A Performance Analysis of the International Environmentally Sound Technology Transfer Framework in Africa

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The international climate change regime's environmentally sound technology framework has evolved from the far-reaching provisions under the 1992 United Nations Framework Convention on Climate Change to having a more streamlined structure under the 2015 Paris Agreement. Transfer channels like the Clean Development Mechanism, Poznan strategy and other non-state initiatives have been explored. More recently, the EST transfer mechanism made up of the Technology Executive Committee and the Climate Technology Centre and Network was established. While its evolution is unquestionable, whether the current framework can be considered more effective is a worthwhile question. To what extent does the current structure reproduce, improve, or diminish previous transfer channels? This article seeks to answer this question using select African countries as case studies. It finds that while there are considerable structural and operational differences between the current Technology Mechanism under the Paris Agreement and previous transfer channels, the current mechanism features flaws which have undermined the effectiveness of previous initiatives.

Le cadre des technologies écologiques du régime international relatif aux changements climatiques a évolué en passant de dispositions de grande portée sous la Convention-cadre des Nations Unies sur les changements climatiques de 1992 à une structure simplifiée sous l'Accord de Paris de 2015. Des canaux de transfert tels que le Mécanisme de développement propre, la Stratégie de Poznan et d'autres initiatives non étatiques ont été explorés. Plus récemment, le mécanisme de transfert EST, constitué du Comité exécutif technologique et du Centre et réseau de technologie climatique, a été établi. Bien que son évolution soit incontestable, il est valable de se demander si le cadre actuel peut être considéré comme plus efficace. Dans quelle mesure la structure actuelle reproduit, améliore ou diminue-t-elle les canaux de transfert précédents? Cet article cherche à répondre à cette question en utilisant certains pays africains comme études de cas.. Il constate que, bien qu'il existe des différences structurelles et opérationnelles considérables entre le mécanisme technologique sous l'Accord de Paris et les canaux de transfert précédents, le mécanisme actuel présente des failles qui ont nui à l'efficacité des initiatives précédentes.

Titre en français: *Analyse des performances du cadre international pour le transfert de technologies écologiquement rationnelles en Afrique.*

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1. INTRODUCTION

The establishment of the technology framework (TF) and the recognition of the Technology Mechanism (TM) under the Paris Agreement in 2015 represent a watershed phase in the evolution of the United Nations Framework Convention on Climate Change (UNFCCC) technology transfer regime.[1] The 1992 UNFCCC mandated developed country parties to take "practicable steps to promote, facilitate and finance" the transfer of and access to environmentally sound technologies.[2] While there have been initiatives (described as "transfer channels" subsequently in this article) since 1992 to make this provision operational, they have been mostly ad hoc.[3] Arguably, the TF and TM represent a more concerted and institutionalized approach to technology development and transfer. This article compares past and current environmentally sound technology (EST) transfer

1 Established in 2010 by the Conference of Parties to the UNFCCC, the Technology Mechanism comprises the Technology Executive Committee (TEC) and the Climate Technology Centre and Network (CTCN). Both bodies have the mandate to "enhance climate technology action" and "enrich coherence and synergy in the delivery of climate technology support." The technology framework was established under the 2015 Paris Agreement to "provide overarching guidance to the work of the technology mechanism." See UNFCCC, "Technology Mechanism: Enhancing Climate Technology Development and Transfer" (2015), online (pdf): *UNFCCC* <unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEM/0e7cc25f3f9843ccb98399df4d47e219/174ad939936746b6bfad76e30a324e78.pdf>; Paris Agreement, 12 December 2015, 27 UNTS 54113 (entered into force 4 November 2016), arts 10(3)–10(4) [*Paris Agreement*]. The TM and TF are discussed more extensively later in this article.

2 United Nations Framework Convention on Climate Change, 9 May 1992, 1771 UNTS 30822 (entered into force 20 January 1994), art 4(3), 4(5) [*UNFCCC*].

3 For example, the Expert Group on Technology Transfer (EGTT) was established in 2001 with the aim to "advance the technology transfer activities under the Convention." See UNFCCC, "Expert Group on Technology Transfer: Five Years of Work" online (pdf): *UNFCCC* < unfccc.int/resource/docs/publications/egtt_eng.pdf>. In 2007, the Poznan Strategic Program (PSP) was established to "provide funding to climate technology development and transfer activities." See TT:Clear, "Poznan Strategic Program on Technology Transfer" (2019), online: *UNFCCC* <unfccc.int/ttclear/support/poznan-strategic-programme.html> [perma.cc/YCS8-HKUP] [*Poznan*]. Although the EGTT is now defunct, the PSP continues to operate under the Global Environment Facility (GEF).

initiatives,[4] identifying the extent to which the current transfer framework and mechanism reproduce previous trends. Importantly, I highlight the challenge of over-marketization of international EST transfer, the preference of transfer of hardware and soft skills over the transfer of advanced foundational (e.g. research and development) capacity, and the disconnect between the needs of host countries and transfer interventions. These trends characterize, albeit in varying degree, the transfer initiatives appraised here, including the current technology framework and mechanism. I argue that redressing these trends is essential for the effectiveness of the technology framework and mechanism. While existing research has focused on the effectiveness of individual transfer channels in Africa, there is no known research which has compared the previous and current regimes in the African context. Drawing from EST transfer initiatives in select African countries—including Ghana, Mauritius, Kenya, Nigeria, and South Africa—I identify recurrent trends in EST transfer initiatives.

The international EST transfer system is complex. Although the UNFCCC occupies a central role in coordinating transfer initiatives, diverse entities—including State and non-State entities—are directly involved in the EST transfer. This multilayered transfer system makes it difficult to assess the overall effectiveness of the transfer regime under the UNFCCC. The difficulty of assessing the transfer of ESTs is made more so by the heterogeneity of ESTs and their unique features. ESTs can either be mitigation or adaptation focused. But this binary categorisation masks the diverse technologies that can be grouped under each category.[5] The IPCC has also referred to the complexity of quantifying EST transfer and the impossibility of measuring it confidently given the diverse ways ESTs can be transferred.[6] This difficulty notwithstanding, appraising the performance of the EST transfer regime is vital, not just for the determination of the effectiveness or otherwise of the regime, but for perspective on the reasons why such initiatives and policies succeed or fail. While African countries have participated in transfer initiatives over the years—mostly as recipients—they have remained at the lower rung of EST dissemination. The reality on the ground (for example, with respect to energy poverty in African countries) does not tally with the spate of acclaimed transfer initiatives between 1992 and now.[7] The continent, therefore, makes for an apt case study of

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4 ESTs have been variously defined. The United Nations Environment Program (UNEP) defines ESTs as "technologies that have the potential for significantly improved environmental performance relative to other technologies … total systems that include know-how, procedures, goods and services, and equipment, as well as organisational and managerial procedures for promoting environmental sustainability." UNEP, "Environmentally Sound Technologies for Sustainable Development" (21 May 2003) online: *UNEP* <unep.or.jp/ietc/techTran/focus/SustDev_EST_background.pdf>. See also UNDESA, *Climate Change: Technology Development and Technology Transfer*, (Paper delivered at the Beijing High-Level Conference on Climate Change, Beijing, China, 7-8 November 2008) [unpublished] at 11, online (pdf): *UN Sustainable Development* <sustainabledevelopment.un.org/content/documents/1465back_paper.pdf>.

