

Renewable energy sources in the sustainable architecture

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ABSTRACT

. In regards to the significant importance of this research, approximately 22–02 percent of the entire energy consumption in developed countries refers to the energy usage of buildings . It is believed that 21st century cities must be greener and smarter; hence, promoting sustainable cities has become a key issue for many developing countries . The benefits of renewable energy includes:environmental benefits, jobs and the economy, energy security and Energy for next generations (Sustainability) .

In this study we introduced the renewable energy sources and their properties.This study clearly illustrated their discriptions and their benefits.After that it compared them from the prospectives of feasible use in urban areas and buildings, the amount of fossil fuel consumption reduction, the amount of initial construction costs enhancement , The amount of maintenance and operation cost reduction , the cost of production energy , The growth during two last decades ,cost of electricity generation ,most used in contemporary architecture ,growth of electricity generation technologies , growth of electricity generation technologies , government support and public awareness .Finally solar pv achieved best score and wind energy earned second place .

The renewable energy sources include: wind energy, passive solar, active solar, geothermal energy and fuel cell each of them have their own properties and choosing of them is related to the conditions of the design

Keywords: sustainable architecture , green architecture, renewable energy sources , energy efficiency

1. INTRODUCTION

Back to US Congress 1332 towards assessment of building energy efficiency, there has been attempts to educate the profes- sionals and ordinary people towards the considerable substance of building energy, level of consumption and conservations for future. The study states that this level of consumption and conservation is highly correlated with technological innovations, technology adoptions, user's lifestyle, economic growth,etc. In regards to the significant importance of this research, it is repeatedly cited that approximately 22–02 percent of the entire energy consumption in developed countries (02 percent in Hong Kong, 97 percent in US, 93 percent in UK, & 91 percent in Japan) refers to the energy usage of buildings. [1] Globally, this high level of energy consumption leads to environmental crisis including the climate change, global warming, lack of energy resources, difficulties in energy supplies, and ozone layer deterioration [9].

sustainable development is highly intertwined with the deliberation of energy. Thus, on one hand, renewable energy sources including solar, winds, and waves, etc. play a substantial role for sustainable developments; on the other hand, sustainable energy sources including the waste-to-energy sources are highly influential in the enhancement of sustainability [2]

