PATENTS AND GREEN TECHNOLOGY: BALANCING INNOVATION AND ACCESS IN A CHANGING CLIMATE

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ABSTRACT

Green technology, which includes renewable energy technology, sustainable transportation technology, waste management technology, and energy efficiency technology, has become a new frontier in the global fight against climate change. Intellectual property rights, especially patents, have become a key player in green technology development. Patents provide a temporary monopoly for inventors in return for a disclosure of their inventions. This monopoly provides a financial incentive for inventors to engage in R&D activities. Patents also allow inventors to profit from their inventions by establishing a licensing regime. The interplay between patents and green technology is fundamentally a complicated relationship. Patents provide a monopoly for inventors that simultaneously limits access to green technology in developing countries, which are most in need of green technology to address the global climate change threat. This paper explores the dual functions of patents in green technology development and access, examining the extent to which the current patent regime incentivises innovation while simultaneously constraining it. Drawing on national and international intellectual property frameworks, relevant case studies, and comparative legal analysis, the paper concludes with policy recommendations for harmonising patent laws, strengthening technology transfer agreements, and constructing a green technology regime that serves not only individual commercial interests but the broader interest of the environment. The paper argues that while the current patent regime provides essential incentives for green technology development, structural reforms — particularly in compulsory licensing, patent pooling, and technology transfer — are necessary to ensure that patent law fulfils its potential as a driver of equitable global sustainability.

Introduction

The accelerating threat of climate change has pushed green technology to the centre of international policy debates. Renewable energy, sustainable transport, waste management, and energy efficiency technologies represent the most promising tools available for addressing environmental degradation at scale. As states have deepened their commitments under global climate agreements, the body of law governing green technology development has assumed correspondingly greater importance. Patent law sits at a particularly contested point within that framework. Patent law is among the most powerful instruments for promoting technological innovation. By granting inventors a time-limited monopoly over their creations, the patent system creates financial incentives to invest in R&D. For green technology specifically, exclusivity allows innovators to recover upfront costs, attract venture capital, and license their technologies to others — a dynamic that has contributed to meaningful advances in solar power, wind energy, battery storage, and sustainable agriculture. Yet the same exclusivity that drives innovation can impede its spread. High licensing fees, complex patent portfolios, and restrictive IP regimes may place green technology beyond the reach of developing countries — precisely those most exposed to climate risk and least equipped to develop indigenous alternatives. This tension between proprietary rights and global public interest is among the most contested questions in contemporary international patent law.

The international legal regime for green technology patents is based on a collection of international agreements and arrangements. The Trade-Related Aspects of Intellectual Property Rights (TRIPS) Agreement, under the guidance of the World Trade Organization (WTO), is the foundational international agreement for intellectual property rights that all member countries are expected to respect.1 The Patent Cooperation Treaty (PCT), under the guidance of the World Intellectual Property Organization (WIPO), facilitates the filing of patents for multiple jurisdictions.2 At the same time, efforts such as WIPO Green3 between developed and developing countries. However, the gap is huge—between the number of patent applications filed for green technologies in different jurisdictions and the ability of developing countries to leverage patented technologies.

[1] Agreement on Trade-Related Aspects of Intellectual Property Rights art. 31, Apr. 15, 1994, Marrakesh Agreement Establishing the World Trade Organization, Annex 1C, 1869 U.N.T.S. 299 [hereinafter TRIPS Agreement].
[2] Patent Cooperation Treaty, June 19, 1970, 28 U.S.T. 7645, 1160 U.N.T.S. 231 [hereinafter PCT].
[3] WIPO Green, supra note 7.

The present study aims to explore the duality of patent law as an enabler as well as a hindrance to sustainable technologies. The study argues that while the current international patent regime is an important enabler for the growth of green technologies, changes are needed to the patent regime particularly with regard to compulsory licenses, patent pools, and international technology transfer so that patent law can be a driving force for sustainable technologies. The study aims to contribute to the growing body of literature on intellectual property law and sustainable technologies.

Research Objectives

1. To examine the role of patent laws in promoting the development and diffusion of green technology.

2. To identify the barriers faced by stakeholders in accessing and implementing patented green technologies.

3. To analyse policy measures capable of enhancing the effectiveness of the patent system in fostering sustainable innovation.

