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AIR POLLUTION FROM FOSSIL FUEL IN ARAB REGION

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ABSTRACT

The issue of air quality conditions and atmospheric pollution in the Arab Region has been addressed through consideration of the energy production and energy consumption pattern. Global, regional and local sources of air pollution in the study have been considered. Emission scenarios of many Arab countries of the region have been outlined. It has been realized that air pollution constitutes one of the major sources of loss on GNP of many Arab countries in the region due to weak institutional capabilities for air pollution management and control. Major types of air pollution sources in the region such as greenhouse gas emissions and other gases from various industries are considered. Local sources of air pollution are found due to urban growth, transportation systems, industrialization and lack of awareness and shortage of institutional capabilities all contributed to the relatively low air quality and weak control in the Arab Region.

The purpose of this paper is to review all available literature on the issue of air pollution in Arab countries due to combustion of fossil fuel coming from mobile sources and petroleum gas flaring in order to present the dire situation of the air quality in Arab countries. The report is organized based on certain factors which make the transport sector , power plants and associated gas flaring are significant polluters of the air in the Arab region. We present a brief introduction to the composition of the transport sector in most of Arab countries and the forms of emissions resulting from it, then the report continues with the explanation of the major impacts that old-aged machines like automobiles, old petroleum production technology and old electrical energy plants technology have in terms of causing air pollution in these countries and thus; making them very inefficient and also very harmful towards the environment in most of Arab countries. In this paper also we have used the statistical data during the years 2005 - 2008 in terms of air pollution in most of Arab countries compared with each other. We have taken for study six largest air polluting agents that are accepted by international organizations such as NAAQS (Air Quality Standards National Environmental), EPA (Environmental Protection Agency) of U.S. and sometimes (USEPA), which today are used widely worldwide, and the WHO. The six pollutants are: CO-Carbon Mono-oxide, Ozone O3, at the lower atmospheric layers, Pb-lead, SO2, sulfur dioxide, PM10 (and in some cases PM2.5) –particles of dust, and NO2- nitrogen oxide.

In the present study is analyzed also the ways of reducing the environmental pollution by emissions of gases that cause mobile engines in urban areas.

In the study is given changes in emissions of gases depending on the improvement of mobile construction, according to years of production, in accordance with the requirements established by the legislation of EU countries and mobile manufactures. The level of emissions from automobile engines in the city of Tabuk (Saudi-Arabia), for all types of engines is taken as examples to be measured and examined according to the years of production. It's found that changing the structure vehicle inserted in use for automobiles of production after 1996, their pollution level decreases twice. Also in the study is analyzed the possibility of modifying the urban intersections with additional lanes before crucifixion to reduce the residence time of vehicles in traffic and reduce environmental pollution to two times.

Furthermore, we analyze the issue of the low quality fuel being used in some of these countries which increases the emissions of harmful waste gases. Moreover, this paper also presents the issue(s) of the lack of legal control which further enables mobile sources to circulate without catalytic converters.

KEYWORDS: Pollution, Pollution reduction, Fossil fuels, Mobile emissions, Cardio-vascular diseases, Cancer, Pulmonary diseases.

INTRODUCTION

Air quality conditions in the Arab region differ widely, due to variation of pollution sources on local scales. Generally, there are two main sources of air pollution in the Arab world:

1. Natural sources, such as dust and sandstorms (local or imported); and
2. Anthropogenic activities, including stationary sources, such as thermal power generating plants, refineries and industrial parks, associated gas flaring, in addition to mobile sources including vehicles, aviation and trains. The continued increase in population, accompanied by urban migration in Arab region, has led to an increase in the severity of air quality scenarios in cities of the Arab region. Among the hazards (anthropogenic and natural) generally affecting megacities are aerosols and air pollution, sand and dust storms severe weather, heat waves, fires and earthquakes desertification, and climate change in particular may have more profound effects.

The environmental impact of fossil fuels combustion machines is highly significant in Arab world because it is a major user of energy and burns most of the Arab world's petroleum. This creates air pollution, including nitrous oxides and particulates, and is a significant contributor to global warming through emission of carbon dioxide, and in addition to these machines is the fastest-growing petroleum production sector as an emission sector. By subsector, road transport is now the largest contributor to global warming especially in Arab countries [1] [2].

Fortunately environmental regulations in developed countries have reduced the individual vehicles and all mobiles emission; however, this has been offset by an increase in the number of used mobile machines, and more use of each machine through the time but most Arab countries have failed to do so while still the number of machines is increasing. Some pathways to reduce the carbon emissions of road vehicles considerably have been studied globally. Energy use and emissions vary largely between modes in most of Arab countries, causing environmentalists to call for a transition from air and road to rail , human-powered transport, and increasing of transport electrification that lead to high energy efficiency especially in some crowded Arab countries.

Other environmental impacts in Arab region of transport systems, power generation plants, include traffic congestion and automobile-oriented urban sprawl, which can consume natural habitat and agricultural lands in addition to health degradation. By reducing transportation emissions, reducing associated gas flaring and power plants emissions globally and in Arab region in particular, it is predicted that there will be significant positive effects on Earth's air quality, acid rain, smog and climate change.

The health impact of fossil fuel emissions in Arab world should be now of high concern. A recent survey of studies on the effect of traffic emissions on pregnancy outcomes has linked exposure to transport emissions to adverse effects on gestational duration and possibly also intrauterine growth [3].

The energy sector as anthropogenic activities in most Arab countries represents the most pollutants sector and plays a vital role in the socioeconomic development at the regional and global levels. This sector relies primarily on oil and gas exports and revenues that are used to meet requirements of socio-economic growth. However, energy production and consumption in the Arab region need to be further developed and upgraded, as a great number of urban and rural dwellers lack access to energy services. Energy production and consumption are among the most important factors affecting the atmosphere as they emit several gases that greatly impact air quality especially in the Arab region. In their meeting on Climate Change held in Cairo in 2007, the Council of Arab Ministers Responsible for the Environment (CAMRE) underlined the necessity of producing and consuming cleaner fuel, improving energy use efficiency in all sectors and diversifying energy sources according to prevailing socio-economic conditions. They also highlighted the importance of expanding the utilization of cleaner production technologies and environment-friendly technologies and the adoption of economic incentives to encourage the utilization of more efficient products and make use of carbon trade and its markets [4]. During the last three decades, Arab development policies were inclined towards meeting requirements of socio-economic development and upgrading the efficiencies and capacities of infrastructure. In the meantime, subsidizing energy prices led to an increasing energy demand with a remarkable decline in usage efficiency. With the intention of shifting to a policy that is more economical and sustainable to the energy sector, a number of Arab countries, like Egypt, Morocco, and Jordan embarked on reconsidering their policies concerning energy and incorporating sustainability as a major part of these policies. Great attention was given to adopting programs aimed at improving energy production and consumption as well as enhancing. The Arab World’s production

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of energy has increased from 51 256 quadrillion British Thermal Units (BTUs) in 1996 to 68 022 quadrillion BTUs in 2005. Moreover, its consumption has increased by about 46 per cent during the same period from 14 309 quadrillion to 20 868 quadrillion BTUs. In addition, a number of Arab countries have become among the highest per capita commercial energy on summers in the world. In Kuwait, for example, the peak power demand increased annually by about 11 per cent in 1990 and 6–8 percent in 2000 onwards. Figure (1) shows energy consumption in different Arab countries while Figure (2) illustrates total energy consumption of OAPEC countries compared to some Arab countries [5]. In figure (1) it's very clear that the energy consumption in Arab countries is differ widely between these countries, some Arab countries rate consumption is even high than even the international rate while the poor countries rate of consumption of energy is very low with the relative to international rate.

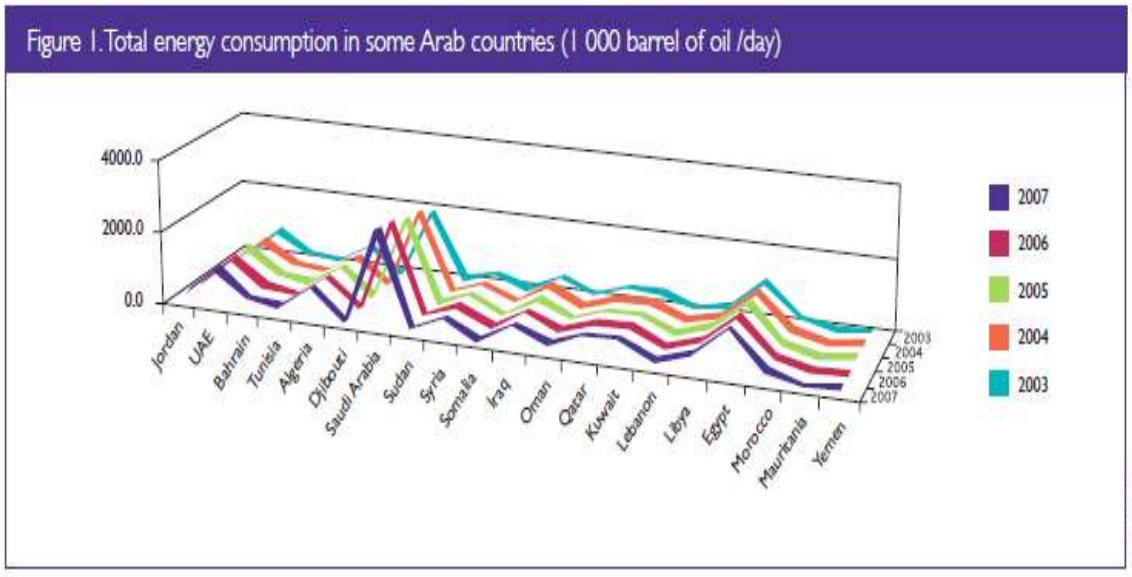

Figure (1)

