International Economic Law Practicum

GREEN TECHNOLOGY TRANSFER

Role of Intellectual Property Rights and Impact on Sustainability

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Executive Summary

This research examines the critical role of intellectual property rights (IPRs) in enabling or obstructing the transfer of green technologies essential for combating climate change. As the global community faces the prospect of surpassing the 2 degree Celsius. warming threshold, equitable access to environmentally sound technologies has become central to ensuring both climate justice and sustainable development.

The study situates its inquiry within the framework of the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS), focusing on Articles 7, 8, and 66.2, which outline obligations and flexibilities for technology transfer. It highlights how provisions such as compulsory licensing, voluntary licensing, and measures against anti-competitive practices provide legal space for diffusion of climate-friendly technologies, but remain underutilized due to political and structural barriers.

The analysis draws on Third World Approaches to International Law (TWAIL) and dependency theory to underline how the global IPR regime perpetuates historical inequities, concentrating innovation in the Global North while leaving the Global South technologically dependent. Empirical evidence reveals mixed impacts of stricter IPR protection, with benefits accruing largely to states with existing absorptive capacities, while least-developed countries face exclusion and high costs of access.

The research further explores alternative mechanisms for facilitating technology transfer, including capacity building, public-private partnerships, and open-source collaborative platforms. Financing instruments such as green bonds, green banks, and environmental fiscal reforms are examined as enablers of sustainable technological diffusion. Case studies from Africa, Latin America, and the EU illustrate both challenges and successful models of aligning finance with environmental goals.

At the policy level, the project stresses the need for coherence between international trade and environmental regimes. It argues that principles such as

Common But Differentiated Responsibilities (CBDR) under climate law should inform WTO interpretations, particularly under Article XX and the Enabling Clause, to prevent conflicts between trade liberalization and environmental sustainability.

Ultimately, the research concludes that effective green technology transfer requires a multifaceted strategy: leveraging TRIPS flexibilities, strengthening local capacities, mobilizing green finance, and harmonizing trade and climate regimes. Only by integrating legal, financial, and policy tools can the international community bridge the technological divide between the Global North and South, ensuring a just and sustainable response to the climate crisis.

1. Introduction

Climate change finds itself at the forefront of the most pressing global challenges of the 21st century. It is not merely an environmental concern but a multifaceted crisis with political, economic, and social ramifications. The consensus among climate scientists, international organizations, and civil society groups has become increasingly robust: global temperatures are rising, biodiversity is declining at an alarming rate, and extreme weather events — such as floods, droughts, wildfires, and cyclones — are intensifying in both frequency and severity.

Global warming has been expedited due to increasing emissions of greenhouse gases, as well as other acts attributable to humans. As these emissions increase globally, the unequal contributions of different countries, both at present and through history, find their roots in unsustainable energy use, consumption patterns, land use, lifestyle, land-use change and productive activities at the individual and collective levels.[1] Climate change has led to far-reaching detrimental impacts, causing significant losses and damages, such as the loss of property, lives, income, human health, food security, social equity.

The IPCC report on climate change highlights that the due to the climate crisis, there is an increase in the climate-related food-borne, water-borne, and vector borne-diseases.[2] Individual livelihoods have also been affected, as the effect of climate change has been felt in sectors such as agriculture, forestry, fishery, energy, and tourism. Climate change is also affecting the mental and physical health of individuals globally.

The World Bank's report highlights that by 2050, due to climate change, around 216 million people will be displaced, which is around almost 3% of the global

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[1] Intergovernmental Panel on Climate Change, Climate Change Synthesis Report, at https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_SPM.pdf

[2] *Id.*

population.[3] The following table represents the region-wise internal climate migrants.

Region	**Internal Climate migrants**
Sub-Saharan Africa	86 million
East Asia and the pacific	49 million
South Asia	40 million
North America	19 million
Latin America	17 million
Eastern Europe and Central Asia	5 million

However, perhaps the most critical, and yet underemphasized, aspect of the crisis is the inherent disproportionality in both the causes of and responses to climate change. Developed countries, historically the largest emitters, possess far more resources to adapt and mitigate climate impacts, while developing countries, with minimal historical responsibility, face the brunt of the consequences and often lack the financial and technological capacity to transition towards a green future.[4]

In this context, international law functions as both a site of cooperation and contestation. Global climate governance frameworks such as the United Nations Framework Convention on Climate Change (UNFCCC), the Paris Agreement, and various multilateral environmental agreements (MEAs) aim to provide a shared platform for dialogue, norm-setting, and action. Climate

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[3] World Bank Group, Groundswell, Acting on Internal Climate Migration, at https://openknowledge.worldbank.org/bitstreams/158b2f56-a4db-5a2d-93b9-0070068fa084/download

[4] IPCC, 2023: Sections. In: Climate Change 2023: Synthesis Report, Contribution of Working Groups I, II, and III to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change [Core Writing Team, H, Lee and J Romero (eds)]. IPCC, Geneva, Switzerland, pp. 335-115.

negotiations at the Conference of Parties (COP) summits, World Trade Organization (WTO) deliberations, and bilateral or regional agreements attempt to bridge the gap between developed and developing nations. However, these processes are fraught with deep structural inequalities, often revealing competing priorities and ideological rifts—especially when it comes to the question of climate finance and technology transfer.

The Paris Agreement of 2015, hailed as a landmark moment in international climate diplomacy, reflects the international community's collective ambition to limit global warming to well below 2 degrees Celsius above pre-industrial levels. Article 10 of the Paris Agreement places specific emphasis on technology development and transfer as a means of strengthening climate action in developing countries. It states:

"*Each Party should, as appropriate, submit and update periodically an adaptation communication, which may include its priorities, implementation and support needs, plans and actions, without creating any additional burden for developing country Parties*."

This provision underscores the need for flexibility and support in climate adaptation planning for developing nations, specifically recognizing their limited capabilities and asymmetric burdens.[5] Further, Article 4 of the UNFCCC lays down a concrete responsibility for developed countries to aid vulnerable developing nations:

"*The developed country Parties shall assist the developing country Parties that are particularly vulnerable to the adverse effects of climate change in meeting costs of adaptation to those adverse effects*."[6]

Together, these provisions suggest a clear normative commitment to climate justice through mechanisms such as capacity-building, climate finance, and technology transfer. However, translating these aspirational goals into practice

[5] The Paris Agreement, 2017, Article 10.

[6] The UNFCC, 1994, Article 4.

remains a major challenge. Perhaps the most significant impediment to real progress is the unequal global access to green technologies—a problem exacerbated by the rigid enforcement of intellectual property rights (IPRs), primarily under the framework of the WTO's Agreement on Trade-Related Aspects of Intellectual Property Rights (TRIPS).[7]

While developing countries consistently argue for greater and more equitable access to green technologies, developed nations have largely conditioned any such transfer on the enforcement of stringent IPR protections. These protections, they argue, are essential to incentivize innovation and maintain the integrity of global trade. However, this insistence often creates a roadblock for developing countries that lack the financial resources or institutional capacity to negotiate or license these technologies under market-based terms. As a result, the promise of technology transfer—which should be central to a fair global climate response—remains underfulfilled, reinforcing existing inequalities in global climate governance.

This power asymmetry is at the heart of critiques inspired by Third World Approaches to International Law (TWAIL), a critical school of thought that highlights how international legal regimes often reproduce historical patterns of domination and exclusion. TWAIL scholars argue that the global intellectual property regime disproportionately favors Global North interests and undermines the developmental aspirations of the Global South. Within the climate context, this manifests through the monopolization of clean technologies—ranging from renewable energy systems and energy-efficient processes to sustainable agriculture methods and carbon capture mechanisms—by private corporations or states that are unwilling to share them without reciprocal benefits.

The fragmented nature of the global climate and trade architecture further complicates matters. Technology transfer provisions within the Paris Agreement and UNFCCC remain largely non-binding, characterized by

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[7] *Supra* note 1.

voluntary commitments and weak enforcement mechanisms. Simultaneously, the WTO's legal architecture offers robust protection for IPR holders, with limited exceptions that are often too narrow or cumbersome for developing countries to utilize effectively. This disjointed legal regime calls for a deeper examination of how TRIPS interacts with global environmental obligations and whether a harmonized policy approach can be envisaged to enable sustainable development through effective technology sharing.[8]

This project begins with an overview of the TRIPS framework and technology transfer obligations [Chapter II], followed by theoretical and TWAIL justifications for technology sharing [Chapter III], further, an understanding of the barriers to green technology transfer [Chapter IV], thereafter, we have discussed the mechanism for green technology transfer [Chapter V] further we have discussed the green bonds and explored the green financing mechanism [Chapter VI], and then the policy coherence for the same [Chapter VII].

[8] *Id.*

2. Analysing the TRIPS Framework: Interplay of Intellectual Property rights and Green Technology

It is no secret that addressing climate change is one of the most formidable goals of the 20th century. Green technology, defined by the United Nations Conference on Trade and Development (UNCTAD) as the technology used to produce goods and services with smaller carbon footprints[9], sits at the microcosm of achieving this goal as it could significantly help in reducing emissions, promote sustainable development, and facilitate the transition to a low-carbon economy. In 2018-2021 alone, the total exports of green technologies from developed countries witnessed a remarkable surge, escalating from around $60 billion to over $156 billion.[10]

Evidently, this surge also indicates a concentration of green technology in developed nations. Consequently, there is an increasing demand by developing nations to tilt the scale of accessibility. The access to green technology, however, is not simply a matter of capability but also deeply intertwined with intellectual property rights (IPR). One major criticism against IPR is that by granting certain monopoly rights, they prevent the universalisation of

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[9] UNCTAD News, Green technologies: Coherent policy action needed for developing countries to reap the benefits, at https://unctad.org/news/green-technologies-coherent-policy-action-needed-developing-countries-reap-benefits.

[10] UNCTAD Press Release, UNCTAD calls for coherent policy action to enable developing countries to benefit from green technologies, at https://unctad.org/press-material/unctad-calls-coherent-policy-action-enable-developing-countries-benefit-green#:~:text=The%20total%20exports%20of%20green,to%20only%20about%20%2475%20billion.

technology and sustains the hegemonic power of the developed nations.[11] A parallel can be drawn from the early stages of the COVID-19 pandemic, where vaccine production was concentrated in high-income countries, leaving low-income nations with limited access. This inequity prompted global calls for a temporary waiver of the TRIPS Agreement—highlighting how IPR can act as a barrier in situations of urgent global need.[12]

In this context, the TRIPS Agreement is crucial to examine, because it sets the global standards for intellectual property protection and attempts to strike a balance between incentivizing innovation and enabling technology transfer. At the same time, it is also controversial in the sense that some stringent provisions on patent protection often pose significant challenges for developing and least-developed countries (LDCs) seeking access to essential green technologies.

Green technology has taken centre stage in global climate discussions, particularly under the United Nations Framework Convention on Climate Change (UNFCCC) and forums like COP 28. At COP 28, the critical role of innovation and technology transfer in achieving net-zero emissions was emphasised. Sultan Al Jaber, President of COP 28, noted that energy transition must be based upon sustainable technologies to combat climate change.[13] The World Intellectual Property Organization (WIPO) also released its research at COP 28, emphasising on the availability and development of a wide range of climate change technologies due to effective IPR and technology transfer.[14]

This section analyses the interaction between TRIPS and transfer of green technologies, focusing on its role in shaping the global discourse on green technology accessibility. It begins by examining the relevant obligations

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[11] Pratyush Nath, Debating International Intellectual Property: A TWAIL Perspective, Queen's University Belfast, at https://pure.qub.ac.uk/en/publications/debating-international-intellectual-property-a-twail-perspective.

[12] World Trade Organization News, TRIPS Council welcomes MC12 TRIPS waiver decision, discusses possible extension, https://www.wto.org/english/news_e/news22_e/trip_08jul22_e.htm.

[13] Dr. Sultan Al Jaber, at https://www.drsultanaljaber.com/.

[14] WIPO Green, Release of the New Green Technology Book At COP28 UAE, https://www3.wipo.int/wipogreen/en/news/2023/news_0027.html

imposed by TRIPS on member states, particularly in the context of patent protection and technology transfer commitments. The analysis then delves into the flexibilities within TRIPS, particularly those available to developing and least-developed countries (LDCs). Lastly, the scope of accommodating transfer of green technology has been explored with reference to existing literature.

1.1. Relevant Obligations in the TRIPS Agreement for Technology Transfer

1.1.1. Provisions of TRIPS Agreement

Article 7 of the TRIPS Agreement states that *"The protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology, to the mutual advantage of producers and users of technological knowledge."*[15] It is relevant to note that this provision only creates a normative framework that obligates *all* countries, which can be considered to align their IP regimes with sustainable development objectives.[16] As the Panel in *US – Section 211 Appropriations Act* has also observed, Article 7 embodies a good faith obligation on the Member states.[17] Its general language leaves its practical enforceability open to interpretation, limiting its direct applicability specifically to green technology.

However, the TRIPS Agreement extends certain obligations specifically to developed countries. For instance, Article 66.2 imposes a specific obligation on developed countries to incentivize the transfer of technology to LDCs. It states: *"Developed country Members shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least-developed country Members."*[18] The 2001 Doha Declaration reaffirmed the importance of Article 66.2, leading to the

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[15] Art. 7, TRIPS Agreement.
[16] IUCN Environmental Law Centre, The TRIPS Agreement, Sustainable Development and the Public Interest, https://portals.iucn.org/library/sites/library/files/documents/EPLP-041.pdf
[17] Panel Report, *US — Section 211 Omnibus Appropriations Act,* WTO Doc No. WT/DS176/R, adopted (adopted on 1 Feb., 2002).
[18] Art. 66.2, TRIPS Agreement.

establishment of reporting mechanisms by the TRIPS Council in 2003.[19] The TRIPS Council decision of 2003 (IP/C/28) set up a mechanism whereby developed countries are required to submit periodic reports detailing their efforts to promote technology transfer.[20]

1.2. Special and Differential Treatment for Developing Countries and Least Developing Countries (LDCs) under TRIPS

As outlined in Article 28.1 of the TRIPS Agreement, patent holders are granted exclusive rights to prevent others from reproducing, using, selling, or importing the patented subject matter without their consent.[21] These rights provide the patent owner with the ability to utilize and enhance their innovation while also receiving compensation through production, licensing, or sale. Such compensation is intended to encourage innovation by rewarding risk-taking and fostering further investments in improving the patented technology. Article 27.1 complements this by mandating that patents must be accessible and enforceable without discrimination regarding the place of invention, technological field, or whether products are imported or domestically manufactured.[22]

Additionally, the right to transfer a patent or enter into licensing agreements is enshrined in Article 28.2, allowing patentees to negotiate agreements freely, though such arrangements may be subject to regulation under national competition laws.[23] These provisions essentially ensure equality for patentable subject matter, because the TRIPS Agreement prohibits member nations from excluding certain technological fields from patent protection. For example, it requires the inclusion of previously unprotected areas such as medicine and

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[19] World Trade Organization, Doha Declaration, at https://www.wto.org/english/res_e/booksp_e/ddec_e.pdf.
[20] World Trade Organization, Implementation of Article 66.2 of the TRIPS Agreement, Decision of the Council for TRIPS of 19 February 2003, https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/C/28.pdf&Open=True.
[21] Art. 28.1, TRIPS Agreement.
[22] Art. 27.1, TRIPS Agreement.
[23] Art. 28.2, TRIPS Agreement.

biotechnology, which were often excluded under earlier frameworks like the Paris Convention.

Despite these enhanced protections, the TRIPS Agreement also incorporates flexibility through specific limitations on patent rights. In this vein, compulsory licensing is an important flexibility under the TRIPS Agreement, that allows governments to authorize the use of patented technologies without the consent of the rights holder.[24] Article 31 of the Agreement permits Member states to issue compulsory licenses on certain grounds such as national emergency or other circumstances of extreme urgency or in cases of public non-commercial use. This flexibility was reinforced by the Doha Declaration of 2001, which clarified that governments are not required to declare a national emergency to issue compulsory licenses.[25] Instead, the necessity of addressing public health or environmental objectives, such as mitigating climate change or adapting to its impacts, constitutes a valid ground for such measures.

The concept of compulsory licensing is neither unique nor exceptional. Developed countries like the United States and the United Kingdom have frequently resorted to compulsory licensing to facilitate access to critical technologies. For instance, the United States government has extensive powers to utilize patented inventions under its Clean Air Act 1970 to meet environmental standards, subject to reasonable compensation.[26] Similarly, between 2001 and end 2007, 52 developing and least-developed countries have employed compulsory licenses to manufacture or import generic pharmaceutical drugs under the "government use" provision, which does not require prior negotiation with the patent holder but mandates fair remuneration[27]. This mechanism could be extended to access expensive,

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[24] Article 31, TRIPS Agreement.
[25] World Trade Organization, Doha Declaration, at https://www.wto.org/english/res_e/booksp_e/ddec_e.pdf.
[26] Congressional Research Services, Compulsory Licensing of Patented Inventions, at https://crsreports.congress.gov/product/pdf/R/R43266.
[27] CUTS-CTIEE, Compulsory Licensing and the Anti-Competitive Effects Of Patents For Pharmaceutical Products: From A Developing Countries' Perspective, at https://cuts-citee.org/pdf/Compulsory_Licenses_and_anti-competitive_effects_of_patents.pdf.

patented climate-friendly technologies when negotiations with patent holders fail to yield affordable solutions.

This discussion also warrants the mention of Article 30 which allows limited exceptions to patent rights. Article 30 provides that such exceptions must not "unreasonably conflict" with the normal exploitation of the patent or "unreasonably prejudice" the legitimate interests of the patent holder, considering the legitimate interests of third parties.[28]

These limited exceptions can be particularly significant in the context of green technology. For instance, countries may allow the research and experimental use of patented green technology without obtaining prior authorization from the patent holder. This could potentially enhance technological learning and innovation – thereby enabling researchers and manufacturers in developing countries and LDCs to study patented technologies to improve their own technological capacities.

In terms of anti-competitive practices, Article 40 addresses anti-competitive practices in licensing agreements. It permits member states to take action against practices that impede the transfer of technology, such as excessive royalty fees or restrictive licensing terms.[29] This provision is relevant in ensuring fair access to green technologies, especially for developing countries. Member states can utilize Article 40 to challenge these practices through domestic competition laws or negotiate fairer licensing agreements. For instance, it can be used to check whether the licensing agreements for green technologies unfairly prohibit the sale, distribution, manufacturing etc. of green technologies in violation of the domestic competition laws of the countries.

An intriguing yet les commonly emphasised flexibility is parallel importation – that is less cited as *allowed* under the TRIPS itself, because it hedges over the grey area. This is because parallel importation – neither prohibited or allowed under the TRIPS Agreement – allows countries to import patented products that

[28] Art. 30, TRIPS Agreement.
[29] Art. 40, TRIPS Agreement

are lawfully placed in the market of another country by or with the consent of the patent holder.[30] The principle rests on the premise of exhaustion of IPR, i.e., that the rights holder's control over a product ends (or exhausts) once it has been sold in a particular market.

