Different Perspectives of Green Technology

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ABSTRACT

Innovation in the path of technology is facing rapid growth in this age. The motivation to curve out new ideas has resulted from the continuous threats that are intimated to the human civilization owing due to the degradation of nature and its resources. The development of countries to improve and impart quality life style it the population has resulted an immense damage to the nature. The quality of air, water and all elements are getting polluted to an alarming rate. In order to save our environment from these severe damage, technologists have developed totally new ways of power generation, building construction and automobile design which will not cause any carbon emission to the environment but it will also not hamper the country's industrial development as well as domestic comfort. In this article, a brief effort is taken to demonstrate the benevolent nature of Green Technology which is a burning research topic having an extreme popularity among scientists. The innovation centered with green technology are encircled with emergence of green buildings, electric vehicles in the urban sector power industries have implemented solar and wind mega projects to secure continuity of power supply. The locomotives as well as automobile industries have redesigned their systems in a new way that energy efficient and less. agro industries also started cultivation using vertical farming by aquaponics and hydroponics.

Keywords—*green technology,green buildings,vertical farming, aquaponics, hydroponics*

I. INTRODUCTION

The concept of Green technology (GT) is related with advancement and deployment of new components, tools and systems used to preserve the environment in all aspects [1]. The main agenda is to mitigate the harmful impact from human actions and to take proper action against all the ill activities, the Government plays a vital role. In this present era, this technology can be thought in the form of green buildings or renewable energy such as wind, hydro or solar.

Green technology satisfy the following criteria:

a) It minimizes the deterioration of the environment

b) It lowers greenhouse gases (GHG) emission to zero as well as its utilization is safe and finally it enhances healthy and improved environment for all forms of life.

c) It saves the use of natural resources and energy.

Green technology is an inventiveness to expand various kinds of schemes and materials for generating energy from non-toxic products [5]. Green technology has been branded as a major necessity to accomplish the tag of "developed country" where designers aim at developing sustainable projects that can be responsible for energy, water savings and thereby procuring a healthy environment in their project arena. A very common example in this regard are the "green building" who's entire functioning depend upon a smart process of energy utilization. The cooling process, lighting process all are planned in a smart manner such that our comfort expectation is fulfilled along with minimum wastage of energy which increases the overall efficiency of the technology. As fossil fuels are getting exhausted and at the same time energy harvest from renewable energy is also having certain challenges, so it should kept in mind that energy expenditure must be made after intense planning so that the future generation do not fall in the dark world without sufficient power.

Due to the impact on the environment from conventional energy sources, many municipalities and organizations are going green. One example includes Chicago where some of the buildings have solar energy panels installed [7]. Another reason governments and corporations are pursuing renewable energy is that according to studies such as the one by Shafiee and Topal [8], the current fossil fuel reserves other than coal are estimated to be depleted by 2042.

Green technology (GT) is an extensive term which defines new innovative ways that create a friendly environmental. It is designed in such a way so that natural resources are conserved. The basic motto of GT is to curb down the use of fossil fuels and causing less damage to the human, animal, and plant health [20]. In this way GT can reduce the injection of pollutants that are released during power generation from fossil fuels and other harmful chemicals that are released during manufacturing process in industry sector [18].

The area under Green technology covers a huge area of production and consumption technologies. The adoption and utilization of green technology embrace the exploitation different features for monitoring and evaluating, pollution prevention, control, remediation and restoration.

To encourage the adoption of green technologies, some governments are providing subsidies to consumers who buy solar panels, electric vehicles.

A national progress is assessed by measuring the development in economy on two basic parameters known as gross national product (GNP) and gross domestic product (GDP).

II. WORLD WIDE SCENARIO OF GREEN TECHNOLOGY

In October 2020, Japan government made a policy whose declaration was provided by the Prime Minister SUGA Yoshihide. The policy described the methods of nationwide greenhouse emission to absolute zero percentage in order to realize a carbon neutral country. Global Zero Emission Research (GZR) was established by National Institute of Advanced Research Center and Technology in 2020 January that has done versatile research projects related to environment and energy technologies around the world. Dr. YOSHINO Akira was the winner of Nobel Prize in chemistry in 2019 who is the director of GZR. Dr. Akira is the pioneer figure in research of lithium ion batteries.