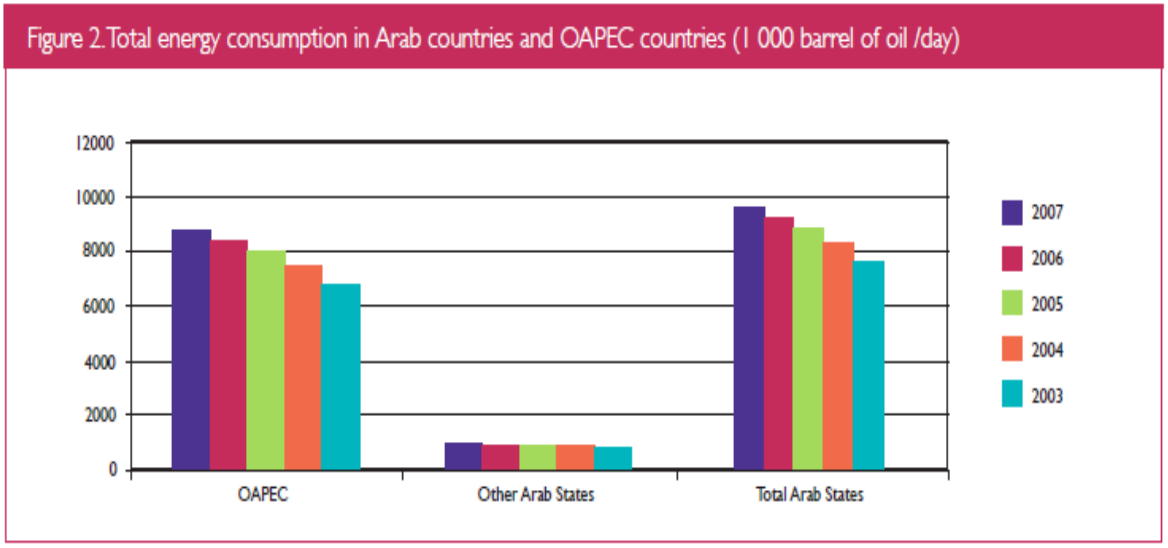

Figure (2)

A large number of industries were developed during the 1960s in the Arab Region. Major manufacturing industries included: food, textile, petrochemical, fertilizer, cement, oil refineries, transport and mechanical, iron and aluminum industries, in addition to natural gas plants, and electricity generation plants. Today, most of these industries are old and highly polluting. The situation is further complicated by the lack of financial resources in poor Arab countries to modernize them to become capital intensive and high technology industries. Therefore in the Arab region, industry and power sectors are the major sources of SO_2 and large contributors to NOx emissions (90 and 60 %, respectively) [6]. The cement and steel industries in the Arab region produce 50 % of the total particulate emissions (World Bank 1995b), and the region contributes about 2.8 % of SO_2 and 2.5 % of NOx emission of the global CFCs and methane, respectively. Industry accounts for about 49.5 % of the GDP in Arab countries. The contribution of the industry and power sectors from pollution is as high as 57, 53 and 47 % in UAE, Oman and Algeria respectively (related mostly to oil and gas), and as low as 9 % in Somalia and 13 % in the Comoros Islands. The region possesses about 57.6 % of the world's oil and 28 % of its gas reserves. It produces 29.6 % of the global oil and about 10.7 % of the world's gas, a contribution that is expected to increase [6]. Per capita energy consumption in the region varies significantly between oil producing and non-oil producing countries. The Gulf region has witnessed significant progress in oil exploration and use, as well as oil refineries. Oil revenues have become a major source of national income where several countries have established various industrial and construction activities. Flourishing industries included: petrochemicals, fertilizers, oil refineries, chemicals and cement, iron and aluminum plants, in addition to other energy-consuming industries are the most common industries in the whole Arab region. Energy exploration, exploitation and transfer led to an increase in gas emissions by 755 848 tons annually, of which carbon accounts for 28 % while sulphur and soot particulates are responsible for 27 and 23 % respectively. Energy demand is expected to increase by about 80 % of the current generating capacity by 2018 [6].

The cement industry in Morocco has become one of the principal sources of air emissions as a result of the increase in production capacity from 1 405 000 tons in 1970 to 3 879 000 tons in 1987. In Tunisia, industrial sources of air pollution are mainly from phosphate production, which is responsible for the emission of 3 800 kg/h sulphur oxides, about 600 kg/h ammonia and about 600 g/tone of fluorides. Air emissions from the cement industry exceed the permissible limits in Tunisia (TSP * 2 g/cm^3). In Yemen, polluting plants are restricted to a few oil refineries and power plants. As for Palestine, the main pollution producing agents are textile factories, power stations and transportation [6].

The level of atmospheric contamination from the transport sector in Arab region is now very critical and depends on several factors, such as mobile fleet size, mean speed, age, technology, fuel quality, and mobile kilometers travelled, and driving modes. Vehicle emissions are among the major sources of air pollution, especially, with respect to CO, CO_2, VOC, NOx, SOx and fine particulates. Pollution from road transport is already high in all urban areas of Arab world, whether due to the proliferation of private cars in all Arab rich countries, or the slow replacement of old and obsolete vehicles with their low fuel efficiency and poor maintenance activities in all Arab countries and even in less-rich and rich Arab countries. High dependency on old vehicles in most Arab region is a result of the high taxes that many governments place on new vehicles, and the lack of financial resources available to consumers. Old vehicles are prolific in some poor Arab countries (Egypt, Sudan, Syria and Palestine). In the GCC countries, most of the cars in use are relatively new. Vehicle proliferation, lack of emissions control, and poor monitoring and enforcement systems, exacerbate pollution problems in all Arab countries.

The transport sector (including passenger cars, buses, trucks, aviation and other transportation services) is the major consumer of energy in the Arab region. It consumes nearly 51 % of petroleum produced in Arab region and 32.1 % of total energy. Vehicular transport accounts for 90 % of the total CO_2 emissions in Arab countries, which release an estimated 16 million tons/year of CO. According to 2003 statistics, the transportation sector's share of primary consumption of energy in the Arab region is about 26.3 %. It is one of the most significant sectors contributing to the deteriorating air quality in Arab cities and urban areas in general. There are several programs aimed at solving the problems of the transportation sector, such as reduction of traffic jams, noise and air pollution, and the interval of time people take to travel within cities. Motor vehicles emit 1.1 million tons /year of nitrogen oxides (NOx), representing 40 % of total releases in the region (60 % emanates from the energy and industrial sectors). With 99.91 % dependence on petroleum products and negligible use of other cleaner technologies, the production of these emissions is primed to increase. NOx and SOx contribute to acid deposition in soil, vegetation and water, and cause damage to crops, forests, rangelands and fisheries. NOx is also the precursor of fog and photochemical smog, which are increasingly observed in urban centers throughout the region [7]. Diesel engines are considered the major contributors of SO_2, lead

and fine particulates, the latter of which are extremely small and can be easily inhaled into the respiratory system. Egypt emits 49µg/m^3 of SO_2 (compared to the WHO standard of 50µg/m^3). Chlorofluorocarbons (CFCs), found in air conditioning systems and foams, also contribute to the depletion of the stratospheric ozone layer. Hydrocarbons (HCs) result from incomplete fuel combustion or from evaporated unburned petrol from fuel tanks and old carburetors vehicles. In Arab countries, vehicles emit 3 million tons/year of HC; the best known kind of which is gasoline. Between 70 and 80 % of total HC emissions originate from transport and play an important role in the formation of photochemical oxidants. Lead, used as an additive in petroleum, still accounts for more than half of the total lead atmospheric emissions in Arab countries and virtually 100 % in urban areas. Most Arab countries use unleaded gasoline. In 2001, Kuwait and Qatar had more vehicles per thousand people than other GCC countries .The high share of transport sector pollution is an indicator of high vehicular ownership in the region. For example, the number of vehicles in Egypt in 2008 was 4.3 million versus 2.1 million In1993. There is a global increase in the number of motor vehicles, as more people prefer to have an independent mode of transportation. However, the problem in most of Arab countries is vehicle fleet ageing, exceeding 15 years on average, and the slow pace of replacement. These vehicles emit 25 times more hydrocarbons (HC) and CO, and 4 times more NOx. Particulate emissions from poorly maintained diesel-fuelled buses and trucks are 5–7 times higher than those of well-maintained vehicles. In addition, environmental safety standards were ignored in many cities, especially in countries that witnessed a rapid development in heavy metal based industries, power plants and cement factories [8] [9]. Egypt is one of the leading Arab countries to commercialize the use of Compressed Natural Gas (CNG). CNG is a promising alternative fuel in terms of the environment. Light-duty vehicles with natural gas engines can produce 85 % less reactive hydrocarbons (the precursor to smog and O_3) than gasoline engines, 90 % less CO, and approximately 18 to 30 % less GHGs. From a zero base in 1996, the market grew by the end of 2007 to a total of 2 274 governmental vehicles converted to CNG. Moreover, the number of taxis converted to CNG, with ageing fleet exceeding 35 years, reached 10 000 in 2008. Morocco, Algeria, and Tunisia have emphasized railways in their transportation infrastructures. The modern network includes new electrified lines, such as those between Casablanca and Rabat, and light rapid-transit systems in major cities like Algiers and Tunis. Egypt has built an underground metro system that has contributed considerably to reducing surface mass public transit and vehicular emissions.