5 For example, while both solar PV and wind turbines are mitigation ESTs, they have peculiar features, and these greatly impact on their development, use, transfer and diffusion. Again, although drought resistant seeds and advanced irrigation systems are both agricultural-adaptation ESTs, they have inherent features which make their conditions for transfer diverse.

6 IPCC, *Methodological and Technological Issues in Technology Transfer* (Cambridge: Cambridge University Press, 2000) at 71.

7 International Energy Agency, " World Energy Outlook 2014 Executive Summary" (2014) at 6, online (pdf): *Institute of Energy Economics* <eneken.ieej.or.jp/data/5794.pdf> (according to the International Energy Agency (IEA), more than 620 million in sub-Saharan Africa are without access to electricity and

this disconnect. What is being considered here is not the effectiveness of ESTs *per se.* Rather, this article focuses on determining how EST transfer initiatives performed and the conditions responsible for such performance. Given the crucial transfer roles played by non-State entities, a review of select initiatives by corporate entities and non-governmental organisations is also set out below. While the point has been made that the UNFCCC has generally performed a facilitative role in the EST transfer regime, it has in a few cases been more directly engaged, particularly, through the Clean Development Mechanism (CDM) under the Kyoto Protocol and the Poznan Strategic Program on Technology Transfer (Poznan strategy).[8]

There are three broad EST transfer channels: UNFCCC initiatives, developed countries' programmes, and non-State parties' initiatives. These channels are, however, not mutually exclusive. For instance, while the UNFCCC, through the Global Environment Facility, participates directly in the implementation of transfer projects under Poznan, it also serves as an implementation platform for States and non-State entities.[9] Outside the UNFCCC's implementation platforms (CDM and Poznan), States and non-State entities initiate and implement stand-alone transfer programmes. Here, Kyoto and Poznan are deemed UNFCCC oriented channels because, unlike other State or non-State initiated projects, they are directly controlled and/or regulated by UNFCCC rules and terms of engagement. While a rubric for assessing the transfer channels considered in this article is developed in part II, the rubric is used in appraising the CDM and Poznan strategy and other State and non-State initiatives in part III. In part IV, I turn to the current technology transfer regime under the Paris Agreement, comparing it to the transfer channels considered in part III. The article concludes in part V that while the UNFCCC EST transfer regime has evolved institutionally, flaws which undermined the effectiveness of previous channels, subsist. To have an effective framework, inherent flaws like the decoupling of the transfer—financial mechanisms and the focus on hardware transfer must be addressed.

2. DEVELOPING AN ASSESSMENT RUBRIC: PERFORMANCE INDICATORS FOR THE EST TRANSFER REGIME

The Intergovernmental Panel on Climate Change (IPCC) defines technology transfer as "a broad set of processes covering the flows of know-how, experience and equipment for

nearly 730 million rely on the traditional use of solid biomass for cooking. 45% of existing on-grid power generation capacity in Africa is from coal, 17% from oil, and 14% from gas 22% is from hydro).

8 See *Kyoto Protocol*, 11 December 1997, 2303 UNTS 30822 (entered into force 16 February 2005) art 12 [*Kyoto Protocol*]; see also *Poznan, supra* note 3. Facilitation has been described to connote "both direct interventions to match supply and demand, transfer specific technologies, and indirect, broader policy interventions aimed at improving enabling environment for science, technology and innovation (STI)." See Wei Liu et al, "An Overview of the UN Technology Initiatives" (23 July 2015) at 2, online (pdf): *United Nations* <sustainabledevelopment.un.org/content/documents/7810Mapping%20UN%20Technology%20Facilitation%20Initiatives%20July%2023%202015%20clean%203.pdf> [*Wei*].

9 See generally UNFCCC, *Technology and the UNFCCC: Building the Foundation for Sustainable Development* (2016), online (pdf): *UNFCCC* <unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/NAD_EBG/54b3b39e25b84f96aeada52180215ade/b8ce50e79b574690886602169f4f479b.pdf> (for the relationship between UNFCCC and different EST development and transfer channels and initiatives).

mitigating and adapting to climate change."[10] In establishing a body of appraisal criteria for EST transfer, there are two broad levels on which transfer can be assessed: the source and the recipient.[11] An effective regime entails competencies at both levels of the transfer construct. The what, when, where, how, and why of technologies transferred at the source level impact how it is received at the recipient level.[12] Vice versa, conditions at the recipient level can determine how effective a transferred technology will be. Although both levels affect each other, they have different measures of appraisal.[13] While the performance of a transfer initiative is no doubt affected by the local context it is to operate in, there is a first-level expectation that such a policy should be properly designed at the source. Primarily, it behooves transfer sources to ensure innate effectiveness of transfer programmes both at the design and implementation phases.[14] How to determine the effectiveness of source transfer channels is, however, less clear. Domestic conditions for the enablement of effective EST transfer at the recipient level have been the focus of previous research.[15] Such recipient dependent effectiveness is, however, not the focus of this article. Rather, I focus on the effectiveness of transfer initiatives based on their design and manner of implementation. While recipient level analysis is vital, attention should be paid to the responsibility of developed States and other source-entities to design effective transfer initiatives. It is my aim in this section to identify metrics with which such effectiveness (source level) can be measured.

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10 IPCC, *supra* note 6 at 3.

11 Although 'the source' in climate change discourse is generally framed as 'developed States', it is used more generally in this article as an umbrella term for the different entities in EST transfer. These include developed States, corporate and non-governmental organizations and, even, developing States with 'transferrable' technologies (including traditional knowledge). The term 'recipient' is however more limited to State entities, specifically developing States. This however does not mean that developed States are ineligible to be 'recipients'. Again, often, corporate entities are direct recipients of technologies through investment. This article, however, only focuses on developing States at the 'recipient' level.

