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Encouraging Green Building in Pakistan

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Abstract
Pakistan is currently facing an energy crisis that many believe has resulted from an incredible growth in electricity consumption. Efforts are underway to encourage alternative sources of energy generation so as to reduce the generation - consumption deficit. These resources range from coal to wind, solar and geothermal. Despite the fact that Pakistan is naturally gifted to harness energy from these sources, their exploitation to date has remained severely limited. It is suggested that Pakistan's energy woes can be rectified by adopting a diversified approach entailing the strategy of energy conservation. Traditionally energy intensive sectors should be targeted, and due attention on improvisations in these sectors can also help bridge the current energy deficit. The consumption of the domestic sector for the year 2007-08 stood at 33,704 GWh, constituting 45 per cent of Pakistan's total consumption. A major chunk of the energy expended is in construction processes, in addition to the heating and cooling of buildings in urban areas, etc. The objective of this paper is, therefore, to explore energy conservation by means of encouraging energy efficient buildings in Pakistan's housing industry. A commitment to reduce energy consumption in buildings is a sustainable way to approach economic development in Pakistan.

Keywords
Building, Pakistan, Energy, Green, Conservation

1. Introduction

A growing energy shortage and a decline in resources have cumulatively impacted Pakistan's exports to compete internationally, thereby spearheading the dwindling of its national exchequer. Substantial shortfalls in gas are expected; high gas prices and their interrupted supply have had repercussions on heating of homes during the winters. A significant dependence on oil as fossil fuel to meet energy needs is incurring the country large sums of money annually. A major chunk of the energy expended is in construction processes, in addition to the lighting, heating and cooling of buildings in urban areas. About 67% of the total electricity generated comes from fossil fuel such as natural gas, oil and coal (Ministry of Petroleum and Natural Resources , 2010). During recent times, tremendous fluctuation in global oil prices and a commensurate decline in supply have rendered electricity to become increasingly unaffordable. As a result, electricity distribution companies have raised their electricity tariffs, which in turn have ramifications on the domestic consumer. In addition to enhancing energy and water conservation in buildings, planners in Pakistan needs to ensure that a mechanism exists whereby the intended policies and regulations are implemented. Efforts need to be made in overcoming barriers in mainstreaming green building as a holistic concept, which comprises of a number of important constituents. Additionally, the nature of the building design process could be made more inclusive, whereby all the concerned stakeholders are involved.

2. Pakistan's Energy Situation and Buildings

The mode of living in Pakistan's urban areas encapsulates to a great degree, reliance on appliances and equipment, which require significant amount of energy for functioning. Most of the energy inefficient appliances include fans and heaters, which ironically are a great necessity due to the local weather conditions (Shrestha, et al., 1998) . Furthermore, a number of existing and new buildings are by default designed according to the conventional approach (Jamy, 1990). This is generally devoid of adequate design and construction details that could potentially enhance energy efficiency credentials of the buildings, and in turn would help eliminate the need for considerable monetary expenditure on appliances.

Inadequate consultation with relevant stakeholders is seen as one of the prime reasons why important input on energy efficiency design measures can be missing. It is necessitated that all those involved in the design and construction of a new building convene on the same platform to engage in discussion, which may yield productive results in consolidating the notion of green building into reality. As far as retrofitting of existing buildings is concerned, there must be a realization on part of building owners and occupants of the need to target 'energy guzzling' hotspots, thereby actively seeking the incorporation of measures to mitigate its overall energy footprint. A commitment to reduce energy consumption in buildings is a sustainable way to approach economic development in Pakistan. An energy efficient building not only increases occupancy levels but also brings monetary benefits that accrue from improved living conditions (Davis Langdon, n.d.). The stages of its planning, design, construction and management are very meticulous, whereby the lifecycle costs of the building are calculated in accordance to the construction materials, site, transport links and the likes.

The Building Energy Code, which was published in the early 1990s, has been a positive development for Pakistan's building sector. Nevertheless, it is to be noted that in theory, Pakistan's performance in promoting green building merits further improvement given the progress made around the world in this area. The government has recently mandated the Building Energy Code to be included in the construction by-laws, which is seen as an attempt to encourage energy conservation across the country. The National Energy Conservation Centre (ENERCON) has played a significant role in chalking out the energy conservation stipulations in Pakistan's Building Energy Code (The National Energy Conservation Centre, 2011). The formulation of the code itself was a rigorous process, entailing the congregation of engineers, designers, contractors, suppliers and equipment manufacturers. They engaged in discussion and developed recommendations on four important building elements i.e. building envelope, HVAC, water heating and lighting. Hence, the new code emphasizes on improved insulations to boost better heating and cooling of buildings (The National Energy Conservation Centre, 2011). The energy conservation measures would subsequently be applied across board on existing and new buildings.

