

Potentiality of energy-plus urban developments in developing countries. Case study: Dhaka, Bangladesh

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ABSTRACT: Our world is going through an unprecedented energy crisis. The increasing global energy demand combined with declining energy resources have resulted in such crisis. Moreover, energy sector is also claimed to be one of the major contributors of climate change as 65% of world's green house gas (GHG) emission is energy related. A huge share of this energy is consumed by the cities and buildings. Reducing energy consumption by the building sector as well as shifting to green energy sources have become one of the prime agendas to address both the issues of climate change and energy security. Several alternative buildings and neighbourhoods have been emerged in developed countries to address this issue. Unfortunately, even after the successful existence of such alternatives for more than a decade, to date these have not yet been very successful to create a market demand. This paper argues that developing countries are rather in a favourable position due to some particular contexts for being successful in the wider deployment of these alternatives. This paper, through an in-depth literature review and personal experiences of the author as an architect and a Dhaka city dweller, examines and presents the potentiality of energy-plus urban developments in the unique context of Dhaka, the capital of Bangladesh.

Conference theme: Buildings and energy

Keywords: Energy-plus urban developments, developing countries, Dhaka

INTRODUCTION

Our world is going through an unprecedented energy crisis. Increasing global energy demand in contrast to the depleting fossil fuels or main energy resources have resulted in such crisis. Moreover, world's energy sector alone accounts for sixty five percent of total green house gas (GHG) emission and this is claimed to have a significant negative impact such as global warming and climate change on environment (Lund 2009; Evan et. al. 2009; UNEP 2007). The overall instability of the energy sector is being manifested through fuel price rise, global political conflict, economic instability and increased competition for an access to finite fossil fuel resources (Williams 2012). As a consequence, the energy security of developed countries is being threatened while the energy scarcity of developing ones is being exacerbated.

Global energy demand is increasing at an exceptional rate mainly due to the rapid growth in population and urbanization in developing countries. It has been projected that the world's population will increase from slightly above 7 billion in 2012 to 9-10 billion in 2050 and the majority of them will be living in Asian developing countries (WB 2011; USCB 2012; UN 2010; Ferrey & Cabraal 2006). Not only the population is growing at a faster rate but also a rapid urbanization is taking place in developing countries as a result of significant rural-urban migrations. It is estimated that 93% of urban growth will be occurring in developing countries and 80% of them will be in Asia (UN 2005; UNFPA 2007). At present, nearly 1.6 billion people predominantly in developing countries are yet to have an access to electricity (Energypedia 2012; IEA 2010). The existing population without energy access along with the future ones will therefore put pressure on energy resources in the coming years, with major energy demand in fact coming from cities and buildings in developing countries.

Since buildings are one of the major consumers of energy and are thus responsible for 30-40% of world's total GHG emission, several alternative buildings and settlements have emerged in developed countries to reduce the energy consumption and GHG emission by buildings (UNEP 2007; Harvey 2006). It has been estimated that to reach the desired target of GHG emission reduction, buildings in developed countries need to reduce energy consumption by sixty percent by 2050 (WBCSD 2007). Alternative buildings that are commonly known as passive, low-energy, zero-net energy and energy-plus buildings not only consume lesser energy than a traditional one but some of them are also able to generate energy on their own by building integrated or mounted micro-generators such as photovoltaic, wind turbine etc. (Williams 2012; Disch 2009). The energy generated by such buildings is from renewable energy sources such as sun, wind, bio-mass or geothermal and therefore is GHG emission free (Williams 2012; Droege 2009). Unfortunately, despite of having the existence of several such successful exemplar buildings for more than a decade now and the high potential of these alternatives to supply clean energy and reduce GHG emission from building sector, to date these alternatives have not yet been very successful in creating a market demand for them in developed countries (Williams 2012).