12 In his seminal work on 'Diffusion of Innovations', Everett Rogers identified four elements in the diffusion of innovations: an innovation (what); channel of communication (how); period (time) of communication (when); and a social system (where). The 'why' of diffusion, also, features under Everett's thoughts on 'innovation decisions'. See Everett Rogers, *Diffusion of Innovations*¸ 5th ed (New York: Free Press, 2003) at 11–35 [*Everett*]. Everett's work is however more suited to 'recipient' level analysis of diffusion (used as a broad term to cover transfer and dissemination of technology), but some his thoughts are adaptable to source level analysis, as will be attempted here.

13 Samuel Bar-Zakay classifies the transfer process into four stages (search; adaptation; implementation and maintenance) distinguished between 'source' and 'recipient' transfer requirements/responsibilities in each of the stages. See generally Samuel Bar-Zakay "Technology Transfer Model" (1970), online: *RAND* <rand.org/pubs/papers/P4509.html#download>.

14 'Innate effectiveness', as used here, means the capacity of a transfer initiative to optimally perform by meeting standards unconnected to external variables, like local conditions at the recipient level.

15 See Damilola S Olawuyi, "From technology transfer to technology absorption: addressing climate technology gaps in Africa" (2017) 36:1 J Energy Nat Resources & Envtl L; Shakespeare Maya, "Capacity Building for Technology Transfer in the African Context: Priorities and Strategies" (Paper delivered at the African Regional Workshop on Transfer of Technology as referred to in Decision 4/CP.4, Arusha, Tanzania, 16-18 August 1999) [unpublished], online (pdf): *UNFCCC* <unfccc.int/files/documentation/workshops_documentation/application/pdf/maya.pdf>.

Few attempts have been made to identify metrics for measuring EST transfer.[16] The IPCC proposed the following criteria:

> **1. Market penetration:** Rate of indigenisation, geographic extent of penetration and impacts on other technologies and ancillary benefits.
>
> **2. Long term institutional capacity building:** Flexibility and capacity to adapt technology to changing circumstances and to sell back to original provider with improvements, capacity of local staff and long-term financing, improvements in training and management practices.
>
> **3. Monitoring and evaluation of continuous delivery of services provided by technology and adequate financial performance:** Continuous delivery of services provided by technology, comparison of actual and intended benefits, performance of technology, quality of benefits, satisfaction of beneficiaries, distribution of benefits (equity), maintenance and service of equipment, adequate financial performance, payback period, financial rate of return, net present value.[17]

Arguably, the above criteria are recipient focused and provide little aid for the assessment of source-level transfer. Drawing from the IPCC criteria, metrics for source level analysis are proposed here. Developing these metrics also entails a re-consideration of the earlier agreements on technology transfer, particularly, article 4(5) of the UNFCCC and chapter 34 of Agenda 21. Article 4(5) mandates that developed States take "all practicable steps … as appropriate" to enable developing States to "implement the provisions of the Convention." Whereas the phrase "all practicable steps … as appropriate" is very nebulous, it is clear that such steps must enable developing States to meet their commitments under article 4(1)(a) to (j).[18] The commitments contained in article 4(1) can be classified into three: duty to report, duty to cooperate, and duty to develop sustainably.[19] A joint reading of article 4(1) and (5) informs the conclusion that EST transfer steps must ultimately aim to enable recipient States to develop the capacity to report, cooperate and develop sustainably. I argue that the overarching criterion of a transfer initiative is whether it is enabling. An emphasis on enablement, as proposed, has diverse implications. For one, it substantially shifts the focus from stand-alone hardware transfer initiatives, to holistic projects with emphasis on the software and orgware components of such transferred technology.[20] Again, an enablement driven transfer construct will potentially

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16 See IPCC Working Group II, "Technologies, Policies, and Measures for Mitigating Climate Change" (1996) IPCC Technical Paper I at 11. See also *Report of the United Nations Conference on Environment and Development*, *Agenda 21 - Rio Declaration*, vol 1, UN Doc A/CONF.151/26 (1992) at para 34.3, which states that ESTs "should be compatible with nationally determined socio-economic, cultural and environmental priorities." [Agenda 21]

17 IPCC, *supra* note 6 at 64–65, 180.

18 Commitments under Article 4(1)(a)–(j) of the UNFCCC apply to "all parties" under the climate regime. Hence, developing States, are inter alia, obligated to "promote sustainable management, and promote and cooperate in the conservation and enhancement, as appropriate, of sinks and reservoirs"; "take climate change considerations into account … in their relevant social, economic and environmental policies and actions," etc. See *UNFCCC, supra* note 2, art 4(1).

19 See *UNFCCC, supra* note 2, arts 4(1)(a)(b)(j), 4(1)(c)(e)(g)(h)(i) and 4(1)(d)(f) (duties to report, cooperate, and develop sustainably).

20 While hardware refers to tangible technologies, software entails "processes associated with the production and use of the hardware" and orgware relates to "the institutional framework, or organisation involved

drive to the surface the imperatives of vertical transfer of ESTs as against the more prominent horizontal transfer.[21] Enablement as the primary criterion of transfer will facilitate developing States' transition from recipients to contributors, as evidently anticipated in article 4(1) of the UNFCCC.

'Enablement', as the fulcrum of EST transfer policy, is reaffirmed in chapter 34 of Agenda 21. It, for instance, affirms that "the primary goal of improved access to technology information is to enable informed choices, leading to access to and transfer of such technologies and the strengthening of countries' own technological capabilities."[22] A close reading of chapter 34 further provides the subcomponents of the enablement criterion—accessibility and sustainability.[23] Paragraph 34.14 of Agenda 21, for example, emphasizes access, availability, transfer of technologies and know-how on favourable terms, promotion of indigenous technologies and support of endogenous capacity building as the objectives of the EST transfer regime. The IPCC criteria also emphasize recipient state institutional capacity building and continued service delivery.[24] The UNFCCC has also identified cost effectiveness, environmental sustainability, cultural compatibility and social acceptability as key EST policy criteria.[25] In summary, *accessibility*, as used here, entails availability, affordability, and cooperation, while *sustainability* includes compatibility, adaptability, and maintenance. Again, the subcriteria adopted here are source-level metrics to appraise EST transfer initiatives. While not exhaustive, they have been developed as a simple and easy-to-apply qualitative appraisal tool. The subcriteria are represented more clearly in the table on the next page.