Research Questions

1. What impact do patents have on the creation and distribution of green technologies?

2. What are the major legal and policy obstacles to using patents as instruments of sustainable innovation?

3. How can the patent system be reformed to better balance innovation incentives with broader environmental and social objectives?

4. Which international agreements and governmental policies most effectively shape patent law in the context of green technologies?

II. Literature Review

Patents as Innovation Incentives in Green Technology

The main rationale for patent protection for green technologies is grounded in the incentive

theory of intellectual property protection. In this respect, scholars like Andersen and Howells argue that exclusive rights provided for under a patent regime enable businesses to recover substantial investments in R&D, thereby perpetuating the innovation cycle. In the context of green technologies, this rationale is particularly relevant given the capital intensity of innovation in renewable resources, carbon appropriation, and sustainable agriculture. An empirical study by Popp, published in the Journal of Environmental Economics and Management, found a statistically significant relationship between patent protection and R&D investments in energy-efficient technologies, implying that a more robust intellectual property regime is positively correlated with higher levels of innovation output.4 However, scholars like Barton argue that although the incentive theory is conceptually sound, it does not capture the unique characteristics of environmental technologies, which have a positive impact beyond the business interests of a patent owner.

TRIPS Agreement and the WTO Framework

The TRIPS Agreement, which came into force in 1995 under the guidance of the WTO, represents the single most important international agreement with far-reaching implications for the regulation of intellectual property rights globally. By stipulating the minimum requirements of patent protection that are universally applicable to all the member states, the TRIPS Agreement has undoubtedly established a fairly uniform framework for the regulation of patents related to green technology. The TRIPS Agreement has been analysed from the point of view of the developing nations by scholars like Correa, who have argued that the uniformity stipulated by the agreement is highly biased in favour of the technologically developed economies, thereby restricting the manoeuvring space for the developing nations.5 The flexibilities provided under the TRIPS Agreement, as stipulated under Articles 27, 30, and 31, which pertain to the grant of compulsory licensing,6 have been the subject of much scholarly debate. Dent & Kennet have argued that the flexibilities provided under the TRIPS Agreement are difficult to operationalize due to the political and economic pressures exerted by the developed economies and multinational corporations. The issue of whether the TRIPS Agreement provides a satisfactory platform for the transfer of environmentally critical green

[4] David Popp, Patents, Citations and Innovations in the Energy Sector, 35(4) J. Envtl. Econ. & Mgmt. 455, 460 (2006).
[5] Carlos M. Correa, Intellectual Property Rights, the WTO and Developing Countries: The TRIPS Agreement and Policy Options 45 (2000).
[6] TRIPS Agreement, supra note 1, arts. 27, 30, 31.

technology is highly contentious.

WIPO and International Technology Transfer

The role of the World Intellectual Property Organization (WIPO) has been seen to be increasingly proactive in terms of establishing the boundaries between intellectual property rights and environmental sustainability. The WIPO Green program was initiated in 2013 to create an international platform that would bring together suppliers and adopters of green technologies, with the specific aim of enhancing the transfer of technology to developing countries.7 Academic literature by Maskus and Reichman has examined the structural deficiencies of the existing technology transfer mechanisms based on voluntary approaches, asserting that market-oriented approaches are not sufficient to bridge the technological gap between developed and developing countries. Academic literature by de Beer and Oguamanam has also highlighted the need to include mandatory technology transfer provisions under international intellectual property conventions, particularly for those technologies that are considered to be critical for mitigating climate change. The overall academic literature on WIPO's role suggests that although significant strides have been made towards promoting dialogue, WIPO's efforts are not legally binding to ensure technology transfer.

Patent Pools and Compulsory Licensing

The two major approaches that have been proposed to address this issue of patent protection and public access to green technology are patent pools and compulsory licenses. The patent pool is a system in which several patent owners agree to cross-license their patents among themselves or to others under agreed terms and conditions. The patent pool has been successfully implemented in industries such as pharmaceuticals and telecommunications. Merges argues that patent pools are best suited for industries that have complementary innovations, making them a good option for industries that fall under the category of green technology, where several patented parts need to be integrated in order for them to be effective. The Eco-Patent Commons, initiated by the World Business Council for Sustainable Development, is arguably the most notable attempt at creating a patent pool for environmental technologies, although its impact is seen to be minimal.8 On the other hand, compulsory

[7] World Intellectual Property Organization, WIPO Green: The Marketplace for Sustainable Technology (2022) [hereinafter WIPO Green].
[8] World Business Council for Sustainable Development, Eco-Patent Commons: A Review of Progress (2012) [hereinafter Eco-Patent Commons].

licenses provide governments with an option of bypassing patent protection in situations of national emergency or public interest. Rai and Reichman have also addressed the possibility of using compulsory licenses for the transfer of green technology, indicating that despite its availability under both TRIPS and domestic patent laws, its implementation is seen to be contentious.