This paper argues that several contexts such as energy scarcity, daily power blackout and managing emergency

power supply during blackout that are particular to a developing country can in fact be considered as advantages for being successful in the wider deployment of alternative buildings in developing countries. In addition to these contexts, majority of future energy demand will be from the developing countries since more than two-thirds of the future megacities are emerging in that part of the world. Therefore, more effort should be dedicated to initiate developments that accommodate energy-generating buildings, especially energy-plus buildings, in developing countries. Successful deployment of such developments in developing countries can play two major roles; 1) it can significantly contribute to meet the energy demand of these countries, which is an absolute necessity for them to get rid of energy poverty and, 2) It can greatly reduce the future GHG emission from these countries beforehand. This paper through an in-depth literature review and personal experiences of the author as an architect and a Dhaka city dweller examines and presents the potentiality of energy-plus urban developments in the unique context of Dhaka, the capital city of a South Asian developing country named Bangladesh.

1. ENERGY-PLUS BUILDING AND URBAN DEVELOPMENT

A building or a group of buildings can be called “energy-plus” if it can generate surplus energy than it consumes through building integrated or mounted micro generators such as photovoltaic, wind turbine etc. from renewable energy sources (Williams 2012; Disch 2009). An energy-plus building was first developed in the last decade of 20th century as a response to emerging energy crisis. Such building can potentially address two central energy issues- increase energy security by reducing dependency on fossil fuels and reduce GHG emission from building sector.

Buildings consume energy in five major stages, namely, manufacturing of the material, transportation of the materials to site, actual construction, operation and demolition. Of all the stages, operational stage alone accounts for 80% of total energy consumption by a traditional building during its lifetime (Williams 2012; Evan et.al.2009). The operational stage of a building consumes energy for lighting, heating, cooling and other activities like cooking, cleaning etc. The energy consumed during operational stage can potentially be supplied by building integrated or mounted renewable energy technologies. However, the amount of energy a traditional building consumes probably cannot be fully supported by building mounted or integrated technologies if the buildings do not consider energy efficiency. Only with increased efficiency and reduced consumption can renewable energy technologies be useful. This in fact is the basic idea based on which energy-plus buildings have been developed. Following the same definition of an energy-plus building therefore an urban development can be called energy-plus if it can (or if the components of an urban development such as buildings, street lights, and traffic lights) can generate surplus energy than it consumes. Nonetheless, the success of an energy-plus urban development will largely depend on to what extent the most important component of the development – buildings- can generate surplus energy.

The first energy-plus building was constructed only in 1994 in Friburg, Germany by the German architect Rolf Disch. The first building he constructed was his domicile known as ‘Heliotrope’. The design of the building was inspired by the heliotrope plants, such as sunflower, which turns with the course of the sun. The cylindrical, three-storied structure of the heliotrope building including a sun sail made of photovoltaic on the roof also rotates to track the sun. The energy generated by the building is entirely renewable, emissions free and CO₂ neutral. The second Heliotrope was built in Offenburg, Germany as a visitor’s centre and showroom and the third Heliotrope was built in Hilpoltstein, Bavaria to be used as a technical dental laboratory (Disch 2009).

After the success of the Heliotropes, Rolf Disch applied the concept for the first solar settlement on earth with positive energy balance. The settlement accommodates 59 plus-energy houses and a commercial centre named ‘Sunship’ in Vauban quarter of Freiburg, Germany. Until today, this is the largest energy-plus settlement development that is built. Energy-plus buildings follow two basic principles. They are,

- 1) Reducing energy demand through low-energy building techniques, such as, passive solar building design, insulation, careful site selection and placement and,
- 2) Generating energy through building integrated or mounted micro generators from renewable energy sources mainly by exploiting solar energies through solar PV module and heat trap.

Following these two basic principles, heliotropes and the buildings in Freiburg generate 4 to 6 times more energy depending on the time of the year (Disch 2009).