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in the adoption and diffusion process of a technology." See Ivan Nygaard et al, "Overcoming Barriers to the Transfer and Diffusion of Climate Technologies" (2012) UNEP Risø Centre on Energy, Climate and Sustainable Development at x.

21 Edwin Mansfield distinguishes between vertical and horizontal technology transfer: "Vertical technology transfer occurs when information is transmitted from basic research to applied research, from applied research to development, and from development to production. Such transfers occur in both directions, and the form of the information changes as it moves along this dimension. Horizontal transfer of technology occurs when technology used in one place, organisation, or context is transferred and used in another place, organisation, or context." See *Technology Transfer, Productivity and Economic Policy* (New York: W.W. Norton & Co, 1982) at 28 cited in Bojan Pretnar, "Commercialism of Patents and Know-how: From Academia to Industry" at 1, online (pdf): *Intellectual Property Office of Slovenia* <uil-sipo.si/uploads/media/Pretnar.pdf>. An example of this kind of vertical transfer is the university–industry transfer. Vertical transfer will potentially allow for the involvement of developing states at the early stage of EST development. Further, considering the location sensitive nature of ESTs, early involvement via vertical transfer will likely make an EST more easily adapted to the peculiarities of a recipient.

22 See Agenda 21, s*upra* note 16 at para 34.8.

23 Sustainability as used here differs from its more common use in the sustainable development context. Here, it means 'sustainable technology transfer', which has been described as "Technology transfer that is more than a one-off transfer of equipment, know-how or both to the host developing country but generates indigenous and lasting embedding of this technology in the host country." See Gary Cox, "The CDM as a Vehicle for Technology Transfer and Sustainable Development" (2010) 6 L, Environment & Development J 179 at 196.

24 IPCC, *supra* note 6 at 64–65, 180.

25 See UNFCCC, "Technologies for Adaptation to Climate Change" (2006) at 10, online (pdf): *UNFCCC* <unfccc.int/resource/docs/publications/tech_for_adaptation_06.pdf>.

Table 1 - Source-Level EST Transfer Metrics[26]

ENABLEMENT			
Accessibility		**Sustainability**	
Availability	• Wholesale availability (hardware, software, and orgware). • Assured access.[27] • Observability.	*Compatibility*	• Compatibility of source-initiative and recipient-priorities. • Compatibility with recipient State policies. • Social/cultural compatibility.
Affordability	• Favourable, concessional and preferential commercial terms. • Macroeconomic considerations (GDP, jobs created or lost, etc.). • Equity considerations (distributive/differential impacts).	*Adaptability*	• Flexibility and non-complexity. • Local technical and managerial capacity development. • Trialability. • Reinvention.
Cooperation	• Design to Execution interparty consultation. • Host-state input and engagement.	*Maintenance*	• Monitoring. • Evaluation of intended and actual benefits. • Local servicing of equipment. • Regional (international) interconnectivity and partnership.

There is no equivalence of article 4(1) and (5) of the Convention in the Paris Agreement. It is, however, arguable that article 2(1) which ties the Agreement to the "implementation of the Convention," in effect incorporates article 4(1) and (5). Again, read together, articles 9, 10, 11 and 12 of the Agreement—on finance, technology transfer, capacity building, and education—suggest that enablement is still a central component of the climate regime. But as shown later, the siloed approach to these provisions with each having a distinct implementing

26 The metrics are distilled from *Agenda 21,* Agenda 21 *supra* note 16 at paras 34.1–34.29; IPCC *supra* note 6; Bar-Zakay, *supra* note 13; and Everett, *supra* note 12.

27 Paragraphs 34.10 and 34.11 of Agenda 21 referenced the concept of "assured access for developing countries to (ESTs) in its relation to proprietary rights." The 'assured access' concept is more commonly employed in the 'global commons' discourse. (See for example, Mark Barrett et al, "Assured Access to the Global Commons" (2011), online (pdf): *NATO* <act.nato.int/images/stories/events/2010/gc/aagc_finalreport.pdf>. In that context, it means that all States, particularly developing States, should have unfettered access to ESTs regardless private proprietary right claims.

body (the Financial Mechanism (FM), Technology Mechanism (TM), and Paris Committee on Capacity-building (PCCB)), unlike the more integrated framework under the 1992 UNFCCC, puts the efficiency and effectiveness of the new regime to question. Article 11 of the Paris Agreement most supports the enablement theme explored here, although article 10 is the most explicit on technology development and transfer.[28] It is difficult to justify the creation of a different implementing body for article 11, given the inseverable connection between technology transfer and capacity building. While it is arguable that capacity building exceeds technology development, the earlier referenced United Nations Environment Program's (UNEP) definition of EST and IPCC's definition of EST transfer make it clear that technology includes sustainability enhancing knowledge.[29] Although the issue of integration of operation has been raised by the PCCB,[30] it has not been a front-burner issue. Nevertheless, the need for an enablement focused technology transfer and development framework under the climate regime is clear. As table 1 shows, the analysis in this work takes its cue from this premise.

3. AN APPRAISAL OF EST TRANSFER CHANNELS

As previously noted, there are three broad channels through which ESTs are transferred globally: UNFCCC facilitated initiatives, State initiatives, and non-State initiatives. What follows is an appraisal of these channels in the light of the above metrics. The countries used in this analysis have been selected based on the availability and/or accessibility of relevant documents. While these examples do not claim to be comprehensive, the findings align with trends observed in other works as will be shown.

3.1. UNFCCC Facilitated EST Transfer Initiatives in Africa

Rather than engaging in the direct transfer of ESTs, the UNFCCC primarily plays a facilitative role.[31] However, the Clean Development Mechanism (CDM) and the Poznan strategy are two of the rare instances where the UNFCCC plays a more direct role in facilitating transfer.

3.1.1. The Clean Development Mechanism

While the 1992 UNFCCC contained broad objectives and provisions on global climate governance, the 1997 Kyoto Protocol, made further to the UNFCCC, stipulated explicit and measurable emission reduction targets and modes of meeting these targets for annex

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28 While article 11(1) of the Paris Agreement provides that "Capacity-building under this Agreement should enhance the capacity and ability of developing country Parties, in particular countries with the least capacity … and should facilitate technology development, dissemination and deployment, access to climate finance, relevant aspects of education, training and public awareness, and the transparent, timely and accurate communication of information," article 10(1) provides that "Parties share a long-term vision on the importance of fully realizing technology development and transfer in order to improve resilience to climate change and to reduce greenhouse gas emissions." See *Paris Agreement, supra* note 1, arts 10(1), 11(1).

