



The Role of Patents in Fostering Innovation in Waste Management and Green Technology in India

Gnanavel L

Advocate, Madras High Court

Abstract

India's economy, one of the world's fastest-growing, faces substantial waste management and sustainability concerns as a result of increased urbanization and industrialization. India has been aggressively investigating green technology and waste management to address them. The nation's green technology ecosystem has expanded quickly, with cutting-edge approaches appearing in the fields of waste management, the manufacture of biofuel, solar and wind power generation, and the production of electric vehicles. In these fields, patents are essential for encouraging innovation and motivating research and development (R&D) expenditures. They encourage companies and inventors to engage in R&D by granting them a brief monopoly. The Patent holders play a crucial role in contributing to the greater economic growth and innovation. This leads to fresh ideas and methods for dealing with sustainability and environmental problems. Additionally, patents safeguard intellectual property rights, preventing the unauthorized use of concepts. This paper examines how patents encourage development in waste management and green technologies in India. It explores how patents support technology transfer, encourage R&D, and aid in creating and adopting sustainable solutions. It also evaluates India's patent system's effectiveness in promoting a greener, more sustainable future.

Category:

Research Paper

Paper Code:

CUKJLS2510

Accepted on:

September 12, 2025

Keywords: Waste Management, Green Technology, Patents, Innovation, Sustainability

Introduction

The Indian economy is considered to be one of the fastest growing economies in the world. The country's sudden, rapid population growth, rapid urbanization, and industrial expansion have led to an unprecedented rise in waste generation and environmental pollution. To solve all these urgent concerns, India has been actively researching solutions in waste management and green technologies. India's green technology ecosystem seems to have been booming in the past several years, with numerous creative solutions emerging in a variety of industries, including waste management, biofuel production, solar and wind power generation, and the manufacture of electric vehicles. The Indian economy is growing, sustainability is being fueled by green innovation, and consumers are being encouraged to embrace green technology items. The Patent holders play a crucial role in contributing to the greater economic growth and innovation.

The Green technology and waste management innovation ideas are significantly supported by many patents. They grant various businesses and inventors a brief monopoly power on their creations, which motivates them to spend more money on the research and development. New, powerful, innovative ideas and a wide variety of

techniques that can aid in addressing the prevailing environmental issues and advancing sustainability are thus produced as a result of this. By safeguarding intellectual property rights, one may also make sure that their idea is not unlawfully utilized by others and can only be used by them and under their permission. In the past ten years, there have been numerous products in the power sector that are based on solar power cells and turbines that are produced in India. Moreover, it is clear from the numerous patent applications filed in recent years that green technology has also grown significantly.

This paper will also analyse and examine how patents encourage development in waste management and environmentally friendly technologies in India. We will look at how patents support technology transfer, encourage R&D, and aid in the creation of sustainable solutions.

The present research seeks to investigate and analyse the impact of patents on innovation in the fields of waste management, green technology, and other related environmental domains. Particular emphasis is placed on understanding how patents have influenced the pace, direction, and quality of innovations in these areas, and whether they serve as facilitators or barriers to technological advancement. The study also aims



to examine a range of innovative patented ideas, along with their current status of implementation, to assess their practical effectiveness in addressing environmental challenges.

Another key objective is to identify the barriers and challenges faced in patenting and commercializing innovative solutions in waste management and green technologies, including legal, economic, and policy-related hurdles. Furthermore, the research explores the urgent need and increasing demand for novel and sustainable innovations in waste and trash management, driven by rapid urbanization, population growth, and the pressing concerns of climate change and environmental degradation. The research methodology adopted for this study is doctrinal in nature, relying predominantly on secondary sources. These sources include government reports, academic journals, websites, books, articles, and other credible mass media references.

By systematically evaluating, analysing, and interpreting relevant information from these materials, the study develops a comprehensive understanding of the interplay between patents, innovation, and sustainability in the context of waste management and green technologies.

This method enables the research to not only highlight existing developments but also to identify gaps and areas that require further policy and academic attention.

India's Green Patents and Innovative Green Technologies:

The primary premise for measuring environmental innovation is the reduction in capacity and collaboration, as well as the negative environmental impact caused by costly industrial and other activities.

The Indian economy is projected to maintain its sustainability through developing technologies that bring about unprecedented technological development.

