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Green Patents and Environmental Sustainability: Role of Patent Law in Combating Climate Change

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ABSTRACT

A nation like India is undergoing fast-paced industrial growth along with severe environmental challenges. We have to face the duality of development, i.e., pursuing the advancement while also trying to uphold our ecological responsibilities. With the escalation of the concerns relating to climate change and worsening environmental conditions, the promotion of sustainable technologies has gained worldwide importance. nearly half of all patents granted in India from 2016 to 2021 were associated with green technologies, with around 25% specifically focused on alternative energy generation. This trend reflects a broader push to expand green technology adoption as a means to stimulate economic growth and promote consumer preference for sustainably produced goods. Some important examples of green technologies in India are solar energy, wind and hydro power, waste management and recycling, and emission control technologies. One of the crucial ways for progressing eco-friendly innovations is green patenting. However, we face the duality of development, i.e., pursuing the advancement while also trying to uphold our ecological responsibilities. The area faces several challenges like legal inconsistencies, gaps in innovation ecosystem as well as barrier to access, and more. This article will explore the role of green patenting as a catalyst for development of environmental sustainability in India, and further discuss these challenges to finally provide some workable recommendations.

Keywords: *Green Patent, Environmental Sustainability, Intellectual Property Rights, Green Technology.*

I. INTRODUCTION

With the escalation of the concerns relating to climate change and worsening environmental conditions, the promotion of sustainable technologies has gained worldwide importance. A nation like India is undergoing fast-paced industrial growth along with severe environmental challenges. India is among the most vulnerable nations to climate change as due to its large

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population, energy demands are rising, and industries are expanding, leading to the high environmental stakes. For instances:

1. Urban air pollution in Indian cities consistently ranks among the worst globally.[3] As per IQAir's 2024 World Air Quality Report, 20 most polluted cities were mentioned of the world, 13 of which belongs to India, making it 5th most polluted nation in the world.
2. As per 2023 reports, India was the 3rd largest greenhouse gases emitter, though its per-capita emissions remain low.[4]

We have to face the duality of development, i.e., pursuing the advancement while also trying to uphold our ecological responsibilities.

One of the crucial ways for progressing eco-friendly innovations is green patenting which is a specific field within Intellectual Property Rights that protects inventions aimed at conservation of the environment. Green patenting is, therefore, an essential pathway for India to build a self-reliant green economy, reduce its ecological footprint, and become a global hub for sustainable technology. These patents, that are often referred to as eco-innovation patents, support the development of technologies that reduce damage to environment, preserve resources, and contribute to the climate recovery as well as clean energy progression. The need for indigenous green technologies is not merely a regulatory or market-driven imperative, but an existential one.

This article will explore the role of green patenting as a catalyst for development of environmental sustainability in India. Against the backdrop of climate change, resource depletion, and rising pollution levels, the adoption and protection of eco-friendly technologies have become not only desirable but imperative. Even the agricultural practices, waste management, and water scarcity are in a critical need for green solutions. Through a multidisciplinary lens, the article aims to:

1. Examine the concept and evolution of green patenting within India's legal and innovation landscape.
2. Analyse the institutional and regulatory frameworks that support or hinder the growth of green technologies.

[3] Cherry Gupta, *Top 10 most polluted cities in the world (2024-25): 6 of them are in India*, INDIAN EXPRESS (Mar. 15, 2025, 01.04 PM), https://indianexpress.com/article/trending/top-10-listing/top-10-most-polluted-cities-in-the-world-2024-25-6-of-them-are-in-india-9880720/

[4] *How India's greenhouse gas emissions stack up globally*, THE HINDU BUSINESS LINE, https://epaper.thehindubusinessline.com/ccidist-ws/bl/bl_bangalore/issues/105076/OPS/GDRDGS7OR.1+GVVDGT4K5.1.html

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3. Highlight key challenges faced by Indian innovators, startups, and industries in securing and commercializing green patents.
4. Showcase real-world examples and success stories that illustrate the transformative potential of eco-innovation.
5. Assess global best practices and compare India's approach with that of other major economies.
6. Offer practical recommendations for policy makers, researchers, and entrepreneurs to strengthen India's green patent ecosystem and ensure that environmental sustainability is effectively integrated into the country's growth model.