This mechanism enables countries, especially those with limited financial resources, to procure patented products from international markets where the prices are significantly lower, rather than being restricted to local prices set by the rights holder.[31] For example, in the context of green technology, a developing country could import advanced renewable energy technologies or energy-efficient equipment from countries where such products are sold at competitive prices, bypassing restrictive licensing terms or monopolistic pricing practices. However, as emphasised earlier, it is not explicitly a part of the TRIPS framework.

1.3. Scope of Accommodating Transfer of Green Technology under the TRIPS Agreement

The Doha Declaration has significantly influenced the interpretation of the TRIPS Agreement, particularly in relation to public health. Article 4 of the Declaration emphasizes that the TRIPS Agreement should not obstruct members from taking necessary measures to safeguard public health.[32] While it reiterates a commitment to the TRIPS framework, it establishes that the Agreement must be applied in a way that supports members' rights to promote access to medicines. Some scholars interpret the Doha Declaration as a strong indicator of the fact that the TRIPS does not explicitly support transfer of green technology and primarily focuses on technologies facilitating "public health" as opposed to environmental concerns. However, the TRIPS agreement does not

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[30] Christopher Heath* Parallel Imports and International Trade, at https://www.wipo.int/edocs/mdocs/sme/en/atrip_gva_99/atrip_gva_99_6.pdf.

[31] Hai Li et al., *An analysis of technology licensing and parallel importation under different market structures*, 238 EUROPEAN J. OPERATIONAL RESEARCH 132 (2021).

[32] World Trade Organization, Doha WTO Ministerial Declaration 2001: TRIPS WT/MIN(01)/DEC/2, November 20, 2001, https://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_trips_e.htm

lay down what measures are allowed to use in order to achieve public health, and it depends on the discretion of Member states. It can also be argued that there is some correlation between public health and environment as environmental challenges like air pollution can pose a public health risk, especially in developing countries.

Moreover, environmental concerns are indirectly referenced in Article 27.2 of the TRIPS Agreement, which allows member states to exclude inventions from patentability to protect public order or morality, including preventing serious environmental harm.[33] Although this provision pertains to patentability, it underscores the potential for addressing environmental issues within the TRIPS framework.

Compulsory licensing for green technology remains a contested issue, with some arguing that it should not apply to long-term problems like climate change. This argument draws from the fact that Article 31 permits compulsory licensing in the "case of national emergency" or for "public non-commercial use."[34] Issuing compulsory licenses for green technology is unlikely to be considered "public non-commercial use" because such technology will undoubtedly be attached to some sort of commercial enterprise. Yet a case can be made that environmental pollution is a "national emergency" in the developing world, and indeed this has been attempted by scholars to provide a justification for green technolgy transfer under TRIPS.[35] Another supporting factor is that Article 31 does not explicitly mention environmental issues, but it neither restricts the subject matter for which compulsory licenses may be issued. Further, existing decisions, such as the 2003 WTO implementation of Paragraph 6 of the Doha Declaration, allow for compulsory licensing without limits on the scope of

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[33] Art. 27.2, TRIPS Agreement.
[34] Art. 27.2, TRIPS Agreement.
[35] Robert Fair, *Does Climate Change Justify Compulsory Licensing of Green Technology*, 6 INT'L L. & MGMT. REV. 21 (2009).

diseases or emergencies.[36] This flexibility could be extended to include green technologies essential for combating climate change.

It is also relevant to note that the scope of compulsory licensing under TRIPS has evolved beyond addressing epidemics to encompass long-term health issues such as heart disease and cancer.[37] This expanded understanding raises the possibility of addressing environmental pollution under the same framework, as pollution causes significant health risks, including premature death. Therefore, there appears to be considerable scope for allowing transfer of green technology under the TRIPS Agreement.

3. Theoretical Justifications To Further Technology Transfer

The TRIPS agreement constitutes one of the three pillars of WTO law, along with GATT and GATS.[38] The primary aim of TRIPS is incorporating protection of intellectual property as part of the multilateral trading system.[39] Arguably, the main benefit stemming from a stronger system of IPR is the promotion R&D by incentivising innovation,[40] a utilitarian argument famously raised by JS Mill.[41] This runs in tandem with the other goals set out under Article 7 of TRIPS, which

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[36]World Trade Organization, Implementation of Article 66.2 of the TRIPS Agreement, Decision of the Council for TRIPS of 19 February 2003, https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/C/28.pdf&Open=True.

[37] Robert Fair, *Does Climate Change Justify Compulsory Licensing of Green Technology*, 6 INT'L L. & MGMT. REV. 21 (2009).

[38] WTO, Frequently Asked Questions About TRIPS, https://www.wto.org/english/tratop_e/trips_e/tripfq_e.htm#:~:text=One%20of%20the%20fundamental%20characteristics,as%20embodied%20in%20the%20WTO.

[39] *Id.*

[40] *See generally*, Mikhalein Du Bois, *Justificatory Theories for Intellectual Property Viewed through the Constitutional Prism*, 21(1) POTCHEFSTROOM ELECTRONIC L. J. 1, 2018.

[41] *Id.*

sets out the objective of promoting intellectual property protection as increasing 'technological innovation and to the transfer and dissemination of technology'.[42]

It is argued that a system of greater stringency will lead to greater innovations by companies in the North, which will then opt for a licencing mechanism with the developing countries, thereby leading to greater diffusion of technology.[43] On the other hand, implementation and compliance will redirect significant monetary funds away from other crucial sectors, and further increase the North-South divide.[44]

Despite the flexibilities provided in TRIPS, there is the practical reality that such technology transfers do not take place as much as the drafters arguably imagined. However, this is not unexpected, as the majority of the 'theoretical' justifications for IPR arise in a western context. Lokesh Vyas, who made the winning entry for the ATRIP Essay Competition 2023, contextualises this as being stuck in an 'epistemological framework given a canonical body of work that has already developed during or before our entry into IP teaching and research'.[45] Open access platforms and research material is also dominated by Global North Scholars, including Social Science Research Network (SSRN), HeinOnline etc.[46] This necessitates a radically different approach to addressing the issues raised. Building on this, the present section argues that the transfer of green technology is not merely a policy preference, but a moral, legal and practical imperative. This is done by integrative critiques of historical inequity, ethical imperatives, and reasons of socio-economic pragmatism.

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[42] TRIPS art. 7

[43] Fatma Mrad, *The effects of intellectual property rights protection in the technology transfer context on economic growth: the case of developing countries*, 23(2) J. ECON. & MGMT. 33, 2017.

[44] *Id.*

[45] Lokesh Vyas, ATRIP Winning Essay 2023: Whither Global South's Copyright Scholars: Lost in the "Citation Game"?, https://spicyip.com/2024/05/atrip-winning-essay-2023-whither-global-souths-copyright-scholars-lost-in-the-citation-game.html

[46] *Id.*

First, we address the historical inequities by relying upon the Third World Approach to International Law ['TWAIL'] approach, Dependency Theory and Postcolonial Approach. TWAIL refers to a particular form of scholarship which recognises the historical western domination and oppression that 'characterizes social and legal relations in the international community'.[47] On the other hand, Dependency Theory highlights how the Global South remains in the 'periphery' of world systems due to historical resource extraction and exploitation by the Global North. Second, we analyse the ethical human rights framework, which encompasses intersectional approach and aspects of human rights and capabilities. Intersectional feminism, climate justice and capabilities approach are discussed here. Third, we explore the arguments of utilitarianism and maximising global welfare in context of transfer of green technology. Through this, the present Chapter seeks to make a coherent case for reform.

1.4. Addressing Historical Inequities via TWAIL, Dependency Theory

The demand for green technology transfer to the Global South is linked to historical inequities perpetuated by colonial and neocolonial systems. The three interconnected frameworks of TWAIL and Dependency Theory highlight the structural biases of international law and trade regimes, including the TRIPS Agreement. The central argument upon which these approaches converse is that the current IP regime entrenches colonial hierarchies, stifles Southern innovation, and obstructs climate justice by monopolizing green technologies in the Global North.

1.4.1. TWAIL Approach

The TWAIL refers to a particular form of scholarship which recognises the historical western domination and oppression that 'characterizes social and legal relations in the international community'.[48] Emerging in the 1990s as a

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[47] *See*, Aishwarya Sandeep, TWAIL Scholarship: A necessary pillar of International law [part 2], https://aishwaryasandeep.in/twail-scholarship-a-necessary-pillar-of-international-law-part-2/

[48] *Id.*

response to the Eurocentric foundations of international law, TWAIL scholars such as Antony Anghie, B.S. Chimni, and Sundhya Pahuja argue that legal frameworks like TRIPS are not neutral instruments of governance but tools designed to perpetuate the dominance of the Global North over the South.[49] According to Prof. Antony Anghie, approaching international law through the Austinian understanding of sovereignty and justice overlooks the historical inequalities and the context of colonialism which has shaped the system of international law today.[50]

In order to address the mechanisms of exclusion described by Anghie, it is necessary to highlight the context of TRIPS formation and understand who benefits from a more stringent IP regime. The TRIPS Agreement is often termed a 'compromise' between the interests of the developed countries and the developing countries. Prior to the TRIPS, IP was governed at a global level by the Paris Convention of 1883, which gave wide recognition to the diversity of nations and their respective socio-economic settings.[51] For example, under Article 4 bis the patents recognized by the States were to be independent of each other.[52] This meant that the grant of patent in one State does not oblige another State to grant such patent.[53] This is in stark contrast to the TRIPS, which seeks universalization of IP regimes across the world.

Industrialized nations, led by the United States and the European Union and backed by transnational corporations, framed IP protection as a prerequisite for global trade, effectively strong-arming developing countries into compliance. Developing nations, many still recovering from the economic destabilization of structural adjustment programs, lacked the bargaining power to resist. There is an ever growing pressure for furthering such universalization by the developed

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[49] *See*, Mutua Makau & Antony Anghie, *What Is TWAIL?*, 94 PROCEEDINGS OF THE ANNUAL MEETING (AMERICAN SOCIETY OF INTERNATIONAL LAW) *31*, 2000.

[50] Antony Anghie, 27(5) *The Evolution of International Law: Colonial and Postcolonial Realities* 739, 740 (2006).

[51] Paris Convention for the Protection of Industrial Property 1883, 828 UNTS 305 (Paris Convention) [Hereafter, 'Paris Convention'].

[52] Paris Convention, art. 4 bis.

[53] *Id.*

countries over the developing countries,[54] as the economic realities of the latter were seen as mere impediments to the project of economic liberalisation.[55] The result was a regime that prioritized corporate profits over equitable development. For instance, TRIPS mandates 20-year patent protections, enabling Northern firms to control critical green technologies like solar panels, wind turbines, and battery storage systems, which are technologies essential for mitigating a climate crisis disproportionately caused by the Global North. The conditions enabling the Global North to remain as innovators is explored in depth in further sections.

The context under which TRIPS was formed has changed, and as the major corporations of the world today are not producers of goods, but of services, the manner in which we treat IPR must be receptive to these changes. To quote Prof. Mark Lemley, '…how will our economy function in a world in which most of the things we produce are cheap or free...IP has allowed us to cling to scarcity as an organizing principle in a world that no longer demands it'.[56] Presently, the system of global IP has created what has been described as the 'tragedy of anticommons' due to its exclusionary nature.[57] Hence, the discussion on IP also must reflect these developments, instead of limiting itself to the text and context under which the TRIPS was formed.

1.4.2. Dependency Theory

At its core, the Dependency Theory argues that wealthy industrialized nations systematically exploit poorer nations through unequal trade relations, resource extraction, and technological control, trapping the latter in cycles of dependency. Thus, while the industrialised Global North becomes the 'core',

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[54] Peter Drahos, *The Universality of Intellectual Property Rights: Origins and Development,* 9 WORLD INTELLECTUAL PROPERTY ORGANIZATION 1998.

[55] Peter K Yu, *The Objectives and Principles of the TRIPs Agreement,* 46 HOUSTON L. REV. 1 (2009).

[56] David Post, What Everyone Needs to Know About Intellectual Property Law, https://law.stanford.edu/press/everyone-needs-know-intellectual-property-law.

[57] Michael Heller & Rebecca Eisenberg, (1998) *Can Patents Deter Innovation? The Anticommons in Biomedical Research*, 240 (5364) SCIENCE 698.

the Global South remains at the 'periphery' and reap much lesser benefits than they ought to.

The origins of the dependency lie in the colonial division of labor. While the European powers extracted raw materials such as rubber from the Congo, cotton from India, and sugar from the Caribbean to fuel their Industrial Revolutions, they actively suppressed industrial development in their colonies. After gaining independence, the exploitation continues in the form of neocolonialism, wherein the former colonial powers retained their influence via multinational corporations, debt, trade instruments, etc. Structural adjustment programs imposed by the IMF and World Bank in the 1980s–90s also forced developing nations to privatize industries, reduce public R&D budgets, and prioritize debt repayment over climate resilience.[58] Thus, while Democratic Republic of Congo holds over 70% of the global lithium export,[59] they earn a significantly smaller amount on the same. Similarly, despite its huge potential for harnessing solar energy, most of the solar panels in South Africa remain imported.[60] Such nuances are required to be brought in under the discussions relating to green technology transfer.

The UNIDO Report of 2006 on the Role of Intellectual Property Rights on Technology Transfer and Economic Growth presents empirical evidence supporting the assertion that while a stronger IPR regime promotes innovation and technology diffusion in some developing countries with the requisite capacities, the same may present additional costs for other countries lacking such capacities.[61] Whether a stronger IPR regime will favor a country depends

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[58] *See for example*, Timon Foster et al., *Globalization and health equity: The impact of structural adjustment programs on developing countries*, 267 SOC. SCI. & MED. 2020, at https://www.sciencedirect.com/science/article/pii/S0277953619304897.

[59] Cobalt Institute, Cobalt Market Report 2021 at https://www.cobaltinstitute.org/wp-content/uploads/2022/05/FINAL_Cobalt-Market-Report-2021_Cobalt-Institute-1.pdf.

[60] Sam Hawkins, Solar exports from China increase by a third, https://ember-energy.org/latest-insights/china-solar-exports/.

[61] UNIDO, The Role of Intellectual Property Rights in Technology Transfer and Economic Growth: Theory and Evidence, at https://www.unido.org/sites/default/files/2009-04/Role_of_intellectual_property_rights_in_technology_transfer_and_economic_growth_0.pdf

on their 'imitative ability' and the 'level of development'.[62] This requires accumulation of the relevant indigenous technologies and capabilities in addition to an extensive science and technology infrastructure which is capable of undertaking creative imitations.[63] A stronger IP regime increases the costs of imitation and also makes it otherwise difficult for developing countries to imitate the technology.[64] Assuming South as the imitator and North as the innovator, Grossman and Helpmann find that a flexible approach to IP will lead to greater imitation and knowledge diffusion, thereby positively impacting the South, whereas a stricter regime will work to their detriment.[65]

It has been observed that low income developing countries file much lesser patent applications. According to Professor John Barton, 'the complexity and cost of acquiring rights, especially in foreign markets and, above all, of enforcing such rights in courts' is a major deterrent factor.[66] Increased stringency of the IP regime may lead to an undermining of the 'basic conditions of sustainable knowledge', as for instance, extension of patent protection to materials merely isolated from nature.[67] It has been an observed phenomena that the IP regimes increase with the technological capabilities of the developed countries.[68] For instance, patent protection was given to pharmaceuticals only when the technologies in European countries became competitive.[69] This option is not available to developing countries, as they have to adapt to an IP

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[62] *Id.*

[63] *Id.*

[64] Elhanan Helpman, *Innovation, Imitation and Intellectual Property Rights*, 61(6) ECONOMETRICA 1247 (1993).

[65] Gene Grossman & Elhanan, INNOVATION AND GROWTH IN THE GLOBAL ECONOMY (MIT Press 1993)

[66] Commission on Intellectual Property Rights, Integrating Intellectual Property Rights and Development Policy, at http://www.iprcommission.org/papers/pdfs/final_report/ciprfullfinal.pdf; Sheila Kaplan, Intellectual Property Rights: One Size Doesn't Fit All, at https://law.stanford.edu/stanford-lawyer/articles/intellectual-property-rights-one-size-doesnt-fit-all/.

[67] Carlos M Correa, How intellectual property rights can obstruct progress, at https://www.scidev.net/global/opinions/how-intellectual-property-rights-can-obstruct-prog/.

[68] *Id.*

[69] *Id.*

regime which has already been established by the developed countries.[70] Additionally, innovation is more expensive than imitation owing to the transitional economic development of developing countries.[71] Increased IP may hinder infrastructural growth, cause inflationary pressures, and raise Balance of Payment concerns amongst others.[72] Prof. James Thuo Gaithii points to the comparative advantage US gained between 1947 and 1986, which then led them to fervently argue for greater IP rights protection.[73] This fuelled and guided the 'fair trade debate', wherein a perception was created that infringements by developing countries reduce 'standards of living' for the developed countries.[74] Pertinent to note is the role of private players and industrial lobbyists in framing these policies. For example, under President Carter's regime, a lead role was played by Edmund Pratt, the CEO of Pfizer, for shaping the foreign policy under the Advisory Committee on Trade and Policy Negotiations.[75]

Thus, empirical research over this matter points both ways, subject to the factors and variables accounted for.[76] For instance, it has argued that patent projection of the antibiotic fluoroquinolone by US affected consumer welfare in India by over $ 250 million.[77] It has also been argued that the West in general, and United States in particular, advocate for global patent reform to increase

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[70] *Id.*

[71] David Gould & William Gruben, *The role of intellectual property rights in economic growth*, 48(2) J. DEV. ECON. 323 (1996).

[72] *Id.*

[73] James Thuo Gaithii, *Construing Intellectual Property Rights and Competition Policy Consistently with Facilitating Access to Affordable AIDS Drugs to Low-End Consumers*, 53(4) FLORIDA L. REV. 728 (2001).

[74] *Id.*

[75] *Id.*

[76] Sourav Chatterjee, Worldwide: Intellectual Property Rights in Developing Nations, https://www.mondaq.com/unitedstates/trademark/57856/intellectual-property-rights-in-developing-nations#:~:text=Intellectual%20property%20rights%20(IPR)%20are,IP)%20for%20a%20certain%20period.

[77] Shubham Chaudhari, *Estimating the Effects of Global Patent Protection in Pharmaceuticals: A Case Study of Quinolones in India*, 96(5) AMERICAN ECON. REV. 1477 (2006).

their market access to the Global South as well as protect their existing IP.[78] On the other hand, a report by OECD claims a positive correlation between increased protection of patent by 1% leading to an increase in FDI by 2.8%.[79] The data remains inconclusive, as another report highlights how a single unit increase in the IPR Index leads to a fall in real GDP per capita growth by 0.73% for developing countries in the middle-income range.[80] In summation, it can be safely concluded that patents in general favor the West. Their impact over the developing countries varies on multiple factors, and solid examples which establish a negative impact can be observed.

