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# **PATENT LAW AND CLIMATE COMMITMENTS: COMPARATIVE LESSONS FOR BRIDGING INDIA'S GREEN INNOVATION GAP**

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K Chaitanya, LL.M. (Intellectual Property Rights and Trade Law),  
School of Law, CHRIST (Deemed to be University), Bengaluru

## **ABSTRACT**

The global transition towards a decarbonized, carbon-neutral world has laid more emphasis on using green technology to improve innovation and sustainability. The misalignment in the current Indian patent system with global requirement of technological transformation driven by climate imperative, is the core argument of this study. It analyses the Patents Act, 1970 and its ability to serve as an instrument of climate change mitigation and industrial policy. Using the prism of double market failure, it indicates that although patents can solve the problem of knowledge spillovers, they have no effect on the environmental externalities that hinder use of green technologies. The study assesses Section 3(d), compulsory licensing, and the working requirement, which form a culture of interpretation prioritizing equitable access and public health. A comparative analysis of efficient green patent systems in other jurisdictions, indicate that the United States invokes the Bayh-Dole model to overcome the gap between technology transfer and equitable access, whereas Europe applies the Y02 classification model for normative integration. The Indian Patent regime has a “Green Patent Paradox”, where individual interests prevail over the need to tackle climate crisis. The patent system thus has to evolve to accommodate the growing demands of climate change, the goals to achieve carbon neutrality, thus facilitating public interest.

**Keywords:** Green Innovation; Double Externality; Section 3(d); Climate Industrial Strategy; TRIPS Flexibilities.

## I. INTRODUCTION

Climate crisis has pushed innovation as a secondary policy issue on the periphery to a structural change towards global decarbonization strategies. The current discussion of climate governance is to become more aware of the fact that the mitigation commitments made in the Paris framework cannot be achieved without leveraging the potential of green patents, especially in sectors such as energy, transport, and infrastructure<sup>1</sup>. However, the intellectual property landscape, particularly the patent law is still doctrinally weak to climate specific innovation. This makes it important to analyse whether India has a normatively and institutionally empowered patent regime that ensures equitable access and public interest in pharmacy patents and whether the same approach could be applied to serve as a climate industrial strategy instrument.

Theoretically, green innovation is defined by the problem of double externality, which means, the environmental innovations create positive knowledge spillovers that are characteristic of the R&D activity and at the same time, they create public environmental benefits that cannot be internalized by markets<sup>2</sup>. This bi-polar market failure makes classical explanations of patent exclusivity complicated. Whereas patents are meant to rectify the knowledge spillovers by facilitating appropriability, it fails to rectify the environmental externality that makes the green technologies socially unavailable on its own.<sup>3</sup> Therefore, the discussion on green technology or climate innovation is oscillating between patent monopolies being barriers to diffusion and practical justifications that patents benefit the economy of a state and hence cannot be equitably accessed.<sup>4</sup> The unresolved contradiction between access and incentive is the core of modern intellectual property studies on climate mitigation.

The patent system in India, despite being formally aligned with the Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), is structurally guided by an access-maximization paradigm that is not adequately responsive to the systemic-innovation requirements of decarbonization.<sup>5</sup> Though this orientation has been normatively justifiable in the pharmaceutical sector, especially considering the imperatives of the public health, its

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<sup>1</sup> Paris Agreement art. 10, Dec. 12, 2015, T.I.A.S. No. 16-1104.

<sup>2</sup> Adam B. Jaffe, Richard G. Newell & Robert N. Stavins, Environmental Policy and Technological Change, 22 *Env't & Res. Econ.* 41, 43-45 (2002).

<sup>3</sup> *Ibid.*

<sup>4</sup> Peter Drahos, Intellectual Property and Climate Change: Inventing Clean Technologies, in *Intellectual Property and Climate Change 1* (Peter Drahos ed., 2010).

<sup>5</sup> Agreement on Trade-Related Aspects of Intellectual Property Rights art. 7, Apr. 15, 1994, 1869 U.N.T.S. 299.

doctrinal spillovers are realized when applied naively to capital-intensive climate technologies. The assumption here is the fact that the patent regime in India is not excessively stringent or excessively lenient, it lacks climate-responsive differentiation. The law is procedurally neutral to the presence of an existential environmental crisis. The primary issue that needs to be addressed is, does the theoretical literature on double externalities and innovation systems complicate traditional justifications for patent protection in the climate context. The other concern being, does the Indian patent regime created a doctrinal imprint favoring equitable access over technological improvements. In this process of identifying the weakness of the green patent system in India, a comparison to the United States and the European Union, has been drawn where the patent law is more transparently deployed as an instrument of industrial strategy. The study incorporates doctrinal and comparative analysis for drawing proximity to the statutory interpretation of the Patents Act, 1970, judicial rulings on the Supreme Court of India and other High Courts, and international commitments under Trade Related Aspects of Intellectual Property Rights (TRIPS).<sup>6</sup> This theoretical discussion is complemented by work with the innovation systems theory that conceptualizes technological change as a part of institutional ecosystems as opposed to unilateral legal stimuli. The comparative aspect looks at how the United States has incorporated the aspects of patent enforcement with the commercialization of its publicly funded research especially in the Bayh-Dole paradigm, and how the European Union has incorporated normative integration of climate objectives in its patent classification and innovation funding system.<sup>7</sup> The research is limited to mitigation technology and not to the adaptation policy, biodiversity regimes and non-patent climate instruments like carbon markets.

The restructuring of Indian patent doctrine in the context of climate industrial policy identifies whether the approach to equitable access in pharmaceuticals can help improve green innovation. Section 3(d) and compulsory licensing have been considered widely in the context of the public health and access to medicines<sup>8</sup>. This interconnection has indicated that normative vocabulary of access that prevails in Indian patent adjudication has not been reconfigured to capture the infrastructural-dependent and capital-intensive quality of climate technologies. Green technologies demand intricate manufacturing ecosystems, grid-integration and long-term capital investment, unlike pharmaceuticals, where generic substitution is possible. The

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<sup>6</sup> The Patents Act, 1970, No. 39 of 1970, INDIA CODE (1970).

<sup>7</sup> Bayh-Dole Act, 35 U.S.C. §§ 200–212 (2018); European Patent Office, Y02 Scheme: Climate Change Mitigation Technologies (EPO Guidelines).