29 UNEP, *supra* note 4; IPCC, *supra* note 6 at 15–16.

30 PCCB, "Third Meeting Report" (20-22 June 2019), online (pdf): *UNFCCC* <unfccc.int/sites/default/files/resource/PCCB%203%20meeting%20report_FINAL.pdf>.

31 *Wei*, *supra* note 8.

I countries.[32] To ease the achievement of these targets, the Protocol provided for multiple channels, generally called “flexible mechanisms” for developed States: Joint Implementation, emission trading and the Clean Development Mechanism (CDM).[33] This section, however, focuses on the CDM as a transfer pathway.

Described as “one of the most innovative tools of the Kyoto Protocol,”[34] the CDM is a market driven mechanism which facilitates undertaking cost-efficient “climate enhancing” projects in developing countries in exchange for an “allowance to emit” in developed States. As noted elsewhere, the CDM’s rationale is that “the marginal cost of emissions reduction in developing … countries would be less than for developed ones.”[35] The Kyoto Protocol is, however, subtler in articulating the objectives of the CDM, highlighting instead, the assistance of non-annex I Parties to achieve sustainable development and annex I parties to achieve compliance with their emission reduction commitments.[36] Understanding that the CDM is primarily an economic device designed as an assistive tool for annex I States is crucial to appreciating its overall workings. It is in this context that the CDM’s sustainable development objective has been described as complementary.[37] Under the CDM, annex I States earn certified emission reductions (CERs) through projects carried out in developing States, with which they can meet their emission reduction commitments. To obtain CERs, however, the project is expected to involve the voluntary participation of parties, result in “real, measurable, and long-term benefits related to the mitigation of climate change,” and ensure “reductions in emissions that are additional to any that would occur in the absence of the certified project activity” (additionality).[38]

Although widely represented as a tool for EST transfer,[39] there is no explicit mention of technology transfer as an incidence of the CDM. Connection has, however, been drawn between the sustainable development objective and the necessity of EST transfer in operationalizing

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32 Developed and non-developed states are recognised as annex I and non-annex I countries under the 1992 UNFCCC and Kyoto Protocol. Under both regimes, climate obligations were differentiated depending on whether a State is annex I or non-annex I. See e.g. *UNFCCC, supra* note 2, art 4(2).

33 See *Kyoto Protocol, supra* note 8, arts 3, 4, 6, 12, 17.

34 Antoine Dechezleprêtre et al, “The North-South Transfer of Climate-Friendly Technologies through the Clean Development Mechanism” (2007) CERNA, École des Mines de Paris at 8; Carsten Warnecke, Thomas Day & Noémie Klein, “Analysing the status quo of CDM projects: Status and prospects” (2015) Research paper for the German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety, online (pdf): *New Climate Institute* <newclimateinstitute.files.wordpress.com/2015/05/newclimate_cdm_evaluation_summary_2015.pdf>

35 Michael W Wara, “Measuring the Clean Development Mechanism’s Performance and Potential” (2008) 55:6 UCLA L Rev 1759 at 1763.

36 See *Kyoto Protocol, supra* note 8, art 12(2).

37 UNFCCC, “The Contribution of the Clean Development Mechanism under the Kyoto Protocol to Technology Transfer” (2010) at 10, online (pdf): *CDM UNFCCC* <cdm.unfccc.int/Reference/Reports/TTreport/TT_2010.pdf.>

38 See *Kyoto Protocol, supra* note 8, art 12(5).

39 Malte Schneider, Andreas Holzer & Volker H Hoffmann, “Understanding the CDM’s contribution to technology transfer” (2008) 36:8 Energy Policy 2920 at 2936; Heleen De Coninck, Frauke Haake & Nico Van Der Linden, “Technology transfer in the Clean Development Mechanism” (2007) 7:5 Climate Policy 444 at 445.

the CDM.[40] In fact, developed States, like the United States, recognise the CDM as a vehicle and incentive for the transfer of ESTs.[41] A more direct link between CDM and EST transfer was subsequently established by the Conference of Parties (COP) in 2001 and 2006.[42] Outlining the information required in a project design document (PDD) to be submitted by a CDM project proponent, the 2001 and 2006 decisions require "a description of the project comprising the project purpose, a technical description of the project, including how technology will be transferred, if any."[43] While this requirement does not mandate technology transfer, it mandates the inclusion of information on technology transfer, if such transfer is intended. Although it might be argued that the CDM was not originally designed as an EST transfer mechanism, source-States, as shown above, consider it as such.

Various studies have been conducted on the performance of CDM as an EST transfer pathway.[44] As noted in several of these studies, only few CDM projects involve the transfer of ESTs.[45] It has also been found that transfer is more likely in larger projects as opposed to unilateral and small-scale projects.[46] The frequency of transfer decreases as the projects of the same type are repeated in the host countries, and projects involving energy efficiency, HFCs, N_2O, transportation and wind are more likely to involve technology transfer.[47] Although a considerable number of projects are said to entail the transfer of equipment and knowledge, the knowledge said to be transferred primarily deals with operation and maintenance, as

40 UNFCCC, *supra* note 32 at 12.

41 See *Development and Transfer of Technology: Status of the Consultative Process,* 4/CP.4, 13th Sess, SBSTA, 2000, UN Doc FCCC/SBSTA/2000/8.

42 Preamble to Decision 17/CP.7 *inter alia* states that "clean development mechanism project activities should lead to the transfer of environmentally safe and sound technology and know-how in addition to that required under Article 4, paragraph 5, of the Convention." See *Modalities and Procedures for a Clean Development Mechanism as defined in Article 12 of the Kyoto Protocol,* Dec 17/CP.7, UNFCCCOR, UN Doc FCCC/CP/2001/13/Add.2.

43 *Ibid,* Appendix B at para 1(a); *Modalities and Procedures for a Clean Development Mechanism as defined in Article 12 of the Kyoto Protocol*, Dec 3/CMP.1, UNFCCCOR, FCCC/KP/CMP/2005/8/Add.1, Appendix B at para 2(a).