The Green technology area in India has been booming fast in the past several years, with a number of creative solutions emerging in a variety of industries, including waste management, biofuel production, solar and wind power generation, and the manufacture and making of electric vehicles.

On the other hand, the Indian economy is also growing and sustainability is being enhanced through green innovation, and consumers are being encouraged to adopt green technology products. According to the World Intellectual Property Organization's 2023 Global Innovation Index ranking, India is ranked 40th out of 132 economies (Dechezleprêtre, n.d.).

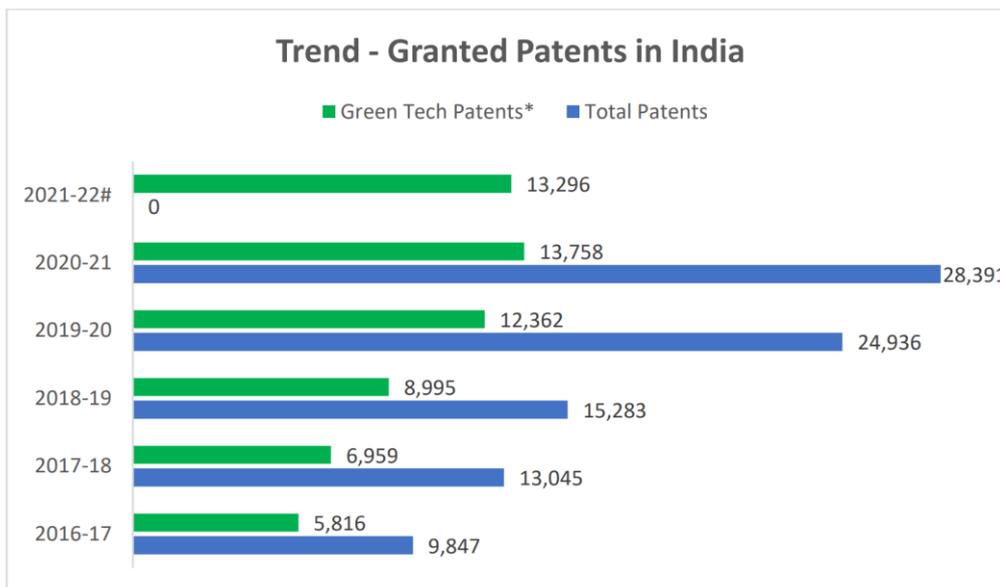
A recent analysis of records from the Ministry of Industry and Commerce clearly indicated and showed that during 2016 and 2017, as well as 2021 and 2022, over 91,500 patents were fully awarded. Within the allotted specified time, 61,186 patents covering green technology were awarded; of these, 90% are related to waste treatment and alternative energy generating technologies, with over 16,000 (26%) and 38,837 (63%) being related to waste management, respectively. Conservation of energy (2,555), technologies for transportation (2,481), nuclear power production (1,079), forestry and agriculture (161), and other topics are covered by the rest of the green technology patents (69) (Ministry of Finance, 2024).

Under the International Patent Cooperation Treaty, the number of patent applications worldwide for energy-efficient and green energy technology increased by around 120% between 2006 and 2020 (PCT) (Ministry of Commerce and Industry, 2023).

According to a report released by India's Intellectual Property Department, most of the patents filed in this area come from outside the country. However, in recent times, Indian innovation has taken off by leaps and bounds. Taking all things into consideration,

Asian countries should work together and collaborate to shape the future of intellectual property (IP), find a balance between innovation and social applications, and create an IP innovation ecosystem establishes a strong system.

It was also highlighted how committed India is to fostering a high level of innovation, leveraging and developing the cutting-edge technology, and realizing the role that intellectual property plays in advancing economic development. The notable rise in brand recognition, patent awards, and design registrations.



Source: [Times of India](#) | *Rounded Off | #Up to Jan 2022 | **Excluding '21-22 total patent numbers

Fig. 10.1: Trend of Patents Granted in India (The Times of India, 2022).

Several developed and well as developing nations have also started taking action to promote the development of green technologies. The UK launched the "Green Channel" in 2009 to expedite the approval of patents for green technology. Similar fast-track schemes were established by Australia, Israel, South Korea, Japan, and the US in the same year; Canada, Brazil, and China followed in 2012, and Taiwan in the year 2014. Also in March 2020, Japan topped the WIPO's list of nations with the greatest overall number of patents about energy produced from renewable sources from 2010 to 2019 (which includes patents for solar and fuel cells). The US leads the world in technology, and Germany comes in second for wind energy.

