TECHNOLOGY TRANSFER FOR CLIMATE CHANGE MITIGATION: Mechanism, Issues and Challenges

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[Abstract: Technology transfer plays a crucial role in climate change mitigation by facilitating the adoption and diffusion of innovative solutions to reduce greenhouse gas emissions and enhance resilience. This paper explores the mechanisms of technology transfer, including public-private partnerships, international cooperation, and financial incentives, while identifying the key issues and challenges that hinder effective implementation. Through a comprehensive analysis of case studies and existing frameworks, the study highlights barriers such as intellectual property rights, funding constraints, and disparities in capacity among developing nations. Furthermore, it examines the role of international agreements, such as the Paris Agreement, in promoting technology transfer and fostering collaboration between developed and developing countries. The paper concludes with recommendations for improving technology transfer processes, emphasizing the need for tailored policies, capacity-building initiatives, and robust financial mechanisms to ensure equitable access to climate technologies and ultimately support global climate goals.]

I

Introduction

According to NASA study published in 'Geographical Research Letter' the Ozone holes are recovering. This recovery is the proof of international cooperation. In this recovery technology plays vital role which enable phasing out CFC in the late 1970's Due Pont was the world's major producer of CFC. In 1980 the company patented HFC-13a which could be used as an alternative for CFC and find more than 20 patents. The alternative to CFC plays important role in recovery of ozone layer.[1]

The Preamble of (UNFCCC) United Nations Framework Convention on Climate Change notes the "global nature of Climate Change calls for the widest possible cooperation by all countries and their participation in an effective and appropriate International response in accordance with their Common but Differentiated Responsibilities respective capabilities and their social and economic conditions."

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[1]Amrita Goldar and Shubham Sharma, *Climate Change and Transfer of Technology – Barriers, Technologies and Mechanisms*, (July 2019), *available at*:https://www.econstor.eu/handle/10419/203716, (last visited May 11, 2023).

Important negotiation process include the Technology Transfer Frame adopted in 2001 as part of Marrakesh Accord and the Poznam Strategic Program on Transfer of Technology in 2008. Significant negotiations further the took step in 2010 in Cancun and Technology Mechanism came into existence. Technology Mechanism consist of two bodies one is Technology Executive Committee. Technology Executive Committee consists of 20 expert members. Technology Executive Committee identify country's need and provide government with recommendation that can promote Transfer of Technology. Another body Climate Technology Centre and Network which creates network of national, rational, sector and international level.

The Bali 'Road Map' agrees in December 2007 to make Technology one of its pillar and call for technology development and transfer. [2]Transfer of Technology is a means to help the countries to achieve Nationally Determined Contributions (NDCs). International commodity should take steps for transfer of (EST) environmentally Sound Technologies. 2020 World Bank report recognizes that existing tested EST could serve the objective of Paris agreement. But these technologies are not available to developing countries.

Effect to and timely development of Transfer of Technology in developed nation is important for global action towards Climate Change. Development and Transfer of Technology is complex process which involved different issues. Developing countries stressed that IPR should be considered as a barrier whereas developed countries believe that IPR indispensable to ensure innovation. Climate Change needs to be taken as Global challenge. There is no definite manner in which IPR and Transfer of Technology affect each other. This impact is different from country to country and technology to technology. One of the direct barrier that IPR pose for Transfer of Technology is the cost of license.

At the Bali negotiation 2007 there was considerable disagreement between US and G77 over the IPR. The G77 argued that IPR needs to be addressed as barrier within Transfer of Technology discussion; the USA and Australia maintained that IPR serve as a catalyst rather than barrier. The cop held at Copenhagen in 2009 IPR was carefully avoided freezing out Ozone Depletion Substance ODS required sophisticated technologies. These technologies are patent protected hence transfer of Technology become a crucial issue.

The main binding regime for IPR protection is Trade Related Aspects of Intellectual Property Right (TRIPS) of WTO. There are some principles and providence that can be used to transfer climate relevant technology to developing countries. Article 27.1 of the Trade Related Aspects of Intellectual Property Right (TRIPS) requires WTO

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[2] Matthieu Glachant and Antoine Dechezleprêtre,*What role for Climate Negotiations on Transfer of Technology*,LSERO 5 (2016).

members to grant patent for all types of invention in the field of Technology, if these invention meet certain basic criteria.