44 Patrick Karani, "Technology transfer to Africa-Constraints for CDM operations" (2002) 3:3 Refocus 20; Schneider, Holzer & Hoffmann, *supra* note 39; Wytze van der Gaast, Katherine Begg & Alexandros Flamos, "Promoting sustainable energy technology transfers to developing countries through the CDM" (2009) 86:2 Applied Energy 230; Dechezleprêtre et al, *supra* note 34; Ana Pueyo & Pedro Linares, "Renewable Technology Transfer to Developing Countries : One Size Does Not Fit All" (2012) Institute of Development Studies Working Paper No 412; Stephen Seres, "Analysis of Technology Transfer in CDM Projects: Report for the UNFCCC Registration & Issuance Unit CDM/SDM" (December 2007), online (pdf): *UNFCCC* <cdm.unfccc.int/Reference/Reports/TTreport/TTrep07.pdf>.

45 A study, for example, found that of the 4984 projects in the CDM pipeline in 2010, 2262 specifically indicated that there would be no technology transfer, 1206 PDD had no mention of technology transfer, while 1516 projects were expected to involve technology transfer. Of the 1516 projects entailing technology transfer, 515 involved the transfer of equipment alone, 209 projects transferred knowledge only, and 792 projects entailed transfer of equipment and knowledge. See UNFCCC, *supra* note 32 at 16; see also Dechezleprêtre et al, *supra* note 34 and Schneider, Holzer & Hoffman, *supra* note 39.

46 *Ibid.*

47 UNFCCC, *supra* note 32 at 18.

against actual capacity building to re-invent and produce technologies.[48] As would be shown later, the focus on the transfer of hardware technologies, and operation and maintenance level knowledge (software) is a common feature that features in the various transfer channels considered in this article.

Unlike Asia and Latin America, Africa has considerably few CDM projects, with most of the existing projects concentrated in South Africa.[49] For example, of the 8,366 projects in the CDM pipeline as of May 2018, only 242 (2.9 percent) are located in Africa.[50] Reasons for the paucity of projects range from the disincentivizing business environment to the absence of institutional capacity.[51] Olawuyi notes that due to their high emissions, countries like China, India and South Africa boast of large CDM projects.[52] Apart from the paucity of African CDM projects, the few existing projects are unsustainable. Warnecke et al. found in 2015 that only 46 percent of CDM projects in Africa have been completed, while only 29% of surveyed African projects were in regular operation.[53] Existing African-CDM studies, however, focus generally on the performance of CDM on the continent, with ancillary reference to the impact on technology transfer. Reviewing select PDDs and data on the United Nations Environment Program (UNEP) CDM pipeline platform, an attempt is made to appraise the trend of CDM projects in Africa and their EST transfer implications below. The CDM spreadsheet shows about 236 CDM projects executed (or being executed) in Africa.[54] Although a comprehensive assessment of the projects is not possible here, a sample review of registered CDM projects in Nigeria and Kenya provide some indicators as to how effective CDM has been as a tool of transfer.[55]

As of May 2018, Nigeria had seven registered CDM projects.[56] With the exception of the Asuokpu/Umuti gas recovery project, six of the projects made reference to technology

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48 Nicolas Kreibich et al, "An update on the Clean Development Mechanism in Africa in times of market crisis" (2017) 9:2 Climate & Development 178 at 188.

49 *Ibid* at 178.

50 UNEP DTU Partnership, "CDM Projects by Host Region" online: *Centre on Energy, Climate and Sustainable Development* <cdmpipeline.org/cdm-projects-region.htm#1>

51 *Ibid*. See also Damilola S Olawuyi, "Achieving Sustainable Development in Africa through the Clean Development Mechanism: Legal and Institutional Issues Considered" (2009) 17:2 African J Intl & Comparative L 270.

52 About 70% of CDM projects are said to be concentrated in China and India. As noted by Olawuyi, for a project to be deemed cost effective, it should deliver at least 100,000 CERs per year, and only countries generating about 10,000–20,000 metric tons of CO_2 are presumed attractive. *Ibid* at 284. See also Axel Michaelowa & Frank Jotzo, "Transaction costs, institutional rigidities and the size of the clean development mechanism" (2005) 33:4 Energy Policy 511.

53 See Warnecke, Day & Klein, *supra* note 39 at 44; Kreibich et al, *supra* note 49 at 182.

54 UNEP DTU Partnership, *supra* note 50.

55 See e.g. *The South African DNA Project Approval Process*, Designated National Authority, online (pdf): *Designated National Authority* <energy.gov.za/files/esources/kyoto/dnaapproval.pdf>. See UNFCCC, Clean Development Mechanism, *Gas Flare Recovery at Suez Oil Processing Company Egypt*: *Clean Development Mechanism Project Design Document Form Version 03*, (28 July 2006).

56 Associated gas recovery process at Kwale oil-gas processing plant; efficient fuel wood stoves for Nigeria; recovery and marketing of gas that would otherwise be flared at the Asuokpu/Umuti Marginal Field; LFG Project in Nigeria; Lafarge WAPCO partial substitution of alternative fuels in cement facilities project

transfer. The commitments made were, however, generally couched without reference to particular steps to ensure transfer. The Kwale gas recovery PDD, for instance, referred to "technology transfer and improvement of local know-how, through the adoption of a reliable state of the art gas engineering technology."[57] The efficient fuel wood stoves project (SAVE80 project) provides more details on its transfer component.[58] This project was, however, fraught with affordability and accessibility issues due to high cost and custom hitches.[59] However, if manufactured in-country, customs hitches would not have been a major challenge. It is apparent that an assemblage, maintenance or operational capacity transfer is insufficient to foster actual technology transfer.[60] From the foregoing, it can be reasonably concluded that the SAVE80 project does not satisfy the requirements of availability, affordability, adaptability and sustainability.

in Nigeria; recovery and utilization of associated gas from the Obodugwa and neighbouring oil fields in Nigeria; and Kainji Hydropower rehabilitation project. See Clean Development Mechanism, "Project Search" (2019), online: *Clean Development Mechanism* <cdm.unfccc.int/Projects/projsearch.html> [perma.cc/6Z5N-PTDT]. It is, however, worth noting that the projects are dominated by gas (flaring) recovery projects. Given that the Nigerian Associated Gas Re-injection Act, CAP A25 LFN 2004, s 3, prohibits the flaring of gas in the country, it is doubtful if the projects would have met the condition of additionality, since the law already compels the non-flaring of gas. Expectedly therefore, without the projects, oil and gas companies are mandated to do the same thing the project supposedly facilitate(d). Again, the focus on gas recovery projects reflects the market-centric and profit propelled nature of the CDM. Since the Global Warming Potential (GWP) of methane (CH_4) is put at 1 tonne of CH_4 to 28 tonnes of CO_2, it is not surprising that companies from annex II countries prefer such projects as they stand to get more Certified Emission Reduction (CER) credits from the projects. See also Kate Ervine, *Carbon* (Cambridge: Polity Press, 2018) at 93–96.