Research Methodology

The current research has taken a doctrinal methodological approach to address the relationship between patent law and green technology innovation. The research is descriptive-analytical in nature, aiming to understand, explain, and critically evaluate the existing legal regime on green technology patents from a national as well as an international context.

The research is primarily based on secondary data. The secondary data include national as well as international legislative instruments such as the Patents Act 1970,9 the TRIPs agreement, the Patent Cooperation Treaty, judicial pronouncements with special reference to the Supreme Court of India in the landmark case of Novartis AG v. Union of India (2013), as well as institutional reports from WIPO, WTO, as well as the World Business Council for Sustainable Development.

The literature on which the research is based includes academic journals like the Journal of Environmental Economics and Management, World Patent Information, as well as literature on intellectual property law and green technology from an Indian context. The relevant case laws as well as literature were available due to the presence of online data services like Manupatra as well as SCC Online.

The case analysis in Section IV of the research is based on a qualitative approach to understand the theoretical arguments that were discussed in the previous sections with the help of the practical scenario of the management of green technology patents.

III. The Role of Patents in Green Technology Innovation

3.1 Patents as a Driver of Research, Development and Investment

The role of patents in fostering green technology innovation warrants careful examination. At

[9] The Patents Act, 1970 (Act No. 39 of 1970) (India), as amended by the Patents (Amendment) Act, 2005.

a fundamental level, the patent system rests on a straightforward bargain: in exchange for public disclosure of an invention, the state grants a temporary monopoly on its exploitation. This bargain carries particular weight in the context of green technology, where R&D costs are high and commercialisation timelines are long. Without patent protection, even well-resourced actors — corporations, research institutions, and individual inventors alike — have limited incentive to commit the capital needed to bring green innovations to market. The empirical evidence is clear healthy patent protection is correlated with significant investment in green technology R&D. According to the World Intellectual Property Organization World Intellectual Property Indicators report, green technology patent applications are growing at a greater rate than overall patent applications in the United States, Japan, Germany, China, and Korea.10 Such growth reflects the patent system's role in incentivising private investment. Patent protection also functions as a credibility signal to venture capitalists, marking a firm as technologically competitive — firms holding patents are demonstrably more likely to attract funding and achieve commercial success than those without. In capital-intensive sectors like green technology, where revenues may be years away from initial investment, this signalling function is not merely useful but often indispensable.

3.2 Fast-Track Patent Programmes and Market Acceleration

Recognising the urgency of scaling green solutions, several leading jurisdictions have introduced accelerated examination programmes for environmentally beneficial inventions. The United States Patent and Trademark Office (USPTO) Green Technology Pilot Program, the United Kingdom Intellectual Property Office's Green Channel program, and India's accelerated examination for green innovations are all based on the policy imperative that a reduction in the period between the filing of a patent application and the issuance of a patent has the potential for greatly accelerating the rate at which green innovations are deployed. The premise is straightforward: delays between application filing and patent grant are an unnecessary bottleneck when rapid deployment of green innovations is a matter of public urgency. The documented success of these fast-track programmes has prompted calls for their international harmonisation, so that green innovators can access accelerated examination across multiple jurisdictions simultaneously.

[10] World Intellectual Property Organization, World Intellectual Property Indicators 2023 (2023) [hereinafter WIPO Indicators].

3.3 Balancing Exclusivity with Public Interest

Yet patents are not without drawbacks, and these are particularly acute in the green technology context. Exclusivity can inadvertently constrain the very diffusion it is meant to incentivise. In developing nations, where these disadvantages are most felt, the cost of licensing patented green technologies may be beyond their means. This gives rise to a rather disconcerting phenomenon whereby nations most in need of protection from climate change are, at the same time, those least able to afford the technologies that will mitigate its impact on their environments. In addition, a thick network of patents, where several individuals own different patents on different aspects of a given technology, may give rise to considerable legal ambiguity, undermine innovation, and heighten transactional costs for all concerned.