A recent survey revealed that the problem of road traffic was considered a major environmental problem by 64 per cent of the respondents in the Arab world [8] [9]. Results from different regions were consistent: 72 % in Saudi Arabia and Jordan, 69 % in Egypt and 77 % in Tunisia. Less than 50 % of the respondents from the Palestinian territories, Sudan, Morocco and Libya found traffic jam a major problem, while Kuwait, UAE and Bahrain scored over 80 %. This reflects rapidly expanding congestion problems in the latter three countries and the accompanying air pollution in the surrounding areas [10].

Emissions from aviations in Arab countries vary based on length of flight. Arab countries of long distances, longer flights are a better investment of the high energy costs of take-off and landing than very short flights. Countries as Saudi-Arabia, Algeria, Egypt, Sudan, have a good chance of aviation investment than small one like gulf countries as Bahrain, Qatar, and Kuwait, yet by nature of their length inevitably use much more energy. CO_2 emissions from air travel range from 24 kg CO_2 per passenger mile for short flights down to18 kg CO_2 per passenger mile for long flights. Researchers have been raising concern about the increasing hyper mobility of Arab society, involving frequent and often long distance air travel and the resulting environmental and climate impacts. This threatens to overcome gains made in the efficiency of aircraft and their operations [11].

PURPOSE AND OBJECTIVES

The problems of environmental pollution are the most acute problems of our times in the Arab region, especially when air pollution reached such high levels in certain regions of the Arab world. This is affected the region temperature increase to the level of damaging the agriculture activity, creating a high risk for future. However in this article is taken to review the impact of mobile air pollution in the Arab countries and its impact on air quality that lead to growth of diseases, mortality, and in increased hospital admissions for three major groups of diseases: chronic respiratory diseases (bronchial asthma, occupational diseases pulmonary) disease cardio-vascular (HTA and SIZ), and cancer (in total, pulmonary cancer, laryngeal cancer).

Objectives of this study were taken in the study materials and statistical analysis to assess their potential impact of increasing of air pollution on air quality and diseases to Arab countries population. In this study we will only analyze the air pollution from mobile pollutants and energy use and production that considered to be the more effected

pollutants sources in Arab world that are confirmed by the WHO, EU, EPA, NAAQS,. Then the effect of associated oil gas flaring. Main objective of this survey is to:

1. Review development of regulations, policies and institutional capabilities of air quality control and its impacts on sustainable developments in the Arab world.
2. Identify gaps and assess priorities of actions for further developments of efforts for air pollution control.

MATERIALS AND METHODS

Without its atmosphere - the envelope of gases that surrounds a planet or moon - the Earth would be unrecognizable. With no gases for light or sound to travel through, the skies would be black and silent. With no air in which to float or fly, birds, and airplanes would fall to the ground. Of course, there would be no plants and animals. The atmosphere is the location of all weather, whether it is a mild summer breeze or a devastating hurricane. The weather may bring much-needed rain or an unremitting drought. Winds serve the planet by delivering heat from warmer regions to cooler ones,resulting in a more evenly heated globe.

The atmosphere is useful to humans for more than just these natural processes. People exploit the atmosphere's vastness by using it as a repository for the gaseous waste products of industrial society. And now the quantity of air pollution is overtaking us. Cities, rural areas, and even national parks are plagued by polluted air. Its impacts on human health could be the most drastic since human lungs, containing very sensitive tissues, receive daily around 15Kg of air compared to 2.5Kg of water and 1.5Kg of food. Moreover, polluted air spreads over long distances and can practically not be avoided. Also, the global impact of pollution-related phenomena such as global warming has been proven to have alarming consequences [12]. This has led governments and local authorities, mainly in industrialized countries, into taking these issues more seriously and hence establishing various emissions limits and standards and implementing mitigation measures to reduce the pollution of the air down to bearable levels. By far, most air pollution comes from the burning of fossil fuels. These pollutants can come directly from a smokestack or tailpipe, or they may be the result of a chemical reaction between these emissions and sunlight. Air pollutants include greenhouse gases, toxic gases, particulates, and compounds that react with water in the atmosphere to form acids, heavy metals, and ozone. The burning of forests and other plant materials produces similar pollutants. Another type of pollutant is volatile organic compounds (VOCs) which enter the air mostly by evaporation. Some VOCs destroy the ozone layer, some are greenhouse gases, and some are toxic to the environment. Humans have been dealing with air pollution for millennia and have been restricting activities that foul the air for centuries. In the on-going war of trying to keep air breathable, some battles are won and others are lost.

Most medium and large cities around the globe are afflicted with air pollution. According to the World Health Organization (WHO), air pollution causes 1.34 million premature deaths each year [12]. This would tell us that investments to lower pollution levels quickly pay off due to lower disease rates and, therefore, lower healthcare costs. Although pollutants include constituents that are naturally part of the atmosphere, such as CO_2, human activities may release them in higher than normal quantities. Some compounds are pollutants because they are present in a region of the atmosphere where they do not belong; for example, the ozone that acts as a shield against UV rays in the stratosphere is a pollutant when it is in the troposphere. Other pollutants may cause important compounds that are naturally present to become less abundant, as with the destruction of stratospheric ozone by man-made chemicals. A few pollutants combine with water vapor to become acids. Excess heat also can be considered a pollutant, and urban areas suffer from increased temperatures and more variable weather as a result. As per the world average 49% of the air pollution is produced by transportation, 28% from fuel burned in factories and power planets, 13% from evaporation of volatiles, 3% from solid waste disposal, and 7% from miscellaneous other sources [11] [12]. The major pollutants include ozone, particulates, sulphur dioxide, nitrogen dioxide, carbon monoxide, and the heavy metal lead. Air pollution in Arab world today is largely caused by the burning of fossil fuels. Primary pollutants enter the atmosphere directly, from a smokestack or tailpipe. Secondary pollutants form from a chemical reaction between a primary pollutant and some other component of air, such as water vapor or another pollutant. Ozone is the major secondary pollutant.

Indoor air pollution is often over looked more harmful than outdoor air pollution, especially because we spend the largest portion of the day indoor, inside our home or office. The air inside our homes and offices can sometimes be much more polluted compared to outdoor air, and thus present a major health threat.

In their latest study the British scientists were measuring air quality inside and outside three residential buildings with different types of energy use. What they have discovered is that the levels of one of the most common air pollutants which is nitrogen dioxide (NO_2) in the kitchen of the city centre apartment with a gas cooker were as much as three times higher than the levels measured outdoors, and well above clean air quality standards.

In order to reduce heating or cooling costs (depending on which region they live) many people try to make their homes and offices more airtight which often leads in inadequate circulation of the air and high levels of indoor air pollution that could have adverse effects on human health. Indoor air pollution is particularly hazardous to elderly people and young children, and can not only lead to respiratory diseases like asthma but also cause heart problems. Indoor air pollution is yet to be widely recognized issue and there has been very little scientific data about emission rates from different appliances we use in our home and offices. There also hasn't been adequate regulation on indoor pollutants that would regulate the acceptable level of indoor air emissions. There needs to be far more research about the indoor air quality because the effects of indoor air pollution on our health mustn't be overlooked. At the below figure (3) is the emission of carbon dioxide by the whole world regions which considered to be a main measuring pollutant for fossil fuel. It is clear that due to this diagram the Arab world is severely polluted hence it's located in Africa and the Middle East region that appears to be the higher rate of CO_2 emission [12]. The table (1) shows the continuing rise of the Co_2 emission per Capita in Arab World that indicates the environmental hazard. Table (2) shows the prediction of temperature rise over parts of Arab region due to continuous degradation of environmental situation in Arab World.

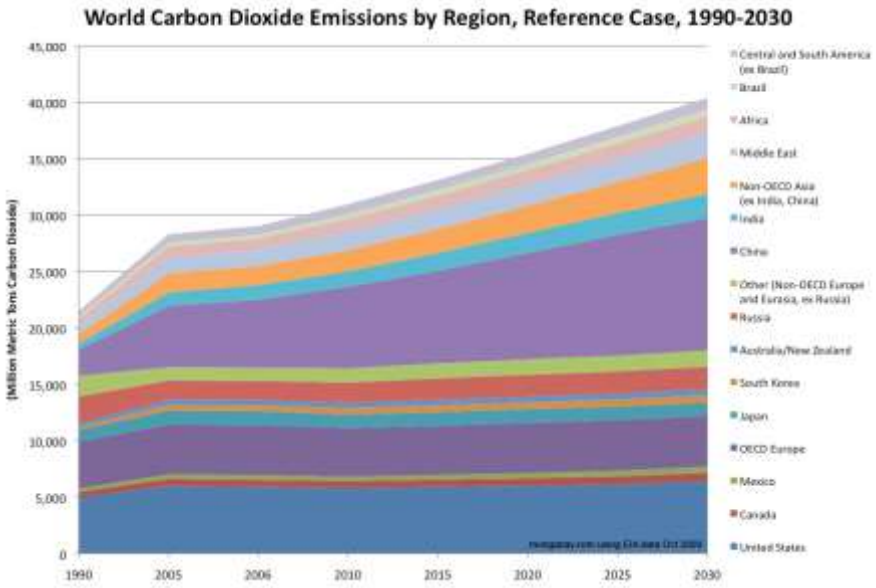

Figure (3)

Year	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009
Co2	3.74	3.57	3.56	3.82	3.92	4.09	4.15	4.26	4.42	4.54

