



Progress in Green Technology

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Abstract: Sustainable Technologies which serve the “Green Purpose” is known as Green Technology. Green signifies “nature” but here Green Technology takes into account the long and short-term environmental impacts. This technology results in products that are environmentally friendly which focus on renewable energy, recycling of materials, and using efficient energy. Solar cells are one the best example of green technology because solar energy is a renewable source of fuel which will result in less consumption of fossil fuels resulting in less pollution and greenhouse gas emission. Green Technologies can be further branched into the following: Green Chemistry, Green Nano Technology, Green Computing, Green Energy, and Green Building. Green Technology is really essential for daily life because it promotes the idea of the 4 R’s (Refuse, Reduce, Responsibility and Recycling). And this will also benefit our earth which in turn secures a bright future for our coming generations.

Keywords: Green purpose, green energy, green technology, green resources

1. INTRODUCTION

Green technology is an umbrella terminology that describes the usage of technology and science to reduce human and artificial impacts on the natural surrounding and environment. It is a technology that is environmentally friendly, developed, and used in such a way that it doesn't disturb our environment and conserves natural resources. In simple words, it is an environmentally friendly way of the production process or its supply chain. It is also known as eco-friendly technology or clean tech. "Green Technology" is a system that uses innovative methods to create an environmentally friendly product. It uses renewable natural resources that never depletes, so future generation can also benefit from it. It can effectively change waste patterns and production in a way that it won't harm the planet. Green technology covers a vast spectrum of scientific research, across energy, atmospheric science, agriculture, material science, and hydrology. Many green tech ideas are introduced to reduce emissions of carbon dioxide and other greenhouse gases in order to fight against climate change.

II. HISTORY

While green technology has become a trend in the modern age, elements of these business practices have been in business since the Industrial Revolution. Beginning in the early 19th century, scientists began to observe the environmental effects of coal-burning plants, and manufacturers have attempted different ways to reduce their bad environmental effects by changing the production processes to produce fewer waste by-products.

After the war, scientists began warning of the bad effects of chemical pesticides, while doctors reported mysterious illnesses linked with nuclear radiation. Many point to this time as the starting point of the ecological movement, which attempted to preserve nature and resources while raising awareness of the negative effects of modern technology. The government slowly recognized the necessity of the preservation of environmental resources. Recycling programs became a new trend over the following decades, raising awareness about different types of waste. The Environmental Protection Agency, established in 1970, set structured requirements on pollution and waste and established mandates for coal scrubbers and other clean technologies.

III. GOALS OF GREEN ENERGY

Green Technology aims to promote the idea of the 4 R’s (Refuse, Reduce, Responsibility, and Recycling)

Refuse: We can refuse to use materials that are not environmentally friendly. For eg, the use of plastic bags, limiting the use of non-renewable energy like coal and petroleum, and promoting the use of clean and renewable energy like solar energy, wind energy, and other energy that are harvested by green means and we should think outside the box to find eco-friendly alternatives of the mentioned items.

Reduce: Waste reduction is all about reducing waste at the source. For example, buying food we don't need because there's a special offer and then wasting it. In short, if we use fewer materials in the first place. It takes materials to manufacture, commute, and waste management of products, so reduction minimizes the use of new resources.



Recycle: Recycling is a way to convert waste materials once they have been used if they can't be again used. It prevents waste accumulation and makes waste into new products. For effective recycling waste management is required for sporting the waste according to their materials. This may turn the old material into a new variation of the same thing or into something completely different.

Responsibility: We must be responsible while using green technology by keeping in mind some simple points:

Don't waste electricity- Turn down electrical appliances when not in use

Don't waste water - Never leave home water valves open while not in use

Don't waste fuel

Don't waste food - Don't cook extra food and throw, always keep in mind that there are millions in the world starving without food.

IV. BRANCHES OF GREEN TECHNOLOGIES

Green Technology: The term green chemistry was coined by Paul Anastas in 1991, Green chemistry, is also called sustainable chemistry. The invention, design, and application of chemical products and processes to reduce or eliminate the use of hazardous substances. For eg., supercritical carbon dioxide - It is a watery state of carbon dioxide where it is held above its critical temperature (304.25 K) and critical pressure (72.9 atm).



Fig.1 Super Critical Carbon Dioxide [1]

Some of its uses are:

- In various laboratories, supercritical carbon dioxide is used as an extraction solution. Eg: It is used to determine the total recoverable hydrocarbons from soils, sediments, and other media.
- Supercritical carbon dioxide is used to remove organochloride pesticides from agricultural vegetation without adulterating the required constituents from the plant matter in the herbal supplement industry. Eg DDT, Dicofol, Aldrin.
- Supercritical carbon dioxide can also be used as a more environmentally friendly solution for dry cleaning.

The principles of Green Chemistry are:

- Prevention of waste materials
- Making chemical synthesis less threatening
- Making chemicals and products safer
- Making conditions for a solution and reaction safer
- Increasing the efficiency of the energy

Environmental Protection Agency- EPA's Design for the Environment (DfE) works in collaboration with industry, environmental groups, and academia to reduce hazards to people and the environment by finding ways to prevent pollution. DfE has evaluated human health and environmental issues connected with traditional and other chemicals and processes in a range of industries.