Beyond access costs, the essential conflict between the interests of patent holders and those of nations in promoting green technologies is not merely theoretical; it is a very real concern that plays out in licensing disputes, failures in technology transfer, and innovation gaps between developed and developing nations. It is imperative for policymakers to grapple with the challenge of whether the current patent system, which is geared primarily towards serving business interests, is adequate for technologies whose diffusion will have a significant impact on environmental sustainability in general.

3.4 The International Patent Framework and Green Technology Governance

The international dimensions of green technology patenting add further complexity. Although national IP systems are shaped by common international standards — principally the TRIPS Agreement and the Patent Cooperation Treaty — they diverge considerably in their treatment of green technology patents, including patentability thresholds, examination procedures, enforcement mechanisms, and the use of available flexibilities. The result is an uneven global landscape that systematically disadvantages innovators and technology users in less developed countries. Institutions such as WIPO and the WTO are increasingly active in trying to bring coherence to these divergent systems. WIPO Green and technology transfer provisions embedded in international climate agreements acknowledge that green technology patenting requires a coordinated multilateral response. Yet as the literature reviewed above suggests, market-oriented voluntary efforts have consistently failed to close the gap between the developed and developing worlds — pointing to the need for a more structured and binding international framework.

IV. Case Studies Demonstrating the Impact of Patents on Green Innovation

4.1 Tesla's Open Patent Initiative (2014)

In June 2014, Tesla Motors announced that its entire patent portfolio would be made available for use by others acting in good faith — a remarkable departure from conventional IP strategy. Elon Musk explained the rationale plainly: the greater threat to Tesla was not competitor imitation but the sluggish global adoption of electric vehicles. By releasing its patents, Tesla sought to accelerate the growth of the EV ecosystem rather than protect a narrow commercial moat. The initiative is significant for two reasons. First, it demonstrated that patent openness and commercial self-interest are not inherently in conflict — a firm can relinquish exclusivity and still benefit from the expanded market that follows. Second, it offered a concrete proof of concept for open licensing in the green technology sector, showing that voluntary patent-sharing can be driven by environmental and market logic rather than regulatory compulsion.

4.2 The Eco-Patent Commons (2008)

Launched in 2008 with the support of the World Business Council for Sustainable Development and leading corporations like IBM, Nokia, Pitney Bowes, and Sony, the Eco-Patent Commons represented a highly ambitious approach to the patent pool model for green technologies.11 The corporations involved pledged to license a range of green patents royalty-free to any organisation seeking environmental benefit. At its peak, the commons covered over 100 patents spanning energy efficiency, pollution reduction, and sustainable manufacturing. Despite these ambitions, the initiative's real-world impact was limited — many of the pledged patents proved to have little commercial value, drawing criticism that the exercise amounted to little more than reputational management. That said, the Eco-Patent Commons set an important precedent: it demonstrated that voluntary IP-sharing arrangements for environmental purposes are viable in principle, even if their execution requires stronger structural underpinning.

4.3 Novartis AG v. Union of India (2013)

The landmark judgment of the Supreme Court of India in the case of Novartis AG v. Union of

[11] Eco-Patent Commons, supra note 8.

India,12 is relevant to the interface of patent law and public interest in a variety of technological fields. The judgment upheld the rejection of the patent application for Glivec, an anticancer drug of Novartis AG, under Section 3(d) of the Indian Patents Act of 1970,13 which bars patenting new forms of existing substances that do not demonstrate enhanced efficacy. The significance of the judgment for the regulation of green technology can be gauged by the broader principle that emerges from the judgment: national patent laws have some scope under the TRIPS regime to balance public interest considerations with patent law. This principle is particularly relevant to the regulation of green technology, especially for developing countries to have access to patented green technology without any hindrances caused by multinational patent owners**.**

V. Legal Framework and Patent Mechanisms

5.1 National Patent Laws and Green Technology Protection

The green technology patents are subject to a multilayered structure of national and international laws. On the national front, every country has its own system of patents regulated under national laws, which provide the necessary guidelines on the conditions of patentability. In India, patents are regulated under the Patents Act of 1970,14 which lays down the conditions under which patents can be granted. The United States patent system is regulated by the USPTO, supplemented by the Green Technology Pilot Program. On the European front, the EPO provides regionalized patent protection with reduced administrative formalities across member states. Though national and international laws are similar in their approach, the dissimilar approaches adopted under national laws have resulted in a high degree of inconsistency.