1.5. Ethical and Human Rights Framework

The demand for green technology transfer is fundamentally rooted in ethical obligations and human rights principles, which position access to climate-critical innovations as a non-negotiable requirement for human dignity, survival, and equity. International human rights law, including the Universal Declaration of Human Rights (UDHR), the International Covenant on Economic, Social and Cultural Rights (ICESCR), and the Paris Agreement, enshrines the rights to life, health, food, water, and a healthy environment. These rights are rendered illusory in the Global South without affordable access to technologies that mitigate climate impacts and enable sustainable development.

Denying the Global South access to green technologies entrenches a form of climate apartheid, where the privileged mitigate harm while the vulnerable suffer. Ethical frameworks and human rights law demand that states and corporations prioritize survival over profit, recognizing technology transfer not as charity but as a legal and moral obligation. As the UN High Commissioner

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[78] Walter G Park, *North-South models of intellectual property rights: an empirical critique*, 148(1) REV. WORLD ECON. 151 (2012).

[79] Organization of Economic Cooperation and Development, Policy Complements to the Strengthening of IPRS in Developing Countries, at https://www.oecd-ilibrary.org/docserver/5km7fmwz85d4-en.pdf?expires=1708495796&id=id&accname=guest&checksum=D7A811BDAA45C1C533D4C33D4982FBAA.

[80] Pervez Janjua & Ghulam Samad*, Intellectual Property Rights and Economic Growth: The Case of Middle Income Developing Countries*, 46(4) PAKISTAN DEV. REV. 711 (2007).

for Human Rights asserts, 'there can be no human rights without a livable planet'.

1.6. Utilitarianism and maximising global welfare.

Utilitarianism, rooted in the works of Jeremy Bentham and John Stuart Mill, evaluates ethical decisions based on their capacity to maximize overall happiness or utility, the greatest good for the greatest number. Furthering transfer of green technology is in line with the UN Sustainable Development Goals. Specifically, Goal 9 of the SDGs calls for building more resilient infrastructure and promoting inclusive and sustainable industrialisation while fostering innovation.[81] Similarly, Goal 13 requires taking urgent action for combatting climate change and its impacts.[82] The United Nations Framework Convention on Climate Change ['UNFCCC'] entered into force in 1998, and outlined 'stabilisation of greenhouse gas concentrations' as its primary target.[83] This obligation was further solidified in the Kyoto Protocol[84] and the Paris Agreement.[85] The Paris Agreement recognised that limiting the rise of global temperatures to 1.5 °C above pre-industrial levels is crucial for mitigating the effects of climate change.[86]

Hence, the urgency of action required has been emphasised.[87] According to a 2024 research paper on the subject, which bases on the data available till 2023, the most 'ambitious mitigation trajectories with updated climate information still manage to limit peak warming to below 1.6 °C ('low overshoot') with around

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[81] UN SDGs, goal 9.

[82] UN SDGs, goal 13.

[83] UNFCCC, art. 2

[84] Kyoto Protocol

[85] Paris Agreement

[86] Paris Agreement

[87] Ezequiel Reficco et al., *Collaboration mechanisms for sustainable innovation*, 203 J. CLEANER PRODUCTION 1170 (2018); Stefan Schaltegger et al., *Business Models for Sustainability: Origins, Present Research, and Future Avenues*, 29(1) SAGE J. 2015, at https://journals.sagepub.com/doi/10.1177/1086026615599806.

50% likelihood'.[88] Here, there is a significant role to be played by green technology in ensuring that the targets are meted out.[89]

Therefore, the empirical studies cited above confirm a positive relation between the imitative abilities and infrastructure of science and technology and the benefits of a stricter IP regime. Technological improvement in terms of its social, ecological and economic standards is considered a sustainable innovation.[90] In context of moving towards sustainable technologies, significant costs of R&D are involved due to the intensive research required in the area.[91] Further, the return on investments for such technologies is generally limited or delayed, thereby requiring sustained and continued investments.[92] A major barrier is that providing such funds is not as easy for DCs and LDCs, since this requires diversion of the limited, existing resources from other areas of vital interests. Further, as noted by IISD, due to non-familiarity of consumers, businesses and regulators with sustainable technology such as solar panels, wind turbines etc, there is a higher risk of investments due to uncertainty and further raises the costs.[93] In this regard, they are left in the position of an

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[88] Christoph Berthram et al., *Feasibility of peak temperature targets in light of institutional constraints*, 14 Nature Climate Change 954 (2024).

[89] Martina Igini, Global Warming of 1.6C Now Best Case Scenario, New Research Shows, https://earth.org/global-warming-of-1-6c-now-best-case-scenario-new-research-shows/.

[90] Samuel Adomaco & Mai Dong Tran, *Exploring the effect of R&D support, green technology transfer, sustainable innovation*, 32(5) SUSTAINABLE DEV. 4758 (2024); Frank Boons et al., *Sustainable innovation, business models and economic performance: an overview*, 45 J. CLEANER PRODUCTION 1 (2013).

[91] David Sarpong et al., *The three pointers of research and development (R&D) for growth-boosting sustainable innovation system*, 122 TECHNOVATION 2023, at https://www.sciencedirect.com/science/article/pii/S0166497222001286?pes=vor&utm_source=wiley&getft_integrator=wiley; Xuefeng Shao et al., *Does environmental and renewable energy R&D help to achieve carbon neutrality target? A case of the US economy*, 296 J. ENV. MGMT. 2021, at https://www.sciencedirect.com/science/article/pii/S0301479721012913?pes=vor&utm_source=wiley&getft_integrator=wiley.

[92] Bettina Becker, *Public R&D Policies and Private R&D Investment: A Survey of Empirical Evidence*, 29(5) J. Econ. Survey 917 (2015), at https://onlinelibrary.wiley.com/doi/10.1111/joes.12074; Jay Bhattacharya & Mikko Packalen, NBER WORKING PAPER SERIES, Stagnation and Scientific Incentives, Working Paper 26752, at https://www.nber.org/system/files/working_papers/w26752/w26752.pdf.

[93] Brad McDonald and Scott Vaughan, Rethinking Technology Transfer to Support the Climate Agenda, https://sdg.iisd.org/commentary/guest-articles/rethinking-technology-transfer-to-support-the-climate-agenda.

imitator, instead of an innovator. Even the extent to which they are capable of imitation is limited by the stage of their development, due to which stricter IP regime necessarily places them behind other developed countries. For instance, while a WEF Report notes that 15% of all merchandise trade can reach low-carbon technologies by 2030,[94] a 2022 UNEP Report highlights that most 'emerging markets' and developing countries are left out from expanding in the low-carbon trade market.[95]

This leads to various material problems, which require a broader contextualisation. For instance, the EU's Carbon Border Adjustment Mechanism ['CBAM'], imposes tariffs on imports based on their embedded carbon, disadvantaging developing nations reliant on carbon-intensive industries (e.g., steel, cement). Without affordable access to decarbonization technologies, these states will require to pay additional tariffs as carbon charge. TWAIL shows how the CBAM replicates colonial extractivism by externalizing the EU's climate costs onto nations already impoverished by historical emissions. An equitable CBAM would pair tariffs with binding tech transfer commitments, ensuring Global South exporters receive subsidized access to green innovations.

Similarly, another issue to technology transfer lies in the royalty driven IP licensing model, which disproportionately burdens developing countries. Patent holders in the Global North often demand exorbitant royalties, effectively pricing out imitators and stifling local innovation. For example, during the HIV/AIDS crisis, pharmaceutical firms charged developing nations royalty rates that rendered life-saving drugs inaccessible royalty stacking, a process wherein multiple patents apply to a single technology and increases costs.[96] Further, the TRIPS Agreement lacks binding provisions to regulate royalty fairness,

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[94] WEF, What Future for Climate and Trade? Scenarios and Strategies for Carbon Competitiveness, White Paper 2023, at https://www.weforum.org/publications/what-future-for-climate-and-trade-scenarios-and-strategies-for-carbon-competitiveness/.

[95] Technology Transfer for Climate Mitigation and Adaptation: Analysing needs and development assistance support in technology transfer processes, at https://unepccc.org/wp-content/uploads/2023/06/tech-transfer-policy-brief-oecd.pdf.

[96] Damien Geradin et al., *The Complements Problem within Standard Setting: Assessing the Evidence on Royalty Stacking*, 14 B.U. J. SCI. & TECH. L. 144, 145 (2008).

instead deferring to “mutually agreed terms” as under Article 7. This enables northern corporations to effectively dictate terms, while Southern states, lacking bargaining power, face the extra costs.

Thus, the transfer of green technology becomes crucial, not only to undo the historical injustices of colonialism, but also because if the 2 °C mark is crossed, then the chances of our survival fall below 20% per the IPCC Report. In this light, the best bet is reliance on green technology, which necessarily requires technological transfers by the North to the South, as the inherent structure of sustainable innovation requires extensive research and costs, thereby making the field difficult to access for the DCs and LDCs.

4. The TRIPS Agreement: Facilitating or Creating Barriers for Transfer of Technology

"Climate change is no longer some far-off problem; it is happening here, it is happening now".

As highlighted in the previous chapters, that due to the gravity of the climate crisis, there is an urgent requirement for adoption of the climate technology, especially by the developing and least-developed countries. Even the Working Group on Trade and Transfer of Technology[97] has acknowledge that there is an urgent need to facilitate digital and green technology transfers. The transfer of technologies requires, "appropriate *Skills, institutions and policies, a friendly international environment and international rules*" to facilitate the transaction, especially of clean technologies for protection of the environment and natural resources.

1.7. Other International agreements and Technology Transfer

The role and the importance of the technology transfer has been recognised in the various international agreements, Such as: UN CHARTER, Montreal Protocol, Basel Convention,The Convention on Biological Diversity, UNFCC and Paris Agreement.

Article 55-56 of UN CHARTER,[98]provides for the role of UN in promoting the high standards of living, full employment, conditions of economic and social progress and development. These articles do not have an explicit reference for the technology transfer. However, it lays down the framework for international

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[97] Communication from the African Group, WT/WGTTT/W/33, World Trade Organization (Mar. 1, 2023) https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/GC/W868.pdf&Open=True.

[98] UN CHARTER, Article 55 & 56.

development and cooperation, which encompass the technology transfer.[99] Whereas the Montral protocol under Article 10A, explicitly recognises and provides for the transfer of technology. It provides for the expeditated transfer of the best available, environmentally safe substitutes and related technologies. [100] Further, The Basel convention On The Control Of Transboundary Movements Of Hazardous Wastes And their Disposal under article 14 facilitates the technology transfer through regional or sub-regional centers for training and technology transfer. Further, the convention of the Biological Diversity, recognises that the transfer of technology is an essential aspect for the attainment of the objective of the convention.[101]

In year 1994, UNFCC entered into force with an objective of preventing dangerous human interference with the climate change. Article 2 of UNFCCC outlines its objective, '*stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system*'. [102] To achieve this objective, technological advancement and the transfer of technology become essential. Article 4.7 along with the Article 4.9 of the UNFCCC provide for transfer of technology to developing countries and LDCs. Article 4.7 states that[103]:

"*The extent to which developing country Parties will effectively implement their commitments under the Convention will depend on the effective implementation by developed country Parties of their commitments under the Convention related to financial resources and transfer of technology*".

Thus, the commitments of developing countries have been made contingent on the financial resources and transfer of technology by developed countries.

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[99] Matthew Littleton, *The TRIPS Agreement and Transfer of Climate-Change-Related Technologies to Developing Countries*, U.N. Dep't of Econ. & Soc. Affs., DESA Working Paper No. 71 (2008), https://digitallibrary.un.org/record/640464?ln=en&v=pdf

[100] Montreal Protocol, Article 10A.

[101] Convention on Biological diversity, Article 16.

[102] UNFCC, Article 2

[103] UNFCC, Article 4.7.

Moreover, article 4.5 of the UNFCC provides that the developed countries are required to take all practicable steps for promoting, facilitating and financing the transfer or access to environmentally sound technologies and know-how to other parties, especially developing countries.[104] Moreover, in 2016, the Paris Agreement entered into force with the objective of "*Holding the increase in the global average temperature to well below 2 °C above pre-industrial levels and pursuing efforts to limit the temperature increase to 1.5 °C above pre-industrial levels, recognizing that this would significantly reduce the risks and impacts of climate change'* as recognised in Article 2(1)(a).[105] Article 10 of the Paris Agreement provides for the technology framework which guides technology mechanism in supporting and advancing the actions related to technology development and transfer.[106] Further, Article 10, paragraph 6 provides for support that includes providing financial support to developing countries.

Intellectual property rights play a crucial role in determining the accessibility and affordability of these technologies. TRIPS plays an important role in the protection, transfer, and dissemination of climate technologies.

1.8. The TRIPS Agreement: Creating barriers for the transfer of technology

In TRIPS, Articles 7, 8, and 66.2 are relevant provisions that deal with technology transfer. Article 7 of TRIPS provides that the protection and enforcement of intellectual property rights should contribute to the promotion of technological innovation and to the transfer and dissemination of technology.[107] Whereas, Article 8 of TRIPS provides a Member a right to undertake measures for the prevention of the abuse of IPR or activities which would obstruct the transfer of technology.[108] Articles 7 and 8 of the TRIPS along with its preamble outline the objective of the agreement and the same is required to be taken into

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[104] UNFCC, Article 4.5.

[105] Pairs Agreement, Article 2(1)(a).

[106] Siddhant Kondarwar, *Technology Transfer for Climate Change Mitigation: Mechanism, Issues and Challenges*, 4 HPNLU J. Env't & Disaster Mgmt. (2023).

[107] TRIPS, Article 7.

[108] TRIPS, Article 8.

the account while interpreting the other provisions of the agreement.[109] Whereas, Article 66.2, casts an obligation on the developed Members to provide incentive to enterprises and institutions for technology transfer.

Despite the intention of Article 7,8 and 66.2 with respect to the technology transfer to the countries, there are several other obstructions that restrict or create barriers in free flow of transfer of technology. These challenges emancipate from both structural aspects of the TRIPS agreement and the practical realities faced by the countries.

1.9. Challenges in implementing the technology transfer under TRIPS

1.9.1. There is no mandate for transferring technology

Under Article 66.2 of TRIPS, an obligation has been casted on developed countries for providing incentives to enterprises and institutions for transfer of technology. However, this provision is silent on the ways or the mechanisms through which these incentives can be created. This was highlighted by Bangladesh, Cuba, Dominican Republic, Egypt, Honduras, India, Indonesia, Jamaica, Kenya, Mauritius, Pakistan, Sri Lanka, Tanzania, Uganda, and Zimbabwe in their communication to the Working Group on Trade and Transfer of Technology.[110] Moreover, this provision only entails the duty to create incentives for enterprises and institutions to transfer technology but does not cast a duty to transfer the technology itself. Thus, the mandate is not to transfer the technology but only to create incentives.

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[109] Panel Reports, Australia — Certain Measures Concerning Trademarks, Geographical Indications and Other Plain Packaging Requirements Applicable to Tobacco Products and Packaging, para. 7.2402.

[110] Communication from Bangladesh, Cuba, Dominican Republic, Egypt, Honduras, India, Indonesia, Jamaica, Kenya, Mauritius, Pakistan, Sri Lanka, Tanzania, Uganda, and Zimbabwe, WT/WGTTT/W/2, World Trade Organization (April 15, 2022),

https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W2.pdf&Open=True WT/WGTTT/W/2 (15 April 2002)

1.9.2. Non-Binding nature of TRIPS

A critical challenge which has been highlighted by the countries is that the TRIPS obligations are non-binding and as a result it lacks enforceability. Countries such as Cuba, India, Indonesia, Kenya, Pakistan, Tanzania and Zimbabwe [111] have stated that the provisions provide only for the best endeavour commitments and are not binding in nature. They are not mandatory provisions. Therefore, developed countries are not under any obligation for technology transfer. Further, it was asserted that most of the provisions in WTO Agreements "*lack financing, implementation, monitoring and technical assistance mechanisms in this area*".[112]

It was suggested by these countries that there is a need to make WTO provisions ***Operational*** and ***Meaningful.***[113]

1.9.3. Restrictive intellectual practices and compulsory licensing

It has been emphasised by the countries, that the Provisions of WTO instead of facilitating technology transfer, hinder technology transfer. Countries have highlighted the same by relying on the provision regarding compulsory licensing and the term of protection for patent application. Countries highlighted for the mitigation of the detrimental effect of these provisions. Moreover, countries highlighted the restrictive practices of multinational enterprises with respect to the technology transfer and that the same needs to be prevented. Also,

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[111] Communication from Cuba, India, Indonesia, Kenya, Pakistan, Tanzania and Zimbabwe, WT/WGTTT/W/6, World Trade Organization (May 7, 2003)

https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W6.pdf&Open=True

[112]Submission to the Working Group on Trade and Transfer of Technology by India, Pakistan and the Philippines, WT/WGTTT/W/10, World Trade Organization (October 13, 2005)

https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W10.pdf&Open=True

[113]Communication from Cuba, India, Indonesia, Kenya, Pakistan, Tanzania and Zimbabwe, WT/WGTTT/W/6, World Trade Organization (May 7, 2003)

https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W6.pdf&Open=True

strategies should be created to make multinational enterprises use licensing route for effective technology transfer.[114]

1.9.4. Lack of Capacity building

It has been highlighted by countries that they lack the technical and institutional capacity for absorbing the advanced technology. Further, even when a country possesses certain technologies, they are not advanced. due to which the standards set by the developed members such as environmental regulation or digital regulations, often exceeds the technological capacity of the developing & the LDCs. The same was highlighted by Cuba, India, Indonesia, Pakistan, Tanzania and Zimbabwe.[115]

Further, it was asserted by countries such as India, Pakistan and Philippines that that the market for buyer with respect to the technology is not even.[116] There are several barriers, such as technical standards, price undercutting and tariff peaks and escalations that have an impact on technology transfer. Therefore, there is a need to overcome this difficulty by facilitating the technology transfer on reasonable terms.

1.9.5. There is no common definition of Technology Transfer

At present, there is no universal definition of technology transfer, that has been accepted by all WTO Members. The absence of having proper definition of technology transfer creates ambiguity which can creates obstacles or hinder the process of technology transfer. Take for example, one country might think

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[114] Ibid

[115] Communication from Cuba, India, Indonesia, Kenya, Pakistan, Tanzania and Zimbabwe, WT/WGTTT/W/6, World Trade Organization (May 7, 2003)

https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W6.pdf&Open=True

[116] Submission to the Working Group on Trade and Transfer of Technology by India, Pakistan and the Philippines, WT/WGTTT/W/10, World Trade Organization (October 13, 2005)

https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W10.pdf&Open=True

that technology transfer merely refers to handing over documents and equipment without providing them the requisite skills to operate the same. Whereas another country might think that technology transfer not only includes the handing over the documents and equipment but also includes training sessions on skill development to use those documents and equipment.