By exploring into these themes, the article aspires to provide a comprehensive understanding of how intellectual property rights, particularly the green patents, can aid as the strategic instruments for achieving a more strong, sustainable, and innovation-centric future for India.

II. UNDERSTANDING GREEN PATENTING AND ITS RELEVANCE TO ECOLOGICAL SUSTAINABILITY

In order to understand Green Patents, it is vital to first understand what do we mean by the Green Technology. Green technology is often also termed as eco-friendly innovations or clean and sustainable technologies. It refers to the innovations that are designed to minimalize environmental impact, conserve resources, and support ecological balance. In India, it is transforming industries ranging from energy and waste management to water purification and agriculture, delivering economic and environmental benefits. It is said that nearly half of all patents granted in India from 2016 to 2021 were associated with green technologies, with around 25% specifically focused on alternative energy generation. As per a report by the Department of Intellectual Property of India, most patent applications for the green technology originate from foreign entities. However, there has been a notable increase in filings by Indian inventors in recent years. This trend reflects a broader push to expand green technology adoption as a means to stimulate economic growth and promote consumer preference for sustainably produced goods.[5] Here are a few instances of green technology in India:

[5] Rashmita Das, *Green technology patenting trends in India*, THE PATENT LAWYER (Feb. 15, 2024), https://patentlawyermagazine.com/green-technology-patenting-trends-in-india/

1. Clean & Renewable Energy

a. Solar Power: India currently ranks as the world's 3rd largest solar energy market.[6] Under the Jawaharlal Nehru National Solar Mission (JNNSM), installations have exceeded 100 GW, with strong policy support encouraging rooftop and utility-scale projects.[7]

b. Wind and Hydropower: India has installed over 50 GW wind capacity, with 5100 MW of pumped-storage hydropower already operational and another 440 MW underway.[8]

c. Green Hydrogen & Storage: The government supports innovation in battery energy storage and green hydrogen as components of the clean energy transition. A budget of 600 crores to the National Green Hydrogen Mission and 19,100 crores to the Ministry of New and Renewable Energy was allocated to expand renewable energy infrastructure.[9]

2. Waste-to-Wealth & Recycling:

a. Attero, India's leading e-waste recycler, uses advanced processes to recover metals and plastics from electronics. It was recognized at a NASA waste-management symposium and is the single e-waste management company to get sanctioned by the Ministry of Environment & Forests.[10]

b. TrashCon, operating from Bengaluru, uses technology to segregate mixed waste into non-bio and bio wastes with 99.6% precision. Biowaste is then converted into compost and biogas while non-biowaste is used to build roads and tiles.[11]

3. Water Purification & Resource Management:

[6] *India overtakes Germany to become 3rd-largest generator of wind, solar power: Report*, THE HINDU (Apr. 08, 2025, 06.56 PM), https://www.thehindu.com/news/national/india-overtakes-germany-to-become-3rd-largest-generator-of-wind-solar-power-report/article69425757.ece

[7] Navin Sreejith, *India Achieves Historic Milestone of 100 GW Solar Power Capacity*, PRESS INFORMATION BUREAU (Feb. 07, 2025 02.17 PM), https://www.pib.gov.in/PressReleasePage.aspx?PRID=2100603

[8] Navin Sreejith, *India's Renewable Energy Capacity Achieves Historic Growth in FY 2024-25*, PRESS INFORMATION BUREAU (Apr. 10, 2025, 06.15 PM), https://www.pib.gov.in/PressReleasePage.aspx?PRID=2120729

[9] Kapil Bansal, *How 2024 policy shifts are advancing India's green hydrogen sector*, EY PARTHENON (Aug. 21, 2024), https://www.ey.com/en_in/insights/energy-resources/how-2024-policy-shifts-are-advancing-india-s-green-hydrogen-sector#:~:text=In%20brief,and%20attracting%20international%20climate%20financing.