5.2 International Treaties and Multilateral Frameworks

At the international level, the overall governance of green technology patents is mainly governed by two basic treaties, namely the Patent Cooperation Treaty and the TRIPS Agreement. The Patent Cooperation Treaty is an international treaty governed by WIPO, which allows a unified filing procedure where an inventor can seek patents in more than 150 member

[12] Novartis AG v. Union of India & Others, (2013) 6 SCC 1 (India).
[13] The Patents Act § 3(d), supra note 9.
[14] The Patents Act, 1970, supra note 9.

states through a single international patent application. This treaty holds significant importance for green technology innovators, as it substantially reduces the administrative complexity and cost of filing patents across multiple jurisdictions simultaneously. The TRIPS Agreement mainly lays down the minimum standards of intellectual property protection to be adopted by all the member states of the WTO. This treaty has helped create a global standard for the protection of patents, thus creating a level of international harmonisation in the overall realm of intellectual property laws. However, as mentioned in the prior sections of this chapter, the TRIPS Agreement has come under significant criticism for laying down a common set of intellectual property laws that do not address the needs of developing nations to access important green technology.

5.3 Compulsory Licensing and Technology Transfer

Among the principal legal mechanisms available to governments seeking to balance innovation incentives with public access to green technology are compulsory licensing and technology transfer. Under Article 31 of the TRIPS Agreement,15 and are reflected in virtually every country's patent laws worldwide. Compulsory licensing allows governments to authorise third-party use of a patented invention without the patent owner's consent in defined circumstances — national emergencies, public health crises, or pressing public interest situations. In the specific case of environmentally sustainable technologies, compulsory patent licensing is seen as a powerful mechanism through which developing countries can gain access to environmentally sustainable innovations that are patented but financially or legally out of their reach. Similarly, technology transfer provisions are also seen as a means through which environmentally sustainable innovations can be transferred from developed countries to developing nations. The WIPO Green Platform is seen as an important mechanism through which technology transfer can be facilitated between technology owners and users worldwide. However, the practical utility of these provisions is also circumscribed by a variety of factors that affect their implementation in reality.

5.4 Patent Pools and Open Innovation Models

Patent pools and open innovation frameworks have emerged as promising mechanisms to address the challenges to the transfer of green technologies resulting from fragmented patent

[15] TRIPS Agreement, supra note 1, art. 31.

ownership. A patent pool is defined as "a group of patent owners who enter into an agreement to license their patents collectively to each other or to third parties on a non-discriminatory basis pursuant to a set of predetermined terms and conditions." The patent pool is an appropriate mechanism for industries related to green technologies that are characterised by complex interdependencies between multiple patented innovations, such as solar energy technologies that require access to patents related to photovoltaic cells, inverters, storage devices, and grid connection technologies owned by different patent holders. Patent pools can play an important role in mitigating the legal uncertainty resulting from patent thickets. The open innovation paradigm, as reflected in Tesla's open patent initiative or the Eco-Patent Commons discussed above in the previous section, extends the patent pool idea by making patents available to any party willing to use them for the environment on a royalty-free basis. Despite the promising potential of patent pools and open innovation frameworks, their voluntary nature has so far prevented any systemic impact to reshape the landscape of green technology transfer.

VI. Challenges in Patent Protection for Green Technologies

6.1 High Costs and Accessibility Barriers

One of the most pressing structural problems facing green technology start-ups is the financial burden of the patent process itself. Filing, prosecuting, and maintaining patents across multiple jurisdictions is expensive — a reality that weighs especially heavily on smaller innovators who already face drawn-out commercialisation timelines. The cumulative cost can deter market entry altogether, concentrating IP ownership in the hands of large incumbents and ultimately working against the widespread diffusion of green technology that the patent system is nominally designed to promote.