Hydropower is Japan's primary renewable energy source with the maximum recorded capacity of electricity generation amounting to over 87 terawatt hours. At the same time Japan is also providing world's largest facility for green hydrogen production from renewables, located in Fukushima.

In Malaysia, the departments responsible for Green Technology are Ministry of Energy, Green Technology and Air. In Malaysia, green technology has been recognized as a driver for future economic growth, energy security, climate change mitigation and adaptation. In April 2009, the Malaysian prime minister proclaimed his vision of a Green Malaysia and demonstrated his commitment to climate change mitigation and energy security by escalating the advancement of green technology through the creation of the Ministry of Energy, Green Technology and Water. To encourage the promotion of green technology Malaysian Government has announced incentives through Green Investment Tax Allowances (GITA) in 2014 **.** The purpose of this incentive is to strengthen the development of green technology and give tax exemptions.

Hi tech countries like America, UK, China have their own ways in realizing the implementation of Green Technology. Asian countries like Japan, Korea and India have already started awareness programs from government departments to popularize Green Technology. The largest number of publications on Green Technology was carried out by China and India, considering the scope to BRICS countries. Reports convey that total percentage of articles analyzed are 50%(94) from China account, 32% (68) from India ,9% (16) from Brazil, 6% (10) from Russia , and South Africa only represents 3% (5). India ranks second in relation to Green Technology practices publications, having emphasis on products/processes/ raw material, green energy/energy reduction, and sustainable agriculture. It was observed that in recent years, renewable energy has received enormous prominence in India, in addition to research and from practical site a lot of projects are initiated related to the sustainability of environmentally friendly technologies.

III. OBECTIVE OF GREEN TECHNOLOGY

The goal of Green Technology is to protect the environment, repair damage done to the environment in the past, and conserve the earth's natural resources. Green Technology has also become a burgeoning industry that has attracted enormous amounts of investment capital. The major objectives can be summarized as:

Reducing waste and emissions: This objective can be minimized if new release carbon foot prints are totally eliminated. The percentage of greenhouse gases existing in our atmosphere has already attained an alarming state and further new inclusion must be avoided. This can be ensured by adopting green technologies like electric vehicles and organic farming which do not release carbon compnds into the atmosphere.

Adopting Renewable ,Clean Energy: Life cannot sustain without electricity and in this present age human civilization has become closely adopted with electricity usage. The power plants must use clean technologies to generate electricity and maximum power projects have been commisioned based on solar and wind energy. The

rural sector have started using biomass stoves that are environment friendly.Hence burning of wood can be avoided and trees can be saved which release oxygen.

Incentive schemes: Power policies are designed which encourage the customers to use green technology and refuse conventional power sources .In this way the response can be improved which will popularize the perspectives of GT.In this regard many industries have taken initiative to promote green buildings which are built on reusable materials which make the building efficient and environmentally friendly.The electrification of these buidings are done by renewable energy sources like solar energy where solar panels are installed at roof top.

Recycling process: The materials like paper,plastic,can and batteries that are dumped after use can be recycled after proper treatment so that the waste products accululation can be diminished at a considerable percentage.

Fig 1 shows the main goals of Green Technology.

Fig 1

The area under Green technology covers a huge area of production and consumption technologies.

