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Steps Towards Mitigation of Air Pollutants as a Key for Sustainable Development I.C

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ABSTRACT

There are about 70% people living in cities in the world, however, urbanization in cities is still in progress. Urban development brings us economic benefits but also results in environmental pollutions. Steps taken to environmental sustainability can lead to the preservation of natural resources while welfare, economic and social dimensions are considered. There are lots of ways to reach sustainability, one of which is through abatement of air pollution which in turn would have direct and indirect impacts on environmental, economic and sociopolitical sustainability. This review outlines the issues concerned in air mitigation such as the use of renewable energies, the role of green lands and sustainable transportation as keys for sustainable development.

Key words: Air pollution, green lands, renewable energy, sustainable development, transportation

INTRODUCTION

Sustainable development is a pattern of resource use that aims to meet human needs while preserving the environment (UN, 1987). In 1987, the United Nations released Brundtland report who explained sustainable development as "Development which meets the needs of present without compromising the ability of future generations to meet their own needs" (Rees and Smith, 1998). Sustainable development has had a substantial impact on the intellectual thoughts and has, since the 1970s, infiltrated all levels of government activities from local to international (Al-Masroori and Bose, 2011). The field of sustainable development can be conceptually broken into three integrated parts which are environmental, sociopolitical and economic sustainability. There are lot of ways to assess sustainable development, one of which is urban air quality (Foxon *et al*., 2002). Urban air quality management is currently based on air quality standards, usually at sectors that are exposed to the exposure of pollutants. One of the main contributors to air pollution is urban transport system. In many cities current policy is to concentrate large numbers of polluting vehicles on to fewer roads. The reduction in gridlocks away from roads is responsible for making progress "Urban background air quality", while reduction in emissions produced per vehicle, prevent air quality from deteriorating at most parts of cities (Stevens *et al*., 2004). Another major contributor to air pollution is Green House Gases (GHGs), which causes climate change, emitted profusely from burning fossil fuels such as coal and oil. Industries are considered as a leading source of GHGs emitters which exacerbate the urban air quality. On the other hand the world energy demand has increased owing to the population growth. Renewable energy such as wind, solar, biomass etc. are leading solutions

to the climate change mitigation by providing a transition to carbon free economy (IEA., 2003). Within this framework, this review outlines recent research advances on renewable energies. It also represents policies on transportation and urban parks as the three main stimuli to sustainability.

AIR POLLUTANTS MITIGATION AND SUSTAINABILITY

In pursuit of economic development, most post-colonial countries veered in industrialization at Independence. The focus was on maximum exploitation of natural resources for rapid economic development with scant regard for resource conservation and sustainability. Industrial activities, usually carried out in developing countries with weak legal framework and regulation infrastructure, led to pollution of water resources, destruction of fauna and flora, health hazards and deterioration of health quality, air and noise pollution, as well as destruction of traditional economic infrastructures within communities hosting some of these high powered investments (Eneh, 2011). Sustainability is a process which considers all aspects of human life affecting sustenance. It involves the simultaneous pursuit of economic prosperity, environmental quality and social quality famously known as "Three pillars" (Hasna, 2012). In 2007, United Nations Commission on Sustainable Development (CSD) released a summary document in which the relation between sustainability and air pollution mentioned as follows: "Air pollution has serious adverse impacts on the quality of life, in particular on human health, the environment and the economy. Therefore an integrated approach is needed to tackle both indoor and outdoor air pollution, which takes into account the related environmental, economic and social consequences. Its mitigation should be better integrated into national development planning processes. Industry and various forms of transportation may significantly contribute to air pollution (UNDP., 2000). In the context of this study the relationship between abatement of air pollutants and sustainability is addressed through usage of carbon free energies, sustainable transportation and urban parks which directly and indirectly affect three dimensions of sustainability. Figure 1 shows the conceptual links between sustainability and factors.