6.2 Patent Thickets and Legal Complexity

A major structural challenge facing the green technology patent system is the phenomenon of patent thickets. This occurs when a set of patents owned by different parties overlap to provide coverage of a technology or innovation space. This problem is especially common in green technologies such as solar power, wind power, and electric vehicles. The rapid pace of innovation in such areas has led to a spread of patents on incremental innovations, alternative technologies, and complementary components of a technology. When a technology or a

product may infringe on a large number of patents owned by different parties, the transaction costs involved in negotiating individual licenses can be substantial. This can be a significant barrier to entry to the market for a new innovator. Patent thickets can also make the risk of litigation prohibitively high. This can be a waste of resources on litigation that does not contribute to the advancement of green technologies. Patent thickets can slow the pace of the green technology market just when the urgency of the climate crisis demands a faster pace.

6.3 Definitional Inconsistency and Examination Challenges

A less obvious yet equally important issue lies in the absence of a universally accepted definition for the term "green patent." In fact, different countries have varying criteria for evaluating whether or not a given invention is a green technology. This has resulted in a high level of inconsistency in the examination, fast-tracking, and reporting of green patents across different countries. In some countries, the classification of green patents is based on the International Patent Classification codes that are used for a given application. In other countries, the classification is based on the self-classification by the applicant or on the discretion of the examiner. This has created a high level of uncertainty for innovators seeking to leverage green patent fast-tracking mechanisms across different countries. In addition, the absence of a harmonised definition for green patents has made it challenging for countries to effectively collaborate on policies that promote green technology transfer and access since the scope of the subject matter being regulated by these policies is ambiguous.

6.4 The North-South Divide in Green Technology Patenting

One of the most important and widespread issues that the green technology patent regime has had to address is the persistent disparity between the levels of patenting activities between developed and developing countries that has come to be known as the North-South divide in intellectual property law. WIPO statistics have consistently shown that the vast majority of green technology patents16 are applied for by entities from a handful of technologically advanced countries that include the United States, Japan, Germany, South Korea, and China. In contrast, the developing countries' share of green technology patents is negligible due to a lack of research and development capabilities, insufficient institutional infrastructure, and a lack of access to the necessary financial resources that are necessary for meaningful

[16] WIPO Indicators, supra note 10.

participation in the global intellectual property regime. The dominance of green technology intellectual property by entities from technologically advanced countries has created a structural dependency wherein developing countries are relegated to the position of technology importers rather than innovators whose access to technology is subject to the dictates of foreign intellectual property owners. In a world wherein many developing countries bear a disproportionate burden for the effects of climate change, the disparity in green technology access is not merely a concern for economic efficiency but a legitimate concern for environmental justice that has not been adequately addressed by the contemporary intellectual property regime.

VII. Future Directions and Policy Recommendations

7.1 Harmonisation of Global Green Patent Standards

The fragmented definitions and examination practices for green patent regulations in different countries pose a significant but still unresolved issue in international IP governance. A concerted international effort towards a set of universally accepted green patent classification criteria would greatly benefit green technology innovators in different countries. Such an international consensus in the examination practices for green technology patents would minimise the administrative burden for innovators who wish to file in different countries, address the disparity in fast track practices that currently place innovators from less developed countries at a disadvantage, and help accurately compare international green technology patenting patterns. The international treaties and conventions that regulate IP rights, such as the TRIPS Agreement and the Patent Cooperation Treaty (PCT),17 and strengthened to include provisions that address green technology patent classification and transfer. The urgent need for a global response to the climate crisis offers a strong political justification for advancing the agenda for green technology patent harmonisation in existing international forums such as the WTO, WIPO, and the UNFCCC.

7.2 Financial Incentives and Reduced Patent Costs for Green Innovators

In order to address the financial barriers that are currently causing the patenting of green technology to be concentrated in the hands of large multinational corporations, interventions

[17] WTO, TRIPS Agreement — Article 31, https://www.wto.org/english/tratop_e/trips_e (last visited Mar. 13, 2026).

are necessary on the part of national governments as well as international institutions. The governmental policy that is necessary to address this problem is the establishment of a comprehensive financial incentive system for green technology innovators. This could include subsidised patent filing fees for green technology innovators, grants for research and development investment in green technologies, as well as tax credits for successful green technology commercialisation. A reduction in patent maintenance fees for green patents — particularly for SMEs, individual inventors, and research institutions in developing nations — would help diversify the innovation landscape, since fee structures disproportionately favour well-resourced entities and contribute to the current concentration of green IP in a handful of large firms.Beyond fee reform, a dedicated fund for green technology innovators from developing nations — administered through WIPO or a comparable institution — would provide targeted financial support for those navigating the patent system with limited resources. Taken together, these interventions would broaden the base of participation in green technology innovation rather than leaving it concentrated in the hands of those already well-positioned to bear the costs.

