

5. Green Innovation and Sustainable Technology for the Future

Prasad Jaladi

Founder and Chief Facilitator of Suraksha,
Austin, Texas, USA.

Reena Aggarwal

Assistant Professor,
Department of Electronics and Communication Engineering,
Lovely Professional University, Jalandhar, Punjab, India.

R. M. Madhumitha Sri

Department of Pharmaceutical Technology,
Alagappa College of Technology, Anna University, Chennai.
Associate Analyst, Zifo Technologies Pvt. Ltd.,
Manapakkam, Chennai, India.

Zeliha Selamoglu

Professor in Medical Biology,
Nigde Omer Halisdemir University, Nigde, Turkey. Western Caspian University,
Baku, Azerbaijan. Khoja Akhmet Yassawi International Kazakh-Turkish
University, Faculty of Sciences, Department of Biology, Central Campus,
Turkestan, Kazakhstan.

S. Ravichandran

Professor in Chemistry,
Lovely Professional University,
Jalandhar, Punjab, India.



Abstract:

Green technology is really a broad concept that help to reduce human environmental consequences and promote long term growth. Social equity, viability and economic feasibility are the main considerations for renewable energy. Green technology is a term that describes a form of technology that is deemed eco-friendly due to its manufacturing process. Excessive use of pesticides and over exploitation of energy have resulted in the greenhouse effect and global warming in recent years, prompting the development of green technologies. Green technology offers solutions to issues such as carbon dioxide emissions, pollution, deforestation and resource depletion. Green technology encompasses a vast variety of gadgets, allowing people to be more concerned about the environment in their real experiences. Hence in future this technology has always come up with better solutions and implemented in very efficient ways. The shift to green technology should help to stabilize global movements toward improving people's well-being and social prosperity thereby reducing environmental concerns. The benefits of green technologies and the profits that can be made from it are the focus of this study. Furthermore, the objective of this study is to highlight importance about renewable technology.

Keywords:

Energy, Environment, green technology, solar, sustainable, renewable resources.

5.1 Introduction:

Technology has been around for even longer than we can remember. It's impossible to say when technology began. In the beginning, technology consisted of hunting fire, utensils and guns. Later times' technology, the wheel was invented which considered as one of the most valuable pieces of technology ever created. The industrial revolution is one of the most recent important periods.

Customers began to purchase more at this time. The use of coal that caused the industrial revolution to take place. Then, electrical energy became more affordable. India has renewable resources in abundant. Energy is capability to produce work or any change. Greener energies could be utilized for reducing the environmental effects primarily greenhouse gas emissions during electricity generation. Green technology¹⁻⁵ is described as technology that is environmentally sustainable, designed and utilized in a move that does not harm the environment.

Green technology is also known as sustainable technology. The aim of green technology is to fulfil societal needs without harming or depleting the natural resources⁶⁻⁹. The need for renewable energy has raised because of following facts:

- The population increases.
- Rising prices for oils and gases
- Concern for the environment
- Government incentives.

It is evident that after the industrial revolution pollution, global warming, sea levels, and diseases rise are threatening our civilization and biodiversity. Therefore, there is an urgent need for innovative solutions that can mitigate environmental impact while promoting economic growth¹⁰. This chapter delves into the realm of green innovation and technology, exploring how cutting-edge technologies revolutionize industries, driving sustainability initiatives and shaping a more environmentally conscious future¹¹⁻¹².

5.2 Technological Enablers of Green Innovation:

Green innovation encompasses a wide range of activities aimed at innovation, development of products, processes and services that minimize environmental impact throughout their life cycle. It involves design thinking and sustainable practices to create solutions that not only solve environmental challenges but also offer economic and social benefits. The key aspects of green innovation include resource efficiency, renewable energy adoption, waste reduction and eco-friendly materials development.

5.3 Renewable Energy Technologies:

Solar Photovoltaic (PV) and Concentrated Solar Power (CSP) systems are rapidly advancing, becoming more efficient and cost-effective, thus driving widespread adoption.



Figure 5.1: Solar Photovoltaic

Wind turbines continue to evolve, with larger, more efficient designs and innovations in offshore wind farms expanding renewable energy generation capacities.



Figure 5.2: Wind Energy

Energy storage technologies such as advanced batteries (e.g., lithium-ion, flow batteries) and hydrogen storage systems are crucial for balancing intermittent renewable energy sources and enabling grid stability.