<sup>8</sup> Novartis AG v. Union of India, (2013) 6 S.C.C. 1 (India).

lack of climate-specific procedural priority, differentiated examination criteria, or innovation sensitive interpretation of the activities defined as working therefore gives rise to an institutional bottleneck. The re-evaluation of the patent system in India is not associated with the rejection of TRIPS flexibilities and the erosion of the protection of access. Instead, it would need to contextualize those flexibilities to climate governance theory, which acknowledges the existence of differentiated responsibilities and the need to improve technological capacity-building.<sup>9</sup> The scholarship on industrial policy also illustrates that historically, states have used intellectual property in a strategic manner in addition to fiscal incentives, mission-driven procurement, and government-funded research.<sup>10</sup> The inability to incorporate these dimensions in the patent discourse in India is what needs to be addressed.

## II. THE DUAL MARKET FAILURE: THEORETICAL FOUNDATIONS OF GREEN INNOVATION POLICY

### A. The Double Externality Problem in Decarbonization

The rationale of patent protection on economic grounds has a long history based on the issue of knowledge spillovers. The original insight made by Kenneth Arrow showed that information, when revealed, was non-rivalrous and partially non-excludable, thereby resulting in underinvestment in research and development unless there are legal systems that provide appropriability insurance.<sup>11</sup> Patent law therefore serves as a corrective mechanism, which transforms the knowledge of the people into temporarily excludable properties in order to encourage individual investment. Nonetheless, there is one more distortion that is brought about by environmental innovation complicating this classical framework. The phenomenon of climate change itself is also a global externality, as demonstrated by William Nordhaus and others: social benefits of reduction of emissions are greater than the returns obtained by innovators or adopters themselves.<sup>12</sup>

Green innovation is thus described as having a double externality. Innovators are not able to entirely internalize the social value of their knowledge because of imitation and diffusion

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<sup>9</sup> TRIPS Agreement art. 8; Paris Agreement, *supra* note 1, art. 4.

<sup>10</sup> Mariana Mazzucato, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths* 15–20 (2013).

<sup>11</sup> Kenneth J. Arrow, *Economic Welfare and the Allocation of Resources for Invention*, in *The Rate and Direction of Inventive Activity* 609 (Nat'l Bureau of Econ. Rsch. ed., 1962).

<sup>12</sup> William D. Nordhaus, *To Tax or Not to Tax: Alternative Approaches to Slowing Global Warming*, 1 *Rev. Envtl. Econ. & Pol'y* 26 (2007).

effects. Second, despite the protection of appropriability, the markets cannot price the activity that is carbon-intensive correctly, therefore, undercutting the demand to use cleaner options.<sup>13</sup> This systematic underinvestment not only in invention but also in commercialization and diffusion is the outcome of this dual distortion. Patent exclusivity is a solution to the first externality, but not the second, which is the environmental mispricing that lowers the adoption of low-carbon technologies. Consequently, the climate innovation policy cannot be narrowed down to intellectual property reform. It needs to incorporate the pricing of carbon, regulatory requirements, state procurement, and state intervention on missions.<sup>14</sup>

There are normative implications of the double externality framework. Unless environmental regulation is enhanced to accompany enhanced patent protection, it is possible that exclusivity will increase monopoly pricing without spurring decarbonization. On the other hand, a regulation that lacks plausible innovation subsidies can discourage privately funded R&D in capital intensive areas like renewable energy storage, carbon capture and green hydrogen. The theoretical dilemma is not whether to use patents or regulation but is the creation of a complementary architecture that internalizes all the knowledge as well as the environmental spillovers. The innovation systems theory also emphasizes the fact that the technological change is within the circle of universities, state research institutes, venture capital market, infrastructural providers, and regulators. The patent law is thus a part and parcel of a larger system of change instead of an independent driver.

In the case of emerging economies, the double externality issue takes a new dimension, namely, developmental asymmetry. The manufacture of technology is geographically concentrated and the vulnerability to climate is distributed worldwide. Such asymmetry has created enduring controversies in the international economic law concerning the trade off between the protection of intellectual property and transfer of technology under the agreement on Trade Related Aspects of Intellectual Property Rights (TRIPS)<sup>15</sup>. The theoretical understanding here is that the patent regimes in developing countries are both a compliance measure by the global trade law and domestic innovation policy. The decision of whether these regimes are calibrated to access, diffusion or native technological capacity hinges on historical, political and

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<sup>13</sup> Adam B. Jaffe, Richard G. Newell & Robert N. Stavins, A Tale of Two Market Failures: Technology and Environmental Policy, 54 *Ecological Econ.* 164 (2005).

<sup>14</sup> *Ibid.*

<sup>15</sup> Agreement on Trade-Related Aspects of Intellectual Property Rights art. 7, Apr. 15, 1994, 1869 U.N.T.S. 299.

developmental priorities.

### **B. Skeptics vs. Pragmatists: The Academic rift on the utility of patents.**

The debate surrounding double externality model has been divided into two schools of thought. According to the skeptics, patents can hinder the speed of diffusion that is needed in mitigating climate. Based on historical experience in both pharmaceuticals and digital technologies, critics argue that monopolies can divide technology into different technological spaces, create so-called patent thickets, and raise the cost of transactions to cumulative innovation.<sup>16</sup> In this respect, it is possible that open innovation models, compulsory licensing, and prize-based incentives can be more effectively used to meet urgent decarbonization schedules. Other researchers go further to believe that green technologies, especially in the renewable energy sector tend to be incremental extensions of earlier art and have greater advantages of network externality than strong exclusivity<sup>17</sup>.

This doubt is overlapped with more general criticisms of intellectual property maximalism in international trade law. The developing nations have traditionally utilized TRIPS flexibilities to protect the interests of the people and the developmental goals of the people in terms of their health and development in history<sup>18</sup>. In the climate debate, the same case has been put forward by arguing that the enforcement of patents can limit access to mitigation technology in developing nations and middle-income nations. Doha Declaration on TRIPS and Public health depicts the effect of ongoing crisis in the world and how it can redefine the intellectual property standards towards humanitarianism concerns<sup>19</sup>.

Pragmatists retort that patents are still essential to the process of gathering private funds, especially those areas that demand large amounts of initial capital and lengthy commercialization periods. A thorough analysis of statistical research on clean energy innovation has indicated that certainty in the intellectual property protection is associated with more patenting and venture capital involvement<sup>20</sup>. Besides, patents may be used to help transfer

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<sup>16</sup>Michael A. Heller & Rebecca S. Eisenberg, Can Patents Deter Innovation? The Anticommons in Biomedical Research, 280 Science 698 (1998).