GLOBAL ENERGY CONSUMPTION

World primary energy demand is expected to increase by almost 60% from 2002-2030 with an average increase of 1.7% year^{-1}. Demand will reach 16.5 billion t of oil equivalents (toe) as it compared to 10.3 billion t in 2002 (Table 1). Fossil fuels will continue to dominate global energy use and their share will increase slightly from 80% in 2002-82% in 2030. Oil will remain the single largest fuel around the world, though its share will decrease marginally from 36% in 2002-35% in 2030. Oil will be increasingly used in transport sector, which will account for two-thirds of the total increase in oil consumption. In many developing countries, oil products will remain major sources of modern commercial energy for heating and cooking, especially in rural areas. Gas consumption will grow at a steady rate of 2.3% year^{-1} between 2002 and 2030. Also, gas will come as the second-largest energy source after coal by the year 2030. The share of gas in total primary

Fig. 1: Schematic diagram of three elements which lead to sustainability

Table 1: World total consumption (IEA, 2006)

Gas species	GWP	Main sources
CO_2	1.0	Combustion, deforestation
CH_4	21	Waste management, agriculture
N_2O	296	Soil, biomass burning
HFC_s	120-12000	Mostly refrigerant fluids
PFC_s	6000-12000	Industrial process
SF_6	22200	Industrial process

GWP: Global warming potential

Table 2: Greenhouse gases according to the Kyoto protocol (Houghton, 2004)

	Year			
Type of energies	2002	2010	2030	Average annual growth rate (%) (2002-2030)
Coal	502	516	526	0.2
Oil	3041	3610	5005	1.8
Gas	1150	1336	1758	1.5
Electricity	1139	1436	2263	2.5
Heat	237	254	294	0.8
Biomass	999	1101	1290	0.9
Other renewable energies	8	13	41	6.2

energy consumption will go up from 21% in 2002 to 25% in 2030. The power sector will be the main driver of demand in all regions. This trend will be especially marked in developing countries, where electricity demand is likely to rise rapidly. Totally global energy intensity, expressed as total energy use per unit of Gross Domestic Product (GDP), will fall by 1.5% year^{-1} over 2002 and 2030 (IEA., 2006).

ENERGY AND CLIMATE CHANGE

Certain gasses in the atmosphere known as Radiatively Active Gases (RAGs), or Green House Gases (GHGs), absorb some of the upward going long wave radiation after it has left the earth's surface. This radiation is transformed into heat resulting in an average temperature of 15°C in the earth atmosphere. However, since the industrial revolution, human societies are affecting the natural balance, disrupting the normal climate cycles. Some 30 gases contribute to anthropogenic greenhouse effect but only six regulated by Kyoto protocol. These six GHGs mentioned in Kyoto protocol are presented in Table 2. Worldwide on average temperature has goes up by 0.6°C during the past 100 years (Houghton, 2004). The Inter-governmental Panel on Climate Change (IPCC) stated in its third assessment report in 2002 that "There is new and stronger evidence that most of the warming observed over the last 50 years is attributable to human activities". The IPCC also identified the following effects of an increase in global average temperature: rise of the sea level, flooding of coastal areas, frequent extreme weather conditions, water shortage, loss of biodiversity, increase of infection and devastation (REN., 2007).

Migration and global environmental change: Interest in environmental migration and displacement that is caused by concerns about the impacts of Global Environmental Change (GEC) on human population has increased. There are several factors which affect migration to the cities among them the characteristics of the event and the degree of vulnerability can be distinguished. Global climate change could directly and indirectly affect movements through the intensification of natural disasters, changes in water availability, rising sea levels and scarcity of natural resources. This huge migration leads to un-sustainability unless the effects of global warming taken into consideration and renewable energy substituted instead (Adamo, 2010). Although much efforts have been given to managing climate change issues in many countries, there is still need for

improvement includes: integration of programmers in various agencies, adjustment of current sectoral-based approaches, stakeholder's consultation and cooperative actions and expansion of the use of market based instruments as well as carbon taxation and a cap-and-trade program augmented by regulatory systems. In addition, there is urgent need to address research and development (R and D) for both adaptation and mitigation. This balancing is required to avoid compromise in economic growth and sustainable development of the countries (Begum *et al*., 2011).