One after two used by countries to access patented technology is old concept of licensing. Compulsory license allows certain entities to pay a royalty and was an invention without patentee's permission. This term CL does not appear in Trade Related Aspects of Intellectual Property Right (TRIPS) but can be read into its clauses. TRIPS Agreement allows countries to grant non-voluntary licenses to third parties without the consent of the patent owner. The compulsory license can be granted in the cases such as government requirement, abuse of patent rights, national emergency noncommercial use, technology advance over the existing patent, and interest of public health. India has made a submission at UNFCCC that climate mitigation technology is subject to IPR and has a similar approach to affordable medicines. This has ensured that privately owned technologies are available on affordable on an affordable base. Developed countries oppose such an approach. Another issue about Compulsory Licensing is that most technologies are owned by private companies.

Developed countries at the international level oppose Compulsory Licensing but, in the past, have often taken recourse to Compulsory Licensing to meet their government plan. United States of America has a long history of Compulsory Licensing. US Legislation provides for the targeted licensing to meet health needs. 42 USC Section 7608 provides for CL of air pollution prevention inventions. Section 308 of the Clean Air Act also provides mandatory licenses. It is a part of domestic IP legislation in different countries like China, India, Indonesia, Malaysia, and Thailand. Trade-Related Aspects of Intellectual Property Rights (TRIPS) provide the freedom to decide and define national emergencies and issue Compulsory Licensing to access EST and Climate Change treated as public goods in domestic and international resumes. Transfer of Technology can be linked to market Monopoly and anti-competitive practices. Article 31c of Trade-Related Aspects of Intellectual Property Right (TRIPS) Refusal to give a license can also be included as an anti-competitive practice.A joint study conducted by the University of Sussex and TERI in 2006 highlights the significance of the transfer of Technology for Climate Change mitigation.The 13th session of the WIPO standing committee on the law of patents in 2019 has decided to deal with the issue of patents and the environment.

According to Art. 27.2 and 3 of the Trade Related Aspects of Intellectual Property Right (TRIPS) WTO members may exclude certain inventions from patentability. Those inventions are the exploitation which is necessary to protect public order and morality, to protect human animal plant life to our serious prejudice to the environment. Some National laws specially provide that the inventions that cause eyes to the health or life of human or animal or on to the protection of environment student from

patentability.[3]World Intellectual Property Organization would be an appropriate forum to promote Transfer of Technology internationally.

II

Recent Progress of Transfer of Technology

The Climate Technology Centre and Network and Technology Executive Committee have stressed the role of the private sector and the link between the Transfer of Technology and finance. It also looks into legal and regulatory Frameworks. TheTechnology Executive Committee and Climate Technology Centre and Network have recently highlighted the significance of the Transfer of Technology. In 2022, the Technology Executive Committee's report also highlighted that the private sector has a strong incentive to protect its ownership and prevent competition.[4]

The United Nations Framework Convention on Climate Change was built on the concept of Common but Differentiated Responsibility, under which developed countries have an obligation to act first. United Nations Framework Convention on Climate Change classified countries into two groups: Annex-I and non-Annex-I countries. Article 4.5 puts an obligation on developed countries. The issue of differentiation has been at the center of the climate discussion. The end result of the process was the Paris Accord of 2015. This Paris Accord removes the discrimination between developed and developing countries compared to the United Nations Framework Convention on Climate Changeand Kyoto Protocol. Article 1 of the Paris Accord stated that all parties are required to provide voluntary Nationally Determined Contributions (NDCs). NDC is a major departure from past agreements. Each country determines for itself the extent of action it will take. this provision was made in order to bring countries like the USA into the commitment by addressing major complaints about the Kyoto Protocol.