According to US daily newsletter on green technology (2016 edition), green products are eco- friendly discoveries that are comprised of efficient energy, recycling, health safety concerns, and resources which are renewable, etc. In the construction of environmentally friendly buildings, the highest goals are; firstly: safeguarding natural resources conservation, eliminating the negative impact of construction activities on environmental safety by producing materials that are reusable or recyclable, and also causing an alteration in production pattern to reduce waste and pollutants. The second target is finding an alternative to undesirable practices which affects the environment and is challenging to humans' existence. When an appropriate design is used and a perfect plan for the construction is obtained, then an improvement in the energy efficiency of the building is unescapably possible

The damage that is done to the atmosphere by human activities have resulted in serious climate changes .The carbon emissions have resulted in global warming that have destroyed our mother nature. To save our planet and the future generation extensive monitoring and control remedies have been adopted. The Prevention technologies refrain the production of hazardous materials or change human activities which minimize damages to the environment. At the same time new product substitution have been encompassed that has redesigned the whole production rather that utilizing new pieces of equipment. Besides, control technologies render hazardous materials harmless before entering the environment. The efforts of remediation and restoration technologies embody techniques and methods that develop the condition a perfect ecosystems. The most well-known example of green technology is solar cell where light energy is converted to electricity through the process of photovoltaic effect. Apart from electricity generation, solar energy also results reduction in consumption of fossil fuels and low emission of greenhouse gases.

IV.CRITERIA FOR SELECTION OF GREEN TECHNOLOGIES

The Green technology is the knowledge for conserving natural environment and resources and reducing human involvement. It can function in varied areas such as bio-fuel, eco-forest, renewable energy, and solid waste management [17]. The selection of tools and techniques as an appropriate technology is an important element in helping communities to decide what their future should be like. In simple language the most appropriate technology's search for those technologies that have beneficial effects on income distribution, human development, environmental quality, and the distribution of political power [14].

In general, the seven criteria have been proposed to judge the appropriateness of technology:

a) System Independence: It is the ability of the technological device to stand alone for doing the required job. Whether the technology will require relatively more capital or labor will be analyzed to check system independence of the technology [21].

b) Image of Modernity: People should perceive themselves as modern by adopting the technology. The message is people's realization that technological device can elevate the user's social status as well as need a basic human need. Image of modernity requires that the social status of people who adopt it either increases or remains unchanged.

c) Individual Technology vs. Collective Technology: It is the criteria to look into the societal/cultural standards in which the technology operates. In other words, it is the careful assessment of the technology that is based on group approach and becomes more systems dependent. A society geared towards individual or single family unit will need more systems independent technology. Collective technologies are more easily adopted as collective action reduces a transaction cost [12].
d) Cost of Technology: Affordability of the technology is an important indicator for their wider use since cost is the major factor in encouraging or discouraging the application of appropriate technology in developing economies.
e) Risk Factor: It is an important factor to find out how smoothly technology works in the local production system and system that explains to what degree is the technology system dependent or system independent. This indicates the need for understanding two types of risk- both the internal and external risk. Although analysis of risk is necessary before applying new technology, it is almost impossible to remove all risks.
f) Evolutionary Capacity of Technology: If the chosen device is static, it will relatively reflect the short-lived solutions to a much larger problem. The technology, which supports the continuation of development by enhancing capability to expand, can be expected to compete at the regional, national and international level. G) Single-Purpose and Multi-Purpose Technology: In contrast to single purpose technology, multipurpose technologies are the ones that furnish a variety of applications (e.g. a tiller who can be used for tilling the land, powering water pump, and drying rice [24].

V. APPLICATION SECTORS OF GREEN TECHNOLOGY

Green technology in construction is an effective way of using resources that can provide energy efficiency, waste reduction, and sustainable systemic evolution. There are a large variety of renewable construction technologies, automobiles and locomotives available today that can make a direct analysis of the degree of initiatives taken to save planet earth.In the key criteria when implementing green technology include energy efficiency,indoor environment quality, sustainable site planning and management , materials and resources , water efficiency and innovation .
a) Energy Sector: The power plants which run on fossil fuels cause high rate of carbon emission .To bring down carbon foot prints, efforts are already given in promoting more solar or wind based power plants depending on geographic benefits of the sites. Green technologies have the potential to ensure environment protection and efficient use of resources. Power projects from solar wind energy and have already become a known issue. Initiatives are taken to replace small diesel and coal-fired boiler houses with heat pumps and do not produce any emissions into the atmosphere or soil in order to reduce operating costs, as well as pollution. The other technologies which are also being deployed in power generation are geothermal technology and fuel cells. Geothermal energy utilizes energy from the earth's crust to generate heat or electricity and fuel cells convert the chemical energy contained in hydrogen to electricity and heat using an electrochemical process.
b) Transportation Sector: The conventional fuel based vehicles whose engine run on diesel or petrol are the biggest contributors of greenhouse gases. The automobile sector of the recent age has started working on advanced transportation infrastructure in the form of electric bus or electric vehicles which are capable of minimization of environmental pollution at a significant percentage. Fig 2 shows how an electric car can be charged with the help of rechargeable batteries.