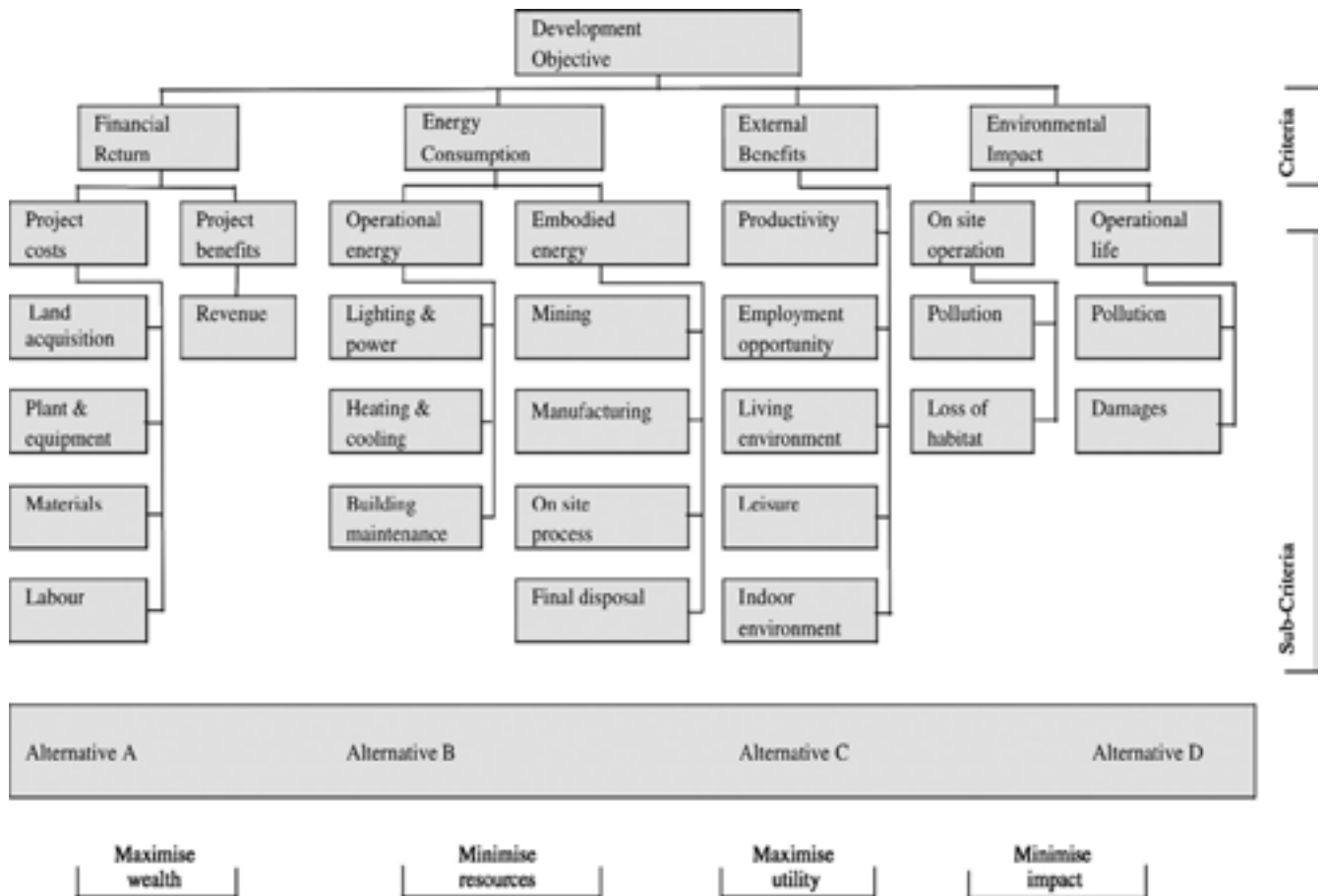


Fig. 1. Key Factors for Sustainable Developments [6]

1.1 Sustainability in build environment

It is believed that 21st century cities must be greener and smarter; hence, promoting sustainable cities has become a key issue for many developing countries. The concept of sustainability is a broad global issue comprising various interrelated studies about people, the environment and society [0]. The significance of sustainable cities could be elucidated by identifying the role of sustainability. Indeed, this sustainability represents a new approach that embraces the concepts of 'green infrastructure', based on a rethinking process designed to link the entire implementation of current cities to the environment, technology, the sustainability encompasses three fundamental constituents as environmental, socio-cultural and economic sustainability while the respectively mentioned components are substantially bound up with the circumstances of the enhancement of well-being for the inhabitants as represented in Fig. 9 [0,5].

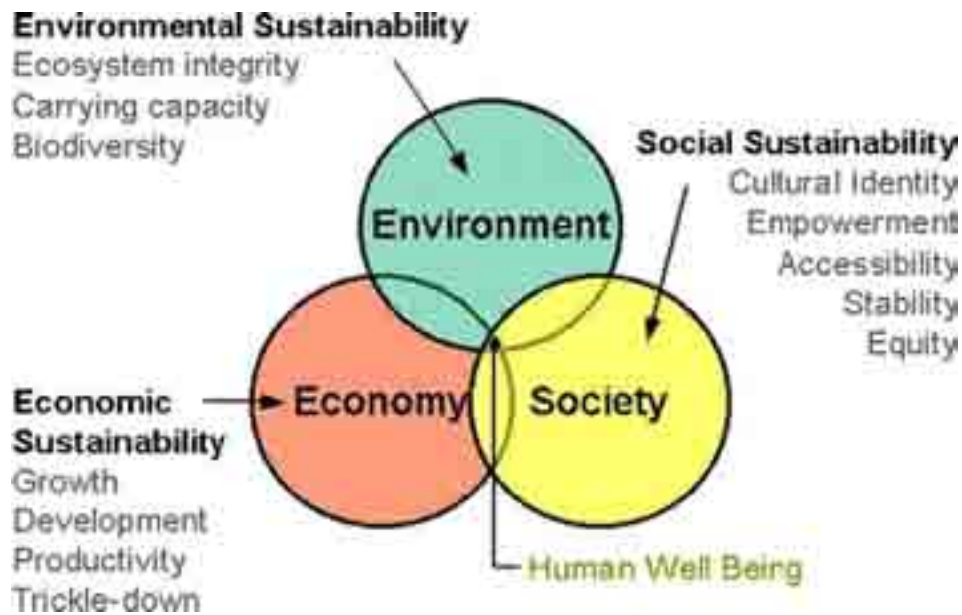


Fig. 2. The Basis of Sustainable Developments [5].