<sup>17</sup> Bronwyn H. Hall & Christian Helmers, Innovation and Diffusion of Clean/Green Technology: Can Patent Commons Help 66 J. Envtl. Econ. & Mgmt. 33 (2013).

<sup>18</sup>Carlos M. Correa, *Trade Related Aspects of Intellectual Property Rights: A Commentary on the TRIPS Agreement* 3–5 (2007).

<sup>19</sup> World Trade Organization, Declaration on the TRIPS Agreement and Public Health, WT/MIN(01)/DEC/2 (Nov. 14, 2001).

<sup>20</sup> Lee Branstetter, Britta Glennon & J. Bradford Jensen, The IT Revolution and the Globalization of R&D, 30

technology by offering formal licensing systems instead of informal secrecy. In this perspective, diminishing patent rights can neither hasten diffusion, rather it discourages cross-border cooperation and lowers the risks of conducting high-risk research.

The gap between pragmatists and skeptics is exaggerated. Both camps recognize that the climate crisis cannot be solved only by the use of patents. The controversy is on institutional sequencing and focus. The internalization of environmental costs is through regulatory mechanisms; that is, carbon pricing, emissions standards, and renewable portfolio mandates. By comparison, market-based instruments work by sending price signals and trading permits<sup>21</sup>. The patent law has an indirect interaction with the tools, by influencing the supply side of technological innovation. Thus, green patents can only work well when they are incorporated into consistent climate governance systems. Intellectual property protection can support decarbonization in jurisdiction with a strong environmental regulation.

### **C. From Invention to Diffusion: Mapping the Green Innovation Pipeline**

The hypothetical weakness of considering patents as individual incentives is the most pronounced when the entire innovation pipeline is considered. Green technologies pass through various levels, which include basic research, applied development, demonstration, scaling, infrastructure integration, and diffusion. The challenges each stage faces deal with different financial and institutional obstacles<sup>22</sup>. Early phases of the research is frequently reliant on social financing, mid-development is risk-taking capital, large-scale implementation is contingent on grid infrastructures, license permits, and long-term purchasing contracts. The main impact of patent protection on the initial and middle phases of this pipeline is the appropriability protection and easing the licensing process. It however does not solve infrastructure bottlenecks or generate demand certainty. The research on innovation systems stress that effective decarbonization process needs to be organized at the level of coordination between ministries, financial institutions, and industrial participants. The state is not just correcting market failures but also making markets in line with its policies. The examples in aerospace and biotechnology, reveal the way in which governments have used intellectual property rights strategically with the help of public funding and procurement<sup>23</sup>. In this respect,

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Innovation Pol'y & Econ. 1 (2018).

<sup>21</sup> Nordhaus, *supra* note 14.

<sup>22</sup> International Energy Agency, *Energy Technology Perspectives*

<sup>23</sup> Mariana Mazzucato, *The Entrepreneurial State: Debunking Public vs. Private Sector Myths* 15–20 (2013).

the problem of the double externality is not only economic but institutional. The dissolution of governance structures prevents the consistency in innovation paths. These conceptual understandings form the analytical connection with the Indian situation. The patent system in India was the result of a post-colonial desire to maintain technological independence and protection of the interests of the people. Its doctrinal framework and especially limitations on incremental innovation and strong compulsory licensing provisions are sensitive to access issues. However, climate technologies are capital intensive, infrastructure based and globally integrated supply chain in comparison with pharmaceuticals. The abstract theoretical issue is not, then, whether India ought to reinforce or weaken patent protection. Instead, it is whether the current access based doctrinal stamp is institutionally resonant with the systemic requirements of green industrial transformation. The knowledge of the problem of the double externality, the skeptic-pragmatist divide, and the innovation pipeline explains what is at stake in this question. Unless the patent law is approached in a doctrinally neutral manner amid climate urgency, structural underinvestment and diffusion delays can be maintained. On the other hand, patent doctrine can act as a catalytic part of innovation infrastructure when recalibrated as a part of a larger climate industrial strategy. The second part discusses how the recalibration of India is mediated by the patent jurisprudence that has been informed by historical promises to access and public health.

### **III. THE DOCTRINAL IMPRINT OF ACCESS-ORIENTED JURISPRUDENCE: INDIA'S PATENT REGIME**

#### **A. Historical Evolution: From Self-Reliance to TRIPS Harmonization**

The patent system in India is a product of a complex historical process determined by the developmental needs of the post-colonial period and the following multilateral trade obligations. The Patents Act, 1970 was as a result of the Ayyangar Committee which opposed the Patents and Designs Act of the colonial era of 1911 as it was seen to encourage foreign monopolization and inhibit the development of local technology in the country.<sup>24</sup> The 1970 Act intentionally left out pharmaceutical and agrochemical product patents, but retained process protection to encourage reverse engineering and industrialization in the USA.<sup>25</sup> This law design incorporated self-reliance and access in the statutory architecture. These objectives are

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<sup>24</sup> Rajagopala Ayyangar, *Report on the Revision of the Patents Law* (1959).

<sup>25</sup> The Patents Act, 1970, No. 39 of 1970, §§ 5, 53 (as originally enacted), INDIA CODE (1970).

enshrined in section 83 of the Patents Act, which states that patents are granted not to allow patentees to exercise monopoly rights but to ascertain that inventions are worked in India on a commercial basis and are not used to harass public health and become an instrument of abuse<sup>26</sup>. Section 83 is written in a way that shows a structural orientation. Patents are conditional privileges contained in developmental purposes instead of proprietary rights. This orientation persisted after India joined the World Trade Organization and was bound by the requirement to conform domestic law to the TRIPS Agreement<sup>27</sup>. The amendments of 2005 reintroduced patenting of products in the field of pharmaceuticals and chemicals but added a series of public-interest protections, such as an expanded compulsory licensing system with the introduction of Section 3(d).<sup>28</sup> The legislative concession therefore maintained an access oriented normative core of a formally TRIPS compliant format. Articles 7 and 8 of TRIPS that acknowledge the balance between the rights and public interest aim were often used in the parliamentary discussions and judicial arguments to support the purpose of such a measured action.<sup>29</sup> The implication of this history on its doctrines is important. Although today India offers a twenty-year protection of patents in all areas of technology, the culture of interpretation of the Act is still based on the fears of abuse of monopolies, cost effectiveness, and technological dependence. The patent law is not considered as an incentive based regime but a control mechanism that follows developmental goals.