7.3 Strengthening Compulsory Licensing and Technology Transfer Mechanisms

The current legal regime on compulsory licensing and technology transfer, although theoretically adequate, needs to be substantially strengthened to attain its potential as a tool for access to green technology. The governments of the developing countries should be encouraged, and if necessary, facilitated, to invoke the flexible provisions of Article 31 of the TRIPS Agreement for the green technology that is deemed essential for the climate mitigation and adaptation strategies of the country. The political and economic pressures that have historically prevented the developing countries from making use of the flexibilities under the TRIPS Agreement for the access to green technology should be mitigated through the commitment of the developed countries and the international community not to impose any trade sanctions or retaliatory measures against the developing countries for the grant of compulsory licenses for the access to green technology. The technology transfer agreements, whether they are bilateral, regional, or multilateral, should be modified to incorporate commitments rather than the current targets, with specific timeframes, obligations, and procedures for addressing disputes. The public-private partnerships, with funding from the governments and facilitation by the institutions, can serve as a useful tool for the implementation of the commitments for the transfer of technology by linking the patent holders

of the developed countries with the users of the technology in the developing countries.

7.4 Expanding Patent Pools and Open Licensing Frameworks

Following the lead established by the Eco-Patent Commons and Tesla's open patent initiative, it is suggested that policymakers and industry players take an active role in pushing forward the expansion of patent pooling and open licensing practices within the green technology domain. Governments can take a catalytic role by providing financial incentives for participation in green patent pools, establishing regulatory frameworks to support the formation and governance of open licensing practices, and actively participating in patent pools by including their own patents related to green technology. International institutions can play an active role by focusing on the World Intellectual Property Organization (WIPO) to develop standardised legal frameworks for the establishment of green patent pools to minimise the transaction costs related to the establishment and governance of open licensing practices. The domain of existing open licensing practices can be extended to include a broader range of green technologies and a broader geographical base for the participant pool, including innovators and technology users from the developing nations. Though existing open licensing practices by key patent players have intrinsic value, they can be complemented by incentive mechanisms to ensure that participation in open licensing is commercially attractive to players.

7.5 Enhancing Capacity Building and Awareness in Developing Nations

A relatively underexplored dimension of green technology patent governance concerns capacity building in developing countries. Even where mechanisms such as compulsory licensing, technology transfer agreements, and patent pools are formally available, their practical utility is constrained if local institutions lack the expertise to deploy them. Capacity building initiatives by WIPO, regional IP organisations, and bilateral development partners should therefore target innovators, policymakers, and legal practitioners in developing countries — equipping them to engage effectively with the global patent regime, exercise available flexibilities, and participate meaningfully in international IP governance. Dedicated training programmes and workshops focused specifically on green technology patents would help close the knowledge gap that has long prevented developing-country actors from accessing the full range of options available to them. Ultimately, any credible reform of the green patent regime must invest in the human capital necessary to make that reform work on the ground.

VIII. Conclusion

The relationship between patent law and green technology innovation sits at a critical intersection of law and policy. As climate change intensifies, the legal architecture governing the development, protection, and dissemination of green technology has acquired significance well beyond the conventional boundaries of intellectual property law, reaching into environmental governance, international development, and distributive justice. This paper has sought to engage with that complexity directly, examining the ways in which the patent system both enables green technology development and erects barriers to its international dissemination.

The conclusions that can be drawn from the above analysis are as follows. First, the patent system is a fundamental tool for the promotion of green technology innovation. By providing innovators with the security that they need to attract investors, recover research and development expenditures, and commercialise their inventions, the patent system has played a fundamental role in the significant technological advances that have been made within the realm of renewable energy, sustainable transportation, and energy efficiency over the past two decades. The increase in green patent applications from major economies, the economic benefits of fast-track patent programmes, and the sophisticated open-source licensing strategies developed by industry leaders such as Tesla are a testament to the continued vitality and significance of the patent system as a force for sustainable technological change.