3. The Building Design Process

There are important stages pertaining to the development of a green building i.e. site selection, design, construction, operation, maintenance, refurbishment and demolition. This covers important aspects such as the materials used for construction, water conservation, waste reduction, decrease in air pollution, power generation from renewable resources and good indoor air quality. Buildings oriented towards the south would benefit from the passive solar energy, which can be used to heat the homes during the winters. Furthermore, appropriate positioning of windows can allow for ventilation, which again can help in cooling houses during hot summers. Green design features such as insulation, water heating and cooling, improvement of lighting system arrangements are integral part of the buildings (Ali, et al., 2009). Generally, it has been observed that houses in Pakistan's rural areas boast of good ventilation and regulation of indoor temperatures.

Traditionally designed homes are generally notable for the improperly designed internal spaces with inadequate lighting, whereby ventilation are one of the most visible design deficiencies. For this purpose, the costs involved in illuminating the internal spaces as well as making up for the high/low ambient temperatures by central heating and air conditioning are tremendous. Another step towards self-sufficiency includes the setting up of independent power producing units onsite. These could include energy harvesting from locally available renewable resources, which pose immense potential for commercial exploitation. Connection to a centralized power grid is not at all a necessity nowadays, given the numerous viable alternatives present in the market already. It is envisioned that the use of photovoltaic systems for generating electricity at a household level can be encouraged, given Pakistan's advantage of having considerable solar exposure, which is consistently available throughout the year and is not affected by seasonal changes in weather There is a great potential to exploit solar energy for electricity generation and for heating purposes (Sheikh, 2009).

There is the belief that if a building has to be designed to make it sustainable, the costs involved may be large. However, the claim is without adequate justification and costs can potentially be restricted to 2% of the costs of a conventional building. Right from the time the need for a facility is conceptualized, the parties involved must vow for engaging the project from all interdisciplinary dimensions and carry out a multifaceted analysis. There has to be an emphasis on undertaking the Whole Building Design approach rather than one which is ad hoc and only satiates the cost and functional requirements, yet is constrained in anticipated dividends (WBDG: Whole Building Design Guide, 2010).

Buildings have a great footprint on the environment, with the activities of the construction industry being at the forefront causes to climate change (UNEP, 2011). A green building is a holistic concept, and it is not restricted to building design alone but all functions and paradigms associated to the building. It is more than just technological props but it is a mindset that has to be adopted. The planning stage is essentially the most critical stage of a building's development. It is at this critical conjecture of time that the planner, which could be architect, engineer, contractor or the likes decide for the approach, which can be opted for (WBDG: Whole Building Design Guide, 2009). A building has to be viewed as a system and not an amalgamation of eclectic components. If it is viewed as the latter, sustainability credentials of building design may be greatly compromised (Chen, et al., 2006).

The developed world has seen considerable advances in the planning and decision making that goes into building design. This specific consultation process is known as an Eco-Charette, which is essentially a meeting or discussion between all stakeholders involved. It is unanimously agreed at the beginning that the proposed building would be designed to achieve sustainability goals; hence, the strategies and objectives in making the said goal a reality are initially brainstormed upon (WBDG: Whole Building Design Guide, 2009). The benefit of an Eco-Charette is that it serves as a platform where all stakeholders can participate proactively and exchange their views on how sustainability credentials of building design can be achieved. If the relevant stakeholders are made to feel part of the process at the beginning stages, they would have more of a sense of ownership of the facility in consideration. As an Eco-Charette comprises of participants who hail from all types of professional backgrounds, they all bring with them their expertise and knowledge of niche subject areas (seattle.gov: Department of Planning and Development, 2010). However, the mere nature of the meeting enables an environment conducive to sharing of ideas; hence, solutions to practical problems, which would have otherwise been overwhelming, can be achieved. A unanimous agreement on what needs to be underpinned as important criteria against which the sustainability of the building would be compared against, is definitely an enduring commitment to success.

4. Areas Meriting Improvement

In Pakistan's urban areas, it is observed that there is a great dependency on resorting to artificial lights i.e. tube lights and bulbs for lighting purposes rather than harnessing sunlight for illumination during

daytime. Pakistan is naturally endowed with sunshine the year round and it is unfortunate that light being a valuable natural resource, is not adequately made use of. A building's features that take this into account are primarily its orientation and window glazing, which is in the path of the sunlight. Day-lighting is a fundamental component to a green building and is essentially the use of natural daylight to illuminate an indoor space. The basic concept behind day-lighting is the reflection of sunlight from outside and inside surfaces, thereby allowing them to illuminate the indoor space. The benefit of this is that the negative effects associated with direct sunlight are screened out due to the medium that comes in between the indoor space and the outside. There are technologies and design modifications that can enable the harnessing of the sunlight for lighting purposes. On the other hand, the costs involved in lighting a building are considerable. Daylight savings are greater for the summer months, and in essence contribute greatest to energy savings made. Electrical lights serve to heat up the indoor space, therefore with their absence; the cooling load from air conditioners is greatly eased. With a shift from heating due to electrical lights, passive solar heating can be used as a substitute for the same function (Hill, et al., 2010).