### **B. Section 3(d) and the Shadow of Pharmaceutical Evergreening**

Section 3(d) of the Patents Act does not make available to patenting a mere discovery of a new form of a known substance, except where it leads to the known efficacy being increased<sup>30</sup>. The introduction of the provision was in response to avoid evergreening, especially in the pharmaceutical industry, where slight changes could be made to prolong exclusivity without any real therapeutic innovation. In *Novartis AG v. Union of India* is the most authoritative statement of its scope<sup>31</sup>. In *Novartis*, the Supreme Court of India refused to grant a patent claim on the beta crystalline form of imatinib mesylate on the basis that increased physicochemical properties did not amount to increased therapeutic efficacy in the context of Section 3(d)<sup>32</sup>. The

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<sup>26</sup> Id. § 83.

<sup>27</sup> Agreement on Trade-Related Aspects of Intellectual Property Rights arts. 7–8, Apr. 15, 1994, 1869 U.N.T.S. 299.

<sup>28</sup> The Patents (Amendment) Act, 2005, No. 15 of 2005, INDIA CODE (2005).

<sup>29</sup> TRIPS Agreement, *supra* note 31, arts. 7–8.

<sup>30</sup> Patents Act, 1970 § 3(d).

<sup>31</sup> *Novartis AG v. Union of India*, (2013) 6 S.C.C. 1 (India).

<sup>32</sup> Id. ¶¶ 180–90.

Court pointed out that the provision establishes a more rigorous standard of patentability so as to weigh the incentive to innovation against drug access. It also confirmed that Section 3(d) is a second level screening device, other than novelty and inventive step, that specifically concerns incremental innovative pharmaceutical inventions.<sup>33</sup> Novartis is important analytically, not merely because of its dogmatic possession, but because of its mode of interpretation. The Court interpreted patent law as the law that is integrated into the constitutional ideals of social welfare and health, relying on interpretive instructions of TRIPS flexibilities and dismissing the argument that Section 3(d) contradicted the international commitments<sup>34</sup>. This argument has spilled over to other areas of pharmaceuticals. Even though Section 3(d) is textually limited to known substances, its purposive interpretation indicates a wider judicial scepticism of incremental claims that are viewed to be carrying monopolies without the corresponding social benefit. The culture of the Indian patent adjudication innovation policy is therefore influenced by the shadow of pharmaceutical evergreening. Patent claims have usually been evaluated in a strategic extension sensitive lens instead of an incentive-based calculus. This method is both theologically defensible in the pharmaceutical industry, but its application to capital-intensive technologies, where minor advances can greatly increase efficiency or scalability, creates interpretive uncertainties. The literal meaning of Section 3(d) is not confined to particular groups of substances but the larger judicial discourse of abuse and access has an impact on the approach to examination and litigation in any industry. This access-based framework is strengthened by compulsory licensing. Section 84 allows an interested individual to seek a compulsory license after three years of grant based on the reasons that reasonable needs of the population have not been fulfilled, the patented invention is not offered at a reasonably affordable cost or is the invention not practiced in India<sup>35</sup>. The Controller of Patents issued the first post-TRIPS compulsory license in India of the anti-cancer drug sorafenib tosylate, on appeal by Natco Pharma Ltd. on the basis of high pricing and insufficient domestic working, in *Natco Pharma Ltd. v. Bayer Corporation*.<sup>36</sup> This rationale was upheld by the Intellectual Property Appellate Board, which stressed the importance of affordability and manufacture in the country as legal requirements<sup>37</sup>. The Natco ruling shows the conjunctive effect of Sections 83 and 84. Section 83 has the principles of the public interest

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<sup>33</sup> Id. ¶¶ 90–94.

<sup>34</sup> Id. ¶¶ 92–100.

<sup>35</sup> Patents Act, 1970 § 84(1).

<sup>36</sup> *Natco Pharma Ltd. v. Bayer Corp.*, Compulsory License Application No. 1 of 2011, Controller of Patents (Mar. 9, 2012).

<sup>37</sup> *Bayer Corp. v. Natco Pharma Ltd.*, Order No. 45/2013, Intellectual Property Appellate Board (Dec. 4, 2013).

upon which the ground of compulsory licensing under Section 84 is interpreted. The resultant doctrinal framework makes access and home industry activity a major assessive measure in patent enforcement.

### C. The “Working Requirement” and Infrastructure Dependent Technologies

The necessity to have patents worked in India is placed in a unique place in the Act. Section 83(b) provides that patents are not granted to permit patentees to have a monopoly in regard to importation and Section 84(1)(c) permits compulsory licensing in instances where the invention is not being worked in India<sup>38</sup>. Further, Section 146 requires disclosure in form of periodic statements on the amount of commercial working<sup>39</sup>. This has historically been the case in judicial and administrative interpretation, which has equated working with local manufacture to importation, which has led to controversy<sup>40</sup>. In the pharmaceutical case, the focus on local production is consistent with the objectives of the public health and industrial policy of developing the local capacity. But when applied to technologies that rely on infrastructure, like renewable energy apparatus, battery storage technologies, or carbon capture technologies, the definition of working is doctrinally ambiguous. Most green technologies are based on international supply chains, intercontinental integration of components and massive capital investments. The narrow definition of working as localized manufacture may pose some compliance challenges to a foreign patentee who may want to license the technology to India instead of coming up with the immediate manufacturing plants. On the other hand, a literal understanding of working as importation can weaken the goals of industrial policy in Section 83. The statute itself lacks a broad definition and the matter is left to administrative discretion and case adjudication. Such ambiguity indicates the structural mark of a pharmaceutical jurisprudence. The legal framework was sharpened according to the discussion of access to medicines, and the major precedents are the pricing of drugs and their therapeutic efficacy. Consequently, affordability, home production and anti-evergreening have all been emphasized in the development of the doctrines. Although these principles are textually based on the Act, their sectoral genesis affects the interpretive expectations in the technological arenas. The overall impact has been a patent regime formally technology-neutral but substantially influenced by access oriented adjudication. The combination of sections 3(d), 83, and 84 forms a regulatory stance which is sensitive to abuse of monopoly and the good of the people. That

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<sup>38</sup> Patents Act, 1970 §§ 83(b), 84(1)(c).