Waste Management System in India

The solid waste management and the framework in India encompasses all phases of trash and waste generation, collection, recovery of waste resources, recycling the waste, delivery, treatment, and disposal. Among the institutional frameworks used in solid waste management are: The Ministry of Environment & Forests clearly oversees the enforcement of national special laws about the garbage waste treatment and the management and disposal.

In addition to providing staff education and technical assistance, the Central Pollution Control Board manages the activities of the state's

Pollution Control Boards. Disseminate information regarding trash management and provide funding for this kind of study in order to fulfill government-mandated obligations. Also the State Control Board: The State Pollution Control Board plans an extensive program for the avoidance, management of water and air pollutants. must routinely inspect any control equipment or processes. Installing a landfill working mechanism or burning requires permission from the SPCB.

One of the most significant duties given by India's many urban local governments to preserve a clean city atmosphere is to take care of solid waste. The poor are neglected, the population is not sufficiently covered, and the methods used are found to be antiquated, unscientific, and ineffective in nature. The Hazardous Waste (Management and Handling) Rules, 1989, and the Bio-Medical Waste Handling Rules, 1998, are two of the most important regulations in the waste management industry.

However, there was a lack of knowledge about the exact functions and responsibilities of waste management as well as the protocols to be followed in the collection, sorting, processing, and disposal of municipal waste. So this led to the creation of the Solid Waste Management Rules, 2016 (Singh & Pillai, 2011).

Solid Waste Management Rules, 2016.



The definition of "urban" has been removed from the Municipal Solid Waste (Management and Handling) Rules 2000, which were amended by the Union Ministry of Environment, Forests and Climate Change (MoEF&CC) in 2000 and replaced with the Solid Waste (Management and Handling) Rules 2016 restrictions. These new rules now apply to metropolitan cities, census towns, notified industrial towns, areas under the jurisdiction of Indian Railways, airports, ports and harbours, security zones, special economic zones, state and government institutions, and places of pilgrimage, religious significance, and historical significance. The main parts of these regulations are as follows:

- Waste generators' obligations and source separation of waste;
- The Swachh Bharat Partnership concept is introduced: the concept of cooperation has been incorporated in Swachh Bharat. Event coordinators, hotels, restaurants, corporate and bulk generators, and market organizations now have direct responsibility for sorting and classifying the waste. These committees work closely with regional boards to provide oversight.
 - Collection and disposal of sanitary waste;
 - Collect all materials for packaging that are biodegradable and usable in a manner that collects packaging waste generated during manufacturing;
 - Encourage the use of its sale for compost; □ Encourage conversion of waste to energy
 - Regulations and requirements for pollution control and waste treatment facilities; and
 - Establishment of a Central Monitoring Committee: The Government has also constituted a Central Monitoring Committee headed by the Secretary to oversee the overall implementation of the rules.

Green Innovation & Waste Management in India: Transformative Policy Measures in Action

The Central government of India is also promoting a great deal of green innovation through its incentive and subsidy programs. India unexpectedly revealed at COP26 a goal of becoming net-zero by 2070, along with a few interim goals, such as targets for renewable energy and carbon reduction by 2030. Similar

large investments should be channelled into the electricity sector for this short-term analysis. One of the key issues addressed in the 2024 Budget was providing incentives to increase India's demand for solar and other renewable energy.

The Budget represents a clear change toward a more reasonable and sustainable future, with a favorable emphasis on the energy sector. According to Finance Minister Nirmala Sitharaman, India will install solar panels on the rooftops of 10 million homes in a bid to offset carbon emissions. The state will also pay feasibility gap financing for the first one gigawatt of offshore wind power. The economy will be the need for compressed natural gas, or CNG, for opportunities to be fueled by compression as of 2024–2025 (Ministry of Finance, 2024).

The finance minister stressed that the rooftop solar panels would enable the government to supply up to 300 kWh of free electricity to 10 million households every month.

India and Denmark formed a Green Strategic Partnership in 2020 to work together on environmentally friendly solutions to development issues. Danish businesses will bring their knowledge of air pollution, water and waste management, and renewable energy to the Indian subcontinent. Similarly, Australia, the United States, Japan, and India decided to form a Climate Working Group (CWG) to promote cooperation on climate change action and capacity development to implement the Paris Climate Agreement.