[10] Bhaswati Guha Maju, *How These Green Startups Are Solidifying Their Position in Waste Management, Promoting Social Good*, NEWS18 (Mar. 28, 2022, 03.39 PM), https://www.news18.com/news/india/how-these-green-startups-are-solidifying-their-position-in-waste-management-promoting-social-good-4916780.html

[11] Bhaswati Guha Maju, *How These Green Startups Are Solidifying Their Position in Waste Management, Promoting Social Good*, NEWS18 (Mar. 28, 2022, 03.39 PM), https://www.news18.com/news/india/how-these-green-startups-are-solidifying-their-position-in-waste-management-promoting-social-good-4916780.html

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a. Tata Swach, a water purification technology, used rice-husk ash imbued with nano silver particles to purify water at the rate of 3 L/hour at low cost, targeting underserved communities.[12]

b. Solar-powered water purifiers from initiatives like Suryagen Renewables and IIT campus projects distil potable water from various sources like sea and river, eliminating pathogens, heavy metals, and fluoride.[13]

4. Sustainable Agriculture & Biomaterials:

a. Global Green Coir, founded by Anees Ahmed in Chennai, converts coconut husk into cocopeat, which can be used as a soil substitute and fertiliser, making it valuable for horticulture. This technology created a ₹75-crore worth of enterprise.[14]

b. Ecowrap helps convert agricultural waste into biodegradable packaging, and therefore explores better waste management options and improve overall sustainability.[15]

5. Emission Control & Air Quality:

a. Chakr Shield, from Chakr Innovation, captures around 17.5 kg of microscopic matter per year from a standard diesel generator, which would otherwise pollute the air. It can purify around 255 billion litres of air over the period of its lifetime. More than 80 units have been installed, which have filtered around 500 kgs of the microscopic pollutant matter.[16]

b. Compressed Bio Gas (CBG) Plant in Bilaspur: Bharat Petroleum Corporation Limited (BPCL) established the ₹100 crore compressed biogas plant that processes 150 metric tonnes of municipal solid waste into around 10 metric tonns of CBG, generating green fuel, fertilizer, and 30,000 jobs annually.[17]

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[12] *Tatas do a Nano in water purifier at Rs 1k*, ECONOMIC TIMES (Dec. 08, 2009, 10.14 AM), https://economictimes.indiatimes.com/industry/cons-products/durables/tatas-do-a-nano-in-water-purifier-at-rs-1k/articleshow/5312187.cms

[13] Dhriti Dutta, *India's 'green' heroes*, DIGIT (Jul. 12, 2020), https://www.digit.in/features/general/digit-mag-indias-green-heroes-53563.html

[14] Tina, *This Man Earns Rs 75 Crore Annually By Innovatively Using Cheap Coconut Husk*, THE BETTER INDIA (Feb. 13, 2024), https://thebetterindia.com/341516/chennai-startup-global-green-coir-anees-ahmed-turns-coconut-husk-into-cocopeat-grow-bags/

[15] *How Jaipur's ECOWRAP Is Using AI To Make Waste Segregation Sustainable*, INC42 (May 30, 2024), https://inc42.com/startups/how-jaipurs-ecowrap-is-using-ai-to-make-waste-segregation-sustainable/#:~:text=ECOWRAP%20provides%20users%20four%20colour,living%20on%20the%20economic%20fringes.

