

Conceptual Analysis of Energy plus Category for Futuristic Urban Human Settlements

Ar. Chetan Verma, Jitendra Singh, Alok Ranjan

Abstract: *There are different energy sources. Categorized in two types renewable and non-renewable sources of energy. Since non-renewable sources are limited, we can put human settlement evolution and further development on stake in future. Making the renewable sources of energy as basics of future human urban settlements is necessary. This paper is about the analysis of the concept of energy plus human settlements in terms of energy saving, energy efficiency and energy generation based on renewable sources of energy, to collectively achieve the category of energy plus human settlements. Such settlements which are capable of generating energy more than consumption in a specific time period from renewable energy sources. Is this paper it is described and discussed that how saving energy, using energy efficiently and energy generation capability contributes to a better futuristic urban settlement of energy plus category and it also explains the need of such settlements in future in the field of sustainable development.*

Index Terms: Energy Plus, Energy Saving, Energy Efficiency, Energy Generation, Urbanization.

I. INTRODUCTION

Saving energy for tomorrow is the latest booming thing in energy sector but, growth and analysis requires constant energy supply in different forms. Every sector requires some form of usable energy to run and hence a settlement develops. But today we are on a stage where we are facing a challenge to mark human settlement independence from non renewable sources of energy to save our environment. [1] Non

renewable sources are not only limited but they are also produce harmful gases while being used which adds to our

environment and pollutes it. Global warming is one of the biggest issue for environmentalists since past two decades. Progressing on the path of sustainability firstly we learn to save energy, secondly we started to generate clean energy using renewable sources of energy. But due to the rapid population growth rate we were unable to produce enough of clean sourced energy. Travelling through multiple stages such as energy saving, energy efficient, energy generating today we are researching on the concept of energy plus. [2]

Energy plus is an concept in which a building or a group of buildings or settlement is capable of generating more energy then used, based on clean source in the specific time interval.

Due to the population explosion in many countries they are unable to maximize use of energy generated from renewable sources of energy, because renewable sources are also having limitation depending upon the varying climatic situations. Main accountable renewable energy are generated from solar energy, wind energy, hydro-power, geothermal and biogas.[3] But depending upon the varying climates we have issues on lacking to receive appropriate amount of source energy to convert it to an usable form. For example places with 3 or 4 sun hours sun per day (cold climatic regions) are unable to use solar energy to meet there energy demands. Similarly in case of other sources.

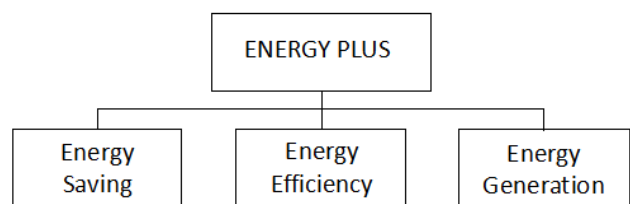


Fig 1 (Source: Author)

Hence we have to develop such settlements which are firstly capable of saving energy, secondly capable of using energy efficiently and thirdly they are capable of generating energy from multiple clean energy sources so that, we can reach the concept of energy plus.

Manuscript published on 30 June 2019.

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II. ENERGY SAVING

Saving energy is nothing less than generating energy. As the saved amount of energy can be used in other situations as per necessary requirements. To save energy 3R (Reduce, Reuse & Recycle) concept is important to be followed.[4]

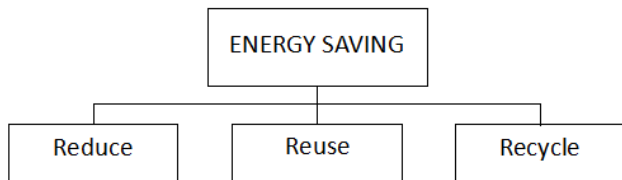


Fig. 2 (Source: Author)

A. Reduce

It is important to understand the value of energy. Energy should be used precisely and accurately. To reduce energy use we need to stop or minimize wastage of energy.

While lighting inside or outside the buildings we must calculate the required wattage and lumen according to the area and use of the particular area. For example area used for reading require brighter devices than non reading rooms.

Preferring public transport over individual transport also helps in reducing the energy consumption. It is important to reduce so that less waste will be produced which require less energy to recycle.