<sup>39</sup> Id. § 146

<sup>40</sup> Bayer Corp., supra note 41.

this posture is capable of serving the systemic needs of climate innovation, in substance of high capital intensity, of cumulative technological overlay, of dependency on infrastructure, is the question of analysis that arises.

#### **IV. PATENT LAW AS CLIMATE INDUSTRIAL STRATEGY: A COMPARITIVE ANALYSIS**

##### **A. The United States: Enforcement Credibility and the Bayh-Dole Framework**

The patent law in the United States exists in an institutional ecosystem that has high credibility in enforcement of remedies, predictability and strong capital markets. The intellectual property rights should be predictably enforced as the structural assumption of the American model to energize private investment in risky technological sectors. Despite the changes in the arguments about injunctive relief after *eBay Inc. v. MercExchange, L.L.C.*, the broad line of federal patent enforcement of special adjudication in Circuit Court of Appeals and strong doctrine of damages provides a fairly stable appropriability environmen<sup>41</sup>. This credibility has an effect on venture capital markets, federal research funding and technology commercialization mechanisms. The institutional hinge of this architecture is represented by the Bayh-Dole Act, passed in 1980, it allows universities, small businesses, and nonprofit institutions to maintain title to inventions resulting in federal funded research, under government use rights.<sup>42</sup> Bayh-Dole also restructures publicly funded research into patentable, licensable property that can attract a commercialization partner. Instead of making patents weaker to improve diffusion, the statute uses exclusivity to facilitate the translation of laboratory research into the market. Universities act as brokers, granting technologies to commercial companies with the capability to manufacture on large scale.

Clean energy research funded by the federal government at an agency like the Department of energy is patentable and can be licensed under foreseeable rules which would reduce transaction costs incurred by individuals who want to adopt it privately. However, in spite of the march-in rights provided in the statute that allows the government to intervene in the situation when inventions are not offered on reasonable terms, there have been few instances of the exercise of the rights, which also depicts a systemic choice in favor of commercialization

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<sup>41</sup> *eBay Inc. v. MercExchange, L.L.C.*, 547 U.S. 388 (2006).

<sup>42</sup> Bayh-Dole Act, 35 U.S.C. §§ 200–212 (2018).

through market means<sup>43</sup>. The American model, therefore, puts more emphasis on incentive continuity and enforcement reliability, which presumes that the demand side pull will be created by environmental regulation, be it tax credits, renewable portfolio standards, or emissions rules. The provision of the opposition infrastructure is provided by patent law, the provision of the market signal by the environmental policy. This is an analytically important structural separation. The patent doctrine itself is technology-neutral, however, the culture of enforcement and commercialization mechanisms around it provides circumstances favourable to capital-intensive innovation. The model presumes that when there is regulatory certainty, strong and credible rights trigger investment. The role of the state is not just to fix market failures but to build an innovation pipeline that unites the work of the public research with the implementation in the private sphere.

### **B. The European Union: Normative Integration and the Y02 Classification Scheme**

The European Union has a different institutional approach that incorporates more explicitly the objectives of patent classification and climate into its innovation governance approach. Whereas the European Patent Convention offers a centralized grant system, comprising the European Patent Office (EPO), environmental prioritization has been proposed by administrative and classificatory procedures instead of substantive patentability standards<sup>44</sup>. The Y02 classification scheme is a set of technologies introduced by the EPO to mitigate and adapt to climate change, allowing to track and analyze green patent applications in a systematic way<sup>45</sup>. Y02 system does not change the standards of novelty or inventive step, rather it instills the relevance of climate in patent information architecture. It promotes transparency, policymaking, and information dissemination in the allocation of funds in the European climatic programs by helping to identify mitigation technologies. This classificatory innovation is functioning together with a wider group of normative commitments that are held in the European Green Deal, which also incorporates industrial decarbonization, sustainable finance, and research funding as one and the same policy vision.<sup>46</sup> The European model is thus structurally different with the United States in two aspects. First, it pre-empts normative integration. Climate goals are embedded in the system of innovation governance via data

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<sup>43</sup> Id. § 203; see also U.S. Gov't Accountability Off., GAO-09-742, *Technology Transfer: Agencies' Rights to Federally Funded Biomedical Inventions* (2009).

<sup>44</sup> Convention on the Grant of European Patents (European Patent Convention) art. 52, Oct. 5, 1973, 1065 U.N.T.S. 199.

<sup>45</sup> European Patent Office, *Y02/Y04S CPC Scheme: Climate Change Mitigation Technologies* (EPO Guidelines).

<sup>46</sup> European Commission, *The European Green Deal*, COM (2019) 640 final (Dec. 11, 2019).

systems, funding instruments, and regulatory alignment. Second, it focuses on procedural facilitation, e.g. accelerated examination programs of green technologies, as opposed to just using credibility of enforcement. At the institutional level, it is indicative of the regulatory tradition of the EU, in which market incentives are supplemented by administrative coordination and harmonization. The Y02 scheme demonstrates that patent classification may be an effective strategic policy tool without re-setting substantive patentability criteria. In comparison, the U.S. model is based more on commercialization routes based on university-industry relationships and enforceable exclusivity.

### **C. Comparative Lessons in Procedural Responsiveness**

The comparative analysis reveals that neither jurisdiction modifies core patentability doctrine specifically for climate technologies. Instead, both deploy institutional design choices that render patent systems responsive to decarbonization imperatives. In the United States, responsiveness emerges through enforcement credibility and the integration of publicly funded research into private markets under Bayh-Dole. In the European Union, it arises through classificatory innovation, accelerated procedures, and policy alignment under the Green Deal framework. These models illuminate several structural variables relevant to India. First, enforcement predictability influences investment decisions in capital-intensive sectors. While India's patent jurisprudence emphasizes public interest safeguards, the relative scarcity of large-scale clean technology commercialization may partly reflect uncertainty regarding long-term exclusivity and working requirements. Second, commercialization pathways matter as much as substantive standards. India's public research institutions generate climate-relevant innovations, yet the statutory framework lacks an equivalent to Bayh-Dole that systematically channels federally funded research into patent-backed licensing ecosystems. Third, data architecture and procedural facilitation can function as policy levers. The EU's Y02 classification demonstrates that patent offices can contribute to climate strategy through information management and targeted prioritization without altering doctrinal thresholds.

The institutional contrast underscores a broader analytical point, patent law becomes climate strategy not through ideological expansion or contraction of rights but through calibrated integration with funding, enforcement, and regulatory systems. Where classification and procedural tools align patent administration with environmental objectives, they enhance systemic coordination. The comparative lesson is therefore structural rather than prescriptive.