During the summer months, there is a considerable reliance on air conditioners for cooling indoor spaces. The high summer temperatures lead to an increase in electricity consumption, leading to electricity shortages. Frequent power outages are common, which further aggravate the common person's woes (PKPOLITICS, 2009). If in hindsight, buildings were designed according to specifications whereby the occupants were not relegated to depend on air conditioners to cool off, the pressure on electricity consumption in the domestic sector would not be prevalent to an extent observed today. An alternative could be the adoption of green cooling systems, which consist of a stack cooling system, cross ventilation and cool towers. Most of these systems are based on having vents near the ceiling that direct the cool air inside and the warm air out of the building. This system does not require fans or electricity. The fundamental concept of ventilation systems involves distinguishing the role of cool and warm air and how they are selectively managed for maintaining the required temperature and air quality (Stack, 2011).

A building needs to be designed as a single entity, and the approach is known as the Whole Building Design, which basically entails the planning stage taking into account all the energy savings and gains made. It is believed by default that self-power generation and energy self sufficiency have more to do with extraordinary renewable energy technologies and less to do with dependency on the national grid for electricity. Self sufficiency and reduced reliance on electricity from elsewhere can play a significant role in the empowerment of citizens. It can, as in the case of some Californian homes, be of monetary benefit to install sophisticated electricity generating gadgetry (SolarServer: Online Portal to Solar Energy, 2010). Another example of harnessing clean energy is biogas, which greatly depends on local conditions such as the presence of livestock and the availability of adequate water for proper functioning of biogas plants. Biogas plants have been introduced at a community level, which makes use of manure for gas production (U.S. Environmental Protection Agency, 2008). This gas is used for heating and cooking purposes. In Pakistan, pilot projects were set up in the Union Council Mandehran and District Dera Ismail Khan in Jhoke Mohana and Jhoke Obechart (Foundation for Integrated Development Action, 2007). In urban areas, a similar concept can be employed on a neighborhood level making use of household waste. This would not only help reduce burden on the already stressed waste management system but can also be exploited for energy production.

5. Energy Intensity of Transportation

Energy consumption in the transportation sector constitutes about 30.1% of Pakistan's consumption (Hydrocarbon Development Institute of Pakistan, 2010). Most automobiles run on fossil fuels such as petrol, diesel oil and natural gas. Their combustion not only adds immense pressure on an already short supply but is contributing to air pollution. An effort has to be made to reduce car usage when commuting to and from the facility in consideration. This can be achieved by promoting public

transport among the office goers. In Pakistan, the trend to use cars has increased over the years leading to chronic traffic problems in the cities and a subsequent loss of productive time. Alternative modes of transport to work also entails promoting cycling, walking and using a bus to work as opposed to car travel, which in most cases is done by an individual only.

It is important to carefully chalk out a transport plan as the energy savings made in a green building may be offset by travel choices. According to estimates, the energy expended in transport is almost twice as much as that used in a building's operation. The energy intensity from the transportation sector is considerable, whereby the location of a building and its additional facilities are great influencing factors.
Efficiency in the travel choices has an undue impact elsewhere too, particularly in terms of water management, urban heat island effect and ecosystem preservation. Therefore, the energy expenditure on transportation is directly related to the situation of the building. At the time of a building's conceptualization, site selection and land use planning need to be executed comprehensively as these are integral to the success of the building in its entirety (Ali, et al., 2009).

6. Water Footprint

There is a great need to carefully manage water at homes, as profligate usage may contribute significantly to water rationing among communities and supply outages in the future (Morton, 2011). Due to depleting water resources, Pakistan's water supply per capita declined to 1000 cubic metres in 2010. In Islamabad, it is estimated that 30 million gallons of water is wasted in faulty pipelines (The Nation, 2011). There is a dire need to initiate water conservation, which includes curbing the enormous amount of wastage already taking place. Grey-water recycling, wastewater recycling and rainwater harvesting are some of the techniques that need to be explored. There have been scattered instances of wastewater recycling in rural areas, partly due to the spatial nature of the surroundings (Nawab, et al., 2006). Similarly, rainwater harvesting has been employed in a few buildings of eminence (Capital Development Authority Islamabad, 2010). Sustainable building design encapsulates a low water usage and maintenance of the right water quality. There has to be an effort made to use water that has been recycled, reused or purified, in order to boost water conservation.