Paris Agreement, 2015 does recognize in several provisions that developing countries may make slow progress towards emission reduction and support to ensure their implementation of commitment. Article 4.5 States that developing countries should be supported Articles 9 and 10 retreats that developed countries remain obligated to provide financial and technical support to developing countries. But on the other hand Paris agreement remove the framework of Annex1 and Annex-II and non-annex countries.The earth continuous to experience record breaking temperatures

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[3]WIPO,*Standing Committee on the law of Patent*50 (2009)

[4]Nicolus M. Perrone, *Transfer of Technology and Climate Change: A Developing Country Perspective, Climate Policy Brief*, (14 Nov. 2022),*available at:*www.southcentre.int, (last visited May 11, 2023).

caused by increased atmospheric concentration of CO2 and other Greenhouse Gases.[5] Climate Change is the biggest threat ever faced by mankind or living beings.

Agenda 21 is the product of the Earth Summit United Nations Conference on Environment and Development, 1992, held in Rio-de-Janeiro. This is not a binding Action Plan of the United Nations. Under Chapter 34 of the Agenda-21 with title transfer (EST) Environmentally Sound Technologies cooperation and capacity building. It provides a plan of action for the transfer of (EST) Environmentally Sound Technologies. Article 34.18 provided support of and promotion of access to transfer technology.

(EST) Environmentally Sound Technologies may be referred as those technologies which have the potential to significantly mitigate the cause of Climate Change. Article 13 of the Vienna Convention for the Protection of Ozone Layer defines (EST) Environmentally Sound Technologies as "Technology for equipment the use of which makes it possible to reduce or effectively eliminate the emission of substances which have adverse effects on the ozone layer."[6]

The problem is that it is difficult for the government to reach a consensus on how to make these transfers happen. Technology exporting countries MNC multinational firms advocate for market-based voluntary transfer of Technology, which is based on terms agreed upon between providers and recipients. Those who lack Technology depend on those who have it to protect the health, well-being, and human rights of their citizen. The COVID-19 pandemic has exposed this risk.[7]

FDI and trade conserve to make technology available where it is needed. But it does not happen to the extent of necessity or to the technology that may not be adopted in developing countries. Domestic and international public rules do not encompass all the determinations of Transfer of Technology. These deals generally involve contract and private agreements or practices. Most Technologies that countries own are privately owned. Most attempts to regulate the Transfer of Technology recognized the importance of the private sector. The International Chamber of Commerce (ICC) considered the questions from a business perspective when it submitted a detailed proposal to UNCTAD. In 1972 under the scope of CNCTAD's Code of Conduct on Transfer of Technology. The negotiations discontinue in 1985. Firms entered into Transfer of Technology deals for market seeking or cost efficiency reasons. They do not do it for charity but for business goals.

The International Framework address Climate Change was established at 1992 UN conference on environment and development in Rio de Janeiro.it's three pillars are

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[5]DalindyeboShabalala, *Climate Change and Human Rights and Transfer of Technology*(2018), *available at:*https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3238430, (last visited May 11, 2023).

[6]IshikaKedwal and KirtiVashisth, *Mechanismof Transfer of Technology for Climate Change Mitigation*.

[7]*Supra* note 4 Nicolas M. Perrone*at* 28.

Rio Declaration, Agenda 21 and UNFCCC. The Rio Declaration and Agenda 21 are not finding documents. They declares that state have common but differentiated responsibility, which said that north countries hold the largest responsibility, because of their historic carbon emission record. Article 4 UNFCCC creates a series of state commitments regarding (EST) Environmentally Sound Technologies. Article 4 provided specific obligation for north and South countries. The north countries have obligation of assistance. North countries are expected to facility and Finance the private technologies. Whereas south countries are expected to focus on domestic Climate Change mitigation, make the best use of Climate Change aid.

Kyoto Protocol 1997 promotes an enabling environment focusing on attraction of foreign investment and license agreement. The 2007 Bali Action Plan made Transfer of Technology one of the 4 finding blocks of future negotiations. However little was decided in Bali about how to make successful Transfer of Technology.

The discussion continued in Copenhagen in 2019 at COP15 when developing countries ask for specific mechanisms. To make this possible they proposed reconsidering balance between IPR and Climate Change. Their request include possibility of Compulsory Licensing, patent pools limited time patterns and other limitations defined by TRIPS agreement. Developed countries rejected this proposal. The COP15 concluded that for rapid reduction in emission there is urgent need to adapt to the Climate Change mitigation, which requires large scale diffusion and transfer EST for this purpose COP16 in 2010 at Cancun Technological Mechanism was created.