2- Sustainable energy performances of green buildings

2.1. Benefits of renewable energy sources

The benefits of renewable energy includes :environmental benefits,jobs and the economy,energy security and Energy for Our Children's Children (Sustainability)

A-Environmental Benefits

Renewable energy technologies are clean sources of energy that have a much lower environmental impact than conventional energy technologies.

B-Energy for Our Children's Children (Sustainability)

Renewable energy will not run out. Ever, other sources of energy are finite and will some day be depleted.

C-Jobs and the Economy

Most renewable energy investments are spent on materials and workmanship to build and maintain the facilities, rather than on costly energy imports. Renewable energy investments are usually spent within the United States, frequently in the same state, and often in the same town. This means your energy dollars stay home to create jobs and fuel local economies, rather than going overseas. Meanwhile, renewable energy technologies developed and built in the United States are being sold overseas, providing a boost to the U.S. trade deficit.

D- Energy Security

After the oil supply disruptions of the early 1372s, our nation has increased its dependence on foreign oil supplies instead of decreasing it. This increased dependence impacts more than just our national energy policy.[7]

2.2 .Diffrent types of renewable energy sources

A. Solar Energy

Solar Energy has the greatest potential for providing clean, safe, and reliable power. The solar energy falling on the Earth's continents is more than 222 times the total annual commercial energy currently being used by humans [8]. The government started solar power adoption with subsidies. A consumer who installs a solar panel array on a house can sell surplus energy to the local utilities. The solar panel cost, reduced to 52%, which would make solar Powered Electricity cost comparable with other types of fuel, is possible within the next decade [3]. Solar Energy can be classified as two types 1. Passive solar and 2. Active solar. Passive solar energy is making direct and indirect use of thermal energies from the sun. Indirect use of Energy is possible only in building (or) structures (as shown in Fig. 1). A southern exposure of a building guarantees the maximum exposure of the sun's rays. Special metal leaf covering over windows and roofs can block out the sun during the summer months. Special thermal solar collectors can circulate water through the collection unit that collect the sun's thermal energy for the purpose of heating the water for use [12]. Active Solar Energy is the use of the sun's Electro magnetic radiation in generating Electrical Energy. Generally semi- conductor silicon Boron solar chips are used for this. The problem of these chips one that they have low Efficiency ratio and can only be used in supplying Energy needs of small devices (i.e. calculators, watches, radio etc.) .

B.Wind Energy

Wind, ultimately driven by atmospheric air, is just another way of collecting Energy. Sun also heats the atmosphere, which produces wind. It works on cloudy days and Rainy season also. The location of wind turbines is a very important factor, which influences the performance of the machine. The windmills are generally located at the top of a tower to heights approximately 92 m. To avoid turbulence from one turbine affecting the wind flow at others it is located at 5-15 times blades diameter. Windmills are working both in horizontal axis and vertical axis.

The basic mechanics of the two systems are similar. Wind passing over the blades is converted in to mechanical power, which is fed through transmission to an electrical generator. Wind turbines will not work in winds below 19 km an hour. They work best where the wind speed averages 22 km an hour. The majority of wind turbines produced at the present time are horizontal axis turbine with three blades, 15-92 m diameter, producing 52-952 Kw of Electricity.

Wind energy produces no air or water pollution, involves no toxic or hazardous substances, and poses no threat to public safety.

C. Biomass Energy

Biomass is the most important source for energy productions supplied by agriculture. Effective harnessing of bio-energy can energize entire rural milieu in a country like India where nature offers various types of biomass. This energy is also available in the form of biodegradable waste, which is the rejected component of available biomass [11]. Biomass energy refers to fuels made from plants and animal wastes. The Biomass resource is, organic matter in which the energy of sunlight is stored in chemical bonds. When the bonds between carbon, hydrogen and oxygen molecules are broken by digestion, combustion (or) decomposition these substances release stored energy. Biomass energy is generated when organic matter is converted to Energy. In alcohol fermentation, the starch in organic matter is converted to sugar by heating. This sugar is then fermented and finally ethanol is distilled and then blended with another fuel. An aerobic digestion converts biomass, especially waste product such as municipal solid waste and market waste. In this process, the facultative bacteria breakdown the organic material in the absence of oxygen and produce

methane and carbon dioxide. Bioconversion is a non- polluting, environmentally feasible and cost effective process [8]. The effluent and digester residues are rich in nitrogen and phosphorus, which can be recycled back to the soil as a fertilizer [3]. By using this method we can derive