Table (1) Co_2 emission per Capita in Arab World

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Table 2. Projected temperature range over parts of the Arab region		
Increase in annual average temperature range in °C		
Years	Best scenario	Worst scenario
2030	0.5-1.0	1-1.5
2070	1.0 -1.5	2.0-2.5
2100	2.5-3.0	3.0-4.0

Table(2)

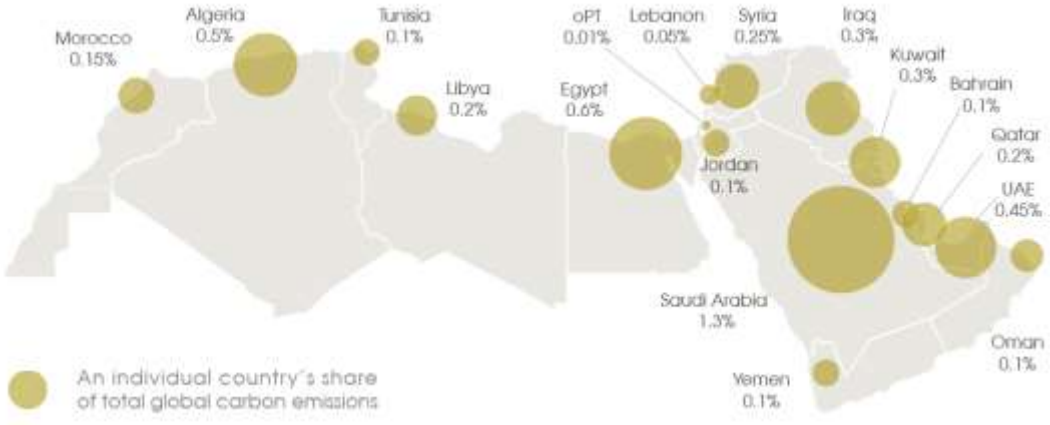


Figure (4)

The Figure (4) illustrates the situation of Arab countries with the relative to whole world CO_2 emissions. Accordingly the environmental situation is seems to be very critical. The Middle East countries representing the most polluted. Also It,s very clear that the range of pollution in Arab world is differs from one country to another. The Middle East countries representing the more polluted than the Arab countries that located in African generally, although the African Arab countries are more populated than The Middle East countries. In the table (3) it represented the main sectors of air polluters in most Arab world.

Table 3 - Arab countries and MNA Region Estimated Pollution Loads (1000 ton) in Main Sectors

	SO_2	NO_x	TSP	CO	HC
- Power	1600 (39%)	1000 (34%)	200 (17%)	150 (>1 %)	50 (>1 %)
- Industry*	750 (18%)	400 (13%)	120 (10%)	50 (>1 %)	30 (>1 %)
- Refineries	1100 (27%)	80 (>5 %)	50 (>5 %)	10 (>1 %)	300 (10%)
- Cement/Steel	150 (>5 %)	300 (10%)	600 (50%)		
-Total Industry	2000 (49%)	780 (26%)	770 (65%)	60 (>1 %)	330 (10%)
-Road Transport	200 (5%)	1100 (37%)	120 (10%)	16000 (<90 %)	3000 (<80 %)
- Residential	300 (7%)	100 (>5 %)	100 (8%)	20 (>1 %)	10 (>1 %)

Table (3)

According to Table (3) the pollution in Arab countries are mainly represented by the following sectors:

Transport

Transport is a significant source of air pollution and, for some pollutants, the main contributor of 90per cent of total emissions of Carbon monoxide (CO) in Arab countries due to intensive use of vehicular transportation. Arab countries emit 16 million tons/year of CO. CO can also indirectly contribute to the increase of "greenhouse gases" which are the cause of global climate warming. The Arab world's motor vehicles also emit 1.1 million tons/year of Nitrogen oxides (NOx) (40% of total-60% originates from the energy and industry sectors). A combination of Nitrogen oxides and Sulphur oxides (SOx) contributes to a large extent (about one-third) to acid deposition on soil, vegetation and water, thus causing damage to crops, forest, fish, etc. Most important, NOx are a cause (or "precursor") of the photochemical smog often observed in large conurbations, particularly during the summer. Hydrocarbons (HC) result from incomplete fuel combustion or from evaporated unburned petrol from fuel tank and carburetor. Arab countries emit 3 million tons/year of HC from vehicle emissions. Benzene is an example of the best-known hydrocarbon. Between 70 and 80 per cent of total HC emissions originate from transport and play an important role in the formation of photochemical oxidants. Lead used as an additive in petrol, still accounts for more than half of total lead atmospheric emission in the Arab countries and virtually 100 per cent in urban areas.

Fortunately, lead emissions are decreasing due to the limitation of lead content in petrol, in particular the promotion of "unleaded petrol" required for cars equipped with catalytic converters. This decrease has been particularly marked in Egypt and Tunisia. Diesel engines also emit Sulphur dioxides (SO_2) and fine particulate. The latter, which are extremely small, penetrate easily into the respiratory system. Egypt emits 69 micrograms/m3 of SO_2 (compared to the WHO standard of 50 micrograms/m^3, World Bank, 1999). Carbon dioxide (CO_2), an important contributor to global climate changes (the "greenhouse effect"), has become a major concern. Gulf countries emit about 50% of total Arab countries (254 million metric tons of carbon oxides) emissions of CO_2. Chlorofluorocarbons (CFCs) contained in air-conditioning systems and foams also contribute to the depletion of the stratospheric ozone layer [13]. The table (4) shows the CO_2 emission due to intensive use of fossil fuel in Arab world in which transport represents a major fuel consumer and air polluter.

TABLE 4 THE ARAB REGION'S NATIONAL PER CAPITA CO_2 EMISSIONS FROM THE CONSUMPTION AND FLARING OF FOSSIL FUELS

Region/Country	1980	1990	2000	2003
Algeria	0.94	0.90	0.75	0.70
Bahrain	6.11	7.68	8.66	9.13
Egypt	0.27	0.44	0.46	0.53
Iraq	1.04	1.03	0.88	0.78
Jordan	0.67	0.85	0.84	0.85
Kuwait	6.12	3.48	8.15	8.16
Lebanon	0.58	0.40	1.24	1.17
Libya	2.83	2.74	2.21	2.77
Mauritania	0.10	0.13	0.33	0.29
Morocco	0.21	0.24	0.28	0.29
Oman	0.88	1.90	2.33	2.17
Qatar	16.37	10.54	12.64	10.78
Saudi Arabia	4.79	3.53	3.39	3.74
Somalia	0.05	0.04	0.03	0.02
Sudan	0.05	0.04	0.05	0.07
Syria	0.52	0.81	0.86	0.80
Tunisia	0.36	0.43	0.56	0.57
United Arab Emirates	8.09	10.99	12.61	14.45
Yemen	0.21	0.25	0.15	0.14
Middle East Average	*1.43*	*1.48*	*1.76*	*1.89*
World Average	*1.12*	*1.11*	*1.07*	*1.11*

Source: EIA World Carbon Dioxide Emissions from the Use of Fossil Fuels

Table (4)

Transport noise Pollution

Transport is the main cause of environmental noise in Arab world. A substantial percent of the population are exposed to "unacceptable" noise levels caused by road, rail and air traffic (i.e. above 65 dB (A)) in most of Arab countries cities. This level of 65 dB (A) corresponds to the noise currently prevailing alongside busy roads or streets; however, traffic noise levels can attain in some cases in Arab countries up to 80 dB (A).

Noise is one of the most resented nuisances caused by transport and is indeed a major public health issue in Arab world. Noise affects activities such as communication and sleep and, long-term exposure to high traffic noise levels (i.e. above 65 dB (A)) can accelerate the loss of hearing usually caused by aging.

The cost to society of damage caused by transport, such as air-pollution-induced mortality, adverse effects of noise, visual intrusion, etc were subject to a monetary value of these negative environmental effects. The damage cost of air pollution – excluding CO_2 – emitted by transport (mainly damage to health, materials and agriculture) is calculated on the basis of health expenditure, working days lost, crop losses, etc. and amounts to 0.4 % of GDP (14). The damage cost of transport noise in Arab region (mainly in terms of annoyance, health and loss in work productivity) is calculated as the loss in value of properties exposed to noise – for instance dwellings along busy roads or in the vicinity of airports, is 0.1 % of GDP. Accidents are 2 % of GDP, time spent is 6.8 % of GDP and user expenditure (including infrastructure) is 9.0 % of GDP, giving a total of 18.3 % of GDP [14]. Faced with rising transportation demand and growing negative impacts, urban areas require new approaches to addressing their transportation needs. Cities cannot continue to expand their urban transportation systems forever. Although some expansion is necessary, the economic, social and environmental costs of doing so are prohibitive. Instead cities need to reexamine urban transportation demand and devise new strategies that provide maximum access at a minimum total cost. In table (4) the general consumption of Arab world from the fossil fuel which represent the main air polluter in Arab countries. Also here it's very clear the obvious difference between the rich and the poor Arab countries.

ELECTRICITY GENERATION

Electricity generation as part of the energy sector and is an important source of air pollutant is rapidly developed sector in Arab countries. Demand for electricity is increasing worldwide as populations' consumption of electricity is rising constantly, as people are increasingly having the willingness and the ability to add more electrically powered devices that are highly used in their daily activities than before.

There are many sources for generating electricity, but the most common and cheap technology at the moment in most of Arab countries is the combustion of fossil fuels to convert thermal energy into mechanical motion and finally into electricity. This conversion accounts for about 71% of the worldwide electricity generation.