Fig 2: EPA's Design for the Environment (DfE) [2]


EPA allows reliable products to have the Design for the Environment (DfE) label. This label informs consumers to quickly identify and choose things that are safer for them, their families, and the environment.


When one sees the DfE logo on a product it means that the DfE review team has checked each ingredient for potential human health and environmental effects.


Chemicals are marked as a



Green circle ()- The chemical is safe to use and it does not cause any harm to human health and the environment.
Ex: citric acid

Green half-circle ()The chemical is expected to be of low risk based on data derived from experiments.
Ex: Aspartic acid, Monosodium - D-glucoheptone

Yellow triangle - () This chemical has some hazard issues. Eg: Terpinolene, Methyl benzoate

Grey square - () This chemical will not be acceptable for use in products. Eg: Bis (2-Ethylhexyl) sodium sulfosuccinate and Benzyl alcohol.

Green Energy: Green energy is derived from natural channels such as sunlight, wind, rain, tides, plants, algae, and geothermal heat. These energy resources are renewable.

Sources of green energy are as followed:

- **Solar Power:** Solar power is the process that converts sunlight into electricity, either directly using solar cells. It can be used for regular household works like pumping water, communication, and charging batteries

Solar Car: In 1955 the first solar car was introduced and it was a small fifteen-inch automobile created by William G. Cobb of General Motors called it Sun-mobile. Samsung India introduced the first solar-powered phone, the Solar Guru 1107, which enables the users to charge the phone under the sun. 1 hour of solar charging gives one 5 to 10 minutes of time to talk.

Solar Road: the Netherlands on 12/11/2014 unveiled the world's first solar bike path, a revolutionary project to harvest the sun's energy that could eventually also be used on roads. The so-called "Solar Road" bike path is made of concrete modules each measuring 2.5 by 3.5 meters implanted with solar panels wrapped in tempered glass. To help prevent accidents, the glass has a unique non-slip surface.

- **Wind Power:** Here the wind turbines changes the kinetic energy in the wind into mechanical power that interns gives power to a generator to give out eco friendly electricity. In 1920 Betz introduced that the max power that may be produced by a wind machine is 59.3% of the incoming energy in the wind. The amount of electricity generated by one turbine is directly proportional to its size and the quality of wind resources. A typical 2-megawatt turbine, when placed in an favorable wind source, it can produce enough eco friendly electricity to power about 500 homes annually.

- **Hydroelectricity:** Hydroelectric plants are developed where running water is stored. The amount of electricity produced is determined by the available volume of water and the amount of "head" (the height from the turbines in the power plant to the water surface) created by the dams. The greater the flow and head, the more electricity is generated. Waves are produced by the wind as it blows across the sea surface. Energy is converted from the wind to the waves.

- **Wave energy:** Wave energy has the potential to be one of the cleanest forms of electricity generation. The first tidal power station was the Rance tidal power plant built over a period of 6 years from 1960 to 1966 at La Rance, France. The Pelamis is an offshore wave energy converter that uses the motion of waves to produce electricity. The machine operates in water depths greater than 50m and is typically installed 2-10km from the coast. On average one machine will provide sufficient power to meet the annual electricity demand of approximately 500 homes.

- **Geothermal Energy:** The term Geothermal originates from two Greek words 'GEO' and 'THERM'. The Greek word 'geo' means the earth and 'Therm' means heat from the earth. Geothermal energy is energy derived from the heat of the earth.

- **Biofuel:** Fuel made from biological sources like Straw, Wood, Wood waste, Sugarcane, and By-products from the agriculture industry. Ex: corn, sugarcane, soybean

Green Information Technology: Green computing describes the study and the use of computer resources in an efficient way. Green IT starts with manufacturers producing environmentally friendly products and encouraging IT departments to consider more friendly options like virtualization, power management, and proper recycling habits.

Green Building: Green building is the practice of increasing the efficiency of buildings and their use of energy, water, and materials and reducing building impacts on human health and the environment through better design, construction, operation, and maintenance. The materials that are used for green building are less volatile organic compounds paints, Bamboo flooring, Woven wool for carpeting, and Ecological concrete (special admixture, dicalcium silicate: $2\text{CaO} \cdot \text{SiO}_2$, instead of cement).



- Skyscraper Farming: A futuristic concept converts skyscrapers into crop farms that could help reduce global warming, improve the urban environment, and help feed the world's growing population. The working materials of the following building are: SOLAR PANEL- Energy is supplied by a rotating solar panel that follows the sun; drives interior heating/cooling system
GLASS PANEL- Clear coating of titanium oxide collects pollutants and makes rain slides down the glass where it is collected and used for watering.

ARCHITECTURE- Circular design allows maximum light into centre.

ECONOMY- The plan combines farming with office and residential stories.