Patent regimes shape innovation outcomes not only through statutory text but through the surrounding institutional architecture in which they operate.

For India, the question is whether its access-oriented doctrinal culture, analyzed in the previously can be complemented by procedural and institutional mechanisms that support climate responsive innovation without displacing public interest safeguards. The comparative experience suggests that recalibration need not entail abandoning developmental commitments. Rather, it may involve reconfiguring patent administration, commercialization pathways, and enforcement expectations to align with the infrastructural realities of green industrial transformation.

## **V. DIAGNOSING THE GREEN INNOVATION GAP: INSTITUTIONAL SILOS AND LEGAL GAPS**

The above discussion shows that the patent regime in India is neither strictly restrictive nor permissive. It has a formal technology-neutral structure and substantively concerned public interest safeguards. However, even neutrality can create structural misalignment in cases where the issues surrounding innovation are asymmetric. Decarbonization is not an additional field of technology but it demands faster discovery, faster scaling, integration of infrastructures and integrated industrial policy. No internal differentiation of climate-relevant technologies is, however, present in the Patents Act, 1970. Section 83 of its objectives clause sets out principles of public interest, abuse prevention and domestic working, but omits environmental externalities and decarbonization imperatives as statutory considerations<sup>47</sup>. This silence generates structural discontinuity between the commitments of climate governance and the administration of patents. India is one of the parties to the Paris Agreement that focuses on the development and transfer of technologies as the key elements of the mitigation strategy.<sup>48</sup> The domestic climate policy tools, including renewable energy goals and production-based incentive programs, are executed by executive and sectoral regulations and not by the coordination of the patent law. The patent system is therefore operating at par with climate industrial policy but not in line. In contrast to the United States, where commercialization pathways under the Bayh-Dole model are designed to incorporate public research with commercial deployment, or the European Union, where classification systems are designed to

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<sup>47</sup> The Patents Act, 1970, No. 39 of 1970, § 83, INDIA CODE (1970).

<sup>48</sup> Paris Agreement art. 10, Dec. 12, 2015, T.I.A.S. No. 16-1104.

institutionalize climate targets into the administration of patents, the Indian patent system is institutionally shielded against climate planning. Their misalignment is structural in isolation and not doctrinal. The doctrine of patents can be internally consistent, but it is not systematically integrated into the climate governance frameworks. There are ministries of renewable energy, heavy industry and climate finance that have no formal procedural connections with patent administration. The lack of coordination mechanisms strengthens institutional silos, which hinder coherent innovation pipelines.

Another green innovation gap identified is statutory silence concerning prioritization. The Patents Act does not offer expedited treatment or various procedural treatment dependent on environmental importance<sup>49</sup>. Although administrative action has sometimes made possible expedited examination, under limited categories, e.g. startups or applicants choosing India as the International Searching Authority, there has been no explicit legislative authority that climate technologies should be given priority treatment. The silence of the statute is opposed to the practice of patent offices across the globe whereby fast-track programs are implemented on inventions that are environmentally friendly. This exclusion is not the vice of compliance but of orientation. Sections 2(1)(j) and 2(1)(ja) provide a general definition of invention and innovative step without any sectoral modulation<sup>50</sup>. The exclusions of section 3 are based on morality, public order, and technical thresholds, but it does not deal with environmental urgency<sup>51</sup>. The policy design is a reflection of a time when access to medicines and industrial self-reliance were the key policy topics. The conceptualization of climate mitigation did not include a patent-relevant objective. The resultant effect is the procedural neutrality in the temporal asymmetry. Climate technologies are defined by compressed schedules determined by emissions paths and global obligations. A patent system that does not distinguish green and non-green technologies can inadvertently slow down the adoption where the backlog of the examination remains. There is also the limitation of the statutory guidance to allow the patent examiners to take into consideration the environmental externalities in the interpretation of provisions like the reasonable requirements of the people under Section 84.<sup>52</sup> Although that expression has been judicially interpreted mainly in the pharmaceutical context, the broad language of the phrase theoretically can be construed to be broader. But unless guided by legislation or policy, administrative practice will still be fixed on the existing precedents. Legal

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<sup>49</sup> Patents Act, 1970

<sup>50</sup> Id. §§ 2(1)(j), 2(1)(ja).

<sup>51</sup> Id. § 3.

<sup>52</sup> Id. § 84(1)(a).

silence therefore works as a governance gap. It is not inconsiderate with climate policy, merely it does not internalize it. Here the issue of doctrinal gaps and governance gaps comes into play. The Act has solid mechanisms doctrinally, such as mandatory licensing, working requirements and disclosure obligations. It also lacks clear integration with environmental priorities or institutionalized co-ordination with climate agencies.

In addition to the statutory silence, the more fundamental institutional fragmentation can be seen in commercialization bottlenecks. Section 146 of the Patents Act compels the patentees to provide statements on the operation of inventions in India<sup>53</sup>. This disclosure regime, though meant to track domestic exploitation, fails to differentiate between the industries that have a complicated infrastructure needs and the ones with less complicated manufacturing chains. Formal adherence to working requirements may not be a measure of effective market integration in green technologies, where implementation can be determined by grid connection, regulatory permissions, and mass procurement. Under Section 84, compulsory licensing has been used, despite its articulation as a protection against inactive or unjustifiably high prices, in the pharmaceutical sector<sup>54</sup>. The jurisprudence in the case of *Natco Pharma Ltd. v. Bayer Corporation* shows that there is statutory focus on affordability and local production.<sup>55</sup> Nonetheless, the same reasoning when applied to climate technologies would create uncertainty in which initial implementation would demand large capital investments and incremental development of infrastructure. The law fails to explain how reasonable demands of the citizens are to be evaluated in the industries where demand relies on regulation frameworks but not consumer prices only. The commercialization gap can thus not be narrowed down to the patent norms; it is the lack of intermediate institutions that can convert the patents granted in the form of industrial capacity. The public research institutions and national laboratories of India create innovations of climate relevance but lacks the statutory equivalent of the U.S. Bayh-Dole regime that provides a systematic way of assigning ownership and licensing incentives to research funded by public bodies. There is also no built-in data architecture that compares to the Y02 classification of the European Union which allows strategic mapping of local green patent portfolios. Such omissions are rather governance gaps, but not failures in doctrine. The problem is aggravated by institutional silos. Administration of

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<sup>53</sup> Id. § 146.

