ZERO CARBON URBAN DESIGN

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Abstract- The world population is 6.5 billion at the moment and rising. Environmental issues like pollution and deplorable conditions in urban centres including waste damping and tanneries that cause foul doors, spread disease and reduce the values of property in urban centres. These have long ceased to be local issues and have raised international concern due to their detrimental effect that have endangered the whole planet. Climate change has caused widespread greenhouse effects like global warming, higher acid levels in oceans and reduced ice cover at the poles (Harrabin 2013). As a result of this governments in various parts of the world have come up with creative ways of reversing this predicament.

Keywords- About four Key Words or Phrases in Alphabetical Order, Separated by Commas.

I. INTRODUCTION

Zero carbon urban design is a revolutionary move that has been favoured by many governments in the past few years with the aim of curbing the damage caused by adverse climate changes. From a documentary by Al Gore (2006), the major causes of greenhouse effect are the by-products of industrialization, and especially carbon dioxide. The level of Carbon dioxide, the main constituent of emission by vehicles, is linked to consumption of fuel by the vehicle. Due to this there is need to regulate the amount of greenhouse gases that are emitted into the atmosphere and this is effective by fuel economy. The construction of better energy efficient buildings has also been established as a way of reducing the reliance on other forms of energy which pollute the environment and has promoted environment-friendly building. Braathens (2010) seeks to show how the transport activity levels in maritime, road, rail and aviation have impacted on globalization and vice versa.

This paper will focus on the various methods that can be applied to ensure zero carbon emissions as a way of improving the quality of life in the urban centres. In particular, fuel economy will be evaluated in detail to determine its application in promoting the success of zero carbon emissions from vehicular automotives.

II. ZERO-CARBON URBAN CENTRES

Greenhouse gases are those that contribute to the greenhouse effect by absorbing infrared radiation, and they include carbon dioxide, chlorofluorocarbon, hydro fluorocarbon and sulphur hexafluoride among others. In both industrial and developing countries alike, cities use fossil fuels such as coal, gas and oil to produce energy and they emit greenhouse gases into the atmosphere. A zero-carbon city is a term used to refer to an urban centre that has zero emissions of carbon and other greenhouse gases and one that is unlikely to cause any harmful effect on the planet. Such a city would run completely in renewable energy as the sole energy source and it maintains an optimal standard of living while reducing the impact on the environment. The process of making an already established modern urban centre into a zero carbon city would involve reducing the amount of emission of greenhouse gases to zero and increasing the use of renewable energy above other sources. This would further be coupled by the use of renewable electricity and transport modes that have zero emission of carbon dioxide.

III. INITIATIVES IN ECO-CITIES

A. Energy

The use of fossil sources energy such as coal is one of the core reasons the planet is experiencing global warming due to the emission of greenhouse gases. An ideal eco-city would be self-sufficient in energy production and use. The use of natural and environment friendly sources of energy in a city would reduce the levels of carbon released into the atmosphere. The use of skylights and clear walls of glass would ensure sufficient lighting during the day and reduce the dependency on electrical power for lighting. Most of the energy utilized by an eco-city would most likely be solar energy, generated using photovoltaic panels, solar collectors and thermal tubes (McKenna 2008). A design in which streets are narrow would ensure maximum shaded areas in the city which would be coupled with wind cooling towers which would aid in reducing the costs of maintaining low temperatures during hot weather. The use of wind and biomass sources of energy to provide the city with power is another initiative that would reduce the levels of pollution (Guggenheim 2007).

B. Transport

The use of transport systems that are battery powered or applying auto piloted personal rapid systems (RPT) in cities to replace fuel vehicles would be one big step towards acquiring an improved, environment friendly transport system (Abbasi et al. 2012). For proposed zero carbon cities such as the prototypic Dongtan city,

people getting into the city would have to park their vehicles outside the city and use the public transport venues available. This would enable developers and planners of the city maintain carbon levels as low as possible within the economic limitations (Cheng & Hu 2009). Cities would also encourage walking and cycling among the people, a move that would work in both reducing congestion in the urban centres and promoting healthy lifestyles (Cheng & Hu 2009). Major cities would also be connected through railroad or cableways for electric trains. Electrical power for the electric trains would be drawn from hydropower hence ensuring minimal emission of carbon into the atmosphere.