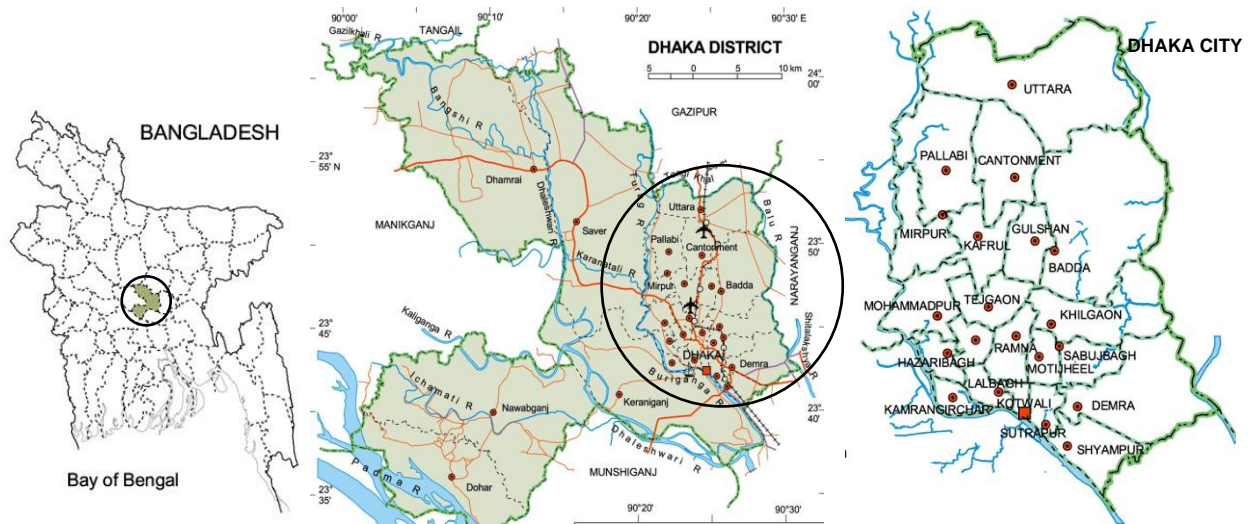
2. THE CASE STUDY: DHAKA

Dhaka, the capital of Bangladesh, is located centrally and lies between East Longitudes 90°20’ and 90°30’ and between North Latitudes 23°40’ and 23°55’. The tropic of cancer is through the southern part of the city. The total area of the city is 1,460 square kilometres (BBS 2011; BBS 2010). Topographically, the city is on a flat land, which is surrounded by low-lying regions and three rivers. Historically, it played an important role on the formation of the city as it could grow mostly towards the north (Ahmed 2006; Islam 1996; Chowdhury et. al. 1991).

The city has experienced several ups and downs in growth before its being born as the capital city of a newly independent country in 1971 after a bloody war with former West Pakistan now known as Pakistan (Ahmed 2006; Islam 1996). However, after gaining the sudden status of a capital city, the city is only experiencing growth (Ahmed 2006). A tremendous growth in urbanization took place and the population suddenly increased from 718,766 in 1971 to 2,068,353 in 1974 (BBS 1997; Chowdhury et.al. 1991). Within a decade one million new populations were added

to the city within an area of about 510 sq. km (Islam 1996). Dhaka was the only city on earth that experienced a population growth at an annual rate of 6.9% during the period 1974-2000 (UN 1999). The rapid growth in population of the city was described as 'exceptional' by the United Nations (UN 1999). The city began to expand in all directions to meet the needs of the newly independent country's capital and the wetlands and low-lying areas within the city and the fringe areas started to disappear quickly (RAJUK 2012).

The current population of Dhaka mega city is slightly over 15 million and still is growing due to rural urban migration at one of the highest annual rates (4.2%) in the world (CIA 2012; Wikipedia 2012; UN 2001). Only 28% of the country's current population lives in urban areas; however, it has been projected that by 2050 this figure will increase to 58.75% (CIA 2012). Dhaka will be inhabited by more than 20 million people in 2015 making it the second largest megacity on earth (Williams 2012; UN 2001).