57 Clean Development Mechanism, "Project Design Document Form (CDM-PDD) " (15 May 2006) at 54, online (pdf): *Clean Development Mechanism,*<cdm.unfccc.int/filestorage/T/2/N/T2N9G73GCSUW91EJUE7BJRW9NGIOLU/Final%20PDD-Nigeria%20_03_08_06.pdf?t=aTh8cTRxNzhpfDBDFtddK33W9eiYH7tMX2m4>.

58 The project entails the SAVE80 system, a firewood efficient stove prefabricated in Germany and shipped to Nigeria for assemblage. The proponent noted its intention to produce the system locally, once there is a 'reasonable' Nigerian market. While 5500 stoves were originally sold at reduced price to users, the high purchase price of the stove and the absence of local manufacturing capacity are few of the challenges which have stifled the project. Clean Development Mechanism, "Project 2711: Efficient Fuel Wood Stoves for Nigeria" (January 2020), online: *Clean Development Mechanism,* <cdm.unfccc.int/Projects/DB/RWTUV1245685309.5/view> [perma.cc/MUX8-N25Z].

59 Oliver Adria, "Residential Cooking Stoves and Ovens: Good Practice Technology: Save 80 Stove" (2014) at 5, online (pdf): *Big EE* < www.bigee.net/media/filer_public/2014/10/08/bigee_residential_cooking_stoves_good_practice_save80.pdf>; see also Yahaya Ahmed, "The Save 80 Woodstove Project: Highly Efficient Fuel Wood Saving Cooking Stoves for Nigeria – a CDM Project 2711" (2011) at 69, online (pdf): *UNEPFI* <www.unepfi.org/fileadmin/events/2011/lagos/Save80CDMProjectPart2.pdf>.

60 Another example is the Obodugwa gas recovery and utilization project, which noted that while the compression equipment will be built in the USA, Nigerian engineers will be trained in the "installation, operation and maintenance of this equipment." See CDM, "F-CDM-PDD" (2012) at 9, online (pdf): *UNFCCC* <cdm.unfccc.int/filestorage/o/q/LTE4YOD03G6N5CX8HRZUA9SKJP2VMB.pdf/P%20081112%20Final%20Obodugwa%20PDD%20public%20vers.pdf?t=V018cTVsbmFvfDA0FP-xGNudSiypQxThTBFv>.

Kenya presently has nine registered CDM projects.[61] While two of the projects explicitly stated that there will be no technology transfer[62] and one project made a tangential reference to the transfer of skills, transfer was more directly provided for in six projects. Like in the Nigerian example, the six CDM projects with explicit transfer provisions provided for both hardware transfer and capacity development. However, the capacity development pertained to the operational and maintenance training of personnel.[63] The Olkaria III Phase 2 Geothermal Expansion Project is an example of how Kenyan CDM projects fail the adaptability metric. While the project has been lauded as a success and an example to other African countries,[64] its transfer impact has received less applause. The project is operated by Orpower 4, Inc, a Kenyan subsidiary of an American company, Ormat, which began the first phase of the project in the late 1990s.[65] Although it has been suggested that the project has resulted in "technology transfer from Ormat to its counterparts," a recent paper in respect of Olkaria IV, operated by Kenya Electricity Generating Company Limited (KenGen) found otherwise.[66] It noted that Olkaria IV's challenges include:

> Poor knowledge by the client. The client lacks the expertise to carry out design and installation of the power plant and has to rely on the consultant and the EPC contractor. Knowledge transfer was inadequate, and this therefore means that the client is still inadequately staffed.[67]

The above survey of the technology transfer dimensions of CDM projects in Nigeria and Kenya lead to some conclusions, including that:

1. Technology transfer is, at best, ancillary to CDM. Thus, it is not a priority for project proponents in the design and/or execution of projects.

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61 The projects are made up of five reforestation projects, and four geothermal, biofuel, energy efficiency and wind electricity generation projects. See <cdm.unfccc.int/Projects/projsearch.html>.

62 Both projects were on the reforestation of Aberdare forest complex and MAU forest complex. The unilateral nature of the project (as it was internally financed by the Kenyan Ministry of Finance) could account for the absence of transfer, as transfer is in this context deemed inter-state.

63 For example, the 5.1MW Grid connected wind electricity generation at Ngong Hills, Kenya, stated in its PDD that "know how transfer is provided by training local personnel to operate the turbines." See CDM, "F-CDM-PDD" (2014) at 7, online (pdf): *UNFCCC* <cdm.unfccc.int/filestorage/F/6/0/F605JS3OBCM4TL9QWENA8DGI1PZUX2/Ngong_I__05_03_2014.pdf?t=WUx8cTRxOXgzfDD9wFRu4Z-PNpKktaC9R31d>. Also see the Karan Biofuel CDM project, which provided in its PDD that "State-of-the art Indian technology has been ordered as new and imported together with dedicated knowhow for commissioning and maintenance." See CDM, "F-CDM-PDD" (2012) at 9, online (pdf): *UNFCCC* <cdm.unfccc.int/filestorage/x/u/XWRFESV1D0G6B8YZ7POL4HMIN29Q35.pdf/PDD.pdf?t=QmR8cTRxYTgyfDAiVBiSK-aT9Eos9JAcgWU7>.

64 See Valerio Micale, Chiara Trabacchi & Leonardo Boni, "Using Public Finance to Attract Private Investment in Geothermal: Olkaria III Case Study, Kenya" (June 2015) *Climate Policy Initiative*, online (pdf): <climatepolicyinitiative.org/wp-content/uploads/2015/06/150601_Final_Olkaria_ForWeb.pdf>

65 The project uses Ormat designed and owned organic rankine-cycle turbines (also called Ormat Energy Converter (OEC)).

66 Pharis Mukeu & Reuben Langat, "Olkaria (Kenya) Geothermal Project Case Study" (2016) 40 GRC Transactions 85.

67 *Ibid* at 88.

2. Technology transfer is not consistent with the economic framing of CDM. Companies engage in CDM primarily to obtain CERs and to make profit. A wholesale transfer of technology (hardware, software and orgware) is, arguably, bad news for multinational companies' (MNC) bottom-line. Hence, as shown in the Nigerian case where MNCs prefer CDM projects in gas flaring than projects which address the country's energy challenge, projects initiated by multi-national companies often do not align with the priorities of host states.