IV. LOW CARBON ECONOMY

This is an economy that has low emissions of greenhouse gases especially carbon dioxide into the environment (Greenpeace 2010). The implementation of low carbon economies around the world is an initiative to work around a looming catastrophe in climate change as well as the creation of a zero- carbon society that is solely reliant on renewable energy. France is a good example of an industrialized country that has the lowest emission of carbon dioxide per unit GDP. This is mainly because 75% of the electricity produced in France is from nuclear power, and it is the largest exporter of electricity in the world with an annual sale of about 3 billion euros (Kellner 2013).

The use of renewable energy involves use of energy from naturally replenished resources that cannot be depleted such as sunlight, tides, wind and geothermal heat. These sources of energy account for about 19% of the final energy consumed globally and with strong policies in place as well as cooperation from all countries, improvement of energy efficiency can be a reality in the next few decades. The conversion of carbon dioxide into methane by combining it with hydrogen, which is created through electrolysis of water using electrical energy that is in excess, is another way of generation of renewable energy without emission into the atmosphere. This provides storage of energy for use as back up when the power from the sun is not enough to generate electricity. The use of technologies such as combined heat and power (CHP) and carbon capture and storage (CCS) are other innovations towards reduced carbon emissions. CHP is a zero carbon option which could reduce the emissions by the use of biomass as a store for energy by allowing for the efficient use of the fuel. It can also be used with a nuclear reactor as an energy source on its own while nuclear power could be used as a primary source of energy despite fears of costs of implementing it to achieve a low carbon economy around the world.

In a bid to decarbonize transport services in urban centres, planners and developers are pushing for more energy efficient modes of transport with alternative actuation. This is made possible by increasing their focus on using fuel efficient vehicles types while advocating for electrical-powered vehicles with rechargeable batteries to decrease the dependency on cableways which would congest the urban centres. The use of flex-fuel vehicular automotive with consideration of local conditions and availability, as well as driver training would serve to improve fuel efficiency. The use of low carbon in biofuels and petroleum products is a sure of decreasing greenhouse gas emission from vehicles that use these fuels. By promoting electric rail and the use of waterways transport for transport, the use of non-motorised transport like cycling and walking as well as availing public transport avenues would reduce the reliance on private vehicles and hence reduce the amount of emission in urban centres. The use of pipeline for the freight of fluid goods like ethanol, gasoline, diesel, petroleum, hydrogen and even water would reduce the reliance on road to transport these common commodities.

This table shows required rate of decarburization of all G20 countries on an annual basis between 2012 and 2050 as well as the progress of these countries in reducing the emission levels of carbon. Countries such as Germany and France that showed reduced carbon emission results owed this to mild winter conditions which led to reduced energy use in the period. However, the adoption of renewable energy by some developed countries was the major reason for the reduced carbon emission. Germany stopped using nuclear energy and this reflected on the decline of the emissions (Grant & Johnson 2012). The United States shifted from the use of coal towards utilization of shale gal in its fuel mix and advocated for the use of more efficient vehicles on its roads in a bid to decarbonize itself (Grant & Johnson 2012).

V. FUEL ECONOMY

Fuel economy has been found to play an important role in the reduction of greenhouse gases and especially carbon dioxide. Due to this, it is pursued by countries seeking to reduce their levels of emissions. Automobile markets as well as manufacturers need to consider the fuel economy set standards within a market or country in making and distributing more efficient vehicles. There has been a shift in the priority of improving fuel economy with preference to reducing the emission of greenhouse gases by vehicles as a way of reducing the greenhouse effect. Even with the renovation of fuel economy standards in developed countries, the increasing demands on oil and increased emission of greenhouse gases is still a major challenge which is yet to be fully addressed (An, Robert & Lucia 2011).

Fuel economy can be measured mainly by the amount

of fuel consumed in order to cover a given distance by an automobile which differs from car to car (GFEI 2013). This is achieved by the use of drive cycles with consideration for external factors that may affect results. These factors include different designs of cars which give varying results and varying operating conditions. Operating conditions either on a highway, an urban environment or a combination of both, would have different results on driving cycles even on the same vehicle. Several factors that influence the fuel economy of a vehicle include the engine characteristics, gear train characteristics, weight and aerodynamics, rolling resistance, driving cycle and driver habits. Change to a higher gear in an internal combustion engine leads to a decrease in the speed reduction ratio, and

Table 1- Low Carbon Economy Index league table for G20 countries (World Bank 2012 & BP Statistical Review 2012)