The most common and cheap source of thermal energy for electricity generation in the Arab world as in figure (5) is gas (53.7%), oil (37.5%), coal (15.5%), and hydro 3.3 [15],

It should be noted that the combustion of fossil fuel is generally agreed to be the most significant source of atmospheric emission of CO_2. Other GHGs (CH_4, N_2O, and O_3) contribute to climate change through the so called Global Warming effect, but their cumulative effect is estimated to be at least one order of magnitude lower than that of CO_2.

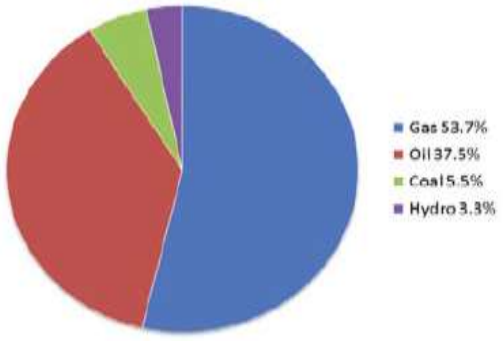
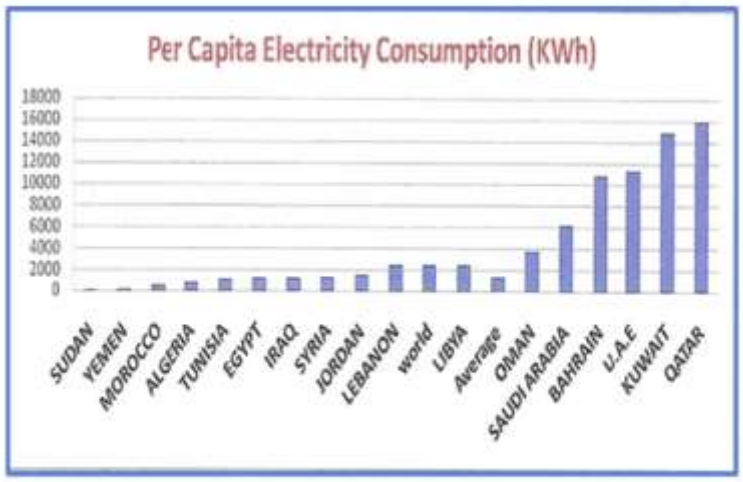


Figure (5) Energy sources diversity in electricity generation in Arab countries.



Source: IEA, world Energy Statistics, 2006

Figure (6)

The energy sector and especially electricity generation is the main source of the gas pollution worldwide and in Arab countries in particular. As mentioned above, gas and oil are the biggest source for electricity generation in Arab countries and a significant source for carbon emissions. Natural gas and oil are more available in the GCC region than coal, and it is considered a less harmful fossil fuel. The burning of equivalent amounts of natural gas and coal in modern thermoelectric plants results in only a marginal decrease in the rate of CO_2 emissions.

The consumption of electricity in the Arab countries is varied largely between the countries. The Arab countries can be divided to poor consumption of electricity under the international rate of electricity consumption like Sudan, Yemen, Morocco, and high consumption rate countries, like GCC. The high consumption of electricity in GCC resulted to high pollution of air and more than three of them are classified in the top ten polluted countries in the world.

TABLE 5 NET THERMAL POWER PRODUCTION [BILLION kWh]

Region/Country	1980	1990	2000	2003
Algeria	6.44	15.01	23.84	27.55
Bahrain	1.55	3.28	5.92	7.30
Egypt	8.56	31.53	57.97	73.99
Iraq	10.05	20.12	29.41	26.23
Jordan	1.00	3.41	6.90	7.47
Kuwait	8.82	19.37	30.88	37.41
Lebanon	1.78	2.13	6.95	8.63
Libya	4.53	15.79	14.57	17.81
Mauritania	0.06	0.11	0.12	0.13
Morocco	3.43	7.90	12.16	15.46
Oman	0.90	5.02	8.56	13.74
Qatar	2.28	4.53	8.59	11.29
Saudi Arabia	20.45	64.90	118.62	143.82
Somalia	0.11	0.25	0.27	0.27
Sudan	0.47	0.52	1.19	2.06
Syria	1.20	5.61	20.67	25.14
Tunisia	2.60	5.16	9.88	11.48
United Arab Emirates	5.90	16.06	37.55	46.57
Yemen	0.47	1.56	3.21	3.85
World Total	5,588.54	7,137.85	9,255.70	10,438.90

Source: EIA World Carbon Dioxide Emissions from the Use of Fossil Fuels

Table (5)

TABLE 6 TYPICAL EMISSION FROM POWER PLANTS [g/kWh]

Fuel type	CO	CO_2	SO_2	NO_x	VOC
Natural gas	0.2	490	0.004	1.5	0.025
Fuel oil	0.19	781	5.1	1.5	0.05
Coal	0.11	1,060	5.5	2.4	0.01

Source: EPRI

Table (6)

As for the Middle East, the IEA expects a production of new electrical energy plants of about 281 (GW) during 2013-35, noting that the production of about 69 GW will stop in obsolete stations. The IEA expects that natural gas will be used to generate 153 GW of power in the Middle East, while oil will be used in plants to generate 31 (GW). Moreover, 26 GW will be generated from wind power, 46 GW from solar energy and 7 GW from nuclear energy. *The table (5) and (6)* show the thermal power plants in Arab countries and the emissions from the power plants. Currently, the United Arab Emirates is building two out of four reactors for this purpose. Saudi Arabia is considering generating electricity from nuclear power [15] [16].

The Arab experts in the electricity sector, warns against the high and rapid increase of demand for electricity in the countries of the Middle East and North Africa. These rates increase by about 6-8% annually, while the rate of global demand for electricity increases by about 2.3% annually.

The Arab Petroleum Investments Corporation (APICORP) expects an increase in the annual demand rate for electricity in the region by about 8.4% during the period 2014-2018 [16].

The reasons behind the annual demand rate increase in the Arab region's countries for electricity, is that economic and population growth leads to an increase in demand for electricity. In Arab countries, the annual economic growth rate ranges between 3% - 4% annually, which is not much differ from the annual economic global growth but the economic and the population growth is strongly differ from one country to another.

The population growth rate in the Arab world is higher than the global growth rate. The economy and demography do not offer convincing answers for the reasons behind the increase in electricity consumption in the Arab world. Most of the increase in electricity consumption is the result of the consumption in households and apartment buildings rather than industrial plants. This means that electrical consumption in the Arab world is the result of the increase in the well-being of people, and not necessarily due to the industrial growth of the country. Some of the main reasons of the increase in electricity consumption are the governmental subsidies to varying degrees for electricity consumers in all Arab countries. Some countries provide electricity for their citizens almost free of charge. Moreover, in addition to this subsidization policy, there are no educational programs to rationalize consumption, which is not surprising because it is difficult to convince citizens to save power while they are receiving it at relatively low prices. Subsidies lead to wasteful energy consumption. Arab officials and experts believe that subsidies are one of the main risks facing the electricity sector.

The high annual electricity consumption leads to costly investments and to the consumption of large amounts of fuel that means more air pollution. Some Arab countries with limited oil reserves are compelled to import oil products, which encumbers the commercial balance and causes an increase in emissions that are harmful to both the environment and citizens.

Regional and civil wars exacerbated the crisis of the electricity sector in various Arab countries. The reasons behind electricity outage varied. Electricity institutions neglected the establishment of new stations to meet the increased demands. Also, many power stations were bombarded or sabotaged during military conflicts in Syria, Libya, and Sudan and now in Yemen. Necessary investments to fix or build new stations and networks were not available. The corruption plagues the electricity sector, as it does the rest of the other sectors in many Arab states. Some countries relied on the import of natural gas from neighboring countries that suddenly cut off the supply. Furthermore, there is mismanagement as some oil countries witness high electricity outages during summer year after year, without making

any plans or being prepared for the peak of consumption during this season. Some countries are infested with chaos, where electricity institutions cannot collect monthly bills. Also in addition to negative factors as clear stagnation in developing the electricity sector in terms of the participation of the private sector with the governments in investing in electricity generation and distribution, network development and collection of monthly bills.

In light of the aforementioned, the accumulation of Arab political problems and the expected steady increase in electricity consumption, it is clear that we are heading toward delicate periods in the future and the electricity problem will be getting worse with more rate of air pollution.

It can be clearly seen that Qatar and the GCC countries relatively are still the leading countries in electricity consumption, according to the United Nations' Environmental Program year 2006 collected information, as shown in Figure (6). It can be noticed again that Sudan, Yemen, Morocco, and others their electricity consumption pro-capite is still considered one of the lowest rate among the world.

ASSOCIATED PETROLEUM GAS FLARING

The flaring of associated gas is still one of the main sources of air pollution in the Arab region. Associated petroleum gas (APG) is gas dissolved in crude oil. Therefore associated petroleum gas is produced in the process of oil production it is actually a derivative. But APG itself is also is a valuable as raw material for further processing. Associated petroleum gas is composed of light hydrocarbons. The APG is composed of methane which is a major component of the natural gas, then accompanied by other heavier components, such as ethane, propane, butane and others.

Associated petroleum gas should be separated from gas content to comply with the applicable international standards range. For a long time and up to now, APG used to be as a by-product for oil companies that are linked to petroleum production. The problem of APG disposal was settled in rather an easy way – it was simply burnt sometimes.