The transfer of EST was again assessed at COP21in Paris in 2015, in order to ensure participation of developed countries to Paris agreement of the objective of keeping the temperature increases well below 2 degree but it lessons the burden on North Country about their Transfer of Technology. Paris accord again show tension between north and South countries.

Technological Mechanism focuses on private sector which is dominant in north countries. The Technology Executive Committee involves actions from government civil society, Academic and business. In 2022 joint annual report of Technology Executive Committee and Climate Technology Centre and Network grant significant relevance to the private sector is stressed on the need to increase its contribution to (EST) Environmentally Sound Technologies. They mention insufficient funding continues to be the key challenge. Public funds are limited and hence it is necessary to tap on the private sector. This report calculated that main obstacles are financial, legal and regulatory.

Thisresearch tries to contribute deeper understanding of transfer of Technology for CC mitigation. The first meeting of Conference of Party (COP-1) United Nations Framework Convention on Climate Change Supreme decision making body of the convention place in Berlin. Culminating the Berlin mandate of 1995. The Berlin mandate

demands for various technology issue to be addressed which include establishing Transfer of Technology projects inventory, financing, establishing network of Technology centers, identify needs adoption Technology. The Buenos Aires Plan action established at COP4 call on industrialized countries to provide list of publicly owner environmentally sound technologies and for developing countries to provide report outlining technical needs.[8]

The UNFCCC has led out a series of specific actions that developed country parties particularly Annex-I to countries to undertake and attend to facilitate the process of Transfer of Technology. In 2008 Conference of Party COP-14 the parties initiated thePoznam strategic program on Transfer of Technology, in order to help developing countries. This program have 3 objectives: assisting developing countries in conducting Technology needs assessment, completing a series of pilot priority technical projects, disseminating UNFCCC experience and Transfer of Technology.

Conference of Party COP-14 spurred the negotiations to establish a Technological Mechanism in 2010 when parties meet at COP16 in Cancun. Technological Mechanism become fully operational in 2012. The Technology Executive Committee acts as the policy component of the Technological Mechanism and set directions for technology development and transfer.The Climate Technology Centre and Network acts as executive body. Climate Technology Centre and Network's primary duty is to respond to requests from developing country parties sent through NDE.

Transfer of Technology

Transfer of Technology means disseminating these environmental friendly Technology with essential information to create them. Article 10c of the Kyoto Protocol stated that the parties take full account of the specific needs and special situations of developing countries with funding and Transfer of Technology as part of the Marrakesh Accord Conference of Party COP-7. Parties further agree towork together on the set of technology transfers to enhance the implementation of Article 4.5 of the United Nations Framework Convention on Climate Change.

Article 10 of the Paris Accord deals with the technology Framework, which provides guidance to technology mechanisms in promoting and facilitating enhanced action on technology and development and transfer. The main contention issue is how and on what terms nation may acquire these Technologies. IPR is both an invention and an obstacle to the Transfer of Technology. Patent is the most important IP when

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[8]Brianna Craft, and Karma Tshering, *Technology Development and Transfer, The Least Developed Countries and the Future Climate Regime Consideration for the Post-2020, International Response to Climate Chang*, (Nov 2015) *available at*:https://www.ldc-climate.org/wp-content/uploads/2017/12/tech-development-and-transfer-and-the-future-climate-regime.pdf, (last visited May 11, 2023).

technologies are being transferred.[9]Enforcement of intellectual property law is one of the greatest concerns of developed countries and multinational companies while conducting business in developing countries.

To promote IPR the World Trade Agreement on Trade Related Aspects of IPR requires signatory countries to develop and provide protection to IPR. China reformed its IPR Framework in 2001 when it joined WTO. Companies have been increasingly willing to conduct business in China because of market opportunity. For example, General Motors committed to a $250 million research center in Shanghai to support the development of energy-efficient alternatives. New York Times reported that General Motors' chief executive believed that the company could keep control of IPR in China while doing research.