RENEWABLE ENERGY: A SOLUTION TO CLIMATE CHANGE

Use of renewable energy is an extremely promising option for both reducing greenhouse gas emission and enhancing diversity of energy supplies. Unlike nuclear energy or coal-derived fuel, solar derived energy has no massive scale waste product requiring expensive and environmentally challenging disposal. With a production cost of around 20-30 cents per kWh^{-1} for solar energy, it is not yet positioned to be a major competitor to fossil fuels, whose electricity generation cost are as low as 2-3 cents per kWh^{-1}. Still, much of the world's population will remain without modern energy services unless new aggressive policies and emerging technologies are launched in the coming years. The advantages of developing a new improved and efficient grid system are tremendous. There are both clear technological and political hurdles that must be overcome to achieve this target (NSTC., 2001).

Hydropower: Hydropower is the only renewable energy source that can already boast a fundamental share of today's electricity generation. The cost of electricity generated by hydropower energy makes it so attractive. Moreover, in contrast to wind or solar power, hydropower plants produce energy without interruption as long as there is enough water. However, the drawbacks of new hydro power plants should be taking into consideration, as they might lead to un-sustainability through, strongly interference with the natural and social balance in the regions located around reservoir or dams. Also, those living downstream are affected, because the new dam can dry up the traditional sources of income (UNDP., 2000).

Solar power: Solar power is being considered as the most expensive type of renewable energies. Only 1% of the electricity supply generate by PV power. Solar energy can be used into various ways to generate electricity (PV application) or to generate heat. For the first the energy of sun light converted to electricity and saved in solar cells which are mostly made of silicon, in future through it is predicted that most of the silicon would be replaced by organic matter which are cheaper. The low maintenance of solar cells has made them attractive for developing countries especially those rich in sunshine (REN., 2005). Solar and wind energy are renewable sources of energy that can be used for renewable electricity generation. Solar and wind energy sources are intermittent sources of energy. They are not available on demand and backup systems are needed to obtain a reliable supply. By implementing a hybrid system where both the solar and wind plants supplement each other can further enhance their energy harvesting capability, thus improving the supply reliability and overall performance (An and Singh, 2011).

Geothermal power: The heat exists inside the earth can be released for heating and electricity generation. It is estimated that only 0.5% of the total energy supply provided by geothermal power. However, experts predict that more than ten times the global energy demand of today can be generated by geothermal power each year. The energy of geothermal power can be used into different ways: (1) hydro geothermal method and (2) hot dry rock method. In both ways water sent

to underground and the heat trapped in reservoirs or rocks heat the water, thus the heated water can be used for different purposes (Lund, 2005).

Wind energy: Increasing world population and interest in reducing oil reserves and resulting requirement for clean, reliable, renewable energy systems, intensifies the requirement for wind energy in long term. Nowadays, wind turbines are used for transforming energy into electrical and mechanical (Kurtulmus *et al*., 2007; Elhassan *et al*., 2011). Figures show that only 0.04% of worldwide total energy comes from wind power. Wind turbines have made progress especially in regions with rich winds. Wind power is an interesting option in remote areas (REN., 2006). It was recognized that the most economical turbines are those with a rating between 1-350 kW. This means that the wind velocity at the potential location of the wind power plant should be a minimum of 6.5 m sec^{-1} with an availability of 25-40%. In this respect the wind energy to be used for electricity production will depend on the single unit production of the specific size but the total installed capacity may be dependent on local demand or grid capacity (IPCC., 2002).