It was suggested by the EU that a common definition of technology transfer should be developed. That definition should not be narrow in nature, as it might hinder the progress of technology transfer. The definition should be inclusive, comprising processes and the factors related to access and use of technology, such as experience, skills, and availability of equipment.

To resolve the above-mentioned challenge with the technology transfer under the TRIPS Agreement, there is a need of comprehensive and multifaceted strategy. Such a strategy should entail (1) clarification and reinforcement of provisions related to technology transfer; (2) enhancement of capacity-building in developing countries; and (3) establishment of robust monitoring and enforcement mechanisms to ensure that developed countries fulfil their obligations.

In light of these difficulties, it ***was recommended by India, Pakistan, Philippines, Cuba, Indonesia, Kenya, Tanzania, Zimbabwe and the EU*** (then EC) that-[117]

1. Article 67 of TRIPS, dealing with technical cooperation, should be linked to Article 66.2 and Article 7 of the TRIPS. In such a scenario, Article 67, would facilitate the technology transfer.[118]

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[117] Communication from the European Communities, WT/WGTTT/1, World Trade Organization (June 10, 2002) https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/1.pdf&Open=True; Communication from Cuba, WT/WGTTT/W/9, World Trade Organization (July 1, 2005) https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W9.pdf&Open=True;Communication from Cuba, India, Indonesia, Kenya, Pakistan, Tanzania and Zimbabwe, WT/WGTTT/W/6, World Trade Organization (May 7, 2003), https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W6.pdf&Open=True

[118] Submission to the Working Group on Trade and Transfer of Technology by India, Pakistan and the Philippines, WT/WGTTT/W/10, World Trade Organization (October 13, 2005) ,

2. There is a need for formal adoption of voluntary guidelines. Moreover, multinational firms should be encouraged to perform science and technology development work in other countries; licenses should be granted on reasonable terms and those practices allowing for ***transfer and rapid diffusion of technology and know-how*** should be adopted.
3. Developing countries should be assisted to ensure the proper implementation and improvement of the competition policies to prevent the firms and business owners to use to restrictive practices.
4. Developed countries need to provide their assistance to the firms in the developing countries by providing access to technological information and drafting ofcontracts and also encourage licensing and subcontracting.
5. Countries are restricting the movement of labour, which restricts the exchange of information, and therefore there is need to encourage the movement of scientists, technologists, and technicians, which will assist the developing countries, to adopt or develop new technologies. Moreover, firms and public institutions should also be encouraged to employ, the fresh graduates from the developing countries.
6. Patent offices should also be encouraged for cooperation with respect to the sharing of information and regulatory standards. They should also be encouraged to provide assistance to develop database for developing countries and to provide access to information to the individuals.
7. Access to scientific literature and databases should be provided to developing countries, that firms should be encouraged to promote the science and development in developing countries and the training of personnel.[119]

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https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W10.pdf&Open=True WT/WGTTT/W/10 [13 October 2005]

[119] Communication from Cuba, India, Indonesia, Kenya, Pakistan, Tanzania and Zimbabwe, WT/WGTTT/W/6, World Trade Organization (7 May 2003),

8. Developed counties should meet their commitments under the principle of common but differentiated responsibility. Further, the different modes of transfer of technology should also be encouraged, along with the elimination of discriminatory practices applied against the third world countries to prevent them from acquiring the technologies.

9. It was further suggested that there is need to identify the proper channels for the transfer of technology, such as foreign direct investment (FDI), trade in services, trade in goods, licensing the technology through IPR, government procurement, development co-operation, and multilateral environment agreements.

1.10. Channels for Transfer of Technology

A detailed manner of selecting the proper channel for the transfer of technology among the various options is as follows as identified by EC[120]-

1.10.1. Foreign Direct Investment

Usually transfer of technology via FDI involves transfer of production factors, provisions of services or licensing agreement. FDI represents a long-term approach of the investor in the host country, thereby, ensuring that technology is maintained, and its effective use is possible, alongside its upgradation. Further, transnational companies ought to provide "*technology, training, management, marketing and other production factors that will help bring effective application of the technology"*

To attract FDI, a country must have good governance, transparency, certainty in the regulatory provisions, restraint on anti-competitive practices along with the capacity building measures that allow the creation of growth opportunities.

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https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/W6.pdf&Open=True.

[120] Communication from the European Communities, WT/WGTTT/1, World Trade Organization (June 10, 2002) , https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/WGTTT/1.pdf&Open=True.

1.10.2. Trade in services

The transfer of technology in trade in services can provide a mechanism for technology transfer by creation of subsidiaries, joint ventures in the host country and it involves skill building and access to knowledge. Therefore, the focus should be on the liberalization of essential service sectors and modes of supplies to encourage more technology transfer.

1.10.3. Trade in goods

Herein, the trade in goods involves transfer of technology through the transfer of equipment or machinery for a production process or as a licensing agreement. The same can be achieved by high tariffs, non-tariff barriers, and tariff escalation. Therefore, they should be examined carefully.

1.10.4. Licensing technology through IPRs

The transfer of technology means the transfer of the legal rights through the sale of patent rights or the license. The decision of an individual to license technology in a host country depends upon the existence and enforcements of IPRs. This increases the faith of the patent holder in the legal system of this host country that enables transfer of technology. for the same.

1.10.5. Government procurement

Another way to facilitate technology transfer is through government procurement. Usually, the government issues a tender, wherein suppliers are invited to compete with one another in respect of design, crafts, models, technology or ideas. The decision of a supplier, to participate in the tender is based on multiple factors like confidentiality, legal certainty, data protection, transparency and certainty. Therefore, the government should create a conducive environment, which encourages the confidence of suppliers and technology transfer takes place.

The effectiveness of above-mentioned proposed channels might often be constrained by structural and policy challenges in both developed and developing countries. Take for example, the success of transferring technology

through FDI depends on legal and regulatory framework. If the legal framework is not certain and predictable, then the investor would not be confident to invest in that country. Further, trade in services, including knowledge-based industries are not fully utilised up to their potential due to the protectionist policies. Whereas licensing agreements are subjected restrictive IP rights that limits the accessibility for developing countries. Therefore, the full potential of technology transfer remains neglected in the absence of significant commitments, desire, and enhanced absorption ability in developing countries from developed Nations.

Further, the TRIPS agreement instead of facilitating, hinders the transfer of technology. This is evident from the COVID-19 pandemic. The same was also highlighted by Namibia, who stated that, "*The COVID-19 pandemic is the latest illustration of how WTO rules and the so-called flexibilities in the TRIPS Agreement have hampered Members' ability to respond reasonably to the multiple crises that ensued. It has also prompted a deeper reflection on the utility of the TRIPS Agreement vis-àvis the manufacturing capacity of developing and least developed countries.*[121] While the provisions of the agreement recognise the importance of technology transfer, however, the provisions of the agreement are not binding. Further, restrictive IPRs, inadequate financial resources and lack of clear mechanism hiders the transfer of technology. To overcome the same, changes are required within the TRIPS, alongside stronger commitments from the developed member under the UNFCC and Paris agreement.

[121] Communication from Namibia A, on behalf of Africa Group, WT/WGTTT/W/34, World Trade Organization. (July 3, 2023), https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/WGTTT/W34.pdf&Open=True

5. Mechanism for the enforcement of green technology transfer

In an era defined by rapid technological advancement and pressing global challenges, the protection of intellectual property rights (IPRs) occupies a delicate balance between incentivizing innovation and ensuring the equitable dissemination of knowledge. While robust IPR frameworks are essential for fostering creativity and rewarding investment, their enforcement must also serve broader societal goals—particularly the urgent need to address crises such as climate change, public health emergencies, and sustainable development.

Central to this balance is the concept of technology transfer, which bridges the gap between innovation and accessibility, enabling developing and least-developed countries to harness cutting-edge solutions for environmental, economic, and social progress. There are multiple mechanisms to enable technology transfer, of which, our focus shall be licensing- compulsory and voluntary, capacity building, public private partnership, and open source and

collaborative platforms. This section will examine the working of each of these mechanisms.

1.11. Compulsory Licensing

Compulsory License ("CL"), a statutorily created licence that allows others to pay a royalty and use an invention without patentee's permission is an important feature of IPR law.[122] It also includes government authorizing itself to use an otherwise protected intellectual property without having to obtain permission or authorization of a patent holder in cases of national emergency or towards a public good. The issue of CL becomes a case for consideration when a patent holder is not willing to share technology with others voluntarily. CL introduces competition in the markets and hence makes relevant goods or services cheaper.[123]

The concept of compulsory licensing is neither unique nor exceptional. Developed countries like the United States and the United Kingdom have frequently resorted to compulsory licensing to facilitate access to critical technologies. For instance, the United States government has extensive powers to utilize patented inventions under its Clean Air Act 1970 to meet environmental standards, subject to reasonable compensation.[124] Similarly, between 2001 and end 2007, 52 developing and least-developed countries have employed compulsory licenses to manufacture or import generic pharmaceutical drugs under the "government use" provision, which does not require prior negotiation with the patent holder but mandates fair remuneration[125]. This mechanism could be extended to access expensive, patented climate-friendly technologies when negotiations with patent holders fail to yield affordable solutions.

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[122] https://www.wto.org/english/tratop_e/trips_e/public_health_faq_e.htm

[123] Aoki Reiko and Small John, Compulsory licensing of technology and the essential facilities doctrine, *Information Economics and Policy*, 16 (1) (2004) 13-29.

[124] https://crsreports.congress.gov/product/pdf/R/R43266

[125] https://cuts-citee.org/pdf/Compulsory_Licenses_and_anti-competitive_effects_of_patents.pdf

While the term CL has not been specifically used in TRIPS, it can be read into the provision of TRIPS Agreement on other use (of the patented subject matter) without authorization of the right-holder. Article 8 of the TRIPS Agreement provides reasonable flexibility to use CL as exceptions to patent holders' rights to prevent the abuse of IP, and practices that unfairly restrict trade or hinder the international transfer of technology.[126]

Article 31 lays down the grounds for use of CL,[127] and, CL is subject to grant adequate renumeration, accounting for economic value of authorization.[128] Additionally, Article 31(b) mandates efforts for negotiations on voluntary licensing, prior to grant of compulsory licensing.[129] However, in cases of national emergency or other circumstances of extreme emergency, or meeting government requirements, public non-commercial use and technical advance of considerable, the requirement for voluntary licensing can be waived off.[130] Rights of the member countries to make use of CL in the interest of public health have been explicitly recognized in the Doha Declaration on Public health and by WTO members.[131]

While member countries have treated public health crisis as national emergencies, does the same hold true for climate change? Climate crises may be similar to an epidemic in the sense that it affects a large portion of the population, whether in terms of sickness or death, and can be assimilated to health crises to some extent.[132] Degradation of the environment leads to chronic diseases and premature deaths caused by pollution.[133] The 6th assessment report of the IPCC has predicted that the rising temperature and

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[126] TRIPS, Article 8

[127] TRIPS, Article 31

[128] TRIPS, Article 31(h)

[129] TRIPS, Article 31(b)

[130] Ibid.

[131] https://www.wto.org/english/thewto_e/minist_e/min01_e/mindecl_e.htm#trips Para 17-19

[132] https://www.plass.com/en/articles/compulsory-licensing-green-technologies-realistic-threat

[133] Ibid.

seal level shall lead to human mortality and human morbidity, coupled with climate induced migration.[134]

Further, there are resolutions have acknowledged climate change being destabilizing factor in the security of region,[135] especially in Lake Chad region where the lake shrunk due to ecological reasons.[136] A situation involving huge refugee inflows has previously been declared as threat to international peace and security.[137] Thus, certain climate change situations have been declared a cause of concern for international community, compulsory licensing provisions can be invoked for climate change as well.

1.12. Voluntary Licensing

Issuing compulsory licensing always end with political rhetoric and threat of trade retaliation and investment red flags.[138] TRIPS Article 31(b) mandates efforts for negotiations on voluntary licensing, prior to grant of compulsory licensing.[139]

While in cases of national emergency or other circumstances of extreme emergency, or meeting government requirements, public non-commercial use and technical advance of considerable, the requirement for voluntary licensing can be waived off,[140] the question of treating climate change as emergent measures is fraught with risks. The empirical data highlight that only in two

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[134] https://www.ipcc.ch/report/ar6/syr/downloads/report/IPCC_AR6_SYR_LongerReport.pdf

[135] UNSC Res 2408 (27 March 2018) S/RES/2408; UNSC Res 2423 (28 June 2018) S/RES/2423.

[136] UNSC Res 2349 (31 March 2017) S/RES/2349.

[137] UNSC Res 688 (5 April 1991) UN Doc S/RES/688; UNSC Res 841 (16 June 1993) UN Doc S/RES/841; UNSC Res 917 (6 May 1994) UN Doc S/RES/917; UNSC Res 940 (31 July 1994) UN Doc S/RES/940; UNSC Res 1132 (8 October 1997) UN Doc S/RES/1132; UNSC Res 1962 (20 December 2010) UN Doc S/RES/1962.

[138] https://economictimes.indiatimes.com/industry/healthcare/biotech/pharmaceuticals/us-threatens-to-take-india-to-wto-over-nexavar-generic/articleshow/14686285.cms?from=mdr

[139] TRIPS, Article 31(b)

[140] Ibid.

WTO disputes- US-Shrimps (Recourse to Article 21.5 by Malaysia),[141] and US-Tuna II (Mexico) (Recourse to Article 21.5 by the United States),[142] was the dispute settlement mechanism of WTO considerate about putting environmental concerns over trade concerns.

To alleviate these concerns, there is provision of Voluntary Licensing ("VL"), which has an in-built mechanism for negotiation with the IP holder over terms of usage.[143] The advantage of VL is the following:

1. The negotiations can be done directly without any litigation or time-consuming process.
2. This could reduce the time for issuing CL and consequent litigation.
3. This will enable transfer of technology and economic development in developing countries.
4. It is not threatening the rights of the companies rather the companies get a good name for helping the developing and least developed countries.[144]

Further, the VL is restricted to local market of the developing country,[145] and reduces the cost and accessibility, attached with parallel importation.[146] An example of Voluntary Licensing can be the International Renewable Energy Agency (IRENA) work with solar companies like First Solar and SunPower

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141 https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=Q:/WT/DS/58ABRW.pdf&Open=True

142 https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/WT/DS/381ABRWUSA.pdf&Open=True

143 https://medicinespatentpool.org/uploads/2024/05/MPP_VALUE-Report_2024_EN_WEB.pdf

144 https://www.wipo.int/edocs/pubdocs/en/licensing/906/wipo_pub_906.pdf

145 https://oms-inet.files.svdcdn.com/staging/files/intellectual-property-rights-2023-14.pdf

146 Ibid.

exemplifies voluntary licensing agreements.[147] These companies have voluntarily entered licensing arrangements to share solar panel manufacturing technologies with emerging markets, which helps scale up renewable energy in developing regions.[148]

1.13. Capacity Building

Technology transfer is not merely the import or purchase of machines and other hardware at commercial rates. A central aspect of technology development and transfer is the building of local capacity so that people and institutions in developing countries can design and make technologies which can be diffused into the domestic economy.[149]

Article 67 of TRIPS states that for facilitating the implementation of this Agreement, developed country Members shall provide, on request and on mutually agreed terms and conditions, technical and financial cooperation in favour of developing and least-developed country Members.[150] The scope of such cooperation includes assistance in the preparation of laws and regulations on the protection and enforcement of intellectual property rights as well as on the prevention of their abuse, support regarding the establishment or reinforcement of domestic offices and agencies relevant to these matters, including the training of personnel.[151] E- TRIPS Submission System (for contact point for technical cooperation) and e-TRIPS Gateway (for accessing notification), has been developed to facilitate such cooperation.[152] As recognised in Agenda 21 (para. 34.12), a "critical mass of research and

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147 https://www.irena.org/media/Files/IRENA/Agency/Publication/2017/Sep/IRENA_Solar_PV_Markets_Report_2017.pdf

148 Ibid.

149 https://www.southcentre.int/question/sdgs-technology-and-finance-the-means-of-implementation/

150 TRIPS, Article 67

151 Ibid.

152 https://www.wto.org/english/tratop_e/trips_e/etrips_e.htm

development capacity is crucial to the effective dissemination and use of environmentally sound technologies and their generation locally."[153]

Illustratively, The United Nations Development Programme (UNDP) partnered with various stakeholders to build local capacities for sustainable agricultural practices in sub-Saharan Africa. Through these programs, local farmers were trained in using water-efficient irrigation systems and organic farming techniques that supported food security and reduced environmental degradation. The knowledge transfer through training workshops, demonstration projects, and access to advanced agricultural technologies boosted local skills and increased sustainable practices.[154]

In the process of technological development, developing countries can go through three stages: (1) initiation stage, where technology as capital goods are imported; (2) internalisation stage, where local firms learn through imitation under a flexible intellectual property rights (IPRs) regime; (3) generation stage, where local firms and institutions innovate through their own research and development (R&D).[155]

In stage 3, the local firms are able to design and make their own original products. Technology transfer may involve the purchase and acquisition of equipment; the know-how to use, maintain and repair it; the ability to make it through "emulation" or reverse engineering; to adapt it to local conditions; and eventually to design and manufacture original products. The process of technology transfer involves progressively climbing through all these aspects.[156]

Several conditions have to be present for technology transfer and development to take place. The absence of such conditions can form barriers to technology

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[153] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf

[154] https://www.undp.org/sites/g/files/zskgke326/files/publications/15_Terrestrial%20_Jan15_digital.pdf

[155] Ibid

[156] Ibid

transfer. Among the barriers that are normally listed are poor infrastructure, inadequate laws and regulations, shortage of skilled personnel, lack of finance, ignorance of technology issues, high cost of certain technology agreements, problems created by equipment suppliers, and intellectual property rights.[157]

1.14. Public-Private Partnership

Public-private partnerships as a new type of relationship is the ability of the public sector to use the experience of the private sector, with the latter providing the services traditionally characteristic of the public sector. PPP schemes are introduced for the first time in the UK in 1992 as called "Private finance initiative" which removes the rule that restricts the use of private capital to finance public assets.[158]

Article 66.2 of TRIPS mandates that the developed country Members shall provide incentives to enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least-developed country members in order to enable them to create a sound and viable technological base,[159] thus hinting at a collaboration between government and non-governmental entities.

