electricity from AED 2,500 (USD 685) by an average of 25% by using solar or wind energy, assuming that more then 30% of the cost in GCC is associated to the price of petrol fuel. The same figure is definitely higher in countries importing fuels like Lebanon.

- Carbon Trade: While this type of trading is very important in the industrialised Europe, it can be very profitable in the touristic ME. However, in the absence of local assessors, computing the real carbon's emission of ME operating business from supply chains could be a delicate task to undertake by international assessors, perhaps for security reasons. ME countries enjoy a good number of qualified people who can be taught and well trained by international assessors for example, to study and compute the real and actual local carbon emission. Nevertheless, Governmental decrees and laws should come and create rigid laws to protect businesses' information from being communicated to foreign parties.

- Invest in students' projects at research centres in universities to produce local sun maps, wind maps, flood maps, and any tool or mean that can provide accurate data and useful inputs to large investors, authorities, renewable energy designers and manufacturers. Environmental and engineering schools and universities could offer esteemed help in creating simulation softwares and in measuring environmental changes in temperature, sea level, and monitoring bio-diversities.

- Eco-tourism: GCC countries can be easily a hub of eco-tourists, taking into account the advanced aviation industry, and the new measure to reduce CO2 emissions, initiated by Qatar Airlines in 2008.

C.13. Conclusion In the absence of rigid plans for creating energy conservation policies (power and water) in the ME, future programs aiming to develop any nation could

be missing a very essential element in securing progressive economy and national security. It is essential that Energy Production is developed in parallel with Energy Conservation. In ME countries, categorised as pure consumers, Energy production's policies seem to come on top of most of annual national agendas, while, Energy Conservation policies, if mentioned, are not prioritised.

The creation and review of national plans should be a technical and not a political process, in order to assure its success and own sustainability. It is highly recommended to allocate necessary budgets to implement those plans, especially if income profit resulting from petrol fuel export could fund research and development sectors or to finance green clean technologies installation and commissioning.

Moreover, national programs should engage with all major stakeholders e.g. national experts, international financing institutions, civil society and the private sector on a regular basis. With minimal risk of future fossil fuel supply's crisis in the region, ME countries are urged, now, especially wealthy GCC countries, to create and follow strict energy conservation policies. **A** "weather crisis" can be far more destructive to societies rather than any other forms of crisis. This paper recommends that ME countries follow the lead from European countries, in similar patterns and policies. There is no reason why **ME countries could not themselves adopt a target of 10:15:20 by 2020?**

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# Appendix A

**CO2 Emission in Developed and developing Countries**

| Country | Kyoto ratified | CO2 emission per capita Tonnes per person | Historical Tonnes per person | Total CO2 Megatonnes | Changes in Emissions since 1990 till 2004 | Kyoto Target |
|---|---|---|---|---|---|---|
| China | Yes | 5.0 | 1.2 | 6,467.0 | 72.7% | |
| Brazil | Yes | 5.3 | 1.6 | 983.0 | 40.7% | |
| South Africa | Yes | 5.3 | 1.6 | 505.0 | 29.7% | |
| Mexico | Yes | 5.0 | 1.3 | 520.0 | 38.0% | |
| India | Yes | 1.6 | 0.6 | 1,744.0 | 57.5% | |
| | | | | | | |
| USA | No | 24.0 | 12.7 | 7,065.0 | 15.7% | -7.0% |
| Russia Federation | Yes | 13.5 | 7.1 | 1,938.0 | -35.1% | 0.0% |
| Japan | Yes | 10.6 | 4.0 | 1,355.0 | 8.0% | -6.0% |
| Canada | Yes | 23.7 | 9.8 | 758.0 | 27.0% | -6.0% |
| Australia | Yes | 26.2 | 10.3 | 529.0 | 25.0% | 8.0% |
| | | | | | | |
| France | Yes | 9.0 | 6.6 | 563.0 | -0.4% | 0.0% |
| Germany | Yes | 12.3 | 9.0 | 1,015.0 | -17.5% | -21.0% |
| UK | Yes | 11.0 | 11.2 | 656.0 | -14.2% | -12.5% |
| Developed and Rapidly developing countries CO 2 Emissions | | | | | | |