3. Most projects surveyed referred to technology transfer and, to some extent, capacity development. But capacity building is generally in the context of operations and /or maintenance, and rarely in terms of ground-up manufacturing and/or construction.

4. Claimed technology transfers in PDDs are generally inconsistent with evidence on the ground, as African countries remain dependent on Annex I countries (companies) several years after projects which claimed technology transfer are completed and handed over.

5. Except for the maintenance metric, the technology transfer components of surveyed CDM projects failed to meet the enablement metrics listed above.

6. CDM is focused on the transfer of mitigation technologies.[68]

Most of the conclusions reached here are supported by existing literature on CDMs in other contexts. For example, Murphy et al note the ancillary nature and mitigation focus of CDMs.[69] Reviewing PDD statements, they note that while 50 percent of 3,949 registered projects had no provision for technology transfer, only about 23 percent mentioned transfer of equipment, knowledge, or equipment and knowledge.[70] Murphy et al, however, did not go further to explore the kind of knowledge transferred as attempted here. The interesting point on the reduction in technology transfer CDM projects in countries like China and India compared to the growth in smaller countries has also been made.[71] No African country is, however, specified in the article as enjoying such growth. But even if argued, as recently done by Kim and Park, that African States and other underdeveloped markets benefit (or will benefit) from CDM facilitated transfer,[72] the question remains, what sort of transfer. This question is vital even as the rule books for market and non-market mechanisms under article 6 of the Paris Agreement are designed.[73] It is not enough that the market and non-market mechanisms aid the transfer

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68 The Kyoto Protocol, however, provides that "a share of the proceeds from certified project activities is used to … assist developing country Parties that are particularly vulnerable to the adverse effects of climate change to meet the costs of adaptation." See *Kyoto Protocol, supra* note 8, art 12(8).

69 See generally Kevin Murphy et al, "Technology Transfer in the CDM: An Updated Analysis" (2015) 15:1 Climate Policy 127.

70 *Ibid* at 130.

71 *Ibid* at 133.

72 Jeayoon Kim & Kwangwoo Park, "Clean Development Mechanism and Deployment of Renewable Energy: Evidence from Countries with Less Developed Financial Markets" (2018) KAIST Business School Working Paper No 2018-012 at 27 [Kim].

73 Article 6 allows for voluntary cooperation by countries in the implementation of their nationally determined contributions (NDCs), through which Internationally Transferred Mitigation Outcomes

of hardware technologies as experienced under the CDM, they should facilitate the transfer of upscale skills and know-how.

3.1.2. The Poznan Strategy

The Poznan Strategic Program on Technology Transfer (Poznan strategy) was the Global Environment Facility's (GEF) response to the COP's request that as the operational entity of the UNFCCC Financial Mechanism (FM), it consults with interested parties and institutions to "elaborate a strategic programme to scale up the level of investment for technology transfer to help developing countries address their needs for (ESTs)."[74] This mandate informed the GEF's long term implementation strategy under Poznan.[75] In appraising Poznan, emphasis will be placed on piloted priority technology projects in Africa. In its 2015 report, the GEF recorded three Poznan projects undertaken in Africa: the solar refrigeration project in Kenya and Swaziland (Solarchill), municipal solid wastes composting unit in Cote d'Ivoire, and thermal insulation material production in Senegal.[76]

Solarchill was conceived by a coalition of multilateral and non-governmental organisations in 2001.[77] This was in response to the need for an environment friendly vaccine solar powered refrigerator, with hydrocarbon-based compressor. Prior to Solarchill, vaccine refrigerators were kerosene or propane operated, with their consequent inefficiency, high cost of procurement and adverse environmental impact.[78] Again, the vaccine refrigerators made use of hydrofluorocarbons (HFCs) and hydrochlorofluorocarbons (HCFCs) as refrigerant and blowing agents, respectively.[79] According to the project's Project Identification Form (PIF), the project was designed to determine technical performance and potential market demand for

will be obtained by the intervening state. States can either engage bilaterally or under a more central mechanism. Interestingly, 'technology transfer' is not stated as an objective of the mechanism under art. 6(4). Although it has been stated elsewhere that, like the CDM, it could be a vehicle for technology transfer if well implemented. See International Chamber of Commerce, "Article 6: What is it and Why is it Important" (18 July 2019), online: *International Chamber of Commerce* <iccwbo.org/media-wall/news-speeches/article-6-important/>.

74 *Development and Transfer of Technologies under the Subsidiary Body for Implementation*, Dec 4/CP.13, UNFCCCOR, 2007, UN Doc FCCC/CP/2007/6/Add at 1, 3.

75 The long-term plan entails support for climate technology centres and a climate technology network, piloting priority technology projects to foster innovation and investments, public-private partnerships (PPPs) for technology transfer and GEF as a catalytic supporting institution for technology transfer. See Chizuru Aoki et al, "Implementing the Poznan Strategic and Long-Term Programs on Technology Transfer" (2012) at 6, online (pdf): *The Global Environment Facility* <thegef.org/sites/default/files/publications/GEF_PoznanTT_lowres_final_2.pdf>.

76 *Evaluation of the Poznan Strategic Programme on Technology Transfer: Final Report by the Technology Executive Committee*, 43rd Sess, UN Doc FCCC/SBI/2015, Annex III.

77 Solarchill Development, "About" (2019), online: *Solarchill* <solarchill.org/english/about/>.

78 Global Environment Facility, "Project Identification Form (PIF), GEF Project ID 4682" (12 October 2011) at 8, online (pdf): <thegef.org/sites/default/files/project_documents/SolarChill%2520PIF%2520GEF_28092011.pdf>.

79 *Ibid.*

Solarchill technology, support the modification and optimization of the technology, attract potential manufacturers, and support governments in countries with production capacity.[80]

Given that Solarchill is, largely, an open sourced technology and local adaptation was a central component of the project design, Swazi owned and staffed company, Palfridge, has been an active partner in the design, manufacturing and adaptation of the Solarchill technology.[81] Palfridge is reputed to have adapted the technology to suit tropical climates.[82] These positives notwithstanding, the huge capital cost of the Solarchill technology has been identified as its major challenge.[83] More fundamentally, it is doubtful if Solarchill aligns with the African State's priority technology needs. For example, it is difficult to place the project under any of the needs identified in Kenya's 2005 and 2013 mitigation Technology Needs Assessments (TNA).[84] Again, Swaziland's 2016 TNA only pertains to adaptation needs.[85] This issue mirrors the observation of the Technology Executive Committee (TEC) in its 2015 evaluation of Poznan. It