[16] Dhriti Dutta, *India's 'green' heroes*, DIGIT (Jul. 12, 2020), https://www.digit.in/features/general/digit-mag-indias-green-heroes-53563.html

[17] *100crore CBG plant to come up in Bilaspur to tackle urban solid waste*, TIMES OF INDIA (Jun. 15, 2025, 12.47 AM), https://timesofindia.indiatimes.com/city/raipur/100crore-cbg-plant-to-come-up-in-bilaspur-to-tackle-urban-solid-waste/articleshow/121854861.cms

Protecting such green technologies is critical for fostering innovation, ensuring commercialization, and accelerating the transition to a sustainable economy, and for that reason, green patents are granted for innovations that offer environmental benefits. By securing legal rights for inventors, green patents help attract investments into clean technology research and development. They also aid in promoting technology transfer, boost foreign investments, and create employment opportunities in green industries.

The Patents Act, 1970 governs the patent system in India, which was amended in 2005 to comply with TRIPS Agreement. While the Act does not have a distinct classification for green patents, several administrative efforts have been made to facilitate the protection of sustainable technologies.

Key initiatives include:

1. Fast-track examination processes for environmentally beneficial technologies under certain conditions.
2. India's membership in the Patent Cooperation Treaty (PCT), allowing easier filing of international patent applications.
3. Policy support through initiatives such as Startup India and Make in India, which emphasize innovation in clean and sustainable technologies.

The National IPR Policy of 2016 also recognizes the critical role of intellectual property in promoting technological progress, including in the area of environmental sustainability. However, issues like limited awareness, institutional bottlenecks, and weak commercialization pathways still hinder the full potential of green patenting.

III. KEY CHALLENGES IN GREEN PATENTING: BRIDGING INNOVATION AND ACCESS

While green patents are instrumental in accelerating sustainable innovation, several systemic challenges continue to impede their potential to create inclusive and equitable environmental solutions. These issues, ranging from economic barriers to legal inconsistencies, threaten to widen the technological divide between nations and limit the adoption of green technologies in regions where they are needed most.

1. Unequal Access and Equity Issues:

A major challenge in the green patent landscape is the disproportionate ownership of green technologies by developed nations. High-income countries continue to dominate both, the filing and granting of green patents, creating technological monopolies that restrict the

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affordability and accessibility of these innovations in developing regions. This imbalance is particularly evident in the field of renewable energy, where countries like the United States, China, Japan, and Germany account for the majority of patents in solar, wind, and electric vehicle technologies. For instance, data from WIPO shows that the majority of green patents are held by entities based in OECD countries. This leaves many developing nations dependent on importing expensive technologies or navigating complex licensing processes.[18] The international frameworks such as the TRIPS Agreement include flexibilities, like compulsory licensing, to promote access, however, these are rarely used due to political resistance, limited legal capacity, or fear of retaliatory trade consequences.[19]

2. Barriers in the Patent System:

Securing a green patent remains an expensive and technically complex process. The average cost of filing, prosecuting, and maintaining a single patent across major jurisdictions can exceed $100,000 USD which is an investment often out of reach for small businesses and innovators in developing countries.[20] This financial burden creates a barrier to entry, particularly for startups or grassroots inventors working on low-cost sustainable solutions.

Moreover, the absence of a standardized classification system for green patents complicates their identification and tracking. While the World Intellectual Property Organization (WIPO) introduced the IPC Green Inventory to tag environmental friendly technologies under the International Patent Classification system, usage and adoption vary across patent offices.[21] As a result, researchers and policymakers struggle to assess the true scope and impact of green innovation worldwide.

3. Innovation Ecosystem Gaps:

Green patents do not automatically translate into market-ready solutions. The path from invention to implementation often falters due to weak innovation ecosystems. In many countries, particularly developing ones, there is a lack of institutional support for R&D commercialization, poor access to venture capital, and limited public–private collaboration.One notable example is India, where local inventors and academic institutions often generate promising green innovations, such as affordable water purification systems or

[18] John H. Barton, *Patenting and Access to Clean Energy Technologies in Developing Countries*, WIPO (Mar. 18, 2009), https://www.wipo.int/web/wipo-magazine/articles/patenting-and-access-to-clean-energy-technologies-in-developing-countries-36734

[19] Kanaga Raja, *WTO TRIPS Council debates IP and the public interest*, TWE 10 (2017).

