

Green Technologies Current Status, Challenges and Way Ahead



The future of green technology is not just about new gadgets and solutions; it is more about a shift in mindset towards a more sustainable way of living. India's continually evolving policies and reforms focused on attaining nationally determined contributions are clearing a path for faster adoption of green technologies and for facilitating investors across the globe. Economically, Green technologies open new markets and create jobs. These technologies also foster business innovation, enabling companies to develop new products and services that meet growing consumer demand for sustainability. Environmentally, green technologies significantly reduce carbon emissions contributing to the fight against climate change and environmental degradation. Socially, they improve the quality of life by providing access to cleaner air and water. And they also offer a path to achieving global sustainability at the national level.

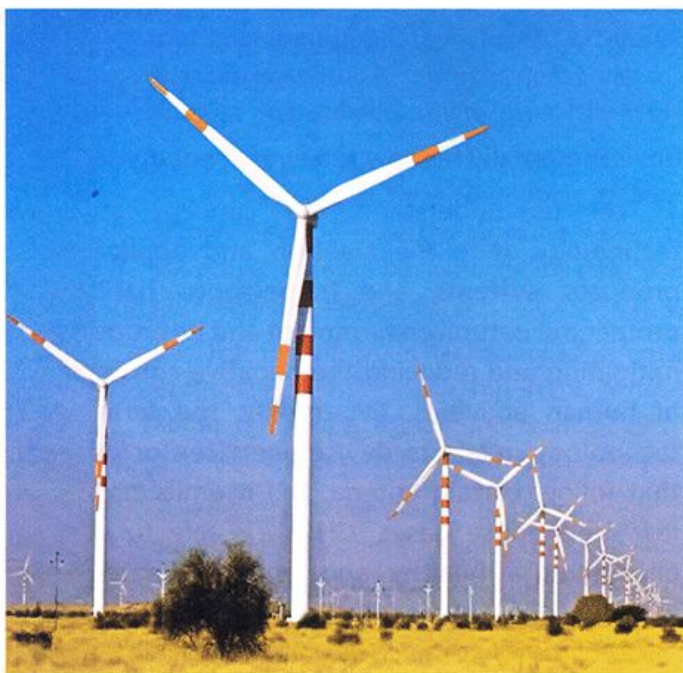
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In view of the huge impact of greenhouse gas emissions, depletion of natural resources, continuously increasing global warming, various stakeholders, for the past two decades have been pondering over United Nation's sustainable development goals (SDGs) and their implementation using clean and green technologies. Clean technology refers to the use of conventional energy resources to address the energy demands, without causing environmental damage and green technology refers to the use of

environmentally friendly renewable energy sources.

Let us understand the concept of green technology. It is the creation and application of products, systems, and frameworks that aim to protect the natural environment and its properties by mitigating and reducing the negative consequences of human activities. To simplify, the term "green technology" refers to devices, services, or processes that follow certain criteria, i.e., it emits no or very few greenhouse gases (GHGs), is safe to use, and encourage a healthy and better climate for all forms of life. It reduces electricity and natural

resource consumption and also encourages the use of natural energy. Green technologies broadly encompass innovations focused on environmental enhancement and resource efficiency. They range from renewable energy solutions like solar and wind power to advanced waste management solutions and eco-friendly materials. These technologies are crucial in addressing global environmental challenges such as climate change and resource scarcity, marking a significant shift from traditional practices to sustainable alternatives. They offer new opportunities for growth and development, challenging conventional business models and promoting sustainable business operations. This shift is evident in the rise of green startups and investments in sustainable innovations. Renewable energy technologies for energy production, such as solar and wind power, are at the forefront, offering alternatives to fossil fuels. Energy efficiency technologies, focusing on reducing energy consumption in buildings and industries, are also critical. Green transportation technologies, including electric vehicles and sustainable public transit systems, are gaining momentum. Furthermore, waste management technologies are revolutionising the way we handle waste, turning it into sustainable resources or energy. Lastly, sustainable materials are replacing traditional, non-renewable materials in the construction industry. These varied types of technologies underscore the comprehensive scope they can have in addressing environmental



challenges. Thus, it is like giving Mother Nature a high-tech helping hand.