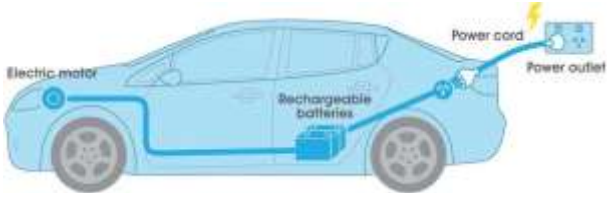


Fig 2

c) Water Filtration: Around the world, green tech is being widely used for water purification. Countries around the world where water supply is limited, green tech may be used for purifying polluted water or extracting salt from seawater to improve the supply of safe drinking water.
Conventional wastewater treatment processes are expensive and require complex operations and maintenance. New wastewater treatments technologies, for example bioreactors and bio filtration employed by sewage treatment technologies, are the most common green technologies for sustainable water management. Bioreactors are devices containing bacteria and microorganisms. Oxygen is supplied to speed up biochemical reactions. These reactions will eventually convert harmful pollutants into non-toxic forms. In bio filtrations, wastewater is passed through the biofilm either up-flow or down-flow and in a continuous or discontinuous manner. During

this process, the immobilized living microorganisms speed up the degradation of organic matter and pollutants present in the wastewater.

d) Green Agriculture : The agriculture sector has adopted various techniques like no-till farming, promotion of genetically modified organisms (GMO), organic farming and vertical farming .Collaboration of Integrated Pest Management (IPM) coupled with application of sensors help to achieve get better productivity with minimum damage to the environment. Integrated Pest Management (IPM) offers long term protection to crops that prevent and combat pest invasion on agricultural lands. IPM can facilitate growth of healthy crops with the least possible disruption to ecosystems. Sensors can track micro-climate data, pH levels in the soil and even the movement of animals. With the support of digital sensors farmers to maximize yields with proper water conservation, reduce waste and increase productivity.

i) **No-till farming**: It is also known as zero tillage which is basically a direct drilling process where crops are grown without soil plough. In this way, percentage of soil erosion is minimized and the amount of greenhouse gases released from the soil is reduced as it is associated with less erosion. This Zero tillage farming also expands the rate of soil carbon sequestration i.e the amount of carbon the soil absorbs and stores and allows crop residue to be left over on the soil surface from the previous harvest. The application cost is not at all expensive but the main requirement in this regard is ensuring proper training to the farmers. The major benefit of this farming is reduction of greenhouse gas emission to the environment.

ii) **GMO**: The next feature which is taken into consideration is application of biotechnology which aids in development of genetically modified organisms (GMO).It is a process by which a crop's DNA is modified in a way that does not occur naturally. The biotech crops are more sustainable for our environment which has the capacity to tolerate climate changes. GMO's can also be grown with less demand of pesticides and do not require to be ploughed frequently.

iii) **Organic Farming**: As the global population is increasing, the demand of food is also rising up. In order to provide continuity of food supply and balance the agriculture production, the researchers have emphasized on organic farming which not only diminishes the application of chemicals but at the same time it takes care of health as well as protects mother earth from the harmful chemical fertilizers which the farmers use to increase the crop productivity. The main aim of organic farming is procuring agricultural production from animal manure, organic waste, crop rotation, legumes using biological pest control techniques. In this way the application of chemical fertilizers can be brought down which consumes a large percentage of fossil fuels during manufacturing process. The crop rotation technique is a major characteristics of organic farming that facilitates planting different crops chronologically on the same plot of land to improve soil health, optimize nutrients in the soil and combat pest and weeds in the agro system. Organic inputs enhance soil quality by intrusion of microbes. Organic production is a universal system designed to optimize the productivity and fitness of diverse communities within the agro-ecosystem.