The four countries (QUAD) will support responsible business practices and knowledge transfer in developing markets, particularly in the field of green technology. Finally, since the launch of the Swachh Bharat (Clean India) campaign in 2014,

India has made remarkable progress in the area of waste management. The majority of Indian cities today have solid waste treatment facilities and are Open Defecation Free (ODF) (Dey, 2014).

Over time, the Swachh Bharat objective has evolved into a nationwide movement, including citizens actively participating in cleanliness initiatives all around the nation. It should come as no surprise that the waste management industry in India is witnessing a fair amount of green innovation.



Advantages of Patent Holders' Rights in the Fields of Green Tech and Waste Management:

1. Market Wider Expansion

Businesses with robust IP protection can also grow smoothly into foreign markets. Intellectual property rights can greatly facilitate the growth of a company in a worldwide market and aid in the large-scale export of innovations in the renewable energy sector.

2. Competitive Benefits

One of the main advantages of intellectual property rights is their business benefits.

Companies that produce renewable energy also profit from patent protection. The renewable energy sector can safeguard its technological innovation because to patent rights. The renewable energy industry has a strong base thanks to intellectual property rights.

3. Promoting Innovation

In addition to providing economic benefits, licenses give the creator of a project exclusive rights to that particular project, which in turn encourages innovation. Companies and individuals are encouraged to provide investment in energy production the development and research of the new. Consequently, advanced technologies are encouraged, increasing the availability of renewable energy (Gattari, 2013).

4. Seeking Investments

One of the key disciplines for investors' confident investment in infrastructure is IP protection. Renewable energy research and development is protected by patent rights (IP rights), which attract new investors because the project is supported and guaranteed by legal rights.

5. Partnerships and others

One of the most popular and common methods for developing innovations and ideas nowadays is cross-licensing. When two parties or groups with comparable interests collaborate, intellectual property rights can be helpful.

Role of Patents in Promoting Diffusion of Green Technology

In research published by Copenhagen Economics, patent data for seven green technology fields from

thirty-eight developing nations was thoroughly examined and analyzed during ten years (from 1998 to 2008) (Copenhagen Economics A/S & IPR Company A/S, 2009). The research showed a noteworthy rise in China, India, and Brazil are among the very small number of developing nations that have green technology patents. Solar power, wind power and fuel cells made the most progress. However, when it comes to less developed countries, generic green patents are essentially non-existent. This strongly suggests that patent protection should not be used to restrict the development and diffusion of green technologies. It could also be argued that the lack of any licensing means that companies do not see these countries as potential markets for green innovation. The heavy reliance of less developed countries on inferior technological and economic resources is a compelling argument for why they do not have robust IPR protection mechanisms. The low number of green patent applications in a scenario where these low-tech innovations address climate concerns in the LDCs is not the result of a failing market, nor does it specifically involve the role of intellectual property rights (IPRs), as these countries lack the very incentives to employ high-tech green innovations (Shafik, 1994).

If you're preparing a reference list for a journal or thesis, I can help format it to match specific style guides or word count limits. Would you like me to generate a downloadable version or help integrate these into your manuscript?

Like other industries, the engineering sector relies heavily on patents to protect intellectual property rights. Companies can share in the added profits generated from their inventions and the costs incurred in their development and growth by using licenses to grant exclusive short-term rights. They act as a symbol of value, especially for potential partners and investors. Furthermore, patents encourage forms of scientific collaboration and long-term partnerships, thereby increasing technological diffusion and development. For example, cooperation between start-ups and governments can help address climate change issues by fostering the development of small businesses. Every time a new patent is issued, the collection of patents creates a library containing the most reliable and inventive technical data. It becomes a storehouse of knowledge and expertise that other organizations can utilize in the regional development of technologies. For example, solar technology developed in the UK could be adapted for use in solar-rich countries such as Egypt and Libya. Many renewable energy-focused



companies will also use trade secrets containing confidential information about the various components of the hardware required, and how they are manufactured and used, and in addition to patents, companies take extra care to protect these. This can be private policy documents, conclusions from the interpretation and analysis of data, or algorithms.