72% of the energy. The biomass is mixed with water and stored in an airtight tank. The organic wastes (Municipal Solid Waste) are collected separately and dried natural method and shredded to the maximum particle size of 2 – 0 mm. This was stored in a plastic container at room temperature and was characterized and it was used during all

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anaerobic digestion treatment. Domestic sewage was collected from a college campus before disposal. It was used in all anaerobic digestion experiment for diluting the feedstock to achieve the required total solids concentration for the present investigation. Experiments were carried out in 5 lit. Capacity batch type reactor operating in semi continuous mode with daily feeding. The digester was operated at room temperature at a constant hydraulic retention time of 25 days with different organic loading rate. To start with, the digester was initiated by charging with 2.75 lit. of feed stocks (22 TS) along with 2 lit. of feed sludge. The digester was maintained anaerobic ally and stabilization was to take place for two weeks. During this stabilization period, pH was maintained in the range of 6.5 to 7.5 by adding sodium hydroxide. The pH and gas production were measured every day. It was found that the maximum biogas production is 2.96m³/kg of VS added/day at the optimum organic loading rate of 2.3 kg of VS / m³/d.

In Chennai the government set up a power plant using vegetable waste as fuel. Daily 02 tones of market waste is going to be used for the power plant. The power plant will generate about 0822 units of electricity/day. The gas comprises 65% of methane and 35% of carbon di oxide, and is transferred into a gasholder and finally electrical energy is produced. The power generated from the plant will be sold at Rs.9.15/unit

D. Geothermal Energy

Geothermal energy is the heat from the Earth. It's clean and sustainable. Resources of geothermal energy range from the shallow ground to hot water and hot rock found a few miles beneath the Earth's surface, and down even deeper to the extremely high temperatures of molten rock called magma.

Almost everywhere, the shallow ground or upper 12 feet of the Earth's surface maintains a nearly constant temperature between 52° and 62°F (12° and 16°C). Geothermal heat pumps can tap into this resource to heat and cool buildings. A geothermal heat pump system consists of a heat pump, an air delivery system (ductwork), and a heat exchanger—a system of pipes buried in the shallow ground near the building. In the winter, the heat pump removes heat from the heat exchanger and pumps it into the indoor air delivery system. In the summer, the process is reversed, and the heat pump moves heat from the indoor air into the heat exchanger. The heat removed from the indoor air during the summer can also be used to provide a free source of hot water [12].

The contact heat-transfer coefficient between the work-piece and the roll is set as 29 kW/(m²°C). The initial temperature of the work-piece, the ambient temperature and roll temperature is set as 862 °C, 22 °C and 222 °C, respectively. The conversion factor from plastic work to heat was set as 2.3 and [19]. 9-D thermo-mechanical coupled elasto-plastic heat capacity and thermal expanding coefficient at different temperature were directly input on the software windows, and the thermo-physical parameters at high temperature can be extrapolated based on.

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2.2 .Advantages and disadvantages of different types of renewable sources

Each renewable source has its own benefits and drawbacks .The choosing a correct renewable source type is related to the terms of the environment so that it is hard to suggest the best type but we can clarify the properties of them .

Table1 –Types of renewable energy sources developed by[10]

Renewable energy	Description and benefits
Active solar energy	<ul style="list-style-type: none"> - Convert solar energy into another more useful form of energy. - This would normally be a conversion to heat or electrical energy. - Inside a building this energy would be used for heating, cooling, or off-setting other energy use at once. - The basic benefit is that controls can be used to maximize its effectiveness. - Photovoltaic solar panels are in this group.
Passive solar energy	<ul style="list-style-type: none"> - In passive solar building design, windows, walls, and floors are made to collect, store, and distribute solar energy in the form of heat in the winter and reject solar heat in the summer. - The key to designing a passive solar building is to best take advantage of the local climate.
Wind energy	<p>Elements to be considered include window placement and glazing type, thermal insulation, thermal mass, and shading.</p> <ul style="list-style-type: none"> - Wind power is the conversion of wind energy into a useful form of energy, such as using wind turbines to make electricity, windmills for mechanical power, wind pumps for water pumping or drainage.
Geothermal energy	<ul style="list-style-type: none"> - Geothermal energy is thermal energy generated and stored in the Earth.
Fuel cell	<ul style="list-style-type: none"> - A fuel cell is a device that converts the chemical energy from a fuel into electricity through a chemical reaction with oxygen or another oxidizing agent. Hydrogen is the most common fuel.