7. Retrofitting the Pakistan Engineering Council (PEC)

Over the past few months, the Pakistan Engineering Council (PEC) has been advancing the goal of establishing Pakistan's building codes, which stipulate energy efficiency measures that can be incorporated in new and existing buildings. However, in order to set a precedent, the initiative has started at the PEC building first. This is Pakistan's first success story in retrofitting, and it has been instrumental in reducing the building's overall energy consumption. These measures have not only boosted the energy efficiency credentials of the PEC building but have simultaneously led to a significant saving in monetary costs. The retrofitting initiative started with carrying out an energy audit of the building, which entails carrying out an inventory of building components that consume energy or have sustainability impacts. A comprehensive energy management system entails collection of data, which allows for identifying energy intensive areas, and exploring the possibility of energy conservation. The people in-charge of the facility can reflect on the data recorded and devise measures to mitigate energy use impacts, and this would subsequently include recommendations to conserve energy and reduce energy wastage. The energy audit of PEC determined that the total amount of electricity load experienced by the building was 345.66 kW. By virtue of the audit, options for reducing energy waste and associated implementation of sound energy practices were adopted. There must be a systematic way of controlling the building's energy consumption pattern, whereby conservation measures need to be chalked out. Following the energy audit, PEC carried out retrofitting of lights. It also started its initiative on solar power, whereby a 110 kW on-grid solar system for PEC was installed. PEC has also engaged in encouraging energy conservation awareness

among the employees, which has been vital to its success in enhancing energy efficiency. The energy efficiency measures have included removal of objects that were obstructing light sources; reduced usage of electronic appliances; generation of awareness among staff about energy conservation measures; replacement of the CRT monitors with LCD monitors/displays and employing a series load to reduce power consumption. Lighting retrofits have been carried out in conference rooms at the PEC, which has resulted in a power saving as high as 1980 kW (Pakistan Engineering Council, 2010).

8. Policy initiatives in Pakistan

In Pakistan, the government can take a number of initiatives to advance the goal of green building development. This could entail encouraging organizations, be whatever sector they are part of, to wholly adopt green principles in their development plans. Among the many steps that the Pakistani government can take in promoting green development, some of the following policy incentives can yield positive results (Chan, et al., 2009; UNEP, 2011; Kallmorgen, 2009; Potbhare, et al., 2009):

i) Establishing a structure for the implementation and enforcement of building energy codes, training of individuals to build a capacity base and carrying out demonstration projects.
ii) Mandatory execution of energy audits of buildings and energy performance certificates to be fundamental to sale and lease to potential customers/tenants.
iii) Enforcing regulatory mechanisms, both normative and informative, in influencing choices in energy conservation (building codes, energy audit, eco-labels, energy management system, etc).
iv) Promulgation of the concept to the public so as to create a demand market with awareness campaigns being advocated by NGOs. Enhancement of knowledge about standards, labeling technologies, energy issues, counseling and advice on the green building market. This can be achieved by organizing workshops, seminars and conferences as well as disseminating information via internet, brochures and books. Therefore, an effective communication strategy needs to be instituted.
v) Making available information about the cost savings associated with green building, health productivity and material conservation. Currently, in Pakistan, there is great dearth of data about the apparent benefits of green buildings, and this is considered one of the major stumbling blocks to the adoption of green building practices in developing countries.
vi) Support for clean technology markets by formulation of green procurement policies and funding R & D in universities and educational institutions.

9. Conclusion

Pakistan's energy crisis has propelled the need to divert attention to the domestic sector, which has a significant share of the country's total energy consumption. Green building design is a holistic concept, which includes taking into account the energy, water and transportation footprint. This is of immense significance to Pakistan as power outages, growing water scarcity and increasing traffic congestion on roads is posing an enormous socio-economic hurdle to the country's progress. The concept of green building is not alien to the region; in fact, many aspects of energy efficiency have been observed in rural houses, which have been present for ages. However, buildings in urban areas necessitate a change in the way they are operated, whereby energy and water conservation should rank top priority for reducing the building's impact on the environment. There needs to be an understanding among planners, owners, engineers and architects about the importance of engaging in thorough consultation prior to starting the building design process, as that is the stage meriting considerable input in order to integrate in the energy efficiency measures. Around Pakistan, there have been sporadic instances of good practice in the encouragement of energy efficiency measures in buildings. However, in order for there to be a tangible effect on reducing the country's overall energy consumption, a lot more needs to be done.

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