Figure 5.3: Flow Batteries

5.4 Sustainable Mobility Solutions:

Electric vehicles (EVs) are experiencing a surge in popularity due to advancements in battery technology, improved charging infrastructure, and government incentives promoting zero-emission transportation.

Developments in autonomous vehicles, shared mobility platforms, and smart transportation systems are revolutionizing urban mobility, reducing traffic congestion, and lowering emissions.



Figure 5.4: Electric Car

5.5 Circular Economy Practices:



Figure 5.5: Life Cycle Thinking

Circular economy models prioritize resource efficiency, waste reduction, and recycling, aiming to close material loops and minimize resource extraction. Technologies such as 3D printing, IoT enabled tracking and monitoring systems, supply chain platforms are facilitating the transition to circularity by optimizing resource use, enabling product traceability, and promoting sustainable consumption patterns.

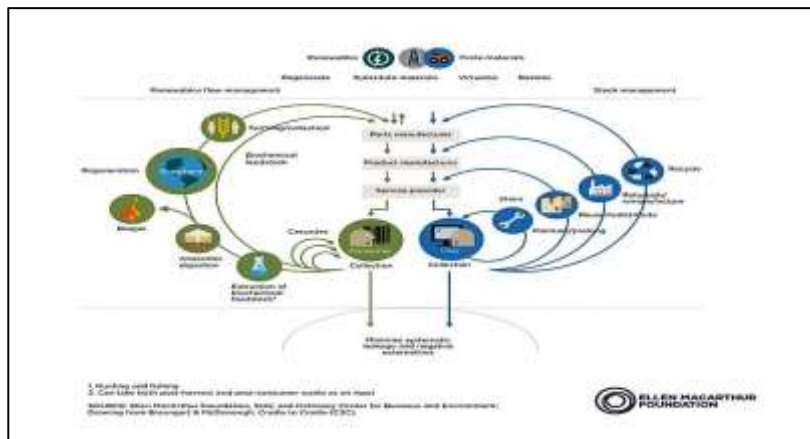


Figure 5.6: Circular Economy Practices

5.6 Impact and Benefits of Green Innovation:

5.6.1 Environmental Benefits:

- Reduction of greenhouse gas emissions, air pollution, and water contamination through cleaner production processes and renewable energy adoption.
- Preservation of natural resources, biodiversity conservation, and mitigation of habitat destruction through sustainable land use practices and eco-friendly materials sourcing.

5.6.2 Economic Opportunities:

- Industrial evolution with new jobs creation with green technologies such as renewable energy, sustainable transportation, waste management, and green building construction.
- Cost savings for businesses through energy efficiency measures, waste reduction strategies, and sustainable supply chain practices.

5.6.3 Societal Advancements:

- Improved public health outcomes due to elimination of pollution and enhanced access to clean water, air, and food.
- Empowerment of communities through smart city /village models with decentralized renewable energy systems, localized industry, food production initiatives, and green infrastructure projects promoting resilience to climate change impacts.

5.7 Challenges and Future Directions:

While green innovation and technology offer immense potential for sustainable development, several challenges must be addressed:

- Cost barriers and investment challenges in adopting green technologies, especially for small and medium-sized enterprises (SMEs) and developing economies.
- Bringing awareness to the public, education, regulatory frameworks and policy incentives need to be strengthened to promote green innovation, create market demand for sustainable products, services and ensure accountability for environmental stewardship.
- Global and local collaborative partnerships among governments, businesses, academia, and civil society are essential to drive innovation, share best practices, and scale up sustainable solutions.

The future of green innovation lies in interdisciplinary collaboration, continuous research and development efforts, as a collective commitment to build a more resilient and environmentally sustainable world.

5.8 Conclusion:

Greener technology is becoming increasingly popular with consumers. The most attractive products in this area are those that decrease energy consumption. Green technology spans a wide range of appliances, making it possible to be more environmentally conscious in daily life.

Energy is a basic requirement for continued economic expansion for supplying and ensuring the welfare of the rest of the population. Therefore, the source of renewable energy helps a lot in getting rid of increasing power crisis and increasing prices of fossil fuels. These are present in abundant in nature and are free of cost. Energy generated from renewable energy sources is clean and pollution free.

Green innovation and technology represent pivotal pathways toward achieving sustainability goals, including resource conservation. With the power of innovation, investing in sustainable solutions, and fostering collaboration across sectors, we can navigate towards a greener, more prosperous future for generations to come.

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