Suggestions & Recommendations

- To Simplify and make it easier the Patent Application Process: Also to encourage more inventors to seek protection from patents for their waste management and green technology solutions, simplify the patent application process and lower administrative barriers.
- Raise Awareness campaigns: Hold the seminars programs and awareness campaigns to inform companies and inventors about the value of getting patents in preserving their intellectual property and stimulating creativity.
- Improving the Patent Examination.
- Support the new Startups and the SMEs: To assist the emerging new small startups and small and medium-sized firms (SMEs) in guiding the patent system and safeguarding their intellectual property, and also offer them financial and technical support.
- Encourage International Cooperation: Work together to exchange best practices,

References

- Gattari, Patrick, The Role Of Patent Law In Incentivizing Green Technology, North western Journal Of Technology And Intellectual Property, Vol. 11, Issue 2.
- Singh, Ham O., and Pillai, P.R. Sreemahadevan (2011), Cost Effective Environment Friendly Technology in the Context of Kerala Economy – A Conclusive Review, Civil and Environmental Research, Vol. 1, No. 1 (ISSN: 2224-5790).
- Awad, Bassem Dr. (2015), Patent Pledges in Green Technology, Centre Of International Governance Innovation (CIGI) Papers.
- Honrubia, Mario (2018), 6 Eco-Friendly Technologies to Help Companies Go Green; available at <https://www.ennomotive.com/eco-friendly-technologies-go-green/>.
- Fair, Robert (2010), Does Climate Change Justify Compulsory Licensing Of Green Technology?, Brigham Young University International Law & Management Review, Volume Issue 1 (Article 3)
- Singh, Ham O., and Pillai, P.R. Sreemahadevan (2011), Cost-Effective Environment-Friendly Technology in the Context of Kerala Economy – A Conclusive Review, Civil and Environmental Research, Vol. 1, No. 1 (ISSN: 2224-5790).
- Honrubia, Mario (2018), 6 Eco-Friendly Technologies to Help Companies Go Green; available at <https://www.ennomotive.com/eco-friendly-technologies-go-green/>
- Copenhagen Economics A/S & IPR Company A/S. (2009). *Are IPRs a barrier to the transfer of climate change technology?* Report commissioned by the European Commission (DG Trade).

align patent laws, and encourage innovation and cross-border technology transfer with other nations and international organizations.

Conclusion

In a nutshell, patents are essential for promoting innovation in India's waste management and green technology industries. By providing exclusive rights to innovators, they encourage R&D and, consequently, investment in new technologies and processes. Over time, the Indian patent system has changed to encourage innovation and bring it in line with global standards. Moreover, India is home to one of the world's largest and most effective renewable energy development programs. The share of renewable energy in the world energy mix is small but growing rapidly. The global issue of climate change mitigation has stimulated interest in strategies that facilitate the creation and deployment of new technologies, sometimes referred to as environmentally friendly innovations or renewable energy but issues remain, such as the difficulty of applying for permits, the need for a strong regulatory framework and a rapidly growing and necessary for mitigate the impact of climate change and create a healthier world. Intellectual property rights are therefore important to maintain protection, encourage innovation, and attract more capital for business.



- Dechezleprêtre, A. (n.d.). *Fast-tracking “green” patent applications: An empirical analysis* (Centre for Climate Change Economics and Policy Working Paper No. 127; Grantham Research Institute on Climate Change and the Environment Working Paper No. 107). <https://www.lse.ac.uk/granthaminstitute/publication/fast-tracking-green-patent-applications-an-empirical-analysis/>
- Dey, S. (2014). E-waste recycling technology patents filed in India – An analysis. *Journal of Intellectual Property Rights*, 19(September), 315–324.
- Gattari, P. (2013). The role of patent law in incentivizing green technology. *Northwestern Journal of Technology and Intellectual Property*, 11(2), 179–200.
- Ministry of Commerce and Industry. (2023). *Annual report 2022–23* (pp. 79–120). Government of India.
- Ministry of Finance. (2024). *Union Budget 2024*. Retrieved September 16, 2025, from India Budget official site
- Shafik, N. (1994). Economic development and environmental quality: Evidence from cross-country data. *World Development*, 22(3), 357–368.
- Singh, H. O., & Pillai, P. R. S. (2011). Cost-effective environment-friendly technology in the context of Kerala economy – A conclusive review. *Civil and Environmental Research*, 1(1), 1–10.
- The Times of India. (2022, January 22). *Trend pattern of patent registration 2022*.
- World Intellectual Property Organization (WIPO). (n.d.). *Patent Cooperation Treaty (PCT)*. Retrieved September 16, 2025, from WIPO’s official page on the PCT
-