Biomass: Biomass is considered the most important renewable source of energy. It is not just wood. Straw, animal drug, biogas and vegetable oil are also considered as biomass. Biomass feedstock has received great interest to be used as an alternative and renewable source of energy. Lignocellulosic biomass has significant potential to contribute to the biofuel production to decrease green house gas emission and global warming (Abdeshahian *et al*., 2010). Production of electric energy from animal's litter and biodiesel production from its feathers which has high impact value on renewable bioresource management provides pathways for low level emission of carbon pollutants. The government should support the farmers to livestock for long term sustainability. Continued development of the livestock sector will lead to rural development and enhance sustainability (Joseph *et al*., 2011; Yilmaz and Akbas, 2010).

This segment of the energy market is likely to grow rapidly and utilities will adapt to the opportunity with challenges. In developing countries people who are exposed to the biomass smoke in poorly ventilated areas suffer from respiratory diseases. The only advantage of burning biomass is that it releases less CO_2 (WIGFMF., 2006). There are two main branches of biomass conversion, bioconversion process and thermal process. The bioconversion processes are alcoholic fermentation and anaerobic fermentation. The thermal processes are pyrolysis and combustion of the biomass. For example, bioethanol fuel which is mainly produced by the sugar fermentation process, or also be manufactured by the chemical process of reacting ethylene with steam can be used as a petrol substitute for road transport vehicles (Ibeto *et al*., 2011).

Nanotechnology: Nanotechnology, a concept for technologies working at the scale of typically 100 nm and lower is considered a technology for a wide variety of traditional scientific disciplines. Nanotechnology offers, for the first time, tools to develop new industries based on cost-effective and cost-efficient economics and then seriously contributing to a sustainable economic growth. According to the "Road map report concerning the use of nano materials in the energy sector" the most application fields for energy conversion domain will be mainly focused on solar energy, hydrogen conversion and thermoelectric devices. The inclusion of nanoscale components in photovoltaic (PV) cells is a way to reduce some limitations of PV cells (e.g., low conversion efficiencies when crystalline silica is used). First the ability to control the energy band gap provides flexibility and inter-changeability second, nanostructured materials enhance the effective optical path and significantly decrease the probability of charge recombination (Serrano *et al*., 2009).

Alternative offered by nanotechnology to conventional silicon-based solar cell is the use of dye-sensitized solar cells. These solar cells are made of colloidal titanium oxide films which are sandwiched between a transport electrode acting as anode and a platinum electrode which acts as a catalytic conductor (O'Regan and Gratzel, 1991). In the field of hydrogen production, most available hydrogen storage systems are quite inefficient. Mesoporous materials exhibit controlled pore size, shape and architecture and large surface areas in excess of 1000 $m^2 g^{-1}$. In this way high hydrogen adsorption capacities can be obtained by using nanomaterials owing to the high surface areas, optimized pore size and shape, high storage capacity controlled desorption and safety, carbon nanotubes both Multi-Wall (MWCNT) and Single-Wall (SWCNT) have been suggested as suitable candidates for hydrogen storage (Ye *et al*., 1999). Some of the most important energy storage systems are batteries, nowadays, studies have focused on the use of nanotechnology for rechargeable lithium ion batteries. Electrolyte conductivity increases up to six times by introducing nanoparticles of alumina, silicon or zirconium to non-aqueous liquid electrolytes (Serrano *et al*., 2009). In the automotive industry nanotechnology applications are manifold vision of nano in cars reach from contribution for body up to a mood-depending choice of color and a self-forming car body. Furthermore, volume effects like diffusion, adsorption and mechanical strength and surface effects like adsorption, hardness and catalytic reaction might be tailored by the usage of nanocomposites or nanostructures (Presting and Konig, 2003). Sustainable governance of emerging technologies like nanotechnology is a demanding societal challenge. Sustainable governance includes trans disciplinarily, i.e., the creation on knowledge through collaboration among science, business, government and the public. To ensure long-term market success of nanotechnology, more than technical and economical aspects will need to be considered. If nanotechnology is to contribute to sustainability, then involving the public early on before significant Research and Development (R and D) has taken place is crucial (Helland and Kastenholz, 2008). It should be pointed that any sustainability policy is confronted of the availability of knowledge. Shaping nanotechnologies for sustainable development therefore has to be carried out under conditions of uncertain knowledge and provisional assessments. Performance of Life Cycle Assessments (LCA) that includes not only ecological but also economic and social issues on specific nanotechnology products or system should be considered for any disciplinary programs (Fleischer and Grunwald, 2008).