Table 2-The Strengths of Renewable Energy Types, Developed by writer

renewable energy type	Feasible use in urban areas and buildings	The amount of fossil fuel consumption reduction	The amount of initial construction costs enhancement	The amount of maintenance and operation costs reduction	The highest growth since two last decades	cost/low per hour of electricity generation (lower 0,15 \$)	most used in contemporary architecture	growth of electricity generation technologies	government support	public awareness
Wind		√			√	√	√		√	√
Solar PV		√			√	√	√	√	√	√
Solar Thermal	√		√	√			√			√
Geo thermal			√			√	√	√		
	√		√			√		√		

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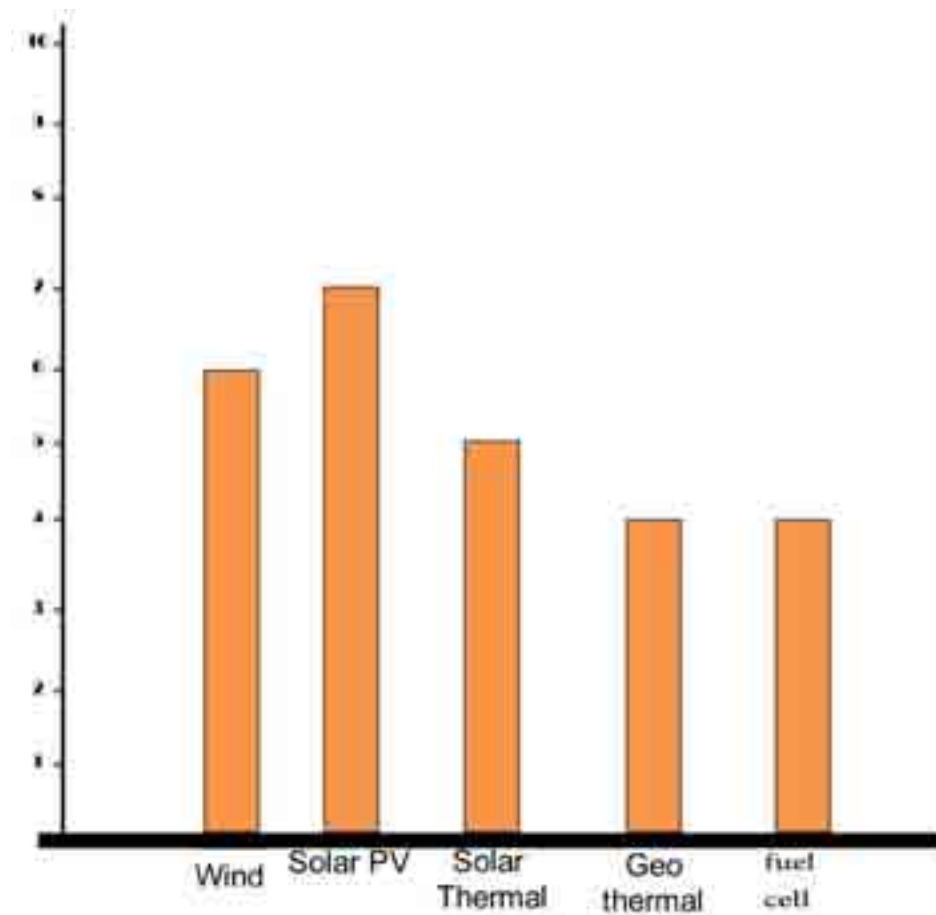


Fig9-The Strengths of Renewable Energy Types, Developed by writer

Conclusions

Nowadays, due to energy crisis and environment problems we should use renewable energy sources undoubtedly. One of the most critical areas for using renewable energy sources is the buildings. approximately 22–02 percent of the entire energy consumption in developed countries refers to the energy usage of buildings..

In this study we introduced the renewable energy sources and their properties. This study clearly illustrated their descriptions and their benefits. After that it compared them from the perspectives of feasible use in urban areas and buildings, the amount of fossil fuel consumption reduction, the amount of initial construction costs enhancement, The amount of maintenance and operation cost reduction, the cost of production energy, The growth during two last decades, cost of electricity generation, most used in contemporary architecture, growth of electricity generation technologies, growth, government support and public awareness. Finally solar pv achieved best score and wind energy earned second place.

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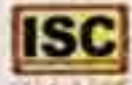
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