Source: (Ahmed 2006)

Figure 01: Showing Dhaka city map and location

2.1. Urban Context of Dhaka city

Since the city expanded unexpectedly after the liberation war, the Government or development authority could not keep pace with the urbanization rate. To address the new pace of urbanization a new master plan was proposed in 1993. The goal of the plan was to provide a long-term strategy for the greater Dhaka development for a period of 20 years from 1995 to 2015 (RAJUK 2012; DMDP 1993). This plan is known as Dhaka Metropolitan Development Plan (DMDP) 1995-2015. The target population was 15 million; however, the city already has crossed the estimated projection of 15 million three years earlier. Inability of the development authority to meet the development demand has resulted in a numerous informal and spontaneous developments in Dhaka city. Evidently, Dhaka city represents a mixed character of formal and informal developments.

Formal developments are essentially undertaken by the formal public and private sectors and both sectors usually follow the same development formula or patterns. The most common type of development by the public sector is land development for housing or township projects along with infrastructural developments such as road networks and utilities. The developed land is then divided into plots and is allocated to citizens to build their residential or commercial buildings by following the building codes and regulations. The common features of such developments are; straight and nearly gridiron pattern road networks, wide roads and same sized symmetric regular shaped rectangular plots. Although during the Pakistan period, sizes of the plots varied mostly between 7500sft (697sqm apx.) to 15000sft (1395sqm apx.), a huge demand on serviced land has resulted in reduced plot sizes in post-independence period. Currently, the plots are around 2250sft (209sqm apx.), 3750sft (348sqm apx.) or sometimes 7500sft (RAJUK 2012; REHAB 2010; Parveen 2006).

For land development, the private sector follows the same pattern of the public sector; however, in addition to land development, the private sector also develops individual apartment buildings in negotiation with the landowner. The most common form of negotiation is 60-40 or 50-50 share depending on the location of the land, where, developers build the apartments and give 40- 50% of the apartments to the landowner and sell the rest of the apartments to buyers. In addition to developing individual apartment buildings, some large-scale developers also build housing complexes with high-rise apartment buildings of 15-20 stories (REHAB 2010; Parveen 2006).

To cater the new population and to shift the pressure from central Dhaka city, numerous development projects & townships around Dhaka are being constructed both by public and private sector following the above-mentioned principles. Currently, the largest township of the country is being developed by the Government at the eastern side of Dhaka city with 25,000 residential plots and 62,000 apartments on 6150 acres of land with four more to come in the future (RAJUK 2012).

On the other side, independent and individual landowners develop informal settlements. These developments are usually adjacent to the established formal developments with the common features include narrow streets with a serpentine character, irregular, inconsistent and asymmetric shapes and size of building plots. The main reason for such characters is that initially these were the fringe areas and lands were bought according to the affordability of a landowner when the area was under developed and cheap; however, eventually with the expansion of the city, these areas have become an integrated part of the city. Streets are narrow and serpentine in nature because landowners mutually left some of their lands to make an access from the main road network of the city to the plot. The landowner usually develops buildings in informal developments over a long period of time with the help of local contractors and in general without consulting a professional such as architect or builder. Usually these are the high-density areas (Parveen 2006).

2.2. Dhaka's urban context and energy consequences

What are the impacts of current urban development pattern and construction practices on energy consumption? Several studies have indicated that Dhaka city buildings have an unsustainable and inefficient energy consumption pattern (Ahsan 2009; Ahmed 1996). The main reason for this is, the present planning and building laws mainly focuses on the density and development control related issues and not on the energy consequences of urban and building development practices. To date, Bangladesh is one of the very few countries that do not have any energy codes for the buildings even though the cities are highly dense. There are no regulations for the building envelope, materials or energy performance of a building. As a result, real estate developers are not obliged to follow passive design principles and to avoid additional costs; they usually construct 125 mm thick external walls instead of 250 mm walls, which have serious consequences on indoor thermal comfort and results in increased use of energy intensive active means such as air conditioners (Ahsan 2009).

The present setback rules are related to a particular plot dimension without regard to any urban module or blocks thus resulting in an uneven building line, which often obstructs the natural airflow. In addition, the setbacks are narrow and do not allow ample daylight into the interior spaces of a building, therefore is resulting in the use of artificial lighting even in daytime. Significant variation in temperatures has been recorded in different parts of the city by several studies, which is suggestive of the growing problem of overheating due to Dhaka's inexorable urban growth (Ahmed 1995, Ahmed 1987).