**Table A 1-Reference Ecofys.**

# Appendix B

## Survey Results May 2010

**2. Does your organization follow any "Green Policy" or "Environmental strategy" ?**

| | Response Percent | Response Count |
|---|---|---|
| Yes | 58.8% | 30 |
| No | 15.7% | 8 |
| Yes In future | 25.5% | 13 |
| answered question | | 51 |
| skipped question | | 0 |

**3. What sector best describes your business?**

| | Response Percent | Response Count |
|---|---|---|
| Government and public sector | 2.0% | 1 |
| Non Profit Organization | 2.0% | 1 |
| Developer | 9.8% | 5 |
| Architect | 7.8% | 4 |
| Engineer | 11.8% | 6 |
| Specialized Consultant | 19.6% | 10 |
| Contractor | 25.5% | 13 |
| Facility management and Operator | 5.9% | 3 |
| Building materials supplier | 7.8% | 4 |
| Industrial Factory | 2.0% | 1 |
| Oil and Gas | 3.9% | 2 |
| Others | 2.0% | 1 |
| answered question | | 51 |
| skipped question | | 0 |

**4. How would you rate your knowledge about Green Building codes?**

| | Very Good | Good | Minimal | Unaware of | Response Count |
|---|---|---|---|---|---|
| Local Guidelines and Codes | 29.4% (15) | **37.3% (19)** | 27.5% (14) | 5.9% (3) | 51 |
| LEED | 29.4% (15) | **43.1% (22)** | 27.5% (14) | 0.0% (0) | 51 |
| BREAM | 3.9% (2) | 25.5% (13) | **39.2% (20)** | 31.4% (16) | 51 |
| CASBEE | 2.0% (1) | 9.8% (5) | 43.1% (22) | **45.1% (23)** | 51 |
| Others | 5.9% (3) | 19.6% (10) | 33.3% (17) | **41.2% (21)** | 51 |
| | | | | answered question | 51 |
| | | | | skipped question | 0 |

**5. What is your perception about Eco-friendly buildings?**

| | Likely | Unlikely | Response Count |
|---|---|---|---|
| Easy to design | **58.8% (30)** | 41.2% (21) | 51 |
| Easy to build | **70.6% (36)** | 29.4% (15) | 51 |
| Cheaper to design | 31.4% (16) | **68.6% (35)** | 51 |
| Cheaper to build | 33.3% (17) | **66.7% (34)** | 51 |
| Reduced Air pollution | **96.1% (49)** | 3.9% (2) | 51 |
| Reduced Water usage and waste | **100.0% (51)** | 0.0% (0) | 51 |
| Negatively Impact the delivery's time of any project | 29.4% (15) | **70.6% (36)** | 51 |
| Negatively Impact the cost of any project | 49.0% (25) | **51.0% (26)** | 51 |
| Should be mandatory | **82.4% (42)** | 17.6% (9) | 51 |
| Impossible to achieve in my geographical area | 21.6% (11) | **78.4% (40)** | 51 |
| | | answered question | 51 |
| | | skipped question | 0 |

**7. Do you encourage subsidizing main utilities' providers?**

| | Response Percent | Response Count |
|---|---|---|
| Yes | 62.7% | 32 |
| No | 37.3% | 19 |
| Show replies You may like to share you opinion about subsidizing utilities | | 9 |
| answered question | | 51 |
| skipped question | | 0 |

**8. What form of incentives would you request or offer in order to build green?**

| | Not important | Minor importance | Important | Rating Average | Response Count |
|---|---|---|---|---|---|
| Expedite Permit process | 7.8% (4) | 35.3% (18) | **56.9% (29)** | 2.49 | 51 |
| Density Bonus | 11.8% (6) | 43.1% (22) | **45.1% (23)** | 2.33 | 51 |
| Buyers Tax Reduction or Tax credits | 15.7% (8) | 19.6% (10) | **64.7% (33)** | 2.49 | 51 |
| Incentive money from Utility provider or seller | 9.8% (5) | 23.5% (12) | **66.7% (34)** | 2.57 | 51 |
| Reduced Utilities connections fees | 5.9% (3) | 33.3% (17) | **60.8% (31)** | 2.55 | 51 |
| Awards, marketing and good publicity | 7.8% (4) | 15.7% (8) | **76.5% (39)** | 2.69 | 51 |
| Development fees and taxes partially or fully refunded | 9.8% (5) | 27.5% (14) | **62.7% (32)** | 2.53 | 51 |
| answered question | | | | | 51 |
| skipped question | | | | | 0 |