Since the gas is a by-product of crude oil processing but immediate markets are not available or if high levels of contaminates, such as hydrogen sulfide, increase the cost of gathering, processing and transporting this associated gas so in this case in some Arab countries there are insufficient incentives to capture and use that gas and therefore it is just vented or flared. Some of the largest waste gas streams are flared also in remote areas where lack of pipeline access and also small volumes do not justify the expense of gas gathering.

The possibility to productive associated gas use will grow if it is can be used domestically or *for electricity generation and prices are controlled at low levels.* Approximately 150 billion cubic meters of natural gas are flared into the global atmosphere each year — which is roughly equivalent to the annual gas use of every residence in the U.S. It's also the same as a 400 million metric ton contribution to global greenhouse gas emissions — which is roughly equivalent to the annual emissions of 77 million cars or about 34 percent of the US fleet (17). Flaring also leads to large impacts on local populations in terms of environmental degradation, which can result in loss of livelihood and severe health issues. Many oil producing Arab countries including Algeria, Saudi Arabia, and in other worlds countries like Indonesia have made progress in gathering and utilizing their associated gas. There's still work to be done in Nigeria and in other parts of the Arab Middle East countries which have an old oil wells. Russia has reduction goals targeted for 2014 and good results are achieved. The technology to address the problem exists today — in fact, much work has been done over the last decade so that large scale flaring is rare at new projects. However the next phase of flare reduction at old and isolated sites like what exist in most Arab countries is going to be more challenging, which is why industry and governments need to work together to address the issue.

In the Arab region as a whole, the cost of environmental degradation is estimated at five per cent of gross domestic product (GDP). More governments in the Arab region had failed to address these mounting economic costs with effective policies. The environmental work carried out in Abu Dhabi, describing the Abu Dhabi Emirate Environment Strategy (2009-2013), adopted by the emirate, as a "model" and called on Arab countries to follow this model but till now no acceptable results in most Arab countries is achieved. By the way the paper praised the clean energy initiative which was launched by Abu Dhabi government. Unfortunately the economic costs of environmental degradation in the Arab region are still growing although they are often largely invisible or ignored. For example, the health bill paid by Arab countries for diseases caused by air pollution from transport only is $5 billion.

Figure (7) and (8) illustrates the associated gas component and gas flaring that excessively harming the environment in most Arab oil producing countries.

Figure number (7)

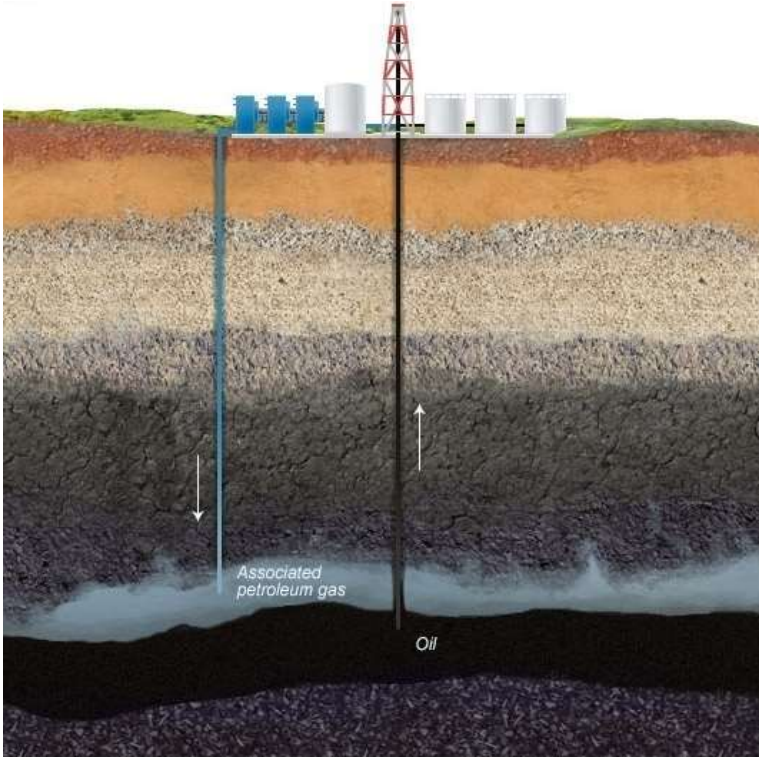


Figure (8)

POLLUTION LEVELS IN SOME ARAB COUNTRIES

According to the 2006 Yearbook of the UNEP Global Environmental Outlook (GEO), the urban growth rates in the Arab region were very rapid; the urban population increased from 38% of the total in 1970, then its 63% in 2005. It's estimated that the urban share in the East Arab sub-region (Iraq, Jordan, Lebanon, the Occupied Palestinian Territories and Syria) increased from 52% to 65% in 2030. The concentration of population in urban areas has resulted, among

other problems, in increased air pollution. According to the yearbook, cities such as Sana'a, Damascus, Cairo, Baghdad and Manama among other major cities in the region suffer air pollution levels that sometimes exceed WHO guidelines. A few Arab countries monitor air pollution levels systematically. Available data and reports indicate that the main sources include industrial processes, inappropriate disposal of solid and hazardous waste, vehicle emissions and the burning of oil in electric power generation. In what follows, a brief statistical overview is offered about pollutants concentration in some cities and urbanized regions in the Arab world.

Egypt

It has been estimated that Egypt's emissions of greenhouse gases (GHG) figure is around 0.6% of estimated total world emissions. Measurements inside urban areas and close to industrial complexes have sometimes recorded pollution levels higher (sometimes 6 to 8 times) than the limits set by Environmental Law 4 (ratified in 1994). Egypt has an average concentration of SO2 of around 69µg/m3 of (compared to the WHO standard of 50µg/m3). Anderson. The peak levels recorded, however, are much higher than recorded averages. High particulates concentrations are generally caused by the climatic conditions and winds blown from the desert. Measurements, however, also showed that smaller particulates that cause major health problems are generated from industrial complexes and power plants. These particle levels are also accompanied by high sulphur concentrations, an indication of the burning of fossil fuels in these complexes. Levels of PM10 have reached 580µg/m3 in Cairo and 450µg/m3 in Alexandria.

Syria

The transport sector in Syria causes around 70% of urban air pollution. The concentration of PM10 in Damascus is estimated at 749µg/m3 in highly congested traffic areas and 333µg/m3 in residential zones. This is due to the fossil fuel combustion in industrial complexes in and around the city, and is also attributed to the generally old and poorly-maintained vehicles fleet, quality of transport fuel, and high reliance of diesel- driven microbuses for public transport in major cities. Diesel stoves are the second biggest polluters. They also strongly contaminate the air with sulphur dioxide. There is hardly a private household in Damascus that does not use diesel for heating in the cold months from November to March. The stoves, which do not cost more than 25 Euro, can be bought everywhere in town, and diesel is cheap.

Lebanon

The power sector in Lebanon relies almost completely on imported fuel oil to operate its thermal power plants. These plants are regarded as the main source of air pollution in nearby areas, and this has been confirmed by series of measurements conducted mainly by academic institutions and NGOs. Levels of particulates and oxides of sulphur were found to be several times higher than international standards.

Air pollution from the industrial sector is recorded in the vicinity of major cement factories along the Lebanese coast. Particulates and dust are the main effluents from these factories.

The transport sector is the major source of GHG emissions in the country. The motor vehicles fleet of Lebanon constitutes over 2.4 million registered vehicles, 55% of which are more than 15 years old. CO_2 emissions in 1999 totaled 4,585 Gg compared to around 3,957 Gg in 1994, an increase of around 16% (see table 8). Currently, emissions have topped the 5,000 Gg level. Lead concentrations in Beirut varied by the end of the 20th century from 0.17 to 4.64µg/m^3 with an average value of 1.86µg/m3, and the total TSP concentrations is 166µg/m3. Levels of ozone and smog measured in Beirut were several times higher than the world norms. This has been partially mitigated by the enforcement of law 341 in 2003 that has banned the use of industrial diesel for transport, and also banned leaded fuel.

Bahrain

The transport sector is the main source of pollution in Bahrain, according to air quality tests. In one such air quality test, air monitoring equipment was set up in each of Bahrain's five governorates; the results revealed a significant increase in pollutants associated with vehicle emissions over the past 10 years – particularly nitrogen oxides and ozone gas. These increases were attributed primarily to vehicle exhaust and industrial emissions, petrol vapors and chemical solvents – as well as natural sources – emitting NOX and volatile organic compounds, which form ozone. Levels of sulphur dioxide (SO_2), which is pumped into the atmosphere by industries such as petroleum refineries, cement manufacturers and metal processing facilities, have been relatively stable in Bahrain at under 5ppb (parts per billion) over the last 10 years. There were spikes upwards to 10ppb in 1998 and 9ppb in 2002, but the figure currently stands

at 7ppb. SO_2 also contributes to respiratory illness and acid rain. However, Bahrain's air quality tests showed that certain parts of the country are more polluted than others.

The amount of low-level O_3 in Bahrain is 51ppb, whereas NOX concentration has risen from 15ppb 10 years ago, reaching a peak of 30ppb in late 2002. CO_2 emissions from the transportation sector represent only 5.6 percent of the total CO_2 emissions in Bahrain.