<sup>54</sup> Id. § 84.

<sup>55</sup> *Natco Pharma Ltd. v. Bayer Corp.*, Compulsory License Application No. 1 of 2011, Controller of Patents (Mar. 9, 2012); *Bayer Corp. v. Natco Pharma Ltd.*, Order No. 45/2013, Intellectual Prop. App. Bd. (Dec. 4, 2013).

patents is provided by the Department of Promotion of Industry and Internal Trade, climate policy is organized by the environmental and energy ministries. Fiscal schemes are used to administer industrial incentives. Lack of procedural cross-referencing or common data systems does not allow the information on patents to inform climate planning or the other way round. The outcome is a disjointed innovation system where patent law does not hinder and in fact does not support the transformation of green industries. To diagnose the gap in green innovation thus, it is necessary to identify three layers. To begin with, there are doctrinal provisions, which include access-based safeguards that are based on historical priorities: 3(d), 83, 84 and 146. Second, the disregard of climate priorities creates temporal and procedural neutrality. Third, the fragmentation of governance generates commercialization bottlenecks that are not based on the patentability standards. The net result is structural underperformance as opposed to explicit legal incompatibility. The identification of this stratified diagnosis offers the analytical basis of assessing whether and how institutional recalibration can make India patent regime consistent with its decarbonization commitments.

## **VI. RECALIBRATING INDIA'S PATENT SYSTEM AS CLIMATE INNOVATION INFRASTRUCTURE**

The first point of recalibration is in the objectives clause of Section 83. The provision states that patents are patented to promote inventions and also to ensure that they are commercially worked in India without unnecessary delay, and to avoid the misuse of the monopoly rights<sup>56</sup>. The language is open-textured and does not restrict to any particular sector any of the commercial scale or the public interest. To understand these words with reference to modern environmental commitments, they have to be understood in a contextual manner rather than to be statutorily amended. The Indian courts have utilized purposive interpretation in previous instances in which they have interpreted provisions of the patent provisions based on constitutional and public interest factors<sup>57</sup>. It would be textually faithful to make such an interpretive methodology the means to identify decarbonization imperatives without necessarily substituting its distributive protections. Second, procedural responsiveness can be done by rulemaking in Patents Act and in the Patents Rules, 2003. Section 159 permits the Central Government to promulgate rules to execute the objectives of the Act<sup>58</sup>. The Act is not a ban on sector specific expedited examination categories, as long as substantive requirements

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<sup>56</sup> The Patents Act, 1970, No. 39 of 1970, § 83, INDIA CODE (1970).

<sup>57</sup> *Novartis AG v. Union of India*, (2013) 6 S.C.C. 1, ¶¶ 90–100 (India).

<sup>58</sup> Patents Act, 1970 § 159.

on patentability are not altered. Novelty, inventive step or Section 3 exclusions would not be altered by introducing or broadening fast-track examination of technologies that are environmentally friendly. It would rather adapt administrative sequencing. Since TRIPS requires non-discrimination on the basis of field of technology in the provision of patent protection,<sup>59</sup> procedural differentiation can never be made in a manner that it changes substantive standards. However, accelerated processing is not a violation of Article 27 provided that patentability requirements are not changed. A comparative practice shows that varied examination rates are not usually considered as discriminatory in TRIPS. Third, the commercialization channels of publicly funded climate research can be made clear in the current legal jurisdiction. India lacks a widely encompassing statutory counterpart to the U.S. Bayh-Dole Act, but the administrative and contractual frameworks that control the rights to intellectual property in publicly funded research institutions in India exist only to a limited degree<sup>60</sup>. Indicating the norms of ownership and licensing of climate research funded by the government by executive instructions would be the prerogative of the competence of the relevant ministries and would not disrupt patent doctrine. TRIPS does not control domestic distribution of ownership of publicly financed invention; it controls minimum level of protection.<sup>61</sup> Therefore, the organized systems of commercialization could be in line with the international requirements, as long as exclusive rights provided by the Act are not violated. Fourth, the working requirement of Sections 83 and 84 should be given an interpretive clarification as opposed to dilution. The law fails to specify what is meant by worked in the territory of India, which has allowed the scope to be taken into consideration by contexts<sup>62</sup>. Working may be reasonable in areas reliant on global supply chains, and where the deployment is staged, such as licensed local assembly, technology transfer relationship or demonstrable stages towards integration of infrastructure. It is not aimed at undermining the protection of compulsory licensing but simply to make the standards of compliance correspond with the realities of the sector. Compulsory licensing under the procedural conditions is explicitly mentioned in article 31 of TRIPS, thus retaining domestic discretion<sup>63</sup>. The clarification of the evidentiary standard of the reasonableness of the requirements of the public in terms of infrastructure-intensive industry would fall within the bounds of statutory law and TRIPS

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<sup>59</sup> Agreement on Trade-Related Aspects of Intellectual Property Rights art. 27(1), Apr. 15, 1994, 1869 U.N.T.S. 299.

<sup>60</sup> See generally Dep't of Sci. & Tech., Gov't of India, *Policy on Intellectual Property Rights* (2016).

<sup>61</sup> TRIPS Agreement, *supra* note 63, arts. 1, 7.

<sup>62</sup> Patents Act, 1970 §§ 83(b), 84(1)(c).

<sup>63</sup> TRIPS Agreement, *supra* note 63, art. 31.

standards.

The counter arguments state that recalibration can lead to the unfair favoring of climate technologies to the detriment of distributive equity. The organization of the Act itself addresses this concern. Under compulsory licensing, sections 84 and 92 maintain a situation of a national emergency or public non-commercial use<sup>64</sup>. Section 3(d) is still limited to particular groups of known substances and still protects against evergreening in pharmaceuticals<sup>65</sup>. These safeguards are not repealed or limited by procedural facilitation of climate technologies. Instead, it works at the administrative prioritization and interpretive coherence level. The distributive balance within the statute, of incentive and access, is still formally in place.

Another counterargument suggests that no single remedy can be effective in systemic climate innovation obstacles, such as patent reform. That is an analytically correct but institutionally incomplete proposal. Patent law is not a replacement of carbon pricing, procurement policy and industrial subsidies. Nevertheless, the re-calibration as innovation infrastructure fills a gap in governance; the lack of coordination between exclusive rights and decarbonization strategy. The need to ensure that the process of patent administration does not hinder nor delay green deployment is a purely statutory goal of promoting invention and ensuring commercial working without abuse<sup>66</sup>.