Studies have also shown significantly higher temperature in city area than the surrounding vicinity (Ahmed 1995). The situation became worse during post-independence period as the reduced plot sizes resulted in increased hard surface areas. Overheating of the city is becoming a growing concern as it has direct link to energy consumption. Studies have indicated that higher consumption of electricity during summer months is possibly due to the urban climatic factor on the energy need (Ahmed 1995).

It is therefore evident that there is a high potential for reducing energy consumption from existing and future buildings and urban developments if necessary steps are taken, which will then provide the base for successful renewable energy deployment. This is important as the country is struggling with poor energy system and extreme energy scarcity with one of the lowest per capita energy consumption of 220 kWh/ year (Energylopedia 2012; Islam 2006). Only 47% of total Bangladeshi population has access to modern energy and a huge gap of 2000MW exists between electricity demand and supply, which is seriously hindering the economic development of the country (MPEMR 2012; Munim et.al. 2010).

2.3. Energy context of Dhaka city

Dhaka city consumes nearly one-fifth of total commercial energy produced daily. Peak electricity demand of the city is 2000MW; however, the city is supplied with only about 1000-1200 MW (Kabir et.al. 2009). Power outage or load shedding is the most common everyday phenomenon experienced by Dhaka city dwellers. During hot summer months when the gap between demand and supply is the highest, the load shedding situation becomes worse and some parts of the city, mainly in fringe areas, experience 8-12 hours of daily power outages. Probably Dhaka city suffers most due to the interrupted and unreliable energy supply, as all major administrative, commercial, institutional or industrial activities of the country are Dhaka centric.

This poor energy condition is seriously hindering daily activities of the city and causing huge economic loss as unreliable and interrupted energy supply reduces the lifespan of energy driven appliances and machines such as, computers, refrigerators or televisions as well as it hampers the production of many small-scale industries that cannot afford alternative power supply through personal generators.

Every household of the city manages their own emergency power supply during power outages through different methods depending on the affordability. The most common power sources are, candle, kerosene lamp, lantern, Instant Power Supply (IPS) by batteries, and diesel or gas run generators. However, the need of emergency power supplies not only hampers the daily activities of the city but also imposes additional costs to avail them. In addition, it threatens the health and well being of people as candle, kerosene lamp and generators produces toxic fumes, which cause air pollution. In addition, generators create noise pollution and the disposal of IPS batteries imposes environmental risk.

To handle the increasing energy demand of the city, which is increasing at an annual rate of 10%, the Government has imposed several embargos (MPEMR 2012). For example, electricity connection to new residential buildings was suspended for two years from 2009-2011, where trading times of the markets and shops have been reduced etc. Any

new apartment building in Dhaka city, which will consume more than 2MW of electricity per year, is now required to install solar photovoltaic (PV) panels to manage some part of their energy demand. The embargo; however, has caused a significant recession in real estate business in last two years. Also, hospitals, schools and large institute buildings are advised to manage some of their electricity demands from solar powers (MPEMR 2012).

Apparently, rather than some policy implementation, no real actions have been taken to meet the immediate energy need of the city. It has been recommended in a study that deploying solar PV on available bright rooftops of the city can potentially fill up the gap between peak energy demand and supply of the city in a short period of time (Kabir et. al. 2009).

3. POTENTIALITY OF ENERGY-PLUS URBAN DEVELOPMENTS IN THE CONTEXT OF DHAKA

As it has been mentioned earlier that even after having a number of successful examples of energy generating buildings and settlements in reality and despite of their high potentiality in addressing the issues of GHG emission and fossil fuel depletion, energy-plus developments have not been very successful in creating a market demand at their place of origin. It has been confirmed by a study that the reason is not technical in fact there is no technical limitation for deploying such developments (Williams 2012). The main reasons are rather non-technical and as identified by some studies are (Williams 2012; Jardine and Ault 2008),

- 1) Need to compromise with six quality of life dimensions such as comfort, convenience, privacy, personal freedom, affordability and, safety and security.
- 2) More active involvement of the consumer in energy management.
- 3) Higher initial costs with no added market value.
- 4) Lack of priority in energy saving.
- 5) People's perception of such projects as aesthetically less attractive therefore less market value.
- 6) Well supported conventional energy system and very strong energy lobbies to dismiss the entry of any new competitor.