ACCELERATION OF RENEWABLE ENERGIES

Renewable energy is growing quickly owing to strong policy support. The fastest growing energy technology in the world is grid-connected solar photovoltaic (PV), which grew by 60% $year^{-1}$ between 2000 and 2004. Other renewable energy technologies grew during the same period as the following: Geothermal power 14%, off-grind solar PV 17%, wind power 28%, solar energy 17% and biodiesel 25%. Other renewable energy technologies like biomass, geothermal and hydro are growing slowly by the rate of 2-4% $year^{-1}$. The environmental benefits of renewable energy are clear when it is compared to conventional fossil-fuel power. The advantages of generating renewable energies are the reduction of nitrogen oxides (NO), sulfur dioxide (SO_2), carbon dioxide (CO_2), particles and heavy metals (Martinot, 2006). The costs of renewable energies have been the main controversial issues among scientists. A good way to point out the benefits emerging from development of renewable energies is through "External costs". The external cost defined as the real economic damage caused by environmental insults (like fossil-fuel). These external costs have been estimated by European commission study by 2-12% k Wh^{-1} for coal power plants though the external coasts of renewable energies estimated 0.1-2.5% by the same study. This indicates that the costs of environmental damages from fossil fuel outweigh the cost differences between fossil fuel and renewable energies. Without external costs added, one might say that "Renewables are

expensive". The cost of coal and natural gas is a function of fuel prices rather than power plants costs though the cost of renewable energy depends on initial investment costs. It indicates that once a renewable energy facility is built the cost of power from that facility is fixed throughout its life time where as the cost fossil based power depends on future fossil fuel price which is vague (Berger, 2002). In 2005 renewable energies will contest conventional fuels in for distinct areas: Power generation, hot water and space heating, transport fuels and rural energy. Total global power-generating capacity will be 3900 GW which 4% (182 GW) of it would be supplied by power generation. This capacity is from hydro, wind, biomass power and small amount of geothermal and solar PV. Solar thermal power and ocean power anticipated to remain at low levels. Developing countries have approximately half of the renewable power capacity with almost 80 GW (Bilen *et al*., 2008).

ENVIRONMENTALLY SUSTAINABLE TRANSPORT

Efficient transport systems are essential for the functioning of modern industrialized economy. It is increasingly clear that current transport systems are not environmentally, socially and economically sustainable in many countries. Consequently, the ecological requirements for a sustainable transport system implement that the movement of people and goods are provided in sustainable way. It means mobility for communications and enabling social contacts as well as access to goods and services needs to be considered as means rather than an end in itself. This thinking led to sustainable transport system defined as "Transportation does not endanger public health or ecosystem and meets needs for access" (Rees, 2002). Working for an environmentally sustainable transport system would be already starting today to take steps towards fulfilling far-reaching goals. One way to address the issues of sustainable transportation is through classification of vehicles. Potential buyers of motor vehicles should be informed to pay extra if they make an environmentally sound choice. A classification would clarify and spell out the environmental performance of each new motor vehicle. The rating system should go beyond what is required as a minimum by legally binding regulations. Vehicles differ greatly in performance, a system for environmental classification would clearly show this. Different ratings reveal real differences in environmental performance. Other issues which should be mentioned are criteria for all categories of vehicles. These criteria would guide the use of more environmental friendly vehicles for general public, for purchasing in public sector and in companies for example for classification, a vehicle with higher carbon dioxide emissions should have larger interior volume to fit the criteria (Table 3) (Olsson, 1999). Three main ideas should be considered for developing sustainable transport: (1) To provide indoor accommodation for people, (2) To allow people and goods to move in, out and (3) Through the city and to allow pollution to move away from people. When these three objectives are met simultaneously, the city can continue to develop. If there is conflict between any two of these, the feedback causes un-sustainability. Sustainable transportation

