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INTELLECTUAL PROPERTY RIGHTS AND GREEN INNOVATION: INSIGHTS FROM CASE STUDIES

ПРАВО ІНТЕЛЕКТУАЛЬНОЇ ВЛАСНОСТІ ТА ЗЕЛЕНІ ІННОВАЦІЇ: ВИСНОВКИ НА ОСНОВІ КЕЙС-СТАДІ

Abstract: This research investigates how Intellectual Property Rights (hereafter IPR) facilitate green innovation by examining the ways in which technology transfer mechanisms, patents, and trademarks impact the development of sustainable technologies. Case studies on Tesla's open patent strategy, the U.S.-China solar panel patent disputes, and the influence of wind power patents on the renewable energy industry are included in this analysis. Optimizing intellectual property strategies that promote technological advancements and guarantee fair access to sustainable solutions requires an understanding of these dynamics. The selected cases—Tesla's open patent approach, the U.S.–China solar disputes, and wind energy patents—illustrate how intellectual property operates across key green innovation sectors, revealing that collaboration, competition, and coordinated strategies play vital roles in the development of the sector.

Keywords: Green Innovation, Technology Transfer, Patents. Trademarks, Electric Vehicles, Solar Energy, Wind Energy.

Анотація: У дослідженні розглянуто роль прав інтелектуальної власності у підтримці зелених інновацій, включаючи механізми патентування, захисту торговельних марок та трансферу технологій. Предметом аналізу стали три кейси: відкрита патентна стратегія Tesla, патентні спори між США та Китаєм у сфері сонячної енергетики, а також вплив патентування у вітроенергетиці. Обрані приклади охоплюють три ключові напрями сталого розвитку — транспорт, сонячну енергетику та відновлювану інфраструктуру і демонструють різні підходи до застосування прав інтелектуальної власності на практиці.

Ключові слова: зелені інновації, трансфер технологій, патенти, торговельні марки, електричні транспортні засоби, сонячна енергетика, вітрова енергетика.

The consequences of rising global temperatures, the scarcity of resources, and the increasing frequency of natural disasters have made it impossible to ignore the damage caused by environmental degradation. These are not distant threats — they are already happening, disrupting lives and ecosystems alike. That is why sustainable development has become a global priority in the face of accelerating environmental breakdown. Green innovation—using environmentally friendly technologies—is crucial to addressing climate change and improving sustainability. Reducing carbon footprints and increasing resource efficiency are the main goals of these developments, which range from renewable energy to circular economy solutions. However, the success of green innovation depends on a favorable legal and economic climate that encourages research, development, and commercialization.

By giving inventors legal protection and promoting investment in sustainable solutions, intellectual property rights (IPR) are essential to green innovation. IPR guarantees that companies and researchers can profit from their work by awarding patents, trademarks, and copyrights. The advancement of innovation with a sustainability focus has been greatly aided by organizations like the World Intellectual Property Organization (WIPO). With more than 130,000 listed technologies, needs, and experts as of 2024, the WIPO GREEN platform reflects the growing global interest in promoting environmentally sound technologies [1, p. 95]. In terms of green patenting, China has become a global leader. About 42,000 green and low-carbon patent applications were submitted by Chinese entities in 2023 alone [2, p. 58]. Additionally, with 37,000 filings, China accounted for 48% of all energy storage patent applications worldwide that year. The nation's strong position in the green tech sector was further strengthened by the fact that it led the world in both solar energy invention patents (8,000) and hydrogen energy patents (5,000) [3, p. 203].

This growth shows a clear increase in awareness of the IPR role in sustainability-driven industries. The spread of technology is still impeded by robust IP protection, particularly in developing countries where access to green innovations is restricted [4, p. 27]. Finding a balance between technology transfer and proprietary protection is crucial for determining how IPR affects green innovation. IP regimes affect how technologies are marketed and whether they remain available in sectors like solar energy, wind power, and electric vehicles. The European Green Deal highlights the IPR role in promoting a green economy by promoting a flexible IP system that encourages open innovation and licensing for sustainability [5, p. 11]. Comparable policies, like mandatory licensing under the TRIPS Agreement, seek to increase access to green technologies while maintaining innovation incentives [6, p. 34].

Our research is based on the case study methodology, which makes it essential to first establish the theoretical context of IPR. These legal tools are designed to protect innovation by granting individuals and organizations the authority to control the use and commercialization of their creations for a limited time. Such protection helps stimulate research and development by allowing innovators to benefit from their work. The main types of IPR are trade secrets, copyrights, patents, and trademarks. In particular, patents promote investment and protect eco-friendly technologies vital to sustainable growth. A study found that green innovators apply different IP models across R&D and commercialization stages [7, p. 345; 348]. Trademarks protect names, symbols, and slogans, helping distinguish eco-friendly products. This builds consumer trust and encourages firms to invest in green tech, supporting sustainable economic development [8, p. 217]. Copyrights protect original works like software and digital content. Though less central to tech innovation, they secure tools that promote sustainability, such as energy management apps and smart grid software [8, p. 223]. Trade secrets protect confidential knowledge like green production methods. They encourage innovation but require strong internal controls to maintain secrecy, which can be difficult in collaborative settings [9, p. 287]. IPR can both support and hinder green innovation. Strong rights encourage R&D but may limit access in developing countries. Policies must balance protection with technology diffusion.