Country	Change in energy-related emissions 2010-2011	Real GDP growth (PPP) 2010-2011	Carbon intensity (tC02/2011$m) 2010-2011	Change in carbon intensity 2010-2011	Annual average change in carbon intensity 2000-2011	Required annual decarburization rate 2012-2050
France	-6.1%	1.7%	153	-7.7%	-2.4%	-4.4%
UK	-6.4%	0.7%	209	-7.0%	-2.8%	-5.2%
Germany	-3.6%	3%	235	-6.4%	-2.2%	-5.2%
Indonesia	0.9%	6.5%	377	-5.2%	-1.0%	-4.9%
EU	-3.6%	1.5%	213	-5.1%	-2.3%	-5.2%
USA	-1.9%	1.7%	374	-3.5%	-2.1%	-5.2%
Italy	-2.5%	0.4%	203	-2.9%	-1.2%	-4.3%
Mexico	1.7%	3.9%	244	-2.1%	-0.2%	-4.6%
South Africa	1.5%	3.1%	781	-1.6%	-1.4%	-5.6%
Russia	2.9%	4.3%	510	-1.6%	-3.9%	-6.0%
Brazil	1.7%	2.7%	197	-1.0%	-0.7%	-4.1%
Argentina	7.9%	8.9%	242	-0.9%	-1.6%	-5.0%
South Korea	2.9%	3.6%	464	-0.7%	-1.0%	-6.5%
Canada	2.0%	2.5%	416	-0.4%	-1.4%	-5.3%
Saudi Arabia	6.7%	6.8%	817	0.0%	-1.9%	-7.0%
India	6.9%	6.9%	377	0.0%	-1.4%	-4.4%
Turkey	8.6%	8.5%	244	0.1%	-0.5%	-5.0%
China	9.4%	9.1%	754	0.2%	-1.4%	-6.1%
Japan	0.1%	-0.7%	281	0.8%	-0.8%	-4.8%
Spain	2.2%	0.7%	211	1.5%	-1.9%	-3.6%
Australia	8.7%	1.8%	415	6.7%	-1.7%	-5.3%
World	3.0%	3.7%	395	-0.7%	-0.8%	-5.1%

this reduces the output torque of the transmission reducing the tractive force. When the resistance force matches the tractive forces by the gear train, fuel economy in the vehicle is maximised. The shape of the vehicle determines its aerodynamic properties with bigger cars having better efficiency in aerodynamic design due to the large area at the front. Air drag coefficient can be reduced by ensuring smooth air flow over the exterior and under body of the vehicle as well as in the interior and this ensures fuel efficiency as less fuel is used to counter the air drag especially when driving along a highway (An, Robert & Lucia 2011). The rolling resistance is determined by various factors like temperature, dimension coefficient, speed, wheel geometry and material characteristics of the road and tyre as well as the interface between the road and the tires. A lower resistance decreases the speed reduction ratio. Increased weight of vehicles due to introduction of more efficient technology and demand for various accessories such as heaters and air conditioners among others by customers causes an increase in the power requirement in a vehicle which does not have a positive effect on the fuel economy (An, Robert & Lucia 2011).

There has been a global initiative under the guidance of GFEI (2013) aimed at reducing the fuel consumption globally from highs of 8 litres corresponding to 29.4 mpg down to 4 litres corresponding to 58.8 mpg for every 100 km in the next 40 years. An adoption of similar fuel economy regulations by major automobile markets which differ

significantly would serve to standardize the issue globally (An, Robert & Lucia 2011). While increasing fuel efficiency in vehicles would increase economic costs to the customer, the ultimate improvements on automobile would be of considerable economic benefit to both the manufacturer and customer. The customer would save more on fuel expenses while the manufacturer would save on potential expenses on penalties for failing to comply with the international fuel efficiency standards. The environment would be the greatest winner in that the emissions of carbon would be reduced considerably.

CONCLUSION

According to researchers, the use of natural resources including solar and wind energy as well as carbon-neutral biogas is a big step in reducing greenhouse emissions, but to achieve zero levels would require changing the diet and transport habits of the people (Kellner 2013). This move would also promote biodiversity and a healthier society while reducing greenhouse gas emissions and creating job opportunities (Kellner 2013). While the ultimate goal should be to reduce the average global temperature to less than ‘2 degrees Celsius above pre industrial levels, there is need for more initiative and action to make these goals a reality and reverse the global warming threat.

A decrease in emissions of noticeable magnitude is only possible if developed industrial countries take the initiative and lead by example in reducing emissions in their cities. If these countries transform themselves into low carbon and highly efficient economies then the climate change strategy will be greatly enhanced.

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