Table 3: Environmental classification mode-the parameters would be explored with each criteria (Houghton, 2004)

Parameters	Aspects	Control mode
Exhaust and evaporative emissions	Regulated pollutants	Low emission targets for key pollutants
	Health effects	Health pollutants
	Reactivity	Reactive hydrocarbons
	Design for environmental control	Specific driving modes. Extended evaporative emission control. Extended cold emission control
	CO_2 reduction	Engine and control system adopted for biofuel use unit per interior volume index
Noise		Lower noise. Low-noise tyres
Recycling potential		Percentage recyclable

development can be viewed as a social movement-a group of people with a common ideology who try together to achieve central general goals. In an effort to encourage the creation of a broadly based social movement in support of sustainable development efforts should be made to encourage communities towards sustainability. University campuses can contribute a laboratory for testing and implementing various alternative transportation strategies, reducing infrastructure costs and minimizing their impacts on surrounding areas. One aspect often overlooked by campus administrator and planners is the colleges potential to affect not only the transportation behavior but also the transportation habits that students can develop in long term as they are going to take roles in government, companies or other organizations (Colvil *et al*., 2004). In a survey conducted by Balsas (2003) large numbers of college students encouraged to use other modes like bicycling and walking instead of driving their own cars by teaching and providing them, enough information and facilities which were environmentally sustainable. The result showed that college campuses had a modal shift from cars to other modes especially to bicycling and walking. To confirm this, in another study institutional linkage at all levels found to be important to reach sustainable development (Budak and Yurdakul, 2004). In another study on Protection of Nigeria's Environment, Environmental sustainability education elucidated to be mainstreamed in the curricula of schools and universities while simultaneously awareness creation on environmental pollution is addressed (Eneh and Agbazue, 2011).

A perspective on Environment Sustainable Transport (EST) in 2030: Environmental policy committees on transport have declared six criteria to address the wide range of transport impact. The indicators related to these impacts are: emission of carbon dioxide, nitrogen oxides and volatile organic compounds, carcinogenic particulate matter, noise and land use. Environmentally sustainable transport systems in 2030 will, by definition meet all six of the EST criteria. Transportation in 2030 is characterized by the followings:

- A significant decrease in car ownership and use, with many cars running on hybrid electric engines
- A focus on reducing long-distance passenger travel and on much greater use of non motorized means for short distances
- All-electric rail system, with increase in high speed modes, efficiency and capacity
- More efficient and less polluting inland and coastal shipping vessels with hydrogen widely used as a fuel. Substantial reduction in long-distance air travel; air craft in use are more efficient conventional types (OECD., 1998; Eppel, 1999)

ROLE OF URBAN PARKS FOR SUSTAINABILITY

Urban parks and open green spaces are of strategic importance for the quality of life in urbanized societies. Evidences indicate that the present of natural assets (e.g., urban parks, forests, green belts) and components (e.g., water, trees) in urban context contributes to the quality of life (Ulrich, 1981). Some cities have developing their own sustainability indicators, to try to measure the quality of life issues in a meaningful way. Beside environmental criteria (waste recycling, transportation, etc.), quality of life issues is a main point for a sustainable city. Different aspects for a peaceful life like "Public parks", "Amount of green spaces per inhabitant" and "Recreation areas" are often considered as important features. The relationship between urban parks and sustainability is addressed through the investigation of the value of urban nature as a source of social services essential to the quality of human life which in turn is a key of sustainable development (Prescott-Allen, 1991). Land use planning through ecological information to the

planning process was found to be imperative to achieve sustainable development in Yangtze (China) (Budak and Yurdakul, 2004; Chibamba *et al*., 2009).