Algeria

Urban air pollution in Algeria is caused by the transport sector in the large cities of Algiers, Oran and Constantine; by burning municipal waste; and by heavy industries in Annaba, Skikda, and Gazaouet. Such pollution has triggered on a yearly basis 353,000 cases of bronchitis, 544,000 asthma attacks and could be a cause behind 1,500 cases of lung cancer. Morbidity and mortality were evaluated in terms of DALYs (Disability Adjusted Life Years). It was estimated that 157,000 DALYs a year are lost because of outdoor air pollution and 88,820 are lost annually due to indoor air pollution. The environmental cost mounts to around 0.9% of national GDP. The annual concentration of PM10 in Algiers is about 50µg/m3, and the ozone concentration is 180µg/m3. SO_2 concentration is 360µg/m3, and NOX is 400µg/m^3.

Saudi Arabia

The air pollution problem in the Riyadh region is mainly attributed to the nearby refineries, power plants, and to transport. Sulphur dioxide is the main air pollutant emitted from the refining processes. The main source of sulphur dioxide emission is the hydrogen sulphide incinerator. There are no apparent serious environmental problems with any other air effluents. In Riyadh the following concentrations were reported: SO_2 concentration is 23.8µg/m^3, whereas the concentration of ozone is 3.4µg/m^3. Average interior CO concentrations (inside vehicles) during non-peak traffic times ranged from 10 to 25 parts per million (ppm). Also, lead concentrations have exceeded international norms [17].

Air pollution control

The first step to controlling air pollution problems in Arab region is to identify their source. Long-term monitoring of major and minor pollutants is to be set up in all regions. Once problems are identified, pollutant emissions are reduced through the use of cleaner fuels and the installation of pollution-reducing technologies. Due to the development of new technologies, the next decade or two should see reductions in emissions from power plants, industries, and motor vehicles, at least in the more developed Arab nations.

- ***Reducing Emissions by Changing Energy Sources***

  It is high time for political leaders worldwide and in Arab region particularly the leaders of industries that cause air pollutant emissions take actions to reduce these emissions. The preferred approach for reducing air pollution is to keep the pollutants from entering the atmosphere. One way to do this is to reduce reliance on the energy sources that produce the most pollutants -fossil fuels - while phasing in alternative energy sources, such as hydropower, wind energy, geothermal energy, nuclear power, and solar energy (although a few of these have other environmental or health impacts that bear serious consideration). A change of this magnitude is difficult to accomplish. For one thing, large scale use of these energy sources would require large technological developments. For another, a change like this would require a transformation in the energy infrastructure. People would likely get energy from different sources depending on their location. Some regions can take advantage of its seemingly nonstop sunshine, for conversion to solar energy which is very reliable for Arab region. Some regions can rely on windmills. A strategy like this would make energy production less centralized, thereby reducing air pollution to a significant level.

- ***Reducing emissions from the power plants***

  First of all the used power plant should be as possible a combined one to high the efficiency of the plant that reduce the harmful emission. Since the Arab region is suffering water sacristy in many places the power plants can be combined always by desalination units.

  There are several ways to remove pollutants from power plant emissions. Scrubbers eliminate particulates, SO_2, hydrogen sulfide, and other pollutants from waste gases as they pass through a solution before leaving the smokestack of coal-firing and other plants. Bag houses, enclosed structures that run emissions through filter bags in the same way as a vacuum cleaner, collect more than 98% of dry particulates. Cyclones collect toxic gases

and particulates by using centrifugal forces, which are motions that proceed outward from a center. Electronic precipitators use static electricity to collect and remove unwanted substances that are suspended in very hot gases. Technologies are being developed that will reduce power-plant emissions even more. One exciting new technology is that of gasification, which has been tested but has not yet been used in a full-scale power plant. Gasification produces clean coal, which is more efficient and produces far fewer emissions than normal coal.

Fuel cell technology may someday be used in motor vehicles, but it is far from ready for that purpose right now. Like batteries, fuel cells convert chemical energy into electrical energy, but fuel cells do it very efficiently. Most of them harness the energy that is released when hydrogen and oxygen are converted into water. The by-products of this reaction are water vapor and heat. Unlike batteries, which are sealed so they contain all their chemicals, fuel cells have chemicals constantly flowing into them, so they never go dead. In addition, vehicles run with hydrogen fuel cells have no emissions—no pollution at all. Fuel-cell use is in its infancy, but it is entering a rapid growth phase. Fuel cells are replacing batteries in portable electronic devices, where they are advantageous since they last longer and are rechargeable.

– ***Policy for emissions control from traffic***

A number of policy tools are available to reduce excessive travel demand especially in Arab region and create more sustainable transportation systems, from road pricing to increasing the efficiency of existing systems, to expanding public transit. Most of these tools will have a limited impact if they are used in isolation. Instead, improving urban transportation systems will require a combination of policies that reinforce each other and help to avoid adverse side effects. Intervention strategies for environmentally sustainable urban transport are to support sustainable development by:

– ***Land-use planning***

An ecological city must use support systems that are environmentally sound and have low energy consumption. This can enable short distance transportation and distribution of basic necessities with an emphasis on public transport. Land use planning should also contain a concept of integration of settlements with local small-scale manufacturing. New links, which bypass sensitive areas, also, can be of local environmental benefit, especially if they are in tunnels. Therefore it is clear that there is a close connection between transport needs and land use. If there is no strict physical planning which addresses also explicitly the transportation needs of new residential, industrial and commercial areas the urban sustainability is not likely to be recognized. Thus a strict coordination between urban transport policy and urban land use policy is badly needed in Arab region as strategy in which also public transportation would have to play a critical role.

Land-use planning also plays a role in creating a balanced eco-system in which the natural environment is enhanced by the city's existence in dealing with city deficiencies such as improper solid waste disposal and high-energy utilization. To achieve this goal the city should be planned so that its by-products benefit the natural environment.

– **Public Transport:**

Development of the public transportation system by making it inexpensive, simple, clean and efficient would be an important aspect. The basis for this system would be as following:

1) Long public transport lines high-density residential development should be done near stations. The motivation underlying such strategies has not necessarily been solely the minimization of car travel, but also the preservation of open space and improvement of accessibility.
   Transport should adopt a creating or preserving a high density of trip-attracting activities in central areas and other locations well served by public transport. It is also associated with policies for restricted parking in the centers of cities.
   Also Transport should adopt an encouraging a commercial development where access by public transport was poor.
2) Using developer contributions to finance new transport infrastructure: impact fees are levied on new development integration of different public transport facilities such as metro, buses, railways so that they complement each other as well as integration with other means such as walking, cycling, etc.

- ***Traffic Management***

The best strategy is to use traffic management and inspection and efficient maintenance programs in an efficient way. Generally for Arab region is to adapt these three intervention lines:

 Restrictions of access to city centers to private traffic or heavy traffic, which is the source of high congestion and heavy toxic emissions;

 Traffic restrictions in urban areas are an efficient policy tool if only a small part of the town is planned as car-free zone: large car-free areas, in fact, act against the possibility of optimizing accessibility in urban areas. In this respect, car restricted urban areas should be coupled with more parking facilities (underground parking space), in order to optimize access to dense traffic areas, such as the city centers.

 Reorganization of urban freight movements; the second area of intervention policies is a reorganization of urban freight distribution, through the implementation of new logistics and combined road/rail transport. With the aim to reduce gas and noise emissions at sources; counteracting policies have been the location of goods traffic centers in industrial areas, and the expansion of the use of pipelines. The distribution of goods to local shops in cities remains in any case a problem, which is partly solved by the delivery on small scale trucks with efficient energy saving motors. Road pricing may also be an efficient tool in this sense.

 Fuel pricing; removing subsidies and increasing taxes in order to reduce fuel consumption increase government revenue and improve public transport services.

- ***Cleaner vehicles***

Improving the efficiency and cleanliness of existing vehicles to help reduce fuel consumption and air pollution is necessary. Catalytic converters and fuel saving techniques may well be exploited to decrease air pollution and the exploitation of non-renewable resources. Unleaded and natural gas are already being used in many countries and increasing their use will lead to lower polluting emissions.

Evolving environmentally sustainable urban transport development is an expensive and complex undertaking. It requires much time and resources in undertaking the diagnostics of the present situation and evolving appropriate measures. Present indications are that few governments are ready to willingly undertake that task due to the pressure for immediate results by their constituents and by resource constraints.

However, some governments in the Arab world have begun to feel the burden of not taking immediate action. In Egypt, a new traffic law has been passed and put into force recently requiring motorists to wear safety belts and vehicle emissions to be periodically checked. It also puts restrictions on the use and importing of older vehicles and registration procedures as well as restricting the use of horns unnecessarily. While this law provides for a transition period for some of its requirements, it is hoped that ultimately it will begin to reduce congestion, air and noise pollution as well as cut down on traffic accidents [17][18].

The study had been done by descriptive method and collecting the data through visiting the Tabuk City the north capital of KSA and one of the more polluted city in KSA. The visit is done to different automobiles selling centers to investigate the selling and importing of vehicles. Also a visit to some petrol station where car maintenance workshops are available to provide service clock the time to stand about maintenance quality. Also data is collected through visiting specialized car maintenance centers at the industrial area. Also a visit is carried to Tabuk electricity generation plant to stand about the general situation of operation and maintenance and its relation with air pollution. Tabuk electricity generation plant consists of 17 uncombined gas turbine units most of them are old with low efficiency that means harmful to environment. Concerning the automobile maintenance workshops we have observed common problems in their activities that resulted to direct air pollution, and they were established and sited beside the civilian regions. The car maintenance wastes are polluted it; beside the maintenance activities is done poorly by low experienced workers.