Understanding these foundations is key for the case studies that follow, which focus on the electric vehicle, solar energy, and wind power sectors. These areas were selected because they represent distinct but critical branches of green innovation: transportation, solar photovoltaics [10], and large-scale renewable infrastructure [11]. Each sector offers a unique perspective on the application of IPR in fostering sustainable technological advancements. The electric vehicle case looks at Tesla's open patent strategy, the solar energy case highlights U.S.–China patent disputes, and the wind power case explores how coordinated innovation and strategic patenting shape the industry. Together, these cases show how IPR works in practice across key areas of sustainable development.

Case Study 1: Electric Vehicle (EV) Industry and Tesla's Open Patent Strategy:

- Elon Musk, the CEO of Tesla, declared in June 2014 that the business would not file patent claims against anyone who was acting in good faith when using their technology. By permitting other manufacturers to use Tesla's innovations, this decision sought to promote sustainability and hasten the growth of the EV market. Tesla aimed to remove obstacles to EV development, promote cooperation, and make its technology a standard in the industry by sharing its patents [12, p. 2]. This strategy's main objective was to increase EV adoption by lowering barriers to innovation. By bringing other automakers on board with its battery and charging technologies, Tesla hoped to improve infrastructure and industry-wide compatibility. Furthermore, this strategy strengthened Tesla's brand in the international market by reaffirming its position as a pioneer in sustainability and innovation [13, p. 3]. Due to increased manufacturer collaboration brought about by Tesla's open patent policy, EV technology is now more widely available, which is driving market expansion. The policy accelerated advancements in battery performance, charging networks, and vehicle efficiency by allowing rivals to build on Tesla's innovations. The industry grew as a result of new players being encouraged to develop EVs by lowering entry barriers [14, p. 4].

But there were risks associated with this tactic as well. Since market dominance is typically secured by intellectual property protection, Tesla's competitive advantage might have been weakened if it had opened its patents. By consistently innovating, Tesla was able to reduce this risk and maintain the state-of-the-art manufacturing processes, AI systems, and proprietary software even after its hardware patents were made public [12, p. 5].

Tesla's open patent pledge included a "good faith" clause, preventing users from suing Tesla or aiding litigation. This safeguarded its open-source strategy, ensuring IP respect and preventing misuse [14, p. 10].

Tesla established a standard for using intellectual property to promote sustainability across the industry with its patent-sharing approach. The company helped the industry grow quickly by putting the broad use of EV technology ahead of exclusive rights. Tesla's strategy showed that intellectual property laws can advance both technological advancement and environmental objectives, despite the ongoing difficulties in striking a balance between open innovation and competitive differentiation [14, p. 7].

Case Study 2: The Solar Panel Patent War (US vs. China):

- The global solar energy sector has experienced significant technological advancements, accompanied by notable intellectual property (IP) disputes. A prominent example is the conflict between U.S.-based First Solar and several Chinese solar manufacturers. In October 2024, First Solar accused major competitors—including Canadian Solar, JA Solar, Longi, Jinko Solar, and Trina Solar—of infringing on its patents related to Tunnel Oxide Passivated Contact (TOPCon) crystalline silicon technology [15].

First Solar, a leading American manufacturer of thin-film solar panels, has consistently invested in research and development to enhance solar efficiency and reduce costs. The rapid expansion of the Chinese solar industry, supported by substantial government subsidies, led to an influx of cost-competitive solar panels into global markets. U.S. firms, including First Solar, alleged that Chinese manufacturers engaged in patent infringement and unfair trade practices.

The U.S. government responded by imposing tariffs and anti-dumping duties on Chinese solar imports, arguing that unfair subsidies and intellectual property violations distorted market competition. While these measures aimed to protect domestic innovation, they also increased the cost of solar deployment in the U.S., potentially slowing the adoption of renewable energy.

This patent war underscores the tension between intellectual property rights (IPR) protection and global sustainability goals. While strong patent enforcement can incentivize innovation, excessive litigation and trade restrictions may hinder technology transfer, particularly for developing countries seeking affordable green energy solutions.

Case Study 3: Wind Power Innovation and Patent Licensing:

- The wind energy sector has also been influenced by intellectual property rights, particularly through collaboration and standardization efforts. Siemens Gamesa and Vestas, two major players in the industry, have entered into partnership agreements to increase standardization within the wind industry, starting with tower transportation equipment. This collaboration aims to enhance efficiency and reduce costs associated with wind turbine deployment [18].

Such cooperative approaches demonstrate how intellectual property can facilitate, rather than hinder, green technology diffusion. By working together to standardize equipment and share technological advancements, companies can accelerate the development and deployment of more efficient wind turbines, benefiting the broader adoption of renewable energy solutions worldwide [18].

The case studies in the electric vehicle, solar energy, and wind power sectors shows that IPR can be a powerful tool for supporting sustainable technologies—but only when applied strategically. Tesla's open patent strategy demonstrates that innovation can grow through openness and collaboration. The U.S.–China solar disputes, on the other hand, reveal how restrictive enforcement of IPR may limit access and slow technological progress. In contrast, the wind energy sector shows how coordinated patenting and cross-sector collaboration can boost innovation across the entire industry.

Together, these cases send a clear signal: protecting innovation is important, but so is making it available. In the context of today's environmental crisis, keeping green technologies behind legal walls is no longer justifiable. Governments must adopt balanced IPR policies that support both invention and diffusion. Businesses should rethink outdated models and combine patent protection with partnerships and shared standards. Researchers should continue exploring how IPR can be used not only to protect ideas but to help scale them to the markets that need them most.

A fair and flexible IPR system—one that values both innovation and access is essential for accelerating the green transition and ensuring sustainable progress for all.

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