B. Reuse

As we know that energy only changes its form before and after use. Many of the time after use of a particular form of energy the residual form is also capable of producing further usable form of energy. For example simple kitchen waste of raw food products is capable of generating usable energy as bio gas using decomposition process moreover the residual of biogas can be used as manure for plants which adds to refresh our natural environment. This thing results in less energy consumption in built environment by reducing the heating and cooling loads using other sources of energy. Even energy generated by movement (kinetic energy), such as in gymnasiums, pedestrian walkways can be reused in small or medium scale applications.

C. Recycle

It is a process to generate various sources of energy that can be converted into usable form. Best example of recycling is solid waste disposal systems in urban settlements. After required treatment it is dumped beneath the earth layer to decompose and become a source of energy in future somewhere. Many plastic generating industries are contentiously working to meet human requirement of plastic in various forms and recycling used waste plastic is an very import factor to keep surroundings clean. Moreover used plastic material can also be used as a material for building

construction.

III. ENERGY EFFICIENCY

Efficiency can be explained as minimum input and maximum output. Gaining quality output as per requirement with minimum required energy. This phenomenon plays an important role in urban level settlements and can be approached in two ways explained below.

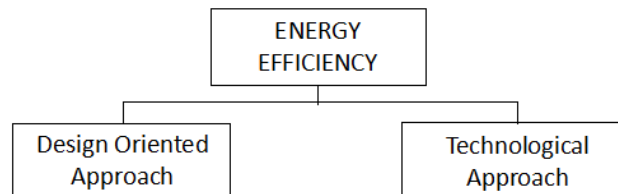


Fig. 3 (Source: Author)

A. Design Oriented Approach

Architecture design and planning plays an important role in producing energy efficient urban settlements. It is important to consider the building typologies and placement methods according to the existing climate of the site which includes sun orientations and intensity, wind direction and speed, water availability and quality.

Introvert design or courtyard house designs, east west housing designs, south oriented house are good for hot, arid and semi arid climatic regions to provide good climatic conditions inside the building.[2]

Use of glass in facade is also an design feature which adds to aesthetic of the building and also helps trapping sun radiated heat inside the building in cold climatic regions. Orientation of a building plays an important role and hence it is an important factor in urban level also.

Cross ventilation while air trapping and passing through a water body while entering inside the building is a good design approach in windy area with hot and dry climatic conditions. Other design related features in the support are green roofs, green walls, water bodies, shading devices, and glazing.

B. Technological Approach

Technological advancements also contributes in saving and intelligent use of energy. Sensor based devices, voice command based devices, time management based devices all such products incorporated in buildings and urban features of a settlement gives an efficient and appropriate use of energy proving capability of being energy efficient.

IV. ENERGY GENERATION

Generating clean energy from renewable sources of energy is one of the major add on and a must feature for futuristic urban settlements to be categorized as energy plus. Below explained are the present and possible sources and products for clean energy generation using natural and renewable energy sources.

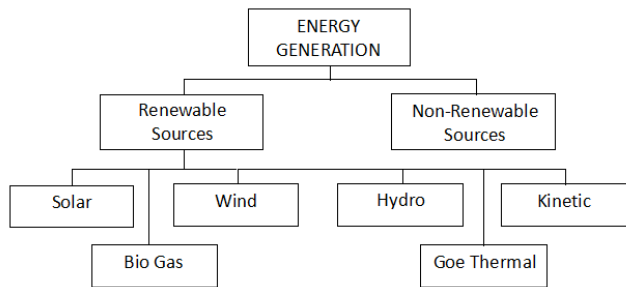


Fig. 4 (Source: Author)

A. Solar Power

Sun is considered to be the most abundant power source. Its presence provides an livable natural environment. But it does not restrict till this. Its quite easy now a days to generate usable form of energy from sun radiations using many devices based on PV cells. Solar panels are most common example of this. Solar energy is the most practiced form to be converted to usable form of energy using multiple devices such as, **solar invent** an device works as in air conditioner for hot climates using solar radiations. **Solar water heater** is used for heating water for household and industrial purposes too. **HCPV** high concentration photovoltaics that increases the power of sun radiation to increase the usable energy production in same amount of radiations.[5]

Basically the climatic regions which are hot due to ample amount of sun radiations can convert solar radiations into usable form to meet energy demands for various purposes.

B. Wind Power

Wind is a very competent natural renewable source of energy. Using devices such as wind mills and wind towers we can generate usable form of energy from flowing wind. There are different systems to generate usable form of energy from wind using win turbines namely asynchronous and synchronous generator systems.[6] Moreover such climates which experience high winds are best suitable to install wind power plants or wind energy generation farms.