The public-private partnership is a key element of European innovation policies with close coordination of public research, technology transfer, private innovative companies and appropriate policy frameworks.[160] There is a building of industrial networks, technology platforms and initiatives which consist of long-term relationships between knowledge generators, consumers and suppliers of goods and services with a variety of options and other mediator units. PPP partnership model usually stipulates the development of research

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[157] https://www.southcentre.int/wp-content/uploads/2013/05/RP45_Climate-Change-Technology-and-IP_EN.pdf

[158] Leahy, P., 2005. "Lessons from the private finance initiative in the United Kingdom," EIB papers, Vol.10, No.2, pp.58-71

[159] TRIPS, Article 66.2

[160] Baranson, J., 1970. "Technology Transfer through the International Firms," American Economic Review Papers and Proceedings, Vol.60, No.2, pp.435-440

joint-ventures with equal distribution of costs and return of investments, information and knowledge sharing.[161] Such a model can lead to development of technologies or practices from the private sector in public scientific structures and, as a result, a reliable institutional capacity is built or increased.

Unlike the traditional model for technology transfer, PPP will be capable of compensating the deficits of institutions in both the donor and donee country, and shall assist in making sure that the whole process is "demand pull" (i.e. an area or field of technology transfer that clearly matches a local entrepreneurial need) and create the proper incentive structure for the local entrepreneurs to engage resources in the project; targeting the appropriate partner (technology holder) and generate the incentive to involve it into the transaction; and creating the proper conditions to contain costs – a crucial condition for increasing the anticipated private profitability of technology transfers.

Additionally, it shall ensure generating the proper organizational forms (internal and external, i.e. platforms) to ensure the technology transfer will successfully meet the different phases (absorption, adaptation, assimilation of subsequent improvements, generalization), since there is no "superior" economic operation that will provide the organizational structure, such as when the technology transfer is a joint product of a direct investment; supervising the whole process so that the various phases of the technology transfer are successfully managed; and creating mutual contractual obligations so that no party can leave the project before its completion.[162]

The PPP model allows interaction between the university and development bases, exchange of experience and strategic decisions by the public sector and efficient use of tools in the public sector to increase the budget and profitability of business, also ensuring links between the university and industrial environments; cross-company projects with the support of the government and

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[161] Chung, W., 2001. "Identifying technology transfer in foreign direct investment: Influence of industry conditions and investing firm motives", Journal of International Business Studies, 32 (2), pp.211-229

[162] https://www.iprsonline.org/New%202009/foray_may2009.pdf Section 5.3.1

the potential of research teams and laboratories; research projects financed by the state and under a mandatory condition for use in private/industrial sector in order to regain investments; and high-tech science projects that are supported by the government and create conditions for inter-company networks for distribution of products/services in different countries/regions.[163]

In Doha, in November 2001, the ministers agreed that the TRIPS council shall plant a monitoring mechanism for the implementation of the obligations under Article 66.2,[164] and the council adopted a decision setting up this mechanism in 2003.[165] The Annexure-II provides illustrations of implementation of Article 66.2 of the TRIPS, undertaken by the United States, the United Kingdom, Japan, Norway, and the European Union, through incentivizing enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least-developed country members.

In any economy, technology transfer is driven by government policies and depends on the role of government, academic and industrial societies for building of a culture of cooperation for effective use of technology.[166] That is why a continuous development of public-private partnership is needed in the direction of flexible policies, competitive business and research activities, ensuring implementation and return of investment.[167]

1.15. Open Source and Collaborative Platforms

While the WTO is primarily dominated by State Actors, non-state actors like NGOs, civil society organizations, and businesses play a significant role in shaping trade policy within the WTO, influencing the public policy-making

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[163] Etzkowitz, H., Leydesdorff, L., 2000. "The dynamics of innovation: From national systems and "Mode 2" to a triple helix of university-industry-government relations," Research Policy, 29, pp.109-123

[164] https://www.wto.org/english/tratop_e/trips_e/techtransfer_e.htm

[165] https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/C/28.pdf&Open=True

[166] Vutsova, Albena. (2014). The role of public-private partnership for effective technology transfer. Applied Technologies and Innovations. 10. 83-90. 10.15208/ati.2014.14.

[167] Ibid.

process and contributing to trade-related discussions at national, regional, and global levels.[168] Additionally, non-state actors, such as firms and industry, engage in lobbying, in dispute settlement in WTO.[169] Gregory Shaffer has stated, "public and private actors depend on each other's resources... [and] have also adapted public-private collaborative governance modes to enforce WTO law and otherwise advance their interests."[170] Thus, within WTO itself, the collaborative governance nodes play a significant role.

Agenda 21 is a comprehensive plan of action to be taken globally, nationally and locally by organizations of the United Nations System, Governments, and Major Groups in every area in which human impacts on the environment.[171] The Chapter 27 of the Agenda 21 calls for Strengthening the Role of Non-Governmental Organization.[172] Non-governmental organizations play a vital role in the shaping and implementation of participatory democracy. Their credibility lies in the responsible and constructive role they play in society. Formal and informal organizations, as well as grass-roots movements, should be recognized as partners in the implementation of Agenda 21. The nature of the independent role played by non-governmental organizations within a society calls for real participation; therefore, independence is a major attribute

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168 https://www.google.com/url?sa=t&source=web&rct=j&opi=89978449&url=https://www.wto.org/english/forums_e/debates_e/debate30_e.htm&ved=2ahUKEwjqkJGNguCMAxW99aACHQEINKsQFnoECD4QAQ&usg=AOvVaw1fNxPXq1qVtsf2FxgTlG0y

169 Joel P. Trachtman, Private Parties in EC-US Dispute Settlement in the WTO: Toward Intermediated Domestic Effect, in TRANSATLANTIC ECONOMIC DISPUTES: THE EU, THE US, AND THE WTO 527, 536 (Emst-Ulrich Petersmann & Mark A. Pollack eds., 2003); Alan O. Sykes, Public Versus Private Enforcement of International Economic Law: Standing and Remedy, 34 J. LEGAL STUD. 631, 641, 654 (2005); Thomas Sebastian, World Trade Organization Remedies and the Assessment of Proportionality: Equivalence and Appropriateness, 48 HARV. INT'L L. J. 337, 338-40 (2007).

170 Gregory C. Shaffer, Defending Interests: Public-Private Partnerships in WTO Litigation 144-46 (2003).

171 https://sustainabledevelopment.un.org/outcomedocuments/agenda21

172 https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Chapter 27

of non-governmental organizations and is the precondition of real participation.[173]

Non-governmental organizations, including those non-profit organizations representing groups addressed in the Agenda 21, possess well-established and diverse experience, expertise and capacity in fields which will be of particular importance to the implementation and review of environmentally sound and socially responsible sustainable development, as envisaged throughout Agenda 21. The community of non-governmental organizations, therefore, offers a global network that should be tapped, enabled and strengthened in support of efforts to achieve these common goals.[174] The following illustrations highlight the role of non-state actors in the field of sustainability:

- The Open Solar initiative aims to provide affordable solar technology to people in developing countries by making the design of solar products available under an open-source license. This allows local manufacturers and engineers in different countries to develop and scale their own solar energy solutions. The initiative has led to the creation of low-cost solar panel systems for rural areas, reducing energy poverty and contributing to sustainable development.[175]
- The Global Infrastructure Facility is a collaborative platform supported by several international organizations and private investors. It facilitates the development and sharing of best practices and cutting-edge technologies for building climate-resilient infrastructure. Using open data and collaborative approaches, GIF helps countries design projects that are both environmentally and economically sustainable. Examples

[173] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 27.1

[174] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 27.3

[175] https://www.opensolar.com

include green buildings, flood protection systems, and clean water projects.[176]

- Companies like the Open-Source Ecology project are developing open-source hardware solutions for sustainable living. OSE is focused on building the "Global Village Construction Set," which consists of 50 different industrial machines that can be used to build sustainable infrastructure (e.g., bricks, biochar stoves, and wind turbines). By making these designs publicly available, the project allows communities worldwide to produce their own energy and materials, fostering local sustainable development.[177]
- The Climate Knowledge and Innovation Community, funded by the European Union, is an example of a collaborative platform aimed at fostering innovation and entrepreneurship in sustainability. It brings together businesses, universities, research organizations, and governments to develop and scale climate-positive technologies. One such project is a collaboration between startups and established corporations to develop solutions for reducing CO2 emissions in heavy industries, such as steel manufacturing.[178]
- Ecolab, a global leader in water, hygiene, and energy technologies, collaborates with multinational companies, governments, and NGOs through the Global Water Stewardship Initiative. This platform shares knowledge, innovations, and solutions aimed at improving water efficiency and sustainable water management, especially in industries with high water usage like agriculture and manufacturing.[179]

Thus, Society, Governments and international bodies should develop mechanisms to allow non-governmental organizations to play their partnership

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[176] https://www.globalinfrafacility.org/about-gif

[177] https://www.opensourceecology.org/ose-4-year-review/

[178] https://culture.ec.europa.eu/node/1182

[179] https://en-in.ecolab.com/corporate-responsibility/environment/water-stewardship

role responsibly and effectively in the process of environmentally sound and sustainable development, [180] and this includes women; youth; indigenous communities; local authorities; workers and trade unions; business and industry; scientific and technical community; and farmers.

The international community has endorsed several plans of action and conventions for the full, equal and beneficial integration of women in all development activities, in particular the Nairobi Forward- looking Strategies for the Advancement of Women, which emphasize women's participation in national and international ecosystem management and control of environment degradation. Several conventions, including the Convention on the Elimination of All Forms of Discrimination against Women (General Assembly resolution 34/180, annex) and conventions of ILO and UNESCO have also been adopted to end gender-based discrimination and ensure women access to land and other resources, education and safe and equal employment. Also relevant are the 1990 World Declaration on the Survival, Protection and Development of Children. Effective implementation of these programmes will depend on the active involvement of women in economic and political decision-making and will be critical to the successful implementation of Agenda 21.[181]

It is imperative that youth from all parts of the world participate actively in all relevant levels of decision-making processes because it affects their lives today and has implications for their futures. In addition to their intellectual contribution and their ability to mobilize support, they bring unique perspectives that need to be taken into account.[182] Numerous actions and recommendations within the international community have been proposed to ensure that youth are provided a secure and healthy future, including an environment of quality, improved

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[180] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 27.5

[181] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 24.1

[182] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 25.2

standards of living and access to education and employment. These issues need to be addressed in development planning.[183]

Indigenous people and their communities have an historical relationship with their lands and are generally descendants of the original inhabitants of such lands. In the context of this chapter the term “lands” is understood to include the environment of the areas which the people concerned traditionally occupy. Indigenous people and their communities represent a significant percentage of the global population. They have developed over many generations a holistic traditional scientific knowledge of their lands, natural resources and environment. Indigenous people and their communities shall enjoy the full measure of human rights and fundamental freedoms without hindrance or discrimination. In view of the interrelationship between the natural environment and its sustainable development and the cultural, social, economic and physical well-being of indigenous people, national and international efforts to implement environmentally sound and sustainable development should recognize, accommodate, promote and strengthen the role of indigenous people and their communities.[184]

Because so many of the problems and solutions being addressed by Agenda 21 have their roots in local activities, the participation and cooperation of local authorities will be a determining factor in fulfilling its objectives. Local authorities construct, operate and maintain economic, social and environmental infrastructure, oversee planning processes, establish local environmental policies and regulations, and assist in implementing national and subnational environmental policies. As the level of governance closest to the people, they play a vital role in educating, mobilizing and responding to the public to promote sustainable development.[185]

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[183] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 25.3

[184] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 26.1

[185] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 28.1

Efforts to implement sustainable development will involve adjustments and opportunities at the national and enterprise levels, with workers foremost among those concerned. As their representatives, trade unions are vital actors in facilitating the achievement of sustainable development in view of their experience in addressing industrial change, the extremely high priority they give to protection of the working environment and the related natural environment, and their promotion of socially responsible and economic development. The existing network of collaboration among trade unions and their extensive membership provide important channels through which the concepts and practices of sustainable development can be supported. The established principles of tripartism provide a basis for strengthened collaboration between workers and their representatives, Governments and employers in the implementation of sustainable development.[186]

Business and industry, including transnational corporations, play a crucial role in the social and economic development of a country. A stable policy regime enables and encourages business and industry to operate responsibly and efficiently and to implement longer-term policies. Increasing prosperity, a major goal of the development process, is contributed primarily by the activities of business and industry. Business enterprises, large and small, formal and informal, provide major trading, employment and livelihood opportunities. Business opportunities available to women are contributing towards their professional development, strengthening their economic role and transforming social systems. Business and industry, including transnational corporations, and their representative organizations should be full participants in the implementation and evaluation of activities related to Agenda 21.[187]

The scientific and technological community and policy makers should increase their interaction in order to implement strategies for sustainable development on the basis of the best available knowledge. This implies that decision makers

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[186] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 29.1

[187] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 30.1

should provide the necessary framework for rigorous research and for full and open communication of the findings of the scientific and technological community and develop with it ways in which research results and the concerns stemming from the findings can be communicated to decision-making bodies so as to better link scientific and technical knowledge with strategic policy and programme formulation. At the same time, this dialogue would assist the scientific and technological community in developing priorities for research and proposing actions for constructive solutions.[188]

The sustainable development of people in marginal and fragile ecosystems is also addressed in Agenda 21. The key to the successful implementation of these programmes lies in the motivation and attitudes of individual farmers and government policies that would provide incentives to farmers to manage their natural resources efficiently and in a sustainable way. Farmers, particularly women, face a high degree of economic, legal and institutional uncertainties when investing in their land and other resources. The decentralization of decision-making towards local and community organizations is the key in changing people's behaviour and implementing sustainable farming strategies. This programme area deals with activities which can contribute to this end.[189]

The mechanisms outlined above—compulsory and voluntary licensing, capacity building, public-private partnerships, and open-source collaborative platforms— offer a range of tools and strategies that can significantly contribute to addressing global environmental challenges. Each play a critical role in promoting the transfer of green technologies, particularly to developing and least-developed countries.

Compulsory licensing, though often contentious, presents a valuable tool for mitigating national emergencies such as the climate crisis, which shares similarities with health emergencies in terms of its global and long-term impact. Voluntary licensing offers a more flexible, less contentious approach, allowing

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[188] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 31.2

[189] https://sustainabledevelopment.un.org/content/documents/Agenda21.pdf Para 32.4

for negotiations that align with both economic and environmental goals. Capacity building ensures that developing countries are not only recipients of technology but also gain the expertise to innovate and create sustainable solutions locally. Public-private partnerships further strengthen this process by leveraging both governmental support and private sector innovation, while collaborative platforms enhance the role of non-state actors in creating a more inclusive and participatory model of technology dissemination.

The implementation of these mechanisms, particularly in the context of climate change, is crucial for fostering global collaboration and ensuring that green technologies are accessible to those who need them most. However, the effectiveness of these strategies hinges on the commitment of developed countries to uphold their obligations under the TRIPS Agreement, as well as the willingness of global actors to work together in overcoming barriers to technology transfer. By aligning legal, economic, and institutional frameworks with the urgent need for environmental sustainability, the international community can make significant strides in addressing climate change and other pressing environmental issues, ultimately contributing to the broader goals of sustainable development and global equity.

6. Green Bonds and Beyond: Exploring Green Financing Mechanisms

Green Financing ["**GF**"] refers to the provision of financial resources to support environmentally sustainable projects and initiatives, such as renewable energy, energy efficiency, and sustainable transportation.[190] GF helps to mobilize capital to support the transition to a low-carbon economy and to finance projects that promote environmental sustainability. The need for GF arises from the fact that traditional financing sources may not be sufficient to sustain the shift to a comparatively low-carbon economy and finance projects that promote environmental sustainability.[191] Further, there is a high risk associated with some environmentally sustainable projects and many of these projects are considered high-risk due to their relatively untested nature and lack of a track record. GF can help to mitigate this risk by providing long term and patient capital to support the development and deployment of these projects.[192] *Illustratively*, by providing funding for R&D of new technologies, GF can help to drive the expansion of those products and services which are more environmentally friendly.

In a nutshell, GF is essential for achieving a sustainable future and addressing the challenges caused by climatic changes. It includes providing the required financial assistance to promote environmentally sustainable projects and help companies to design, produce, and use products and services in a way that minimizes waste and environmental impact while maintaining economic

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[190] Soundarrajan, P., Vivek, N., 2016. Green finance for sustainable green economic growth in India. Agric. Econ. (Zemeˇdeˇlská Ekonomika) 62 (1), 35–44. https://doi.org/10.17221/174/2014-AGRICECON

[191] Campiglio, E., 2016. Beyond carbon pricing: The role of banking and monetary policy in financing the transition to a low-carbon economy. Ecol. Econ. 121, 220–230. https://doi.org/10.1016/j.ecolecon.2015.03.020.

[192] Bhatnagar, M., Taneja, S., Özen, E., 2022. A wave of green start-ups in India—The study of green finance as a support system for sustainable entrepreneurship. Green Finance 4 (2), 253–273. https://doi.org/10.3934/GF.2022012.

viability.[193] This means there are multiple mechanisms through which the financing mechanisms play a significant role in development of closed-loop supply chains that recover and reuse materials, the utilization of renewable energy sources, and the promotion of sustainable practices in the production process and use of products.[194] This section shall emphasise on available market based mechanisms; greening finance sector; green fiscal reforms; and driving green investments, drawing illustration from African economies.

1.16. Market Based Mechanisms: Harnessing Climate and Sustainable Goals

Climate finance has become important in addressing both climate change and sustainable development objectives. This has led to a broadening of the scope and mandate of environmental funds (EFs), which are vital financing mechanisms for the implementation of national environmental action plans and green programmes. Some of the key success factors of EFs include:

- a strong government commitment to ensuring that they are used only to provide funding and technical expertise, build capacity and support the transition to a Green Economy;
- a strong governance system with representation from diverse sectors;
- long-term financial commitment; and
- strong legal and financial practices.[195]

Adding stakeholders from the private sector and non-governmental organisations will ensure greater transparency in the governance and management of EFs. Government funding should be used to capitalise EFs and

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[193] Geissdoerfer, M., Morioka, S.N., de Carvalho, M.M., Evans, S., 2018. Business models and supply chains for the circular economy. J. Clean. Prod. 190, 712–721. https://doi.org/10.1016/j.jclepro.2018.04.159.

[194] Govindan, K., Jha, P.C., Garg, K., 2016. Product recovery optimization in closed-loop supply chain to improve sustainability in manufacturing. Int. J. Prod. Res. 54 (5), 1463–1486. https://doi.org/10.1080/00207543.2015.1083625.

[195] Najma Mohamed et al., "The Green Fund of South Africa: Origins, Establishment and First Lessons", *Development Southern Africa Journal* 31, no. 5 (2018): 658–674, https://doi.org/10.1080/0376835X.2014.935295.

to act as a stimulus to crowd-in private and donor investments. EFs should, however, aim to have diverse revenue streams in the medium to long term. Having clear priorities will also help attract grant funding. It is important that proper due diligence processes be followed to ascertain the bankability, scalability, additionality, replicability and sustainability of the project. This will help to identify the key sectors driving the green economy transition in a country while highlighting sectors that may need additional support. EFs should also consider funding innovative and strategic capacity-building programmes to support and strengthen domestic capabilities (infrastructure, resources and products, skills, etc.) in pursuit of a transition to a Green Economy.[196] Any economic support by the government, private sector or donor community should be consistent with resilient and climate-smart growth in order to ensure that the investments made now have long-lasting impacts.