The general ideologies of organic farming are:

a) *Minimal soil degradation and erosion,*

b) Maintaining long lasting soil fertility by optimizing biological activitties within the soil

c) Improvement of *Nitrogen self-sufficiency by the use of legumes that promote biological nitrogen fixation.*

d)Recycle of organic materials and crop residues to the greatest extent possible

e) Taking care of animal welfare issues with respect to nutrition, housing, health, breeding and rearing

f) Maintaining biological diversity within the system

g) Weed, disease and pest control relying primarily on crop rotations

h) Dependent on renewable resources in locally organized agricultural systems like biomas.

Fig 3

Fig 3 shows the different aspects associated with organic farming. In spite of having different advantage, the major limitation associated is the requirement of large land to produce the same amount of crops from inorganic sources.

iv)**Vertical farming**: The fundamental concept of this process of growing crops in vertically stacked layers rather than the traditional horizontal farming. Under this technique, plants are grown indoors in layers using LED lighting under controlled- environmental agriculture techniques such as aquaponics and hydroponics. Hydroponics is a method of growing plants, without soil, that has been utilized for thousands of years. This new farming technique can help in growing significantly more food on the same amount of land. Aquaponics is another innovative system of growing plants in absence of soil. Fertilizers are added to nourish the roots in hydroponics but in aquaponics, fish are grown simultaneously in the aquatic environment that provide a natural source of organic nutrients through their excreted waste. Europe's biggest vertical farm has the ability to grow 1,000 tonnes of food a year. The farming sector have experienced increased yield and reduced water and fertilizer waste.

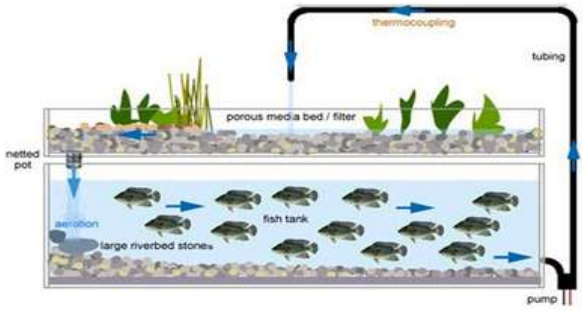
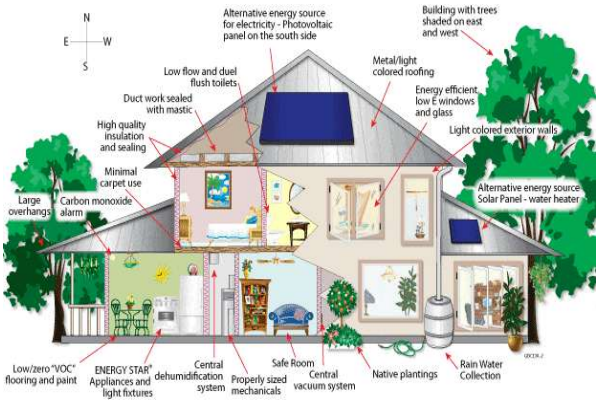


Fig 4

Fig 4 demonstrates the scheme of aquaponics used in vertical farming

e) Building: The emergence of green building has shown a new path in construction engineering which has minimum impact on atmosphere quality as it uses reusable materials which make the building efficient and pleasant. The feature of recycle is employed here that saves natural resources by using new alternative building materials. This process of recycle reduces the wastage of materials and also the dumping of construction wastes to landfills. The interior lighting system of such buildings are dependent on sensors with highly efficient HVAC (heating, ventilating, and air-conditioning).The floors, furniture and painting are done using low-VOC (volatile organic compound) materials.