Conference of Party COP 13 of the United Nations Framework Convention on Climate Change and COP3 of the Kyoto Protocol held in Bali in 2007 provided opportunities for the Transfer of Technology.[10] Robinson observed TT as a two-way learning process and hence called it Technology communication. He said,"the development by people in one country of the capacity on the part of national of another country to use or a replicate modified or further expand the knowledge and skills associated with different manner of consumption or product use."[11]

We use termTransfer of Technology because it commonly appears in the literature. Many other terms in the literature are used in place of or in parallel for the term transfer which include diffusion, dissemination, deployment, development, adoption, application, Corporation, market penetration. [12] In 1996 second assessment report the IPCC (International Panel on Climate Change) concluded that human induced Climate Change gives a new stress on ecosystem.Technologies for higher performance and low carbon fuel like natural gas, nuclear power recognized as a means for reducing CO2 emissions. Transfer and diffusion of Technologies for reducing Greenhouse gas emission having stressed in much of the international dialogue on Climate Change.

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[9]ArindamBasu, *Grasping Climate Transfer of Technology: A Brief Discussion on Indian Practice, Journal of Intellectual Property Rights*, (Jan 2018) *available at*:https://nopr.niscpr.res.in/handle/123456789/44690, (last visited May 11, 2023).

[10]Kenneth Markowitz, *Transfer of Technology: A Pillar of Climate Change Solution, Page No. 2007, Akin Group, Thomson Returns*, (Nov 5, 2007) *available at*:https://www.akingump.com/a/web/4832/Climate-Article-K-Markowitz-Technology-Transfer-Nov-20.pdf, (last visited May 11, 2023).

[11]Nitya Nanda and NidhiSrivasthava, *Facilitating Transfer for Climate Change Mitigation and Adoption, The Energy and Resource Institute, Discussion Paper*, (Dec. 2011),*available at*:https://www.teriin.org/projects/nfa/2008-2013/pdf/Facilitating_Tech_Transfer.pdf, (last visited May 11, 2023).

[12]EricMartinot, Jonathan E. Sinton, *International Transfer of Technology for Climate Change Mitigation and the Cases of Russia and China*, (Nov 1997), *available at*:https://www.annualreviews.org/doi/abs/10.1146/annurev.energy.22.1.357, (last visited May 11, 2023).

III

TRIPS and IPR

There are several options within the framework of trips that could assist in facilitating access to climate related Technologies. This include:-

1) exceptions to patent rights
2) strict application ability criteria
3) Compulsory Licensing

1) **Article 30** of trips allows exceptions to patent rights. Under this provision, countries may allow the use of patent inventions without the consent of the patent folder. It is up to the country to define these circumstances which depend on national policies. Few exceptions to patent rights in National patent laws are like acts done on non-commercial scale, use of scientific research, uses for teaching purposes.

2) **Article 27** after Trade Related Aspects of Intellectual Property Right (TRIPS) members to determine on case by case bases whether to grant patent or not. An invention needs to fulfill three conditions, i.e. novelty, inventive steps, industrial application. WTO member countries are free to determine this criteria. TRIPS allows nations to adopt policy for patentability. They can limit the number of patent granted to climate Technology.
3) **Compulsory Licensing:-** This is license or permission granted by government to use patent. Article 31 of the TRIPS deals with Compulsory Licensing. It gives examples or grounds for granting Compulsory Licensing. Hence WTO members have not only the right to issue Compulsory Licensing but have freedom to decide grounds or conditions for granting Compulsory Licensing. Grounds for issuing CL may include National Emergency, to remedy against anti-competitive practices, public interest, and non-commercial use, public health, security reasons.

   USA in its Clean Air act provides for Compulsory Licensing when the patented innovation is necessary to comply with emission requirements. A distirct court can decide whether to grant patent or not.[13]

Transfer of Technology

A comprehensive definition of Transfer of Technology involves the purchase, acquisition, and transfer of skills and know-how to use, operate, maintain, and

[13]THIRD WORLD NETWORK,*Climate Change and Transfer of Technology : Addressing IP Issues*, *available at:*https://www.twn.my/title2/IPR/pdf/ipr14.pdf, (last visited May 11, 2023).

understand the technology. It also includes the ability to adapt technology to local conditions and to design and manufacture original products. TRIPS agreement has several references that deal with the Transfer of Technology. These are:

Article 7: It seems to indicate that the protection and enforcement of IPR may promote technological innovation and transfer.