Secondly, however, the current patent system is structurally unsuitable to address the full range of the global green technology challenge. The distribution of green technology patent ownership among a handful of technologically advanced economies, the expense of patent acquisition or licensing, the complexity of patent thickets, and the lack of a global standard for green patent standards all contribute to a patent system that structurally favours the developed world—at the expense of the very nations that face the brunt of climate change. This is not an efficiency problem; it is a global environmental justice problem that deserves immediate attention.

Third, the legal tools available for addressing these structural deficiencies, such as compulsory licensing, technology transfer, patent pools, and open licensing, are theoretically sound, although they are not as widely used as they should be. The Eco-Patent Commons and Tesla's open patent initiative demonstrate the effectiveness of voluntary collective action, while the

Supreme Court of India's ruling in Novartis AG v. Union of India18 the substantial policy space available to national governments under the TRIPS framework, which can balance the public interest against patent rights. The problem for policymakers is how to build upon these precedents to create a more binding international framework that ensures access to green technologies on a consistent and equitable basis.

The policy recommendations developed in the current paper—global green patent harmonisation, financial incentives for green innovators, enhanced compulsory licensing and technology transfer, patent pools, open licensing, and capacity building in the developing nations—point the way to a more effective patent system that can better balance the competing demands of innovation and sustainability. However, the implementation of these suggestions depends upon the political will of the international community, the quality of the multilateral engagement, and the willingness of the developed nations and major patent holders to limit their patent rights for the greater good of the international community as a whole.

The transition to a sustainable global economy cannot be achieved through technological innovation alone, as the latter is a necessary, although insufficient, step for the achievement of the former. Rather, the latter necessitates a supportive legal and institutional framework that ensures access to the results of that innovation for all nations, regardless of their level of economic development. Patents, used judiciously, can become a powerful tool for the achievement of that goal. The international community's challenge is to reform the current patent system so that it addresses not only the commercial realities of the present, but the environmental realities of the future.

[18] Novartis AG v. Union of India, supra note 12.

Bibliography

I. Primary Sources

A. Statutes and Legislative Instruments

- The Patents Act, 1970 (Act No. 39 of 1970), India, as amended by the Patents (Amendment) Act, 2005
- The Trade-Related Aspects of Intellectual Property Rights Agreement (TRIPS Agreement), Annex 1C, Marrakesh Agreement Establishing the World Trade Organization, 1994
- The Patent Cooperation Treaty (PCT), Washington, 1970, as amended and modified

B. Cases

- *Novartis AG v. Union of India & Others*, (2013) 6 SCC 1 (Supreme Court of India)

II. Secondary Sources

A. Journal Articles

- Popp, David, 'Patents, Citations and Innovations in the Energy Sector' (2006) 35(4) *Journal of Environmental Economics and Management* 455
- Salgado, Eduardo Gomes and Franchi, Rosângela Aparecida da Silva, 'Green Technologies: The Role of Green Patents for Innovation[19], Preservation and Sustainable Development' (2021) *World Patent Information*
- Rao, Ramya R., 'Accelerating the Future[20]: The Rise of Green Technology and Intellectual Property Rights — An Overview of Global and Indian IP Undertakings to Encourage Greener Tech Patents' (2022) *Indian Journal of Intellectual Property Law*

---

[19] Eduardo Gomes Salgado & Rosângela Aparecida da Silva Franchi, Green Technologies: The Role of Green Patents for Innovation, Preservation and Sustainable Development, World Pat. Info. 1, 5 (2021).
[20] Ramya R. Rao, Accelerating the Future: The Rise of Green Technology and Intellectual Property Rights, Indian J. Intell. Prop. L. 112, 118 (2022).

B. Reports and Institutional Documents

- World Intellectual Property Organization (WIPO), *World Intellectual Property Indicators 2023* (WIPO, Geneva, 2023)

- World Intellectual Property Organization (WIPO), *WIPO Green: The Marketplace for Sustainable Technology* (WIPO, Geneva, 2022)

- World Business Council for Sustainable Development (WBCSD), *Eco-Patent Commons: A Review of Progress* (WBCSD, Geneva, 2012)

C. Online Sources

- WTO, 'TRIPS Agreement — Article 31' <https://www.wto.org/english/tratop_e/trips_e\> accessed 13 March 2026