In a survey conducted by Chiesura (2004), the role of urban parks on providing the social services and their importance for city sustainability were addressed. Some results were presented of a survey aimed at exploring the motives and ideas of visitors of a Dutch urban park. The results showed that urban nature fulfilled many social function and psychological needs of citizens which made the urban nature as a key for city sustainability. Moreover, different age-groups had different motives to visit the parks and different activities they were going to undertake (Chiesura, 2004). Promotion of environmental quality brought by green land preservation will attract people's immigration and investments, which are good for urban sustainable development. More land development will get more economic benefits due to the economic benefits it brings to urban development (Jim, 2000; Jackson, 2003). On the contrary, the result of study conducted by Chen showed that, though land development can get instant economic benefits it also results in many environmental pollution problems like urban air pollution owing to the reduction of commuters and attraction of peoples' immigration to the cities. Green land preservation, instead of increasing, possesses long-term modification effects evidently to environmental problems by way of land development quotas control and reduced active commuters outside city, though they are invisible at first periods of implementation (Chen *et al*., 2006).

CHALLENGES OF SUSTAINABLE DEVELOPMENT

One of the ways to define sustainable development is in what specifically seeks to achieve. For this purpose three steps of goals that use different time-horizons indicated: the short-term goals (2015) of the millennium declaration of the United Nations, the two generation goals (2050) of the sustainability transition and the long term goals (beyond 2050) of the great transition. To mark the millennium, in September 2000, the UN general assembly adopted some 60 goals regarding peace, development, environment and human rights, etc. Many of these contained specific targets. The UN agencies recently estimated that at existing rate of progress in many developing countries, they will fall short of the goals particularly in Africa. In 1995, the board on sustainable development sought to make sustainable development more meaningful to scientific analysis and contribution. To do so the board decided to focus on two generation. In the time period the board suggested that a minimal sustainability transition would be one in which the world provides the energy, materials and information to feed, nature, house, educate and employ people of 2050 while reducing hunger and poverty and the basic life support system of the planet. The board on sustainable development conducted a scenario analysis of "Sustainability transition" with the assistance of the global scenario group. It especially focuses on hunger and emission of greenhouse gases. This scenario not only achieves the goals of sustainability transition outlined by the board for 2050 but also goes further to achieve for all human kind a rich quality of life, strong human ties and a fundamental connection to nature. In such a world, it would be the quality of human knowledge, creatively and self-realized that represents development, not the quality of goals and services (Raskin *et al*., 2002; Parris and Kates, 2003). Regardless to the definition of sustainability by its specific time, following remarks should be taken into consideration as the challenges of sustainability:

- Sustainable development requires breakthroughs to innovative system renewals
- Development of human capacities to achieve system renewal requires education in transdisciplinary knowledge and skills in higher education

- Experience should be gained by organizing system renewal on micro and meso scales
- Sustainable developmental policies demand a long-term, stable and powerful decision system supporting provided by governments
- Sustainable development needs to be thoroughly analyzed by holistic view (Chen *et al*., 2006)
- Internet and e-commerce are contributors to environmental solutions and enables to reach sustainability goals. The concepts of e-commerce and sustainability and their relationships were fully understood. Some policies and issues of e-commerce and the internet and its effectiveness for achieving sustainability goals to meet emerging challenges also have been explored (Hossain, 2002)

CONCLUSION

In the context of this study the role of air mitigation as a key for sustainable development was addressed. This review encompassed published research to data on how renewable energies, public transportation and green land helped mitigation of air pollution and how each of these criteria influence sustainability. City should be thought as a complex system composed of hierarchically structured departments when sustainable development is pursued. Moreover, deep realize system structure of environment with holistic view for exploring the fundamental ways to deal with environmental air pollution problems among economy, society and environment were indicated as fundamentals for sustainability.

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