Article 8.2: It recognizes the need for "appropriate measures" to prevent abuse of IPR to resort to practice set which unnecessarily restrain trade or affect international Transfer of Technology.

Article 66(2):

TRIPS agreement put obligation on developed countries to promoteTransfer of Technology for least developed countries. Developed countries shall provide incentives to enterprise and institutions. Developed countries have frequently raised questions in the WTO body about the fact that developed country compliance with Article 66.2 is not satisfactory. The Indian delegate stated that there has been little effort implement Article 66.2 to rising doubt about effectiveness of agreement.

Paragraph 5 of the Doha Declaration on TRIPS agreement and public health:

The importance of commitment under Article 66.2 has been reaffirmed in paragraph 11.2 of the implementation decision adapted by the WTO Minister conference at the start of the Doha round of multilateral trade negotiations in 2001. According to India, the transfer of Technology and know-how should be aided by suitable IPR region. Private sector owner of IPR could be compensated by their government. India proposed joint development with IPR sharing to ensure the affordability of goods and services.[14]

***IPR: A Barrier to Transfer of Technology*?**

In one of the cases, an Indian company sat access to HDFC 134, which is a substitute for chlorofluorocarbon (CFC) on ozone-depleting substances used in refrigerators and ACs. The patent holder company quoted a price of $25 million for access to technology. They also proposed two alternatives that are Indian firms allowed to take majority ownership in a joint venture or Indian form agree to export restrictions on CFC 134 produced in India. Both options are acceptable. Indian company estimated that the patent price could be between two and eight million, and their efforts to access Technology were unsuccessful. Korean firms also faced difficulties when they wanted to replace CFC with acceptable substitutes by foreign companies.IPR are the drivers for the innovations. They aim to inspire innovation and originality.

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[14]SangeetaShashikant and Martin Khor, *Intellectual Property and Transfer of Technology Issues in the Context of Climate Change, available at:*https://www.un.org/en/development/desa/policy/cdp/cdp_news_archive/egm_climatechange/khor.pdf , (last visited May 11, 2023).

In the USA, government research usually ends up being patented. This happened due to the Bayh-Dole Act of 1980, which gives Universities and small businesses the right to retain ownership of their invention. For example, Dart Mouth College has granted worldwide exclusive license to reduce ethanol from Salute LogicBiomass policy is similar to Act improving the competitiveness. Hence diffusion of climate Technology would typically long pathway

FDI is important channel for transfer of technology. Technology can be transferred through multiple channels these channels could be as:-

1) Imputation of goods through international trade
2) movement of knowledge through FDI
3) movement of people
4) licensing for the use of technology
5) International research collaboration
6) knowledge and TT between buyer and supplier
7) diffusion of codified and disadvantage knowledge

Transfer of Technology through FDI is consider as more intensive because of longer term and deeper engagement in receiving country. Research find that FDI receiving countries benefit strongly from direct and indirect spillover.[15]

IV

Conclusion

The COVID-19 pandemic has provided lessons that maybe useful for EST transfer. The distribution of EST is of Paramount importance. Because nature do not have any idea about employment, economic progress. This is the natural and each and everyone have access to the tools generated by technology. Their must not be delay in Climate Change mitigation and adoption. It is not possible for poor countries to spend huge amount on scientific research. Hence providing then proper technology is the only solution to deal with Climate Change. To conduct this process their must be proper and just use of laws at national as well as international level. It is found that developed countries does not apply same principles at international level which they strictly observe in their own country. Their must be fairness their foreign policy. Because for nature their no concept of country or nation. Nature put this responsibility on all the living beings.

[15]Miria A. Pigato, Simon J. Black, *Transfer of Technology and Innovation for Low-Carbon Development*, *available at:*https://documents1.worldbank.org/curated/en/138681585111567659/pdf/Technology-Transfer-and-Innovation-for-Low-Carbon-Development.pdf, (last visited May 11, 2023).