The study suggested that the people's perception of quality of life is rather biased and are valued against what they are already accustomed to as a passive consumer of energy and are unable to assess as an active consumer of energy (Williams 2012). Further, the dramatic reduction of new building constructions due to economic recession in developed countries also has played a significant role against the wider deployment of energy-plus developments. These projects were initiated mainly to address and encourage the future building stocks but now the opportunity has become limited. Therefore, the scale of constructions needed to gain the momentum for creating a market demand as well as to develop the skill and expertise for wider deployment of such developments are absent in developed countries (Williams 2012).

On the other hand, the contexts in developing countries are completely opposite. If we consider the case of Dhaka we see that a huge number of new constructions and urban developments are going to take place in coming years. More than five million new population needs to be accommodated in Dhaka by 2020, which can provide the necessary momentum to create a market demand for energy-plus urban developments in Dhaka city.

In addition, the barriers such as compromised living quality or more involvement in energy management are very unlikely to become an issue for Dhaka city dwellers. The main reason is people in Dhaka city already live in a substandard living condition with interrupted and insufficient energy supply due to extreme energy scarcity. Also, they are involved with personal energy management because of the need of managing emergency power supply during power outages. Therefore, a little improvement in energy supply in fact will improve the living quality significantly and compromising with living qualities such as comfort, convenience etc. is much more acceptable than no energy or lack of energy. Besides, the existing energy system of the country is poor and state owned therefore energy lobbies are not as strong as in developed countries and policy making is easier.

However, higher costs can also be a potential barrier in the context of Dhaka, but the advantage is the Government is in a better position to offer more economic incentives since CO₂ trade is an option for developing countries. Moreover, energy-plus urban developments will reduce the need for investments in new energy plants thus will save a significant amount of money, which can be directed towards promoting energy-plus urban developments in Dhaka city. In addition, access to climate change fund or other similar funds will be much easier for financing such developments.

The geographic location of Dhaka city also offers excellent potentials for energy-plus developments. Energy-plus buildings are highly solar energy dependent and aim at maximizing the use of solar energy for surplus electricity generation. According to Ar. Rolf Disch, the architect of the first energy-plus house in the world, 'The solar era has begun. The era of fossil and nuclear fuels is a thing of the past' (Disch 2009:11). Therefore, solar potential of a particular location is important for achieving the best result or to what extent surplus energy can be produced. Dhaka, being located on the tropic of cancer offers high Global Horizontal Irradiance (GHI) value equivalent to 4.2 kWh/m²/day (Kabir et. al 2009). Also, the daily average sunshine hour is 5-7 hours and sunshine is available for 300 days/year (Ahmed, 1996). A study revealed that geophysical factors like geographical location, GHI, sunshine duration are fully supportive to large-scale photovoltaic (PV) application in Dhaka city and the current available bright roof tops of Dhaka city alone can generate nearly 1000MW of electricity through standalone solar PV, which is half of the peak energy demand of the city (Kabir et al 2009).

Solar PV has been deployed in nearly one million rural households of Bangladesh commonly known as solar home system (SHS) to meet the very basic energy needs (IDCOL 2007). Except the PV module, the country produces all the necessary supporting accessories needed for PV deployment, such as battery, wire, inverters etc. Two PV industries are currently under construction near Dhaka city, which will allow the country to produce its own PV modules. Therefore, the technical knowhow to install and generate energy through standalone PV modules is already available in Bangladesh, which offers an additional advantage for initiating energy-plus buildings and urban developments in Dhaka city (REIN 2007).

In addition to solar energy, energy-plus buildings and settlements also utilize waste to generate surplus energy. In Dhaka, an average household produces 7 kg of organic waste daily, which is mainly due to the absence of processed food and consumption of raw foods, such as undressed chicken, meat, fish or vegetables. Therefore, a high potential for generating energy through organic wastes is also present.