C. Hydro Power

Water is considered to be the basic of life and flowing water is capable of generating usable form of energy. Hydro power dams on rivers are one of the major source of electricity in many countries around the world. Even tidal waves in oceans are also capable of generating energy that can be used for various tasks further. Considering the natural flowing water

sources can prove an major asset for clean energy generating for future energy plus urban settlements.

Mega dams around the world are capable of generating huge amount of usable form of energy using power of water and gravitational system.

D. Kinetic Energy

Already a energy but wasted generally without being converted into usable form. Walking is a part of daily life for many people around the globe. Countries with large population have multiple nodal points in metro cities. Choosing such nodal points with large amount of footfalls each day and each hour and installing such tiles on pedestrian walkways, crosswalks and underpass which are capable of generating energy from each footfall can help generating ample amount of energy.

Speed breakers can be designed to tap, store energy from passing by vehicular traffic and convert it into usable form of energy.[7]

Such a device is very helpful in a futuristic urban settlement efficiently designed to promote walking and cycling for its inhabitants

E. Geo Thermal Power

Earth itself is filled of energy which is an result of internal movements and molten heated elements in the core of earth. Hence, many parts of earth have such energy releasing holes covered under the top soil which are used to generate usable form of energy. Since this process requires advanced technical knowledge and its hard to handle the pressure on small scale hence this source is not recommended on micro scale. But is very useful on urban level application as per availability.

F. Bio Gas

Such foul smells which we avoid are practically useful as these smells are generated from microbial reaction for decomposition of organic substances based on natural decomposition. Such house hold wastes can be stored with micro and macro level applications and energy generated from emitting gases can be used to generate usable form of energy. Such fuels are total non harmful for environment and the energy generated in accounted as clean energy.

V. CONCEPTUAL APPLICATION RESULTS

Considering the application of the integrated concept of energy saving, efficient energy use and energy generation in an human settlement in terms of consumable for various tasks in different sectors following are the observations Replacement of lightning products from halogen to LED technology reduced energy consumption by 65%.

Reuse of plastic and glass containers reduced the need of disposal items which resulted to be cost effective also.

A. Heat produced in process of cooling in summer is stored in underground thermal banks and recycled back using heat pump for heating in winters without using fossil fuels.

B. In case of hot and dry climatic regions use of passive cooling strategies such as louver shading devices, double glazing, natural ventilation, green roofing, insulation, evaporate cooling via water bodies, indirect radiant cooling and light external facade color coatings on buildings for high reflection resulted in making the buildings energy efficient and were helpful in lowering energy demands.

C. Introduction of turbochargers increased to fuel efficiency of the engines resulting in less fuel consumption and automated dispensing system for various products saved wastage of materials.

D. Generation of usable form of energy from solar power at individual and mass level using PV and HCPV technology lowered the use of non renewable sources and also provided zero carbon emission generated energy.

E. Similar in type like solar traditional wind mills and latest blade less wind mills / turbines are capable of generating appropriate amount of clean energy for use.

F. Introduction of technologies such as energy generating tile for walkways and corridors, energy generating speed breakers on urban level were helpful to generate usable form of energy form kinetic energy of humans and vehicles.

G. Land filling system of urban solid waste management helps generating usable form of energy from biogas generation counted as an clean energy source and a solution to the solid waste of urban settlements.

H. Hydro and geothermal power systems are effective on large scale usable energy production due to high infrastructural costs and many countries around the world depends on clean energy generation from these sources.

VI. DISCUSSION

The results above indicates clearly that if an integrated development approach is applied having energy saving, efficient energy use and energy generation as basic principles then it is possible to develop an human settlement which can be categorized as energy plus. Although many countries are pioneering in this direction but still political and economical constraints in present systems in many countries can be considered as limitations for this concept.

VII. CONCLUSION

Above explanations clearly indicates that an appropriate combination of energy saving, energy efficient and energy generation techniques can lead an futuristic urban human settlement to reach energy plus category.

However energy saving can be achieved using the 3Rs of Reduce, Reuse and Recycle. Energy efficiency can be a combined approach of Architecture design, Planning and technology. And Energy generation can be carried out as per the site climatic conditions and availability of natural and renewable energy sources using various products to generate energy from multiple sources to meet urban energy demands.

VIII. FURTHER DISCUSSIONS

A study can be carried out individually for different compatible climate zones with sources availability and detailed analysis of different types of shapes and forms for settlement structures to reach more precised level of energy plus human settlements. Another thing that need to be studied about is the compatibility of different climates with possible energy generation techniques to find out an better hybrid composition for generating energy using multiple renewable sources of energy.

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