# Appendix C

## Comparision Between Breen Building Ratings

| GREEN BUILDINGS RATING SYSTEMS | | | | |
|---|---|---|---|---|
| LEED NC2.2 - US GREEN BUILDING COUNCIL | | | | |
| Third Edition - Version 2.2 - October 2007 | | | | |
| LEED CERTIFICATION LEVEL | | | | Scoring |
| LEED -Certified | | | | 26-32 |
| LEED -Silver | | | | 33-38 |
| LEED -Gold | | | | 39-51 |
| LEED -Platinum | | | | 52-69 |
| ASPECT OF GREEN BUILDING DESIGN | | | | |
| | | Criteria | | Weighting |
| 1- | SS | Sustainable Sites | (a) | 20% |
| 2- | WE | Water Efficiency | (b) | 7% |
| 3- | EA | Energy & Atmosphere | (c) | 25% |
| 4- | MR | Material & Resources | (d) | 19% |
| 5- | EQ | Indoor Environmental Quality | (e) | 22% |
| 6- | ID | Innovation & Design Quality | (f) | 7% |
| LEED INDIA NC-v1.0 -INDIAN GREEN BUILDING COUNCIL | | | | |
| First Edition - Version 1.0 - January 2007 | | | | |
| LEED CERTIFICATION LEVEL | | | | Scoring |
| LEED -Certified | | | | 26-32 |
| LEED -Silver | | | | 33-38 |
| LEED -Gold | | | | 39-51 |
| LEED -Platinum | | | | 52-69 |
| ASPECT OF GREEN BUILDING DESIGN | | | | |
| | | Criteria | | Weighting |
| 1- | SS | Sustainable Sites | (a) | 19% |
| 2- | WE | Water Efficiency | (b) | 9% |
| 3- | EA | Energy & Atmosphere | (c) | 25% |
| 4- | MR | Material & Resources | (d) | 19% |
| 5- | EQ | Indoor Environmental Quality | (e) | 22% |
| 6- | ID | Innovation & Design Quality | (f) | 7% |
| ESTIDAMA New Building Guidleines (ENBG) | | | | |
| First Edition - May 2008 | | | | |
| CERTIFICATION LEVEL | | | | Scoring |
| Unclassified | | | % | 0 |
| 1 Pearl | | | % | 35 |
| 2 Pearls | | | % | 45 |
| 3 Pearls | | | % | 55 |
| 4 Pearls | | | % | 65 |
| 5 Pearls | | | % | 75 |
| Above Ratings are for Minimum Percentage Score where Total is 100 | | | | |
| ASPECT OF GREEN BUILDING DESIGN | | | | |
| | | Criteria | | Weighting |
| 1- | W | Water | | 30% |
| 2- | E | Energy Use | | 20% |
| 3- | IEQ | Indoor Environmental Quality | | 15% |
| 4- | ECO | Ecology | | 7.5% |
| 5- | M | Management | | 5% |
| 6- | T | Transport | | 5% |