In order to attract private sector investment in climate-resilience programmes, governments must improve the policy and regulatory environment and create market-based mechanisms to incentivise businesses. For any market strategy to be successful in unlocking green finance, it should focus on creating a dedicated green fund, de-risking investments and credit enhancement, and co-investing with local financial institutions. De-risking can be done by providing long-term grant and concessionary funding to an investment. Public capital can be used to provide credit enhancements (by government-owned development finance institutions [DFIs]) that will attract private capital to sustainable green investments and serve to partially de-risk investments for the private sector, allowing the investment to meet the required rate of return. Market practice strategies to unlock green finance should also include co-investment by the private sector for large projects and the creation of umbrella facilities to local financial institutions. DFIs or green banks can advance the minimum financing required to make the investment viable, with the remainder of the financing requirement topped up with private capital. This way, public funds are used to

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[196] Najma Mohamed et al., "The Green Fund of South Africa: Origins, Establishment and First Lessons", *Development Southern Africa Journal* 31, no. 5 (2018): 658–674, https://doi.org/10.1080/0376835X.2014.935295.

leverage private sector funding. In instances of lending to small and medium-sized enterprises (SMEs) with good investment opportunities but high transaction costs per dollar invested owing to their small size, international funders can provide a large umbrella facility to a local financial institution with low transaction costs to on-lend those funds to smaller entities and projects.[197]

African countries are starting to experiment with innovative financing approaches such as 'green market-ready products', a green growth fund that will be replenished through proceeds from trading credits from emission reduction projects, crowd-funding for clean energy and green bond financing, etc, to finance adaptation and sustainable development projects.[198] The creation of green and ethical banks has been an interesting development in sustainable finance. Ethical banks are financial institutions that invest ethically and sustainably. These banks only offer ethical investments developed by ethical borrowers to attract ethical investors, which may allow greater mobilisation of local currency funding for sustainable investments. Green banks are defined as public-purpose finance institutions dedicated to green investment with the aim of addressing the local market's climate investment shortfall.

Green banks will have to compete with local development banks in Africa, as they have been trying to take up the green finance space. Be that as it may, the keen exploration of green banks in Africa (in Morocco and South Africa), together with profitability, sustainability and deposits, shows that there may be gaps in the provision of finance that existing institutions are not able to fill.[199] For instance, Mozambique is a climate-vulnerable state that has recently experienced (October 2020) extreme flooding, prompting the government to

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[197] Zanizeni Sustainable Finance, "Green Finance Concept Document to Inform the 2019 Partnership for Action on the Green Economy (PAGE) Conference" (Working Paper, Department of Environmental Affairs, Pretoria, January 10–11, 2019), https://www.tips.org.za/images/Green_Finance_Concept_Document.pdf.

[198] https://cer.org.za/wp-content/uploads/2021/07/Shipalana-Policy-Briefing-.pdf

[199] Zanizeni Sustainable Finance, "Green Finance Concept Document to Inform the 2019 Partnership for Action on the Green Economy (PAGE) Conference" (Working Paper, Department of Environmental Affairs, Pretoria, January 10–11, 2019), https://www.tips.org.za/images/Green_Finance_Concept_Document.pdf.

launch a Green Economy Action Plan solidifying commitments towards sustainable infrastructure, among others. Mozambique will need to build investor confidence after its sovereign default in January 2017, but the currency (the metical) rose by 19% (against the dollar) last year, making foreign debts easier to service. [200] South Africa's National Strategy for Sustainable Development and Action Plan is a policy framework that sets out steps to a just transition to a Green Economy. It also laid the foundation for establishing its Green Fund in 2012. The fund is part of a national environmental programme managed and implemented by the Development Bank of Southern Africa (DBSA) on behalf of the Department of Environmental Affairs. One of its mandates is to leverage and attract additional resources to support South Africa's transition to a Green Economy by using public finance as a stimulus for green investments.[201] Other African countries with EFs include Namibia and Mauritius.

1.17. Greening the Finance Sector

The World Bank published guidelines for developing a green taxonomy, owing lack of clarity about which activities and assets can be defined as green, which was a barrier to scaling up green finance.[202] This will help to scale up green finance and assist regulators in emerging economies to 'green' their domestic financial systems. A 'green taxonomy' is a common language on environmental issues for use by the financial sector. It identifies activities or investments that deliver on environmental objectives, thereby helping the financial sector to efficiently channel capital towards environmentally sustainable projects by originating and structuring green banking products such as loans, credits and guarantees. [203] In such a market, investors seeking impact investment

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[200] Mindy Hauman and Tallat Hussain, "Green Finance in Africa", White & Case LLP, February 7, 2018, https://www.whitecase.com/publications/insight/ green-finance-africa.
201 DEA, "The Green Fund", https://www.sagreenfund.org.za/wordpress/.
[202] "World Bank's Guide to Scale Up Green Finance in Emerging Markets", *ESI Africa*, July 14, 2020, https://www.esi-africa.com/industry-sectors/financeand-policy/world-banks-guide-to-scale-up-green-finance-in-emerging-markets/.

[203] Ibid.

opportunities can easily identify those opportunities that comply with sustainability criteria. The methodology and recommended approach avoids one-size-fits-all definitions and standards by developing a taxonomy based on a country's particular environmental objectives.

Central banks play a key role in facilitating the development of green finance in their domestic markets. They are urged to intervene as regulators to unlock green and sustainable finance by reducing information asymmetries and requiring financial institutions to change risk management frameworks to take environmental, social and governance factors into account. Central bank regulatory intervention can also ensure that financial institutions provide a technically sound justification for those activities and investments considered green. This is because environmental risks are not taken into account in BASEL III, which provides the main regulatory guidelines for the global banking system. A voluntary approach is recommended for countries that have not started integrating green finance considerations into central bank regulations.[204] An example of central bank intervention in South Africa is the case of the Land Bank. It owns 29% of the country's agricultural debt, and recently defaulted on two of its domestic medium-term notes (ZAR 50 billion [$2.63 billion]) owing to liquidity shortfalls. This led to Moody's downgrading the bank further into junk status to B1, despite its having crossdefault clauses. The South African Reserve Bank responded by suspending (on 12 May 2020) the qualification of the Land Bank's short-term debt (which was previously considered 'High Quality Liquid Assets') as collateral to obtain funding for liquidity from its repo auctions. Effectively, local banks were prevented from using the Land Bank's debt for their Liquidity Coverage Ratio calculations.[205] Climate risk poses a serious risk to the agricultural sector, and its effects are impacting the quality of

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[204] Zanizeni Sustainable Finance, "Green Finance Concept Document to Inform the 2019 Partnership for Action on the Green Economy (PAGE) Conference" (Working Paper, Department of Environmental Affairs, Pretoria, January 10–11, 2019), https://www.tips.org.za/images/Green_Finance_Concept_Document.pdf.

[205] "South Africa Strips Land Bank Debt of High-Quality Asset Status", *Reuters*, May 12, 2020, https://www.reuters.com/article/safrica-landbank-idUSL8N2CU3W4.

the bank's loan book, with some farmers struggling to repay loans. Half of the bank's debt matures in 2021. The government has had to guarantee the Land Bank's debt and adjusted bank capitalisation funding during the COVID-19 crisis.[206]

Central banks have a role to play in 'greening' financial systems, especially in developing and emerging economies where environmental regulation is badly implemented by weak public institutions. In developing and emerging markets, central banks are powerful and sophisticated institutions overseeing the dominant banking sector within the financial system. If central banks were assigned an environmental mandate, they could effectively exert influence over private investment decisions through their command over the banking sector.[207] In addition, central banks' financial market expertise and transnational networks through their various regional and continental initiatives can promote 'best practice' reforms in the financial sector. The UN Environment Programme[208] recommends, with caution, potential tools that central banks can use to impact investment decisions, create and allocate credit into green investments, and direct credit away from environmentally harmful activities.

Introduce green macroprudential regulation and climate-related stress testing to address environmental systemic risk. The former includes ceilings on credit extension to certain carbon-intensive or polluting activities and exemptions from credit ceilings that can be used to channel investments into priority sectors. Suggested macroprudential instruments include higher risk weights either for carbon-intensive and dependent sectors (such as transport, mining and energy) or for particularly carbon-intensive and dependent companies in these sectors. Climate-related stress testing would assess the likely impact of hypothetical climate scenarios on the financial health of individual financial institutions and

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[206] Planet Tracker, "South Africa: A Call for Green Recovery", May 14, 2020, https://planet-tracker.org/south-africa-a-call-for-green-recovery/.
[207] Ulrich Volz, "On the Role of Central Banks in Enhancing Green Finance Inquiry" (Inquiry Working Paper 17/01, UN Environment and Centre for International Governance Innovation, London, February 2017), https://www.yumpu.com/en/document/read/57004893/banks-in-enhancing-greenfinance.
[208] Ibid.

the financial system as a whole with the aim of ascertaining their resilience to adverse shocks.

Use directed green credit policy instruments such as differential rediscount rates to incentivise commercial banks to extend credit to green investments with rediscounted bills at lower loan rates. There will be some compensation (partially or fully) for lending at subsidised rates of interest when they rediscount priority loans at the central bank on concessional terms.

Green differentiated reserve requirements allow central banks to lower required reserve rates on privileged green assets, thereby favouring green investments over traditional investments.

Institute differentiated capital requirements for low-carbon activities or green projects as it is done for loans to SMEs under BASEL III.

Accept carbon certificates for low-carbon projects as part of commercial banks' legal reserves – this will enhance their market and make them exchangeable for concessional loans, thereby reducing the capital costs of low-carbon projects.

Encourage green quantitative easing, whereby asset purchases are directed toward green financial assets such as green bonds, and reserve management to allow central banks to manage their assets according to social impact investment standards. This would release an additional $24 trillion to the funds already pledged under the UN Principles on Responsible Investing.

Develop green finance guidelines and frameworks aimed at guiding banks towards greener lending.

The Financial Stability Board [209] recommends mandatory disclosure requirements for all financial organisations in their public financial filings in order

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[209] Financial Stability Board, *Final Report: Recommendations of the Task Force on Climate-Related Financial Disclosure* (Geneva: Bank for International Settlements, 2017), https://www.fsb-tcfd.org/wp-content/uploads/2017/06/FINAL-2017-TCFD-Report-11052018.pdf.

to improve the transparency of climate-related risks. This will provide the basis for green macro-prudential regulation and climate-related stress testing.

Other initiatives that contribute to the greening of the financial sector include the Sustainable Banking Network, which was established in 2012 to encourage the development of national policies or road maps for sustainable banking. The Sustainable Insurance Forum brings together industry players to share learning and best practice on greening the insurance industry. African countries such as Kenya, Morocco and Nigeria are also developing sustainable banking standards, initiatives, policies or regulations. Voluntary approaches may be effective in encouraging risk based environmental due diligence and incentives, while mandatory requirements may be necessary to mobilise funding into specific green investment areas.[210] The Global Investors for Sustainable Development (GISD) Alliance, a grouping of 30 CEOs, asset managers, banks and bourses, has agreed to urge the global investment community to integrate the SDGs into their core business models, introduce long-term performance metrics, accelerate company disclosure and report on social and environmental issues. The GISD is also calling for a coordinated international approach to financial regulation and encouraging ratings agencies to incorporate sustainable development considerations into their decision-making.[211]

1.18. Green Fiscal Reform for a Sustainable Future

Green fiscal reform is the umbrella term for the application of pricing mechanisms that internalise externalities and mobilise public revenues. Thus, Environmental Fiscal Reform (EFR) uses a number of tax and pricing instruments that can raise revenues while furthering environmental goals such as mitigating climate change. There is a range of EFR instruments, but their suitability differs by country and sector. In particular, environmental taxes are used to deal with negative externalities. Cap-and-Trade systems are

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[210] UN Environment, *Green Finance for Developing Countries: Needs, Concerns and Innovations* (Nairobi: UN Environment, July 2016), http://unepinquiry. org/wp-content/uploads/2016/08/Green Finance for Developing Countries.pdf.

[211] UN, "SDGs: Joint Statement by Global Investors for Sustainable Development Alliance (GISD)", https://www.un.org/esa/ffd/wp-content/uploads/ 2019/10/GISD-joint-statement.pdf.

'internalising' mechanisms for greenhouse gas (GHG) emissions that set maximum levels of emissions and provide incentives to remain below those levels through a trading system. Investment incentives that are used include low-interest loans, tax exemptions and micro finance. Other incentives that offer direct support are subsidies and feed-in tariffs.[212] Green fiscal policy instruments such as carbon tax and fossil fuel subsidies can help generate and re-allocate significant resources for economic recovery measures by incentivising greener solutions and energy efficiency recovery plans (eg, business and industrial re-engineering, etc).[213] For instance, South Africa, which also has a carbon tax, provided subsidies for the roll-out of one million solar water heaters in an effort to reduce GHG emissions from the use of coal-powered electricity.[214] On the other hand, the removal of harmful subsidies or feed-in tariffs is also a financing mechanism employed to achieve certain SDGs.[215] One example is Egypt's halving of the fiscal cost of subsidies to bring average electricity tariffs closer to cost recovery, using the World Bank's Energy Sector Management Assistance Program.[216]

Green fiscal reforms, if designed well, can be a valuable instrument for medium- to long-term rationalisation of inefficient expenditures, such as environmentally harmful subsidies, and the alignment of domestic budget processes with national development plans aimed at achieving sustainable and inclusive

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[212] Zanizeni Sustainable Finance, "Green Finance Concept Document to Inform the 2019 Partnership for Action on the Green Economy (PAGE) Conference" (Working Paper, Department of Environmental Affairs, Pretoria, January 10–11, 2019), https://www.tips.org.za/images/Green_Finance_Concept_Document.pdf.

[213] Gilbert E Metcalf, "A Conceptual Framework for Measuring the Effectiveness of Green Fiscal Reforms" (Paper, Green Growth Knowledge Platform Third Annual Conference, University of Venice, Venice, January 29–30, 2015), https://greengrowthknowledge.org/sites/default/files/Metcalf_A_Conceptual_Framework_for_Measuring_the_Effectiveness_of_Green_Fiscal.pdf.

[214] Department of Mineral Resources and Energy, "Solar Water Heating", http://www.energy.gov.za/files/swh_frame.html.

[215] Zanizeni Sustainable Finance, "Green Finance Concept Document to Inform the 2019 Partnership for Action on the Green Economy (PAGE) Conference" (Working Paper, Department of Environmental Affairs, Pretoria, January 10–11, 2019), https://www.tips.org.za/images/Green_Finance_Concept_Document.pdf.

[216] World Bank, "Reforming Fossil Fuel Subsides for a Cleaner Future", November 21, 2017, https://www.worldbank.org/en/news/feature/2017/11/21/reforming-fossil-fuel-subsidies-for-a-cleaner-future.

growth. Green fiscal reform has not taken off owing to obstacles such as special interest groupings' lobbying against it; lack of political will; limited transparency and awareness; and administrative, institutional and technological constraints.[217] It is, however, important to assess the efficiency and distributional implications of any proposed environmental fiscal reforms.

1.19. Catalysing Green Investment for a Low-Carbon Future

Most African countries have managed to deploy fiscal stimulus packages, but they need to be re-focused on the twin COVID–climate crises in order to achieve a green recovery and come out of these crises more resilient. The Global Centre on Adaptation and African Adaptation initiative have made recommendations on ensuring stimulus investment in Africa is used to 'build back better' by focusing on resilient infrastructure and food and water security – all three having been affected by both the pandemic and climate change. COVID-19 could create a severe food security crisis in Africa, where 400 million people live in poverty and 74% of the population is already food insecure. Sub-Saharan Africa relies on massive food imports for its fast-growing population, which is estimated to increase from $35 billion in 2017 to $110 billion by 2030. Over 320 million people in Africa do not have access to safe drinking water, and over half the population does not have access to sanitation.[218] It is therefore imperative to use stimulus packages to enhance access to water and sanitation. This should happen in parallel to improving water governance by promoting investments that take into account the management of 'natural infrastructure' and support the effective distribution of scarce water resources for multiple uses.

A green stimulus should be at the core of Africa's recovery effort. Such a plan should be tailored to domestic socio-economic conditions instead of

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[217] Sirini Withana, "Overcoming Obstacles to Green Fiscal Reform", *The International Journal on Green Growth and Development* 2, no. 2 (2016): 161–188, http://bookstore.teri.res.in/docs/journals/IJGGD_Vol%202%20Issue2_Article_4.pdf.

[218] GCA and African Adaptation Initiative, "Integrated Responses to Building Climate And Pandemic Resilience in Africa" (Policy Brief, GCA and African Adaptation Initiative, Rotterdam, May 2020), https://www.africaadaptationinitiative.org/assets/AAI-GCA%20Policy%20Brief.pdf.

transplanting green stimulus models from developed countries. Green stimulus packages should also be guided by the principles of harnessing domestic solutions and building local capacity, as well as improving climate resilience and reducing carbon intensity and resource inefficiencies in African countries. These packages should be broadened beyond renewable energy to include water and other ecological infrastructure.[219] Five key pillars for green recovery packages[220] that can be adopted for technology transfers are:

Build the network infrastructure needed for a green and just transition, such as smart electricity and water grids, e-mobility and broadband infrastructure and improved rail and waste management; and maintain ecological infrastructure.

Make the regulatory changes to unlock private sector investment in sustainable energy, water, waste and sanitation systems. For instance, governments have rolled out emergency water and sanitation provisions to un/under-serviced informal communities as they are considered hotspots for the spread of COVID-19. However, these provisions are done in a temporary manner, making them expensive. Green Cape's Market Intelligence Report 2020 shows that investment opportunities in infrastructure in agro-processing and water and sanitation could be significant; for example, non-sewage sanitation for informal settlements and schools in communities that do not have access to sewage infrastructure.[221]

Support localisation of manufacturing technologies such as smart meters, biomaterials, electric vehicles, batteries and green hydrogen, while stimulating sustainable tourism and agriculture. Since the COVID-19 pandemic has hit, investors have been looking for investment opportunities in the Green Economy

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[219] Terence Creamer, "Placing Green Stimulus at Heart of South Africa's Post Pandemic Recovery Would Yield Big Co-Benefits", *Polity*, June 4, 2020, https://www.polity.org.za/article/placing-green-stimulus-at-heart-of-south-africas-postpandemic-recovery-would-yield-big-co-benefits-2020-06-04.

[220] Terence Creamer, "Placing Green Stimulus at Heart of South Africa's Post Pandemic Recovery Would Yield Big Co-Benefits", *Polity*, June 4, 2020, https://www.polity.org.za/article/placing-green-stimulus-at-heart-of-south-africas-postpandemic-recovery-would-yield-big-co-benefits-2020-06-04.