In general, Dhaka city buildings are not as energy intensive as the buildings in developed countries due to the limited use of modern energy-driven thermal control appliances such as air conditioner or heater. Yet again, the buildings are highly suspected for inefficient energy consumption for the tight setback rules, the absence of energy code, highly dense built environment that does not allow ample daylight and airflow inside buildings and for not following passive design options. Therefore, the already low energy demand can significantly be reduced further if energy efficiency measures are applied both at urban and building level. It can be expected that the energy generated through solar, waste and other methods afterwards will potentially be able to surplus the reduced energy demand.

Theoretically, Dhaka city is better prepared than any other developed countries to embrace and initiate energy-plus urban developments and possess higher potentiality for being successful in wider deployment of such developments.

4. CHALLENGES

Although Dhaka city may offer considerably higher potentials for successful deployment of energy-plus developments over developed countries; several challenges will need to be addressed to achieve real success. In contrary to the situation in developed countries, the primary challenge for energy-plus urban developments in Dhaka will be technical rather than social, economical or political.

One of the major challenges will be the application of energy efficiency measures since energy-plus buildings require more stringent standards for maximizing energy saving to generate surplus energy, which may only be achieved through the construction of complex and highly technical energy efficiency measures such as high-tech façade, rotating solar sail or window glazing etc. Such expensive and highly technical measures may not be suitable to apply in the context of a developing city like Dhaka where the construction of a building in majority of cases is completely based on manual labor under the supervision of a half educated contractor therefore inexpensive. Less technical efficiency measures that are suitable for a developing country therefore need to be developed. However, since the buildings in Dhaka city are much less energy intensive compared to the ones in developed countries, buildings with less technical and less stringent efficiency standards may still generate surplus energy.

The only energy-plus settlement available to date is the solar settlement in Freiberg, which is a suburban moderate density settlement. To generate surplus energy by any building in a settlement, maximum exploitation of solar energy is needed therefore the distance between buildings is important as shadow casting of one building on another is not desirable. This principle in low density developments where the buildings are two-three storied high can be followed easily; however, this will impose a serious challenge for a high density multistorey development, which is the case of Dhaka city.

Moreover, the solar settlement in Freiberg is located in cold climate of Germany where the buildings are primarily focused on preventing heat loss in contrast to the climatic context of Dhaka where the focus is on cooling rather than heating. A contradictory situation may arise from deployment of solar technologies in Dhaka as to generate energy from solar PV; buildings need to receive as much solar radiation as possible, which will result in increased temperature inside the building and requirement for further cooling. Achieving thermal comfort while maximizing energy generation from solar PV will be a great challenge for a successful implementation of energy-plus urban developments in Dhaka city.

Therefore, the success of energy-plus urban developments in Dhaka city will largely depend on the way it is being implemented in a densely populated hot-humid area.

CONCLUSION

An energy-plus development can be considered as a highly promising approach in addressing three major energy challenges – depletion of fossil fuel resources, GHG emission from energy sector and increased energy demand. However, predetermined notion about quality of life, strong conventional energy lobby, higher costs, and recent recessions in new building constructions are obstructing the market penetration and wider deployment of such developments in developed world. It is now time to look towards developing countries for deployment of such developments since these are the countries where the majority of megacities are emerging and hence the majority of future energy demand is surfacing.

The context of Dhaka city presented and examined in this paper has shown that the apparent backward contexts

such as energy scarcity, daily blackouts or poor energy system that prevail in this city in fact offer higher potentiality for being successful in embracing and wider deployment of this new type of urban development if technical challenges are addressed properly. This possibility can start a whole new era since not only this can be a potential way to meet the future energy demand in developing countries, it also offers a solution with minimal negative impact on the environment. Therefore, much effort should be dedicated to, and more in-depth researches should be conducted for deploying and promoting energy-plus urban developments not only in Dhaka but also in other developing countries as a step forward towards a more socially just energy poverty free and environment friendly world.

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