Ever wondered, how we can make our planet greener while still enjoying the benefits of modern technology. Here are the irresistible goals of Green Technologies, summarised as under: -

- ▶ Reduce the rate of increase in energy demand thus promoting economic growth
- ▶ To promote the development of the green technology sector and its contribution to the national economy
- ▶ To increase the potential for competition in the production of green technology and to improve the sector's performance in the field
- ▶ To ensure long-term sustainability for posterity
- ▶ In addition, to raise public consciousness about green technologies as well as to promote their wider use
- ▶ While discussing the current promotion and coverage of green technologies, we find their footprints in various sectors such as

Energy Sector: Green Technology in electricity generation and energy resource management, including cogeneration in the manufacturing and commercial sectors.

Building Sector: Green technology is being used in the design, administration, repair, and demolition of houses.

Water and Waste Management Sector: Green technology usage in water supply control and usage, wastewater disposal, and solid waste landfills.

Transport Sector: Green technology integration into transportation infrastructure and automobiles, including bio-fuels and public transportation.

Now that we have dipped our toes into the world of green technology, let us dive deeper into the heart of the matter. The opportunities presented by green technologies are vast. Economically, they open new markets and create jobs. These technologies also foster business innovation, enabling companies to develop new products and services that meet growing consumer demand for sustainability. Environmentally, green technologies significantly reduce carbon emissions contributing to the fight against climate



change and environmental degradation. Socially, they improve the quality of life by providing access to cleaner air and water. Additionally, they offer a path to achieving global sustainability at the national level. These opportunities can augment the pace of economic growth and serve as a step towards a more sustainable and equitable world.

It is the best way to address environmental issues while still promoting economic development. It also aligns with the global agenda of governments currently prioritising environmental betterment, including the phenomena of climate change. The greatest advantage of using green technologies is that it improves people's quality of living by making the climate more sustainable. If air, water, and noise pollution continues, it would have a very bad effect on the quality of life. The negative effect on the climate is minimised as we use green technologies. Green technology has a lot of promise for propelling the nation forward. Industries that use or produce goods based on green technologies may help the local population find work.

In the coming days, the green technology landscape will be marked by several adventurous innovations. One important development is in the realm of solar energy, where advances have led to more efficient and affordable solar panels, making renewable energy from solar energy accessible

to a broader audience.¹ Another area of notable progress is being witnessed in the electric vehicle technology. EVs are becoming popular day by day, thanks to improvements in battery life and charging infrastructure. Waste management technologies are also undergoing transformation. Innovations in recycling and waste-to-energy processes are enabling more sustainable management of resources. These technologies have the potential to reduce landfill waste and greenhouse gas emissions. Moreover, green architecture is gaining momentum, with sustainable buildings designed for energy efficiency and minimal environmental impact. These structures utilise sustainable materials and incorporate features like green roofs and energy-efficient lighting, contributing considerably to urban sustainability and lowering temperatures in adjacent areas.

While looking at the Agricultural sector, we find sustainable farming technologies are evolving. Techniques like precision farming, which uses Artificial Intelligence and the Internet of Things (IoT) for efficient resource usage, are revolutionising food production, making it more sustainable and less harmful to the environment. These illustrations clearly signify the dynamic and impactful nature of green technologies. They are not just transforming industries but are also paving the way for a more sustainable and eco-friendly future. The continued evolution and adoption

of these technologies will, undoubtedly, be crucial in addressing the global environmental challenges of our time.

Currently, the manufacturing sector contributes to nearly 40% of the country's total energy consumption and is one of the major sources of greenhouse gas emissions. As manufacturing sector continues to witness growth, its rapid consumption of coal, oil, and natural gas has become a concern due to their significant contribution to pollution. The adoption of renewable energy sources offers opportunities for companies to reduce their carbon footprint. Renewable energy such as biomass, green coal, and solar power can provide reliable energy for manufacturing processes. The initiative taken by Government Of India under Production Linked Incentive scheme is presented in pictorial form:

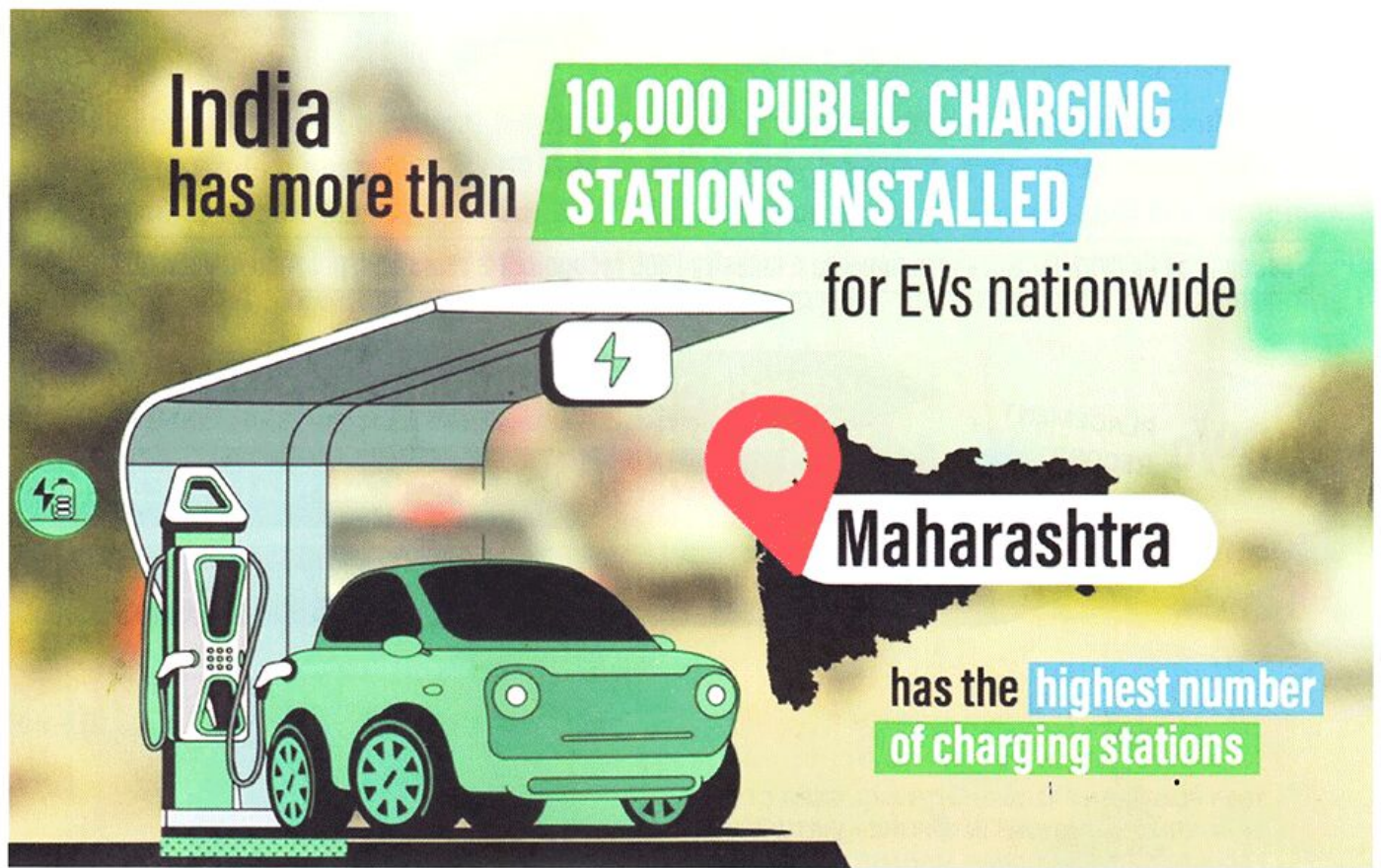
Another initiative is National Green Hydrogen Mission, which will lead to significant decarbonisation of the economy, reduced dependence on fossil fuel imports, and enable India to assume technology and market leadership in Green Hydrogen. Initially, two distinct financial incentive mechanisms proposed with an outlay of ₹ 17,490 crore up to 2029-30, are:

- ▶ Incentive for manufacturing of electrolyzers
- ▶ Incentive for production of green hydrogen

It will support the development of supply chains that can efficiently transport and distribute hydrogen. This includes the use of pipelines, tankers, intermediate storage facilities, and last-leg distribution networks for export as well as domestic consumption. Here are the Mission outcomes presented in pictorial form: -