# Appendix D

| CO2 Emissions per kWhr from electricity and heat regeneration using oil | 1992 | 1993 | 1994 | 1995 | 1996 | 1997 | 1998 | 1999 | 2000 | 2001 | 2002 | 2003 | 2004 | 2005 | 2006 | 2007 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Bahrain | - | - | - | - | - | - | - | - | - | - | - | - | - | - | 1 229 | 1 269 |
| Islamic Rep. of Iran | 876 | 1 013 | 970 | 968 | 933 | 960 | 1 051 | 1 020 | 883 | 812 | 830 | 816 | 811 | 841 | 1 400 | 1 509 |
| Iraq | 609 | 637 | 738 | 712 | 712 | 707 | 691 | 691 | 745 | 829 | 763 | 799 | 824 | 823 | 824 | 824 |
| Jordan | 939 | 905 | 870 | 860 | 833 | 821 | 814 | 756 | 717 | 716 | 755 | 686 | 753 | 700 | 675 | 675 |
| Kuwait | 715 | 723 | 720 | 734 | 749 | 753 | 725 | 730 | 746 | 722 | 667 | 700 | 795 | 847 | 693 | 695 |
| Lebanon | 807 | 836 | 792 | 753 | 798 | 772 | 865 | 849 | 778 | 783 | 776 | 814 | 634 | 744 | 751 | 680 |
| Oman | 1 055 | 1 056 | 1 056 | 1 056 | 1 057 | 1 057 | 1 054 | 1 056 | 1 056 | 1 056 | 1 055 | 1 055 | 1 055 | 1 056 | 1 056 | 1 055 |
| Qatar | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Saudi Arabia | 808 | 840 | 805 | 804 | 787 | 799 | 813 | 830 | 844 | 805 | 743 | 718 | 763 | 744 | 746 | 714 |
| Syrian Arab Republic | 800 | 807 | 776 | 777 | 769 | 767 | 765 | 763 | 729 | 728 | 730 | 714 | 730 | 729 | 779 | 731 |
| United Arab Emirates | 972 | 972 | 972 | 968 | 969 | 977 | 928 | 925 | 953 | 976 | 999 | 1 052 | 1 194 | 1 194 | 1 194 | 1 194 |
| Yemen | 886 | 771 | 916 | 946 | 962 | 930 | 995 | 921 | 930 | 930 | 919 | 884 | 874 | 841 | 781 | 679 |
| **CO2 Emissions per kWhr from electricity and heat regeneration using Gas** | | | | | | | | | | | | | | | | |
| Bahrain | 1 055 | 890 | 876 | 815 | 811 | 766 | 822 | 852 | 868 | 840 | 835 | 883 | 881 | 873 | 805 | 833 |
| Islamic Rep. of Iran | 507 | 507 | 507 | 507 | 507 | 507 | 507 | 507 | 507 | 529 | 527 | 525 | 511 | 516 | 451 | 430 |
| Iraq | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Jordan | 548 | 545 | 635 | 681 | 676 | 676 | 769 | 688 | 671 | 626 | 646 | 667 | 622 | 582 | 576 | 566 |
| Kuwait | 522 | 528 | 529 | 539 | 550 | 553 | 531 | 539 | 553 | 539 | 478 | 516 | 586 | 627 | 510 | 515 |
| Lebanon | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| Oman | 808 | 800 | 802 | 776 | 728 | 698 | 690 | 759 | 742 | 765 | 780 | 809 | 848 | 819 | 830 | 819 |
| Qatar | 1 014 | 1 040 | 1 080 | 1 131 | 1 051 | 1 015 | 865 | 823 | 771 | 781 | 782 | 779 | 649 | 618 | 626 | 623 |
| Saudi Arabia | 864 | 834 | 829 | 830 | 823 | 822 | 817 | 784 | 766 | 749 | 759 | 761 | 760 | 761 | 765 | 764 |
| Syrian Arab Republic | 543 | 543 | 543 | 543 | 543 | 543 | 543 | 543 | 543 | 543 | 543 | 543 | 543 | 543 | 543 | 543 |
| United Arab Emirates | 735 | 735 | 735 | 730 | 732 | 740 | 702 | 700 | 721 | 740 | 758 | 798 | 906 | 836 | 812 | 824 |
| Yemen | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - | - |
| **CO2 Emissions per kWhr from electricity and heat regeneration** | | | | | | | | | | | | | | | | |
| Bahrain | 1 055 | 890 | 876 | 815 | 811 | 766 | 822 | 852 | 868 | 840 | 835 | 883 | 881 | 873 | 831 | 847 |