IRRIGATION- Filtered, sterilized wastewater from sewage system can be used for irrigation.

Some famous green buildings are:

- Bahrain World Trade Center, Manama: It is the first skyscraper in the world to integrate wind turbines into its design. The turbines supply about 15 percent of the electricity used by the skyscraper approximately the same amount of electricity used by 300 homes.
- National Library Singapore: Building is oriented away from the east-west sun, combined with sun shading features on the west face of the building as an additional shield against solar heat gain. An open area between the two blocks, which allows natural ventilation and day lighting. Extensive landscaping, and roof gardens are utilized to lower local ambient temperature. Use of rain sensors as part of the automatic irrigation system for rooftop gardens.
- Residence Antilia, Mumbai: This is 70 storey, 570 foot tall tower is a home for a single family, that of Indian Mukesh Ambani. The tower has been designed by perkins in 2010. The design is innovative with rooftop gardens.
- India Tower Mumbai: India Tower, (formerly known as "Park Hyatt Tower"), the 74-storey, 301 meter tall mixed-use residential and hotel tower has officially begun construction. The 882,000 sq ft tower has set a number of records ranging from "Mumbai's Tallest" to "India's First Supertall" to "India's Greenest Skyscraper."
Solar shading, natural ventilation, day-lighting, rainwater harvesting are used in this building.

Green Nano Technology: Green nanotechnology refers to the use of nanotechnology to enhance the environmental sustainability of processes producing negative external effects. It also refers to the use of the products of nanotechnology to enhance sustainability. Eg: One major project that is being worked on is the development of nanotechnology in solar cells. Solar cells are more efficient as they get tinier and Nanotechnology is already used to provide improved performance coatings for photovoltaic (PV) and solar thermal panels.

PV covered with nanotechnology coatings are said to stay cleaner for longer to ensure maximum energy efficiency is maintained.

V. GREEN RESOURCES AND ORGANIZATION

- Environmental Protection Agency: independent executive agency of the United States federal government tasked with environmental protection matters. Many public health and environmental groups advocate for the agency and believe that it is creating a better world. Other critics believe that the agency commits government overreach by adding unnecessary regulations on business and property owners.
- Green Power Partnership: The United States Environmental Protection Agency's Green Power Partnership is a voluntary program that supports the organizational procurement of green power by offering expert advice, technical support, tools and resources. It provides public health and environmental benefits by expanding U.S. renewable energy markets through the voluntary use of green power.
- Energy Star: Energy Star (trademarked ENERGY STAR) is a program run by the U.S. Environmental Protection Agency (EPA) and U.S. Department of Energy (DOE) that promotes energy efficiency [4]. The program provides information on the energy consumption of products
 - and devices using different standardized methods.
 - The U.S. Green Building Council (USGBC): co-founded by Mike Italiano, David Gottfried and Rick Fedrizzi in 1993, is a private 501(c)3, membership-based



Fig 3. Environmental Protection Agency & Green Power Partnership [3]



- non-profit organization that promotes sustainability in building design, construction, and operation. USGBC is best known for its development of the Leadership in Energy and Environmental Design (LEED).



Fig 4. Energy Star & The U.S. Green Building Council (USGBC) [4,5]

Leed Rating: The U.S. Green Building Council (USGBC) created a program called: Leadership in Energy and Environmental Design (LEED) The five key areas of LEED are: Sustainable site development, water saving, energy efficiency material selection, indoor environmental quality based on the following areas points and ratings are distributed 29-36 points for certified rating, 37-43 for silver ratings, 44-57 for gold rating and more than 57 for platinum rating.

VI. GOVERNMENT'S STAND ON GREEN TECHNOLOGY

Governments are taking various steps to secure the environment and promote Green Technologies. The government of India has introduced multiple Environmental laws to support the motion. Some of the examples are:

- Fundamental duties (Part IV A) Article 51A: To protect and improve the natural environment.
- The Air (prevention and control of pollution) act, 1981: To provide for prevention, control, and abatement of air pollution.
- The Water (Prevention and Control of Pollution) Act, 1974: To provide prevention and control of water pollution.

Many national policies has also been introduced by the government of india for green technologies: New and Renewable Energy Plan, (2011-2017), Electricity Act, 2003. amended in 2004 and 2007, National Bio-fuel mission, 2003, The Government of India approved the National Policy on Biofuels in December 2009, The Jawaharlal Nehru National Solar Mission was launched on the 11th January, 2010, Through these provisions India aims to meet 20% of countries total requirement of energy from renewable sources by 2020.

VII. CONCLUSION

To conclude, it can be said that sustainable development brings out stability in the requirements of the environment. It makes the resources available for use for the future generations. Sustainable development is an amazing way to conserve the resources provided by nature. This can be achieved by using eco- friendly resources and technologies that will have no serious impact on the environment. The resources that are available to us shall be used in a sustainable manner so that they do not become extinct for the usage of future generations. The development of green technologies will result in bringing the necessary changes and ensuring a bright future for the present and future generations. So we all have to cooperate unanimously and make this dream a reality.

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