The vehicles which are taken as sample are contain 57% of them produced before 15 years, 33% of them produced before 10 years then and the rest of them are produced less five years. Also there is a general

observation that resulted to low vehicles performance and high air pollution. The car drivers technically have low experience in maintenance, adjustment and car services activities. This resulted to the followings: 33% of heavy trucks samples are underinflated, 8% is overinflated, 3% improper alignment, 2% dissimilar pairs of tires and with11% misbalanced tire.

For light cars samples, 23% is underinflated, 27% is overinflated,13% improper alignment, 22% dissimilar pair and with 8% misbalanced tires.

It is very clear that the performance of such vehicles will be very harmful to environment leading to more and more air pollutions and car accident.

RESULTS AND DISCUSSION

According to data obtained from general sources the Arab world which constitutes 5% of the world's population, emits just under 5% of global carbon emissions according to World Bank data, and except for Saudi Arabia, no single Arab country is responsible for more than 1% of global emissions. The energy use of an average Arab person is still below the world average and less than half that of an average of European. The rapidly growing consumption of energy globally resulted to emissions of the average Arab person that have almost doubled while global carbon emissions per capita have only marginally increased over the last 30 years. At current rates, it is expected that the emissions of an average Arab person will exceed the global average in the next 5 years, with no sign of a slowing down. Such rapid growth in emissions is compounded by the fact that the energy use responsible for the region's emissions is not particularly efficient. In fact, with the exception of sub-Saharan Africa, the Arab World's economy has the lowest energy efficiency record of any region in the world. The region generates a mere $4.6 of GDP per unit of energy consumed (kg of oil equivalent), which compares poorly against energy efficient economies such as those of European Union, which creates $8.1, and Latin America, which creates $7.5. The region even compares unfavorably to the energy inefficient North American economies which generate $5.6 per unit of energy consumed.

In an investigation of intra-regional variation in energy use and emissions suggests that the use of the term 'average Arab person' may not be the most pertinent in describing the region's environmental condition. Much of the variations in energy use and emissions in the region appear not to correspond to population sizes but rather to patterns of consumption. Saudi Arabia, for example, represents 7% of the region's population yet is responsible for 28% of the region's emissions. Remarkably, Saudi Arabia – with a population of 25 million – produces more carbon emissions than more populous and industrialized countries such as France of (62 million), Brazil (194 million), and Spain (45 million). Egypt on the other hand, which represents 25% of the region's population, is responsible for a mere 13% of the region's carbon emissions.

To better understand this diverse regional picture it is more appropriate to divide the region's states into groups representing the dominant energy, emissions, and environmental trends. In such classification two groups emerge, a resource-rich group, representing fossil-fuel exporting countries with reinters economies and high per capita oil and gas exports, and a resource-poor group, with more diverse economies and generally less resources. The resource-rich group, which includes Qatar, Kuwait, UAE, Bahrain, Saudi Arabia, Oman, and Libya, is characterized with extremely high levels energy use and carbon emissions per capita. In fact, residents of the first four countries in this group are ranked amongst the world's top five emitters per capita, with Qatar topping the global list at a staggering rate of 12 times the global average. In comparison, emissions from the resource-poor countries, which include Sudan, Jordan, Syria, Iraq, Lebanon, Tunis, Egypt, Morocco, Yemen, and the Palestinian territories, tend to have much lower levels and never exceed the global average. Part of the reason behind such a high rate of energy use and emissions in resource-rich countries is water scarcity. Countries that belong to this group share a general lack of sufficient renewable water resources within their borders, and have to depend on other non-renewable water sources in order to satisfy the needs of growing populations. In most cases, especially in Saudi Arabia and the United Arab Emirate, these countries adopted desalination of sea water as a solution to their water challenges. But given the energy-intensive nature of the desalination process, and given that these countries rely on fossil fuels as an energy source for operating desalination plants, this has only added to their energy demand and subsequently their carbon emissions. It is estimated that the emirate of Abu Dhabi uses more than half of its domestic energy use in desalination. In resource-rich countries, energy use is so high that it makes for exceptionally low economic energy efficiency. Producing an average of $3.7 of GDP per unit of energy consumed, economies that belong to the resource-rich group have low energy efficiency even when compared to the resource-poor states. As a matter of fact, the economic energy efficiency of resource-rich countries

is only marginally higher than that of sub-Saharan Africa which produces $3.3 of GDP per unit of energy. This low efficiency and increased energy use and carbon emissions cannot be explained by water desalination alone. Instead it can also be attributed to the heavy subsidies on energy prices which are common in their economies. On average, the cost of petrol in resource-rich countries is a fifth of global prices, compared to three quarters in the case of the resource-poor group. Similarly, the average cost of electricity in the resource-rich group is a mere sixth of electricity prices in the US, according to study by the Arab Union of Producers. This compares to electricity prices in resource-poor countries that are half of US prices. Introduced as a social welfare mechanism, these energy subsidies now act as a catalyst for increased consumption, disconnecting consumers from the cost and impact of their growing consumption. It can also be argued that subsidies on petrol have encouraged a reliance on the use of private vehicles and prevented the development of viable public transportation networks, while subsidies on electricity have lower energy efficiency measures and encouraged wasteful energy use. In addition, subsidies on water in most of the resource-rich group have also led to increased water use in its countries. This has lead to additional demands for sea water desalination, which in turn led to an increased demand for energy. In Saudi Arabia, for example, is estimated that a third of oil production is used to satisfy domestic energy needs. This ratio has grown from 3% in 1970 and is expected to rise to 50% over the next 20 years. Such diversion of resources away from revenue-generating exports suggests that growing domestic consumption in resource-rich countries is not only bad for the environment, but it also presents a real danger to its economic development. These energy use and emissions trends should ring alarm bells for the Middle East and especially its resource-rich nations, not least because they do not track an economic development curve. Instead, they appear to be fueled by inappropriate policy choices and uncontrolled consumption as the region remains in flux amidst the greatest reshaping it has seen in decades, it is hoped that when the dust settles that such policies are remedied for a more sustainable future for the region and the world. In the Middle East and North Africa region, electricity and heat production are responsible for 41% of total carbon emissions according to IEA data from 2009. And while not representing a consumption sector, electricity generation ranked well higher than any individual sector, including transportation, which comes second and accounts for 25% of the region's total carbon emissions. Yet carbon emissions from electricity generation are not equal across the region. In fact, the top 5 contributors to carbon emissions from electricity generation – namely Saudi Arabia, Egypt, the UAE, Kuwait, and Iraq – together represent 70% of the region's electricity generation carbon emissions, according to 2009 data by the IEA, a share that represents approximately 30% of the region's total carbon emissions.

CONCLUSION AND RECOMMENDATIONS

It has been well recognized that the Arab region is suffering from shortage of institutional capabilities for monitoring, analysis, assessment and control of air quality conditions at many aspects of its development. Transportation systems, excessive use of polluting fuels in industry, shortage of awareness of stakeholders and the rapid growth of urbanization constitute major factors responsible for low air quality. According to the Report of Arab Countries at Millennium of Sustainable Development Johannesburg; the following needs were recognized especially for the Arab region:

Patterns of Consumption

Actions at the National Level: Governments and the private sector are urged to change the unsustainable pattern of production and consumption of goods, services, and natural resources.

Steps should be taken to encourage the use of traditional products and goods, to promote the concept of cleaner production and consumption, and to encourage reuse and recycling activities, including research and development.

Actions at the Regional Level: Collective efforts of the countries are needed to revive Arab and Islamic traditions and teaching as a distinct feature of the region, which can reflect positively on sustainable development.

Actions at the International Level: The developed world is urged to change unsustainable production and consumption patterns that deplete global natural resources and have a high ecological footprint. It is also urged to devote more resources to develop eco-efficient technologies and make them affordable to developing countries.

Air Quality

Actions at the National Level: There is a need to improve and establish air pollution monitoring and control programs for mobile and stationary emission sources, and to continue assessment and analysis of ambient air data. It is necessary to use sound urban planning for cities with support systems that are environmentally sound and have low energy consumption. This can enable short distance hauling and distribution with emphases on public transportation systems

quality and accessibility. Cities should also use modern efficient traffic management systems to reduce traffic idle time, which produce peak emissions. It is also necessary to continue efforts to eliminate leaded gasoline, replace aging vehicles and industrial production facilities, increase availability of cleaner fuel including natural gas stations and intensify forestation.

Actions at the Regional Level: Joint programs are needed to address common priorities of the countries in the region domain of air pollution monitoring and control, assessment of health impacts associated with air pollution, and the exchange and dissemination of air pollution. Developing sub regional and regional transportation networks and energy efficient systems and grids should be considered as a matter of priority.

Actions at the International Level: The international community is urged to provide technical and financial assistance to address the issue of air pollution, including trans-boundary air pollution such as haze clouds.

Governance and Public Participation for Sustainable Development

Actions at the National Level: The need for good governance is strongly emphasized to include strengthening the legal and institutional framework, nurturing democracy, accountability UNEP-Regional Office for West Asia (ROWA). Environment impacts of the Arab oil and transparency, effective participation of the civil society, especially women and youth, and the private sector in the decision making process. Eliminating social, political and economical corruption is also considered essential to achieve good governance. Furthermore, adopting decentralization, and establishing linkages and coordination mechanisms between environment ministries, other concerned ministries and relevant sectors are of paramount importance in improving governance for sustainable development.

Actions at the Regional Level: The role of the League of Arab States (LAS) should be enhanced in terms of the cooperation and coordination between Arab governments. An Arab Council for sustainable Development to meet at the level of Prime Ministers should be established. Cooperation and coordination regarding the implementation of MEAs and regional conventions needs to be strengthened and enhanced.

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