[20] *How Much Does A Patent Cost In Major Countries?*, TT CONSULTANTS (Jan. 13, 2023), https://ttconsultants.com/how-much-does-a-patent-cost-in-major-countries/

[21] Yusen Luo et al, *Effects of Environmental Regulation and Intellectual Property Protection on Green Technological Innovation: Evidence from China*, 15 SAGE (2025).

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biomass-based energy devices, but struggle to scale them due to bureaucratic hurdles, lack of IP awareness, or funding constraints. A data from the Indian Ministry of Commerce and Industry acknowledged that while the number of green patent applications is growing domestically, translation into usable technology remains low.[22]

Additionally, green technologies often face a "profitability gap." Unlike conventional products, their returns on investment may be delayed, diffuse, or dependent on externalities (such as reduced emissions). This makes them less attractive to private investors focused on short-term gains. Without targeted subsidies or policy incentives, many green patents never progress beyond the prototype stage.[23]

4. Legal and Policy Inconsistencies:

A fragmented global legal environment further complicates the development and dissemination of green technologies. While some countries have adopted progressive IP reforms, such as Japan's Green Transformation Patent Program or the UKIPO's accelerated processing scheme, others lack frameworks for compulsory licensing, patent pooling, or open innovation in the environmental sector.[24] The inconsistency extends to enforcement mechanisms. In jurisdictions with weak patent enforcement or overburdened judicial systems, inventors often refrain from patenting due to fears of infringement without recourse. Conversely, overly stringent patent protections in high-income nations can stifle downstream innovation and limit the customization of technologies for local needs in lower-income regions.[25]

IV. CONCLUSION

Green patenting is not merely about protection of inventions; it is about building a future where innovation serves people and the planet. It holds real promise for helping us cut carbon emissions and bring sustainable solutions to life. But as we have seen, there are still major gaps in how the global patent system works, especially for those in the Global South. Fixing this is not just about tweaking laws or streamlining processes, it is about creating an ecosystem where innovation is truly inclusive, where collaboration between nations is encouraged, and where fairness and access are part of the foundation, not afterthoughts.

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[22] Rashmita Das, *Green technology patenting trends in India*, THE PATENT LAWYER (Feb. 15, 2024), https://patentlawyermagazine.com/green-technology-patenting-trends-in-india/

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[24] Yosuke Kimura, *Market-based patent value of green transformation technologies*, 68 FRL (2024).

[25] *Do Patents Stifle Innovation? Everything You Need to Know*, CYPRIS (May 3, 2023), https://www.cypris.ai/insights/do-patents-stifle-innovation-everything-you-need-to-know.

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If we bridge these divides, green technology can move beyond boardrooms and lab benches and start making a difference where it matters most, in the hands of communities, farmers, inventors, and changemakers working every day to protect our environment and build a better tomorrow.

V. RECOMMENDATIONS

1. There is a need to make the Green Patents easier to **Access and Afford**. Right now, the cost and complexity of getting a patent can discourage smaller innovators, especially in developing countries. By providing free expert support through national or international help centres to guide people through the patent process, and simplifying application steps and offering resources can help with this goal.
2. We need to harmonize fast-track criteria across patent offices to ensure consistency and global applicability. Patent backlogs delay the deployment of crucial green innovations. Countries that have implemented fast-track programs for green tech have seen notable improvements.
3. Allow governments to step in and make green technologies available to the small industries, especially when there is urgent need, by using compulsory licensing.
4. As more green inventions are needed now and cannot sit in a queue for years, fast-track programs need to be created, so green patents are reviewed quickly and fee reduction for green patents is necessary as well.

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