The journey of green technologies is of course, quite optimistic but not without challenges. Economically, the high initial investment costs for green tech is a big barrier. Businesses may face challenges in securing the necessary funding for implementing green technologies. There are also challenges in achieving widespread adoption and integration into existing systems and infrastructures. Regulatory hurdles can impede the development and implementation of these technologies. Furthermore, public acceptance and awareness remain crucial for widespread adoption. One of the key challenges in adopting green technology is the need for reduced energy

consumption, which requires us to change our habits and lifestyles. Reducing Waste is yet another challenge. Green technology promotes a circular economy where waste is minimised and resources are reused or recycled. However, to achieve it, we not only need to recycle more, rather design products and systems that generate lesser waste. Products need to be designed not just for functionality and efficiency but also for longevity and end-of-life recyclability. In Agriculture, the shift towards more eco-friendly practices may pose a challenge. It is a complex issue that requires a balance between maintaining productivity and protecting the environment. Green technology also aims to reduce water consumption. Realising this objective, particularly in the industries where water use is high, requires an out of the box approach and a staunch commitment to conservation. Another challenge is reducing Air pollution, particularly in big cities where pollution levels are very high. Effectuating it requires cleaner energy sources, improved industrial processes and stricter regulations. Reducing Carbon footprints, though a global challenge, is the one that green technology is uniquely equipped to tackle. Not only renewable energy sources and energy efficient technologies are required but also a societal shift towards sustainable lifestyles. Addressing these challenges is essential for the successful integration and maximisation of green technologies' potential. The Vertical Farming, No-till Farming, changing dietary habits, and embracing innovative foods like plant-based meat substitutes and Precision Fermentation can help us to create foods which can reduce our carbon footprints and contribute to more sustainable food systems. In the manufacturing sector, the challenges hinder the widespread adoption of renewable sources. For instance, India heavily relies on imported materials for the solar supply chain, leading to foreign exchange pressure. Based on conservative estimates, more than 50% of the project costs for each megawatt of solar PV power plant installation in India lead to the outflow of foreign exchange. To overcome this, developing a domestic solar value chain could help stimulate the usage of renewable energy in manufacturing sector as well as lead to the creation of jobs. Bioenergy offers promising solutions to mitigate carbon emissions, especially in sectors that are challenging to transition



to sustainable and clean practices. Bioenergy involves deriving renewable energy from organic matter, such as agricultural waste or energy crops. However, the adoption of bioenergy in manufacturing faces obstacles, particularly in regions where consumer and producer markets for manufacturing products are not abundant in biomass resources. This misalignment creates logistical barriers to integrating and utilising biomass. To enable widespread adoption, solutions such as developing efficient supply chains, establishing biomass collection and processing infrastructure, and implementing supportive policies and incentives are needed. Overcoming these challenges would allow the manufacturing sector to tap into the potential of bioenergy, reducing greenhouse gas emissions and promoting sustainability. The adoption of electric vehicles (EVs) and hybrid vehicles for logistics and transportation can significantly reduce emissions. Certain companies like 'Exponent Energy' have developed a charging infrastructure and battery pack that enables rapid 15-minute charging for commercial electric vehicles, which have different requirements than passenger vehicles. 'Log9 Materials' is also developing batteries specifically designed for commercial vehicles. This shift toward electric mobility

can play a crucial role in bringing down emissions throughout the manufacturing supply chain.

Way Forward

Looking ahead, we visualise the future of green technology is not just about new gadgets and solutions; it is more about a shift in mindset towards a more sustainable way of living. India's continually evolving policies and reforms focused on ease of doing business and attaining nationally determined contributions are clearing a path for faster adoption of green technologies and for facilitating investors across the globe. India's 'Aspirational District Programme' is the best initiative to channel such a transformation by leveraging local communities, as it removes heterogeneities in regional variations in development. The programme, with its increased scope in energy transitions, will power India's ambitions as a world leader in green energy and achieve Agenda 2030. It serves as a lighthouse not just for our green energy revolution but also provides a model that is replicable across the world. To conclude, we must remember the words of Bob Brown, the Senator of Australian Greens:

"The future will either be green or not at all" □