Lastly, the compatibility of TRIPS has been a core aspect of viability. Articles 7 and 8 acknowledge the fact that protection of intellectual property must play a role in technological innovations and transfers that promote social and economic welfare in a way that is conducive to protection of intellectual property<sup>67</sup>. Reducing procedural mechanisms or interpretive framework to aid the process of mitigating climate is consistent with these goals as long as there is no discriminatory approach and minimum standards are followed. Doha Declaration confirms that TRIPS is to be interpreted to support the aim of public policy<sup>68</sup>. Climate change as a global public good problem is within that normative horizon.

Recalibration, in this case, is not an abandonment of the tradition of patent in India, but rather

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<sup>64</sup> Patents Act, 1970 §§ 84, 92.

<sup>65</sup> Id. § 3(d).

<sup>66</sup> Id. § 83(a)–(b).

<sup>67</sup> TRIPS Agreement, *supra* note 63, arts. 7–8.

<sup>68</sup> World Trade Organization, Declaration on the TRIPS Agreement and Public Health, WT/MIN(01)/DEC/2, ¶ 4 (Nov. 14, 2001).

a shift in the tradition. The legal text authorizes a purposive interpretation, procedural modification, and coordinated commercialization without access protection. Institutional alignment is the problem and not the reconstruction of doctrines. The idea that the patent system is climate innovation infrastructure does not turn it into environmental regulation; it places it in the larger framework of technological transition without changing the distributive balance that has characterized Indian patent jurisprudence in the past.

## VII. CONCLUSION

India's patent regime does not obstruct green innovation by virtue of excessive stringency or doctrinal hostility, rather, it underperforms because it remains structurally decoupled from the institutional demands of climate industrial transformation. The challenge is not one of formal incompatibility but of functional alignment. A patent system historically shaped by equity and access, particularly in the pharmaceutical domain, operates today within a global decarbonization imperative that requires coordinated commercialization, infrastructural integration, and procedural responsiveness. The theoretical foundation for this conclusion lies in the double externality problem. Knowledge spillovers justify temporary exclusivity, while environmental externalities necessitate regulatory and industrial policy intervention.<sup>69</sup> Patent law corrects only one dimension of this dual market failure. Without integration into broader climate governance frameworks, it cannot independently generate diffusion or deployment. The skeptic-pragmatist divide clarifies that the debate is not about the intrinsic virtue of patents but about institutional design. A comparative analysis of the United States and the European Union demonstrates that patent systems function as climate-relevant infrastructure not through doctrinal transformation but through embedded commercialization pathways, enforcement credibility, and administrative coordination.<sup>70</sup>

Doctrinally, India's Patents Act, 1970 remains internally coherent. Sections 3(d), 83, 84, and 146 reflect a calibrated balance between incentive and access grounded in constitutional and developmental commitments.<sup>71</sup> Judicial interpretation in *Novartis AG v. Union of India* affirmed the legitimacy of this balance within TRIPS parameters, reinforcing the view that

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<sup>69</sup> Adam B. Jaffe, Richard G. Newell & Robert N. Stavins, A Tale of Two Market Failures: Technology and Environmental Policy, 54 *Ecological Econ.* 164 (2005).

<sup>70</sup> Bayh-Dole Act, 35 U.S.C. §§ 200–212 (2018); European Commission, *The European Green Deal*, COM (2019) 640 final (Dec. 11, 2019).

<sup>71</sup>The Patents Act, 1970, No. 39 of 1970, §§ 3(d), 83–84, 146, INDIA CODE (1970).

patent protection in India is purposive rather than absolutist.<sup>72</sup> Yet this jurisprudential legacy, while normatively defensible in the pharmaceutical context, has generated an innovation policy culture oriented towards preventing abuse rather than facilitating infrastructure-dependent technological scaling. The statute is silent on environmental prioritization, it does not integrate patent administration with climate governance institutions; and it lacks procedural mechanisms tailored to the temporal asymmetry of decarbonization. These features constitute governance gaps rather than textual prohibitions.

The institutional permit for recalibration therefore emerges from within the statute itself. Section 83 articulates that patents are granted to encourage inventions and secure commercial working without abuse.<sup>73</sup> Articles 7 and 8 of TRIPS affirm that intellectual property protection must contribute to technological innovation in a manner conducive to social welfare.<sup>74</sup> Interpreting these provisions in light of climate commitments does not require doctrinal rupture. It requires contextual alignment. Procedural differentiation, commercialization clarity for publicly funded research, and interpretive guidance regarding working requirements are feasible within existing authority and compatible with international obligations.

The strongest counter-argument maintains that any recalibration risks diluting distributive justice safeguards and privileging climate technologies at the expense of access concerns. That caution is neither trivial nor dismissible. India's patent jurisprudence has been shaped by commitments towards affordability and public health. However, recalibration as conceptualized here does not entail weakening compulsory licensing, narrowing Section 3(d), or displacing public interest principles. It instead addresses institutional sequencing and administrative responsiveness. The distributive architecture of the Act remains intact; what evolves is its coordination with climate industrial policy.

A further objection contends that patent reform is marginal relative to fiscal subsidies, carbon pricing, or infrastructure investment. This critique is analytically sound but incomplete. Patent law does not substitute for environmental regulation. Yet, as an instrument governing appropriation, disclosure, and commercialization, it shapes the conditions under which private and public actors invest in long-term technological transformation. Institutional misalignment

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<sup>72</sup> *Novartis AG v. Union of India*, (2013) 6 S.C.C. 1, ¶¶ 90–100 (India).

<sup>73</sup> Patents Act, 1970 § 83.

<sup>74</sup> Agreement on Trade-Related Aspects of Intellectual Property Rights arts. 7–8, Apr. 15, 1994, 1869 U.N.T.S. 299.

at this node reverberates across the innovation pipeline. Alignment, conversely, reduces friction without overstating the system's capacity.

The conclusion, therefore, is qualified rather than utopian. Patent law alone will not close India's green innovation gap. Nor does the statutory framework demand radical overhaul. The task is more modest but structurally significant, to situate patent administration within the architecture of climate governance so that exclusivity operates as innovation infrastructure rather than as isolated entitlement. Such recalibration preserves India's distributive commitments while acknowledging that decarbonization is not merely an environmental objective but a developmental and technological imperative.