[221] "Unpacking the Green Economic Recovery in South Africa", *ESI Africa*, June 30, 2020, https://www.esi-africa.com/industry-sectors/business-andmarkets/unpacking-the-green-economic-recovery-in-south-africa/.

that will deliver returns, including green technology solutions. There should also be a re-evaluation of technologies that could be deployed in communities that will be more sustainable and affordable for local government.

Improve access to sustainable services such as sustainable housing and mobility.

Implement fiscal reforms to remove fossil fuel subsidies, incentivise new green solutions, promote resource efficiency and preservation, and reform energy and water tariff structures to make pricing inclusive and drive behavioural change.

1.20. Case Studies

1.20.1. The Peruvian case

In 2019, ISA CTM – Consorcio Transmantaro S.A. issued Peru's first international green bond by a non-financial corporate, raising USD 164.4 million with 58% co-financing to fund the *500 kV Mantaro-Nueva Yanango-Carapongo Interconnection and Associated Substations* project. This initiative enhances Peru's energy transmission capacity, improving the reliability and integration of renewable energy sources, particularly hydroelectric power, into the National Interconnected Electric System. The project strengthens transmission infrastructure in the central zone, ensuring efficient power evacuation from the Mantaro region to Lima. Third-party assessments by Moody's and S&P Global Ratings confirmed strong alignment with ICMA's Green Bond Principles, reinforcing transparency and governance. Proceeds from the bond exclusively finance projects in three categories: renewable energy transmission, energy efficiency improvements, and energy storage solutions. This bond issuance marks a significant milestone in Peru's green finance landscape, facilitating the transition to a more sustainable and resilient energy system.

1.20.2. The Brazilian Case

In 2016, the Brazilian Federation of Banks (FEBRABAN) developed voluntary green bond guidelines to mobilize financial sector resources for

environmentally beneficial projects and leverage Brazil's natural capital.[222] Created with support from the Brazilian Business Council for Sustainable Development (CEBDS) and sustainability organizations, the guidelines outline pre- and post-issuance requirements, external reviews, and reporting. Given Brazil's complex regulatory landscape, FEBRABAN opted for a market-driven approach without amending existing regulations. A working group of banks, issuers, and regulators studied international green bond frameworks to shape the guidelines. Challenges included a limited number of external reviewers and weak investor demand due to a lack of ESG mandates. The guidelines positively impacted the market, increasing issuances from two to fourteen. Future growth is expected in pulp and paper, renewable energy, and agribusiness, with more private bank participation. So far, only one bank, BNDES, has issued a green bond.

i. *The South African case*

South Africa's Green Finance Taxonomy (GFT) is a classification system designed to define and standardize green economic activities, aiming to attract sustainable investment and align the financial sector with climate goals. However, its uptake has been limited since its launch in April 2022, with financial market participants hesitant to implement it.[223] Key barriers include weak governance engagement, lack of regulatory mandates, uncertainty about its long-term role, and competition from parallel classification systems. Unlike the EU, South Africa has no mandatory disclosure requirements tied to the GFT, making adoption costly and unattractive. Additionally, its alignment with the EU taxonomy has not led to formal recognition, reducing incentives for foreign investment. The complexity of GFT assessments, lack of data availability, and financial sector dependence on fossil fuels further hinder

[222]Creating Green Bond Markets – Insights, Innovations, and Tools from Emerging Markets, available at https://www.sbfnetwork.org/wp-content/uploads/pdfs/Creating_Green_Bond_Markets/Green_Bond_Markets_Case_Studies.pdf

[223] The Implementation of Sustainability Taxonomies The Case of South Africa, available at https://www.idos-research.de/uploads/media/DP_15.2023.pdf

adoption. Pension funds, often seen as potential drivers, face constraints due to domestic investment requirements and high carbon intensity in the economy. To improve uptake, South Africa needs clearer regulatory backing, international recognition, streamlined reporting mechanisms, and integration into a broader policy strategy for sustainable finance.

1.20.3. The European Union: A Green Deal

The European Green Deal represents a comprehensive approach to sustainable financing. Launched in December 2019, this policy initiative aims to transform the European Union into a resource-efficient, competitive economy with no net greenhouse gas emissions by 2050, while also targeting a minimum of 55% reduction in net emissions, compared to 1990 levels. .[224] Central to the European green financing framework is the EU Taxonomy Regulation, which establishes a classification system for environmentally sustainable economic activities based on technical screening criteria. This taxonomy provides legal certainty for investors and companies by creating standardised definitions of "*green*" activities, thereby addressing the definitional inconsistencies that plague green financing. Complementing this taxonomy, the Sustainable Finance Disclosure Regulation imposes mandatory ESG disclosure requirements on financial market participants, creating transparency and accountability in sustainable investments.

The European approach demonstrates the value of legislative coherence, with various regulations working in concert to create a comprehensive framework. The European Green Bond Standard, while voluntary, builds upon the EU Taxonomy to establish rigorous standards for green bonds, enhancing their credibility and attractiveness to investors.[225] Meanwhile, the incorporation of climate risk assessment into prudential regulations through amendments to the

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[224] European Commission, *Communication from the Commission: The European Green Deal*, COM(2019) 640 final (Dec. 11, 2019).

[225] *Id.*

Capital Requirements Regulation strengthens the financial system's resilience to environmental risks.

In conclusion, GF represents a critical mechanism for facilitating the transition towards a low-carbon, sustainable global economy. As the urgency of addressing climate change intensifies, it is evident that traditional financing sources are insufficient to support the scale of investments required to mitigate environmental degradation and promote sustainability. GF addresses this gap by mobilizing capital for projects that drive innovation, enhance environmental sustainability, and contribute to a resilient, low-carbon economy.

Market-based mechanisms such as Environmental Funds are central to driving green investments and ensuring the integration of sustainability in national development plans.. Particularly, in certain countries, innovative financing solutions, such as green bonds, crowdfunding, and the creation of green banks, are gaining momentum and attracting international attention. Green banks, for example, have shown great promise in addressing market gaps and fostering green investments that would otherwise remain underfunded.

A crucial aspect of scaling up green financing lies in the greening of the finance sector. The establishment of a clear, country-specific green taxonomy helps financial institutions identify capital towards sustainable projects. Regulatory interventions by central banks play a pivotal role in this process, as they can reshape financial systems to prioritize climate risk management and promote green investment.

Furthermore, green fiscal reforms are indispensable for creating an environment where sustainable projects can thrive. The example of South Africa’s carbon tax and Egypt’s subsidy reforms demonstrates how green fiscal policy can drive economic recovery while reducing the environmental impact of industrial activities.

Finally, as countries face unique challenges posed by both climate change and the economic impacts of COVID-19, a green recovery is crucial for fostering resilience and driving sustainable development. Green stimulus packages tailored to local contexts, combined with investments in green infrastructure,

sustainable agriculture, and water systems, will not only help nations build back better but also create opportunities for job creation, innovation, and socio-economic progress. Therefore, GF through a combination of market-based mechanisms, fiscal policy reforms, and institutional support, is key to addressing the challenges of climate change while fostering economic growth.

7. Policy Coherence

The ever-growing awareness of climate change has fostered a global push for sustainable trade practices. Consumers and producers alike are increasingly demanding environmentally friendly products and services. This trend is particularly evident in the West, through initiatives such as the Glasgow Financial Alliance for Net Zero and the proposed US-EU Carbon-Based Sectoral Arrangement on Steel and Aluminum Trade.

Today, international economic law and international environmental law are two prominent but often overlapping regimes. Their intersection reflects a complex and increasingly important area of global governance, where the dual goals of promoting economic development through trade and ensuring environmental sustainability frequently come into conflict.

International trade law, governed by the World Trade Organization (WTO), aims to facilitate smooth and fair trade practices among nations by reducing trade barriers and fostering interdependence. In contrast, international environmental law — anchored in multilateral environmental agreements (MEAs) like the

UNFCCC, Kyoto Protocol, and Paris Agreement—focuses on sustainable development, biodiversity preservation, and mitigation of climate change.

1.21. Legal Framework for Environment Protection

The United Nations Framework Convention on Climate Change (UNFCCC) entered into force on 21 March 1994. Article 2 of the UNFCCC states its objective as the *"stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system."*

To advance this goal:

- The Kyoto Protocol (2005) imposed binding emission reduction obligations on developed countries.
- The Paris Agreement (2016), a legally binding treaty adopted at COP 21, further enhances the UNFCCC's aims. Article 2(1)(a) commits parties to limit global temperature rise to *"well below 2°C above pre-industrial levels,"* and to *"pursue efforts to limit the temperature increase to 1.5°C."*

However, climate change is not just an environmental issue—it is reshaping global trade, posing a serious threat to long-term economic prosperity. As WTO law seeks to liberalize trade, environmental measures adopted under MEAs may conflict with WTO obligations, raising legal challenges.

WTO dispute panels have frequently found environmental trade measures incompatible with WTO law. For instance, cases like Brazil–Retreaded Tyres, US–Gasoline, and US–Shrimp I were struck down for failing to meet the requirements of the chapeau of Article XX. Only in rare cases, such as US–Shrimp II, have environmental measures been upheld—highlighting the high thresholds for justifying exceptions under WTO law.

1.21.1. UNFCC and WTO: Legal Overlap and Challenges

The UNFCCC and the Paris Agreement obligate all parties to take climate action in accordance with their respective capabilities. Article 3 of the Paris Agreement introduces Nationally Determined Contributions (NDCs), allowing each country to set its climate targets, taking into account its development status.

This reflects the principle of Common But Differentiated Responsibilities and Respective Capabilities (CBDR-RC)—a recognition that industrialized nations, due to their historic emissions and greater capacity, bear greater responsibility for combating climate change.

However, the flexibility in NDCs creates a problem of carbon leakage. If some nations adopt stringent climate measures (e.g., carbon taxes, renewable subsidies, or energy efficiency standards), while others don't, industries may relocate to countries with laxer regulations, undermining global climate efforts.

Under WTO law, members can adopt environmental measures, but these must be non-discriminatory, necessary, and least trade-restrictive. They must also allow sufficient flexibility to others. For example, US–Shrimp I was struck down for failing to provide such flexibility, while US–Shrimp II succeeded because it adjusted its approach.

This illustrates that climate-related trade measures may be justified under WTO law if designed appropriately. The key is equitable implementation—ensuring comparable effectiveness without imposing identical policies on countries with vastly different circumstances.

1.22. Interpreting the CBDR Principle into the WTO

1.22.1. Chapeau of Article XX and Article 3.5 of UNFCCC

Both Article XX of GATT and Article 3.5 of UNFCCC caution that climate measures should not become *"a means of arbitrary or unjustifiable*

discrimination between countries where the same conditions prevail, or a disguised restriction on international trade."

Since WTO law forms part of public international law, it should not be interpreted in isolation. Article 3(2) of the DSU mandates that covered agreements be clarified in line with the customary rules of interpretation, particularly Article 31 of the Vienna Convention on the Law of Treaties (VCLT).

In US–Shrimp, the Appellate Body held that the chapeau must be read in light of general principles of international law. The CBDR-RC principle under UNFCCC, therefore, becomes relevant in assessing whether a measure is unjustifiably discriminatory. Importantly, the WTO preamble itself recognizes the need for environmental protection according to countries' different levels of development.

1.22.2. The "Same Conditions" Test

In EC–Seal Products, the Appellate Body clarified that the subparagraph under Article XX and the substantive WTO obligation at issue both provide context for interpreting whether countries are in "same conditions." This creates a two-step test:

1. Evaluate the environmental objective under Article XX.
2. Assess whether the measure violates substantive WTO obligations like MFN or National Treatment.

A climate measure that grants differential treatment to developing countries (e.g., more lenient emission standards) may appear to violate MFN, but could be justified under Article XX(g), especially if it aligns with the CBDR-RC principle. In this way, the principle of differentiated responsibilities can be read into WTO law through contextual interpretation.

1.22.3. The Enabling Clause

The Enabling Clause of the GATT permits developed countries to offer preferential treatment to developing and least developed countries, even if it violates the MFN principle (Article I:1).

This clause allows for:

- Non-reciprocal, generalized, and non-discriminatory preferences.
- Differential treatment based on developmental needs, as affirmed by the Appellate Body in EC–Tariff Preferences.

The term *"non-discriminatory"* here means that similar developing countries must be treated similarly. However, different treatment is allowed if based on legitimate development needs, reinforcing the CBDR logic.

Thus, the Enabling Clause complements the CBDR principle by allowing room for targeted, climate-friendly trade policies that support sustainable development.

8. Conclusion

This project explores the critical intersection of trade regimes and IPR barriers to technology transfer, while acknowledging the alarming rate of acceleration of the climate crisis, which projects a likely exceedance of the critical 2 degree warming threshold by the end of the century.

Beginning with an analysis of the TRIPS framework, the project begins with acknowledging the role of Articles 7, 8, and 66.2, which provide for normative obligations for technology transfer, addressing the very core of this issue, along

with the flexibilities institutionally provided to developed countries by way of compulsory licensing under Article 31, and anti- competitive practices under Article 40. The same is contextualised, however, with the TWAIL approach, which recognises the fact that the existing balance of access to IPR historically favours the global north, while also recognising the fact that there exist mixed empirical evidence on whether stricter IPR regulations promote or hamper development.

A comprehensive strategy for green technology transfer must integrate robust enforcement mechanisms, supportive financial structures, and coherent policy alignment. Legal tools such as compulsory and voluntary licensing under TRIPS play a crucial role—while compulsory licensing can address environmental crises by treating them as public emergencies, voluntary licensing provides a more collaborative and politically viable path for enabling access. However, technology transfer is not just about access to hardware; it hinges equally on building local capacity to absorb and innovate. Public-private partnerships can bridge institutional gaps by leveraging both state incentives and private sector innovation, while open-source and collaborative platforms demonstrate how decentralized efforts can democratize technology.

At the policy level, coherence between trade and environmental regimes remains essential. The principle of CBDR under international climate law must be harmonized with WTO obligations, particularly through nuanced readings of provisions like Article XX and the Enabling Clause. Without such alignment, legal contradictions may continue to obstruct the very objectives that sustainability frameworks aim to achieve.

In sum, fostering effective green technology transfer demands a multifaceted approach—grounded in legal flexibility, institutional capacity, financial commitment, and policy synergy. Only by addressing these dimensions collectively can the global community ensure equitable climate action and bridge the technological divide between the Global North and South

9. Annexure

ANNEXURE -I

Illustrations of implementation of Article 66.2 of the TRIPS, undertaken by the United States, the United Kingdom, Japan, Norway, and the European Union, through incentivizing enterprises and institutions in their territories for the purpose of promoting and encouraging technology transfer to least-developed country members.

S. No.	Incentive providing entity	Beneficiary Country and Enterprise	Description of the Project	Financial Implications
			THE UNITED STATES[226]	
1	*USAID/Washington*[227]	*Beneficiary Country: Cambodia* *Beneficiary Entity: RUA, local farmers, NGOs, and*	*Center of Excellence on Sustainable Agricultural Intensification and Nutrition (CE SAIN) – Cambodia:* *Through this program, USAID is establishing a center of excellence at the Royal University of Agriculture (RUA) to ensure research on agriculture innovations is disseminated to farmers, NGOs, and the private sector. The research is meant to meet market and farmer demand for information and technology to reduce production costs*	*USD 6.1 million*

[226] *United States, Report on the Implementation of Article 66.2 of the TRIPS Agreement, IP/C/R/TTI/USA/5, available at https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/CRTTI/USA5.pdf&Open=True*

[227] *Ibid, Page 7.*

		private sector agribusinesses	***and increase efficiencies for farmers and agribusinesses, and ultimately to reduce poverty. In FY 2024 the activity: a. Demonstrated new climate-smart technologies at seven Technology Parks in different agro-hydro-ecological zones in partnership with 16 different US Universities; b. Continued to strengthen RUA's capacity to deliver vocational and non-degree training to extension professionals, government staff, NGO employees, and farmers; c. Improved RUA faculty education, research and extension capacity through long and short-term training; d. Provided technical expertise and supported research and degreegranting opportunities for Cambodian students in the areas of sustainable agricultural intensification and nutrition; e. Empowered farmers to shift from conventional production systems to profitable soil and ecosystems, enhancing conservation agriculture production systems; f. Engaged the private sector to scale up agriculture services in conservation agriculture practices. Also in FY24, CESAIN demonstrated autonomy from USAID/Cambodia by signing a new MOU with the University of Tennessee to work with youth in agriculture. CESAIN and the South Korean Government via the Korean International Cooperation Agency (KOICA) also initiated a new project to develop a school of agricultural extension based at RUA.***	

2	*USAID, FCDO[228]*	*Beneficiary Country: Malawi* *Beneficiary Entity: Government ministries, private sector, local communities*	*Modern Cooking for Healthy Forests:* *The purpose of this activity is to promote sustainable forest management of selected landscapes and promote sustainable energy options in order to sustainably maintain forest cover and reduce land-based emissions.*	*USD 16,999,942.00*
3	*USAID, Power Africa[229]*	*Beneficiary Country: Malawi* *Beneficiary Entity: Urban households in selected areas in Lilongwe*	*Pay-As-You-Go Utility Platform for Clean Energy Distribution:* *The goal of this activity is to spearhead the adoption of clean energy technologies in Malawian households from the use of charcoal to liquefied petroleum gas (LPG) as a household cooking fuel and increase the use of solar home systems for lighting and small scale businesses.*	*USD 500,000*
4	*USAID/Cambodia; USAID/RDMA[230]*	*Beneficiary Country: Cambodia*	*SERVIR Southeast Asia – Cambodia:* *SERVIR Southeast Asia (SERVIR SEA) uses publicly available satellite technologies to support regional institutions, governments, and communities in adapting to transboundary climate issues and*	*USD 1 million*

[228] Ibid, Page 29.

[229] Ibid, Page 32.

[230] Ibid, Page 36.