| Islamic Rep. of Iran | 561 | 585 | 590 | 605 | 598 | 592 | 562 | 582 | 568 | 578 | 560 | 534 | 532 | 528 | 545 | 536 |
| Iraq | 592 | 623 | 723 | 698 | 698 | 693 | 678 | 678 | 731 | 813 | 751 | 787 | 811 | 811 | 811 | 811 |
| Jordan | 895 | 860 | 831 | 834 | 811 | 800 | 807 | 747 | 708 | 702 | 740 | 680 | 682 | 631 | 602 | 588 |
| Kuwait | 644 | 608 | 620 | 638 | 638 | 648 | 650 | 673 | 689 | 670 | 624 | 663 | 754 | 808 | 643 | 645 |
| Lebanon | 653 | 704 | 668 | 654 | 706 | 690 | 783 | 815 | 733 | 751 | 722 | 709 | 565 | 667 | 695 | 638 |
| Oman | 854 | 848 | 850 | 830 | 786 | 757 | 751 | 809 | 796 | 817 | 829 | 853 | 885 | 862 | 870 | 861 |
| Qatar | 1 014 | 1 040 | 1 080 | 1 131 | 1 051 | 1 015 | 865 | 823 | 771 | 781 | 782 | 779 | 649 | 618 | 626 | 623 |
| Saudi Arabia | 833 | 838 | 816 | 815 | 802 | 809 | 815 | 811 | 810 | 778 | 751 | 739 | 762 | 752 | 755 | 736 |
| Syrian Arab Republic | 547 | 560 | 581 | 586 | 589 | 591 | 596 | 598 | 567 | 559 | 554 | 563 | 556 | 588 | 606 | 606 |
| United Arab Emirates | 743 | 743 | 743 | 737 | 740 | 749 | 710 | 708 | 728 | 746 | 764 | 805 | 913 | 844 | 820 | 831 |
| Yemen | 886 | 771 | 916 | 946 | 962 | 930 | 995 | 921 | 930 | 930 | 919 | 884 | 874 | 841 | 781 | 679 |
| **CO2 Emissions per population** | | | | | | | | | | | | | | | | |
| Bahrain | 22.47 | 21.07 | 20.58 | 20.11 | 20.63 | 21.11 | 22.16 | 21.68 | 21.74 | 22.15 | 22.93 | 23.30 | 23.68 | 25.03 | 27.31 | 28.23 |
| Islamic Rep. of Iran | 3.74 | 3.78 | 4.19 | 4.23 | 4.29 | 4.44 | 4.47 | 4.62 | 4.77 | 4.89 | 5.09 | 5.25 | 5.59 | 5.79 | 6.28 | 6.56 |
| Iraq | 3.02 | 3.45 | 3.82 | 3.67 | 3.52 | 3.43 | 3.40 | 3.37 | 3.61 | 3.79 | 3.56 | 2.89 | 3.34 | 3.27 | 3.31 | 3.33 |
| Jordan | 2.86 | 2.77 | 2.82 | 2.89 | 2.91 | 2.94 | 2.96 | 2.92 | 2.98 | 2.88 | 2.98 | 2.87 | 3.16 | 3.31 | 3.30 | 3.35 |
| Kuwait | 18.32 | 21.01 | 22.49 | 22.76 | 21.26 | 21.18 | 23.36 | 23.70 | 22.90 | 21.97 | 20.94 | 24.94 | 27.24 | 29.33 | 25.66 | 25.09 |
| Lebanon | 2.48 | 3.10 | 3.25 | 3.60 | 3.83 | 4.29 | 4.18 | 4.19 | 3.76 | 4.04 | 3.96 | 4.35 | 3.85 | 3.94 | 3.28 | 2.77 |
| Oman | 6.64 | 6.06 | 5.53 | 6.63 | 6.57 | 6.45 | 6.43 | 7.24 | 8.23 | 9.35 | 9.94 | 10.26 | 10.10 | 11.15 | 12.02 | 13.79 |
| Qatar | 33.63 | 34.61 | 35.56 | 36.31 | 37.01 | 38.94 | 40.18 | 42.37 | 39.34 | 38.85 | 39.16 | 40.93 | 45.53 | 46.81 | 51.13 | 58.01 |
| Saudi Arabia | 10.78 | 11.08 | 11.35 | 11.05 | 11.48 | 11.35 | 11.81 | 11.93 | 12.15 | 12.18 | 12.76 | 13.03 | 13.48 | 13.92 | 14.36 | 14.79 |
| Syrian Arab Republic | 2.68 | 2.61 | 2.53 | 2.64 | 2.66 | 2.66 | 2.87 | 2.86 | 2.77 | 2.68 | 2.72 | 2.60 | 2.60 | 2.53 | 2.61 | 2.70 |
| United Arab Emirates | 28.37 | 28.53 | 29.70 | 29.02 | 31.23 | 29.02 | 28.18 | 27.01 | 26.50 | 25.28 | 27.00 | 27.11 | 27.24 | 26.80 | 27.24 | 29.91 |
| Yemen | 0.64 | 0.54 | 0.54 | 0.60 | 0.59 | 0.62 | 0.65 | 0.71 | 0.73 | 0.75 | 0.76 | 0.83 | 0.84 | 0.89 | 0.91 | 0.92 |

**Table D 1 CO2 Emissions in ME countries-Source –www.iea.org/co2highlights-CO2 Emissions from Fuel Combustion, IAE, Paris, Edition 2009**