A delivery centre of TCS in Bhubaneshwar is known to be India's first LEED certified IT campus. TCS Kalinga Park which is spread over 45 acres with 50% green area received the highest ratings (Platinum) from Leadership in Energy and Environment Design (LEED) which is under the control of US Green Building Council that gives ratings to environmentally sustainable constructions. Use of energy efficient and eco-friendly equipment.



Fig

g) Railways : The introduction of three phase locomotive technology in railway have reduced 500 tonnes of CO annually. These locomotives are equipped with regenerative braking feature which are capable to regenerate electricity during braking act and power is fed back to grid. WAG7 conventional locomotive from BHEL Jhansi was the first to deploy regenerative braking feature in 2019. The first pure 120000 HP Indian made locomotive named WAG12 has been manufactured by Madhepura Electric Locomotive Pvt. Ltd. (MELPL) which equipped with regenerative braking system that provides substantial energy savings during operations.

The lighting sector of Zonal Railways have been replaced by CFL/FL lights in self-propelled (EMU/MEMU) coaches with energy efficient LED lights. During 2019-20, 36500 coaches have been provided quipped with energy efficient LED lights. All newly manufactured coaches from production units are being turned out with LED light fittings. Vision 2020 document of the Indian Railways states to procure utilization of at least 10% of its energy requirement from renewable sources. Solar power plants of 500 Mega Watt (MW) capacity solar plants on roof top of Railway buildings which will be used for meeting non-traction loads at Railway Stations.

VI. BENEFITS AND CHALLENGES OF GREEN TECHNOLOGY

Technology is a tool which is applied to extract the best solution to help in developing a quality life style. But sufficient precaution should be followed in order to monitor that the ecosystem and environment are not endangered. Green technologies guide the correct path to apply technology so that adverse human impacts can be minimized. Social equitability, economic feasibility and sustainability are the basic key parameters for green technologies. The present environment is already heading towards a serious threat where a damage is made that cannot be reverted back easily. Present human actions are pulling the world towards an ecological landslide which can ensure an inevitable destruction. Green technologies are an approach towards saving earth. Thus both its positives and negatives need to be investigated.

Green Technology has inherent positive traits in it. The following points summarize in brief all the advantages:

i) It does not emit anything harmful for the environment.

ii) It has become popular as consumers of the technology are becoming more environment conscious. This will give benefits to investors at long run in certain areas.

iii) It requires less cost for maintenance. This reduces operating cost and hence overall cost on the long run.

iv) As it uses renewable natural resources and hence we will never run out of vital resources such as water and electricity.

v) It will slow down effects of global warming due to reduction in CO_2 emissions.

Generally, green technology is more expensive than the technology it aims to replace, because it accounts for the environmental costs that are externalized in many conventional production processes. Because it is relatively new, the associated development and training costs can make it even more costly in comparison with established technologies. The perceived benefits are also dependent on other factors such as supporting infrastructure, technology readiness, human resources capabilities and geographic elements. Hence, what could be a feasible green technology in one country or region may not be in another. Adoption and circulation of these technologies can be constrained by a number of other barriers. Some may be institutional, such as the lack of an appropriate regulatory framework; others may be technological, financial, political, cultural or legal in nature. From a company's perspective, the following are likely barriers to adopting green technologies:6

• High implementing costs

• Lack of information
• No known alternative chemical or raw material inputs
• No known alternative process technology
• Uncertainty about performance impacts
• Lack of human resources and skills

VII. CONCLUSION

The environmental protection, resource conservation and addressing other socioeconomic aspects for sustainable development are essential. The green initiatives adopted for resource conservation, and environmental protection shall help sustain higher economic growth rate necessary to fulfill basic needs with some acceptable quality of life in the future. According to Brundtland Commission (1983), sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs. Sustainable development that is respectful of the social equity and environmental healthiness may occur only when it gets stronger international awareness and large-scale changes into tendencies in production and consumption patterns. Recognizing the debilitating and even devastating – impact of climate change, countries all over the world should pledge to reduce their contribution to the climate by cutting down carbon dioxide emissions. To move toward sustainable development, policymakers should consider not only domestic economic concerns, but also the major scientific and technological challenges affecting all countries.

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