		Beneficiary Entity: Asian Disaster Preparedness Center	*mitigating the impacts of climate change. Aligning with the US vision of a connected, resilient, and sustainable Indo-Pacific, SERVIR SEA and key stakeholders codevelop tools to improve drought, flood and other natural disaster response, food security, air quality monitoring, and sustainable landscape management.*	
5	*USAID/Cambodia*[231]	*Beneficiary Country: Cambodia* *Beneficiary Entity: Inland Fisheries Research and Development Institute (IFReDI), Royal University of Agriculture, Royal University of Phnom Penh, Cambodian Institute of*	*Wonders of the Mekong:* *The activity provides technical assistance, tools, and training to Cambodian natural resource managers to establish data collection and monitoring networks that will enhance existing capacity and complement ongoing projects within the Lower Mekong Basin. Objectives are: □ Improve capacity for monitoring of the freshwater environment, hydrology, and fishery resources within Cambodia; □ Gain critical biological information necessary to promote sustainable environmental management for key areas and fisheries, including the Tonle Sap Lake to River and Lower Mekong Rivers; and □ Provide information to communities, fishery managers, and policy makers at multiple levels of government and civil society to support sustainable environmental pathways and policies.*	*USD 2 million*

[231] *Ibid, Page 54.*

		Technology (ITC)		
THE UNITED KINGDOM[232]				
1	*UK Public Weather Service (PWS)[233]*	*Beneficiary Country: Burundi; Lesotho; Rwanda* *Beneficiary Entity: National Meteorological and Hydrological Services (NMHSs) of Burundi, Lesotho, and Rwanda*	*UK contribution to the WMO (World Meteorological Organisation) Voluntary Cooperation Programme (VCP), managed by the Met Office:* *To work in partnership with the National Meteorological and Hydrological Services (NMHSs) of developing countries, supporting delivery of effective weather and climate services. This includes provision of equipment, training and technology transfer. Note – many, but not all, countries worked with are LDCs.*	*GBP 821,890*

[232] United Kingdom, Report on the Implementation of Article 66.2 of the TRIPS Agreement, IP/C/R/TTI/GBR/5, available at https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/CRTTI/GBR5.pdf&Open=True

[233] Ibid, Page 2.

2	*Commonwealth and Development Office (FCDO)*[234]	*Beneficiary Country: Ghana; India; Kenya; Malawi; Nepal; Viet Nam; Zambia* *Beneficiary Entity: Research institutions, government departments and non-profit organisations. Beneficiaries include policy-makers in host governments who are involved in co-creating the evidence base for improved infrastructure*	*Climate-Compatible Growth programme (CCG):* *To achieve conditions for infrastructure investment in developing countries that both supports economic growth and is low-carbon. CCG does this by providing tools and evidence that support investment decision-makers in countries in Africa and Asia to take an integrated and climate compatible approach to deployment of critical infrastructure capital. With a focus on energy and transport, the research addresses how the design of physical infrastructure, regulatory and market systems can promote decarbonisation and how different infrastructure systems interact and can evolve to secure low carbon futures.*	*GBP 95 million*

[234] *Ibid, Page 7.*

		decision-making, investors (including national public and private institutions). Ultimately the indirect beneficiaries are the communities and businesses who can benefit from improved economic infrastructure.		
3	*Commonwealth and Development Office (FCDO)*[235]	*Beneficiary Country: Bangladesh; Burundi; Cambodia; Cameroon; Democratic*	*Modern Energy Cooking Services (MECS) Programme:* *Modern Energy Cooking Services (MECS) is the flagship FCDO research and innovation programme that accelerates the uptake of clean and modern energy cooking practices in Africa, South and Southeast Asia, and the Indo Pacific. MECStech is the lead UK programme delivering on the 'Modern Cooking' Challenge under the up to GBP 1 billion Ayrton Fund – a UK International Climate*	*GBP 55 million*

[235] *Ibid, Page 8.*

		Republic of the Congo; The Gambia; Ghana; Guinea; India; Indonesia; Kenya; Lao People's Democratic Republic; Lesotho; Malawi; Malaysia; Mauritania; Mozambique; Myanmar; Nepal; Niger; Nigeria; Papua New Guinea; Rwanda; Sierra Leone; South Africa; Tanzania; Uganda; Viet Nam; Zambia *Beneficiary Entity: Private sector and non profits. People in*	*Finance (ICF) commitment on clean energy innovation between 2021-2026. Key activities covered by the MECS programme that support technology transfer include policy-focused research that informs and influences developing countries to transition to modern energy cooking, and pilots and demonstrators of new clean cooking technologies and business models in developing countries.*	

		developing countries who benefit from the research activities and clean cooking pilots and demonstrators funded by MECS.		
4	*Commonwealth and Development Office (FCDO)*[236]	*Beneficiary Country: Bangladesh; Democratic Republic of the Congo; Ghana; Kenya; Nepal; Nigeria; Pakistan; Rwanda; Senegal; Tanzania; Uganda; Zambia* *Beneficiary Entity: Private*	*Sustainable Manufacturing and Environmental Pollution (SMEP):* *The Sustainable Manufacturing and Environmental Pollution (SMEP) programme is addressing environmental pollution associated with manufacturing and industrial process in developing countries, by generating evidence on pollution and environmental health and developing and testing the application of technology-based solutions and cleaner production methods, and associated technical assistance.*	*GBP 19 million*

[236] *Ibid, Page 11.*

		sector companies (eg: GIVO Africa), academic institutions (eg: National Textile University of Pakistan), technical institutes (eg National Cleaner Production Centres in Kenya and Tanzania; Council of Scientific and Industrial Research, South Africa)		
5	*Grand Challenges Canada[237]*	*Beneficiary Country: Afghanistan; Democratic*	*Creating Hope in Conflict (CHIC):* *CHIC is a challenge fund for supporting humanitarian innovation in conflict. CHIC identifies and scales innovations that apply new insights, technologies, and approaches to increase survival or improve*	*GBP 28 million*

[237] *Ibid, Page 12.*

		Republic of the Congo; Uganda; Yemen *Beneficiary Entity: Grants made to academic institutions, private sector, or NGOs.*	*the lives of the most vulnerable people and the hardest-to-reach in humanitarian crises caused by conflict.*	
JAPAN[238]				
1	*Tokyo University of Agriculture[239]*	*Beneficiary Country: Djibouti* *Beneficiary Entity: University of Djibouti*	*The Project for Advanced and Sustainable Methods on Water Utilization Associated with Greening Potential Evaluation:* *The project aims to develop and share the method of creating the wide area distribution map of water resource potential and greening potential for the sustainable agriculture and the land use.*	

[238] Japan, Report on the Implementation of Article 66.2 of the TRIPS Agreement, IP/C/R/TTI/JPN/5, available at https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/CRTTI/JPN5.pdf&Open=True

[239] Ibid, Page 11.

2	*Ehime University*[240]	*Beneficiary Country: Malawi* *Beneficiary Entity: University of Malawi*	*The Project for Establishment of a Sustainable Community Development Model based on Integrated Natural Resource Management Systems in Lake Malawi National Park:* *The project aims to contribute disseminating sustainable community development model, with enhancing environmental conservation, improving the quality of life and livelihood for people in the project area (Chembe village located in Lake Malawi National Park, Malawi).*	
3	*Japan International Cooperation Agency*[241]	*Beneficiary Country: Cambodia* *Beneficiary Entity: Institute of Technology of Cambodia*	*The Project for Establishment of Risk Management Platform for Air Pollution in Cambodia (SATREPS):* *Overall Goal: The risk management platform for air pollution is continuously operated. Project Purpose: The risk management platform for air pollution in Cambodia is established.*	
4	*The Association for Overseas Technical Cooperation and*	*Beneficiary Country: Angola; Bangladesh; Benin; Burkina Faso; Democratic*	*The Training Programme for Kaizen:* *Enhancement of middle to top managers' managerial knowledge and skills in various aspects such as corporate management, production management, quality control and Kaizen (continuous improvement)*	

[240] *Ibid, Page 14.*

[241] *Ibid, Page 17.*

	Sustainable Partnerships[242]	*Republic of the Congo; Guinea; Mali; Senegal; Tanzania; Uganda; Zambia* *Beneficiary Entity: Private companies in Bangladesh, Ethiopia, The Gambia, Guinea-Bissau, Mozambique, Myanmar, Nepal and Tanzania*	*techniques through a better understanding of the Japanese companies' efficient production system and practices.*	
5	*Be-A Japan ITOCHU Corporation,; Hinode Sangyo,; Ebara Corporation; and Kaiho Industry*[243]	*Beneficiary Country: Morocco; South Africa; Uganda*	*STePP Industrial Vocational Training Programme in Africa:* *To provide training to local engineers and technicians in Africa (Ethiopia, Morocco, South Africa, and Uganda) on technologies from Japanese companies that contribute to sustainable development and*	

[242] *Ibid, Page 20.*

[243] *Ibid, Page 23.*

		Beneficiary Entity: Private companies and vocational training college in Ethiopia; Uganda; Morocco; and South Africa	*disseminate the newly acquired knowledge within their home countries.*	
NEW ZEALAND[244]				
1	*InvestPacific investment fund manager (Camco Pacific)[245]*	*Beneficiary Country: Solomon Islands* *Beneficiary Entity: Private enterprises in Pacific Island countries*	*Invest Pacific* *To strengthen Pacific Island country resilience through increased private investment in inclusive and sustainable development outcomes.*	*NZD 17 million*

[244] *New Zealand, Report on the Implementation of Article 66.2 of the TRIPS Agreement, IP/C/R/TTI/NZL/4, available at https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/C/RTTINZL4.pdf&Open=True*

[245] *Ibid, Page 4.*

2	*New Zealand Ministry of Foreign Affairs and Trade*[246]	*Beneficiary Country: Cambodia; Lao People's Democratic Republic; Myanmar; Solomon Islands* *Beneficiary Entity: Government Departments, community leaders and Pacific groups*	*Climate Change Programme:* *Supporting Pacific countries to lead their climate change response*	*NZD 1.3 billion*
3	*Renewable Energy Facility*[247]	*Beneficiary Country: Cambodia; Lao People's*	*ASEAN Renewable Energy Facility: Lao, PDR and Cambodia:* *Provides technical assistance to increase the beneficial use of renewable energy resources to support economic and social development in Lao, PDR and Cambodia. Assistance is provided through a facility which implements multiple projects.*	*NZD 11.85 million*

[246] *Ibid, Page 5.*

[247] *Ibid, Page 7.*

		Democratic Republic *Beneficiary Entity:*		
4	*Pacific Trade & Invest (New Zealand)*[248]	*Beneficiary Country:* *Beneficiary Entity: Private sector businesses in Pacific Island countries*	*Pacific Trade & Invest (New Zealand):* *Pacific Islands Trade and Invest (PT&I) works with exporters from the Pacific Islands to promote their products and services as well as attract investment to Pacific Island businesses.*	*NZD 12.8 million*
THE EUROPEAN UNION[249]				
1	*Horizon Europe*[250]	*Beneficiary Country: Ethiopia*	*Expanding Integrated Assessment Modelling: Comprehensive and Comprehensible Science for Sustainable, Co-Created Climate Action:* *Neither the first round of Nationally Determined Contributions (NDCs) nor currently implemented climate policies are on track to*	*EUR 30,750*

[248] *New Zealand, Report on the Implementation of Article 66.2 of the TRIPS Agreement, IP/C/R/TTI/NZL/3, Pg 12, available at https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/CRTTI/NZL3.pdf&Open=True*

[249] *New Zealand, Report on the Implementation of Article 66.2 of the TRIPS Agreement, IP/C/R/TTI/EU/5, available at https://docs.wto.org/dol2fe/Pages/SS/directdoc.aspx?filename=q:/IP/CRTTI/EU5.pdf&Open=True*

[250] *Ibid, Page 24.*

		Beneficiary Entity: Addis Ababa University	***meeting the Paris Agreement's objectives. Parties are expected to increase their ambition and produce new NDCs covering the post-2030 period. The design of a multi-dimensional set of policy measures that comprise countries' climate policy agendas is supported by equally diverse integrated assessment modelling (IAM) activities. Notwithstanding the recent progress in the IAM literature and scenario space, the modelling world has fallen short of its promise to include nonscientists in its process; to account for individual choices and lifestyle changes that are indirectly narrated as assumptions not interacting with the vividly modelled technology-economy-environment-policy flows; and to place climate action as a cross-cutting theme in the sustainability spectrum. IAM COMPACT will support the assessment of global climate goals, progress, and feasibility space, as well as the design of the next round of NDCs and policy planning beyond 2030 for major emitters and non-high-income countries. We will use a diverse ensemble of models, tools, and insights from social and political sciences and operations research, and will integrate bodies of knowledge to co-create the research process and enhance transparency, robustness, and policy relevance. We will explore the role of structural changes in major emitting sectors and of political, behaviour, and social aspects in mitigation; quantify factors promoting or hindering climate neutrality; and account for extreme scenarios, to deliver a range of global and national pathways that are environmentally effective, economically viable, politically feasible, and socially desirable. In doing so, we will fully account for COVID-***	

			19 impacts and recovery strategies, and align climate action with broader sustainability goals, while developing technical capacity and promoting ownership in non-high-income countries.	
2	*Horizon Europe*[251]	*Beneficiary Country: Zambia* *Beneficiary Entity: University of Zambia*	*Transformative Environmental Monitoring to Boost Observations in Africa:* *Objective: Set up cost effective innovative sensor networks that can be financed by climate services built on top of these networks. Concept: Transformative new methods to measure five essential hydrological variables (rainfall, soil moisture, river flow, bathymetry) at less than 10% of current costs. These reduced costs are essential to have realistic business models for services that cover the costs of building and operating the networks. The five essential variables will be available through GEOSS. Innovation: Seven new sensing methods will be introduced in Africa. The innovation does not focus only on moving up Technology Readiness Levels of new measuring methods but, especially, on the usefulness and practical applicability of these methods in the specific contexts. The direct linkage of sensors and new value-creating services is part of this innovation because this is essential for long-term financial sustainability. New services assimilate in situ and satellite data in numerical models to make optimal use of strengths of different sources of information. Knowledge of the African market: Building on earlier research-*	*EUR 154,173*

[251] *Ibid, Page 27.*

			oriented projects and on experience in development of geoservices in Africa, in-depth knowledge of the opportunities and limitations of the African market is widely available within the consortium. Selection of focus services was based on this knowledge. These focus services are Flood Early Warning Systems, reservoir management, and crop germination insurance. These have been selected as the most promising services in the broader climate-oriented areas of geo-hazards, water management, and agricultural information."	
3	*Horizon Europe*[252]	*Beneficiary Country: Tanzania; Uganda* *Beneficiary Entity: Uganda Martyrs University; Sustainable Agriculture Tanzania; Regional Universities Forum for*	*Potentials of Agroecological practices in east Africa with a focus on Circular (PrAEctiCe) water-energy-nutrient systems:* *PrAEctiCe will provide a novel agro-ecology indicator set for East Africa, aimed at helping smallholder farmers in their agro-ecological transition. The project goes beyond the existing indicator frameworks by putting the "concept into action" with a decision support tool for agro-ecology advisors supporting the selection of the best suited combination of agroecological practices in a local context. In addition, it puts a focus on circular water-energy-nutrient systems of integrated aqua-agriculture, an practice with high potential for efficient farming with minimal climate impacts, which has not been sufficiently explored in previous indicator work. Through a multi-stakeholder approach, new insight on agro-ecological practices in East Africa will*	*EUR 1,845,688*

[252] *Ibid, Page 30.*

		Capacity Building in Agriculture; National Agricultural Research Organisation; Makerere University; Alliance for Food Sovereignty in Africa	*be gathered to inform on existing successful practices as well as the barriers and drivers of East African smallholder farmers. This insight will help develop an indicator framework for agro-ecology, which, while building on existing frameworks, is adapted to the East African context and captures integrated aqua-agriculture practices in detail. The PrAEctiCe decision support tool will then, at the farm level, help assess environmental and socio-economic impacts, with a particular focus on impacts on climate change mitigation and adaptation as well as financial viability. The tool will be validated in three living labs, situated in Kenya, Uganda and Tanzania, covering different integrated aqua-agriculture farming set-ups. Knowledge sharing activities through trainings, student exchanges and events, ensure the dissemination of results across East Africa and between AU and EU. To reach practitioners at every level, a cascade training mechanism with a train-the-trainer course will help agro-ecology advisors train farming representatives at the local level who then will help the farmers in their agro-ecological transition. Policy recommendations for AU and EU policies will round off the project.*	
4	*Horizon Europe*[253]	*Beneficiary Entity: Liberia* *Beneficiary Entity: Laskaridis*	*Retrofit Solutions to Achieve 55% GHG Reduction by 2030:* *The proposal develops a combination of energy-saving solutions that can be adopted in retrofitting aimed at achieving the 35% of GHG*	*EUR 110,625*

[253] *Ibid, Page 39.*

		Shipping Company Ltd.	***emissions. Two new technologies, i.e. wind assisted ship propulsion and an innovative air lubrication system, will be developed together with other solutions that, although based on already mature technologies, such as operational and hydrodynamic design optimization and ship electrification, have to be expanded to be integrated with the new solutions as well as to cope with the constraints posed by the original ship design. The final objective of RETROFIT55 is to create an advanced web-based Decision Support System (DSS), that fuses together digital twins of the different systems into an integrated digital ship model. The DSS will feature a catalogue of retrofitting solutions that are up-to-date and ready to be deployed at the end of the project and easily extendable afterward while developed and demonstrated at TRL 7-8, suitable for different ship types and operational contexts. The DSS will enable the user to configure the retrofitting by combining different options which are suitable for the specific ship type and comparing them in terms of life-cycle cost, return-of-investment and several KPIs, such as EEXI, CII. Referring to the ZEWT strategy, while primarily contributing to the Design and Retrofit, the implementation of the project will also intersect other topics, such as Use of Sustainable Alternative fuels, Energy Efficiency, Electrification and Digital Green. The consortium brings together universities and research institutions, three developers of the new technologies, a ship design office, software developers, ICT experts, a classification society, a ship-repair company, and two large ship operators.***	

5	*Horizon Europe[254]*	*Beneficiary Country: Senegal; Uganda* *Beneficiary Entity: Veritas Consulting Plc; Makerere University; Centre de Test des Systemes Solaire; Addis Ababa University*	*Open Modelling Toolbox for development of long-term pathways for the energy system in Africa:* *OpenMod4Africa aims to develop an open Toolbox populated with state-of-the-art models for analysing long-term pathways to sustainable, secure and competitive energy systems in Africa. The Toolbox will build on EU projects like Open ENTRANCE, Plan4RES and FocusAfrica, and will adapt and further develop open models in accordance with the African context and needs. The models are scalable, and can be applied to cities, industries and countries. Furthermore, a main objective for OpenMod4Africa is capacity building among energy models in academia. Four African universities will be actively involved in adapting models and conducting two regional case studies. The additional capacity and the open Toolbox will enable the universities to train new generations of energy modelling experts for the energy industries in Africa. A network of energy industries and universities in 25 African countries will also be engaged. These players will be invited to use the Toolbox, and to be involved in training activities. They will also be invited to a permanent network of expertise, which will be developed for further capacity building and collaboration beyond the project. Two case studies will develop energy pathways for rural areas, cities, countries and large regions of countries in Western and Eastern Africa. The*	*EUR 445,300*

[254] *Ibid, Page 57.*

			replication strategies will pave the way for further analyses beyond the project. Finally, OpenMod4Africa aims to collaborate with other ongoing initiatives to maximize the impacts of the project and create synergies. The consortium consists of 12 partners and 2 associated partners. Five partners are African. Important long-term impacts from the threeyear project include enabling academia and decision-makers in Africa to conduct their own analyses for the optimal development of their energy system, supplying energy to a much larger share of the population, and establishing a system based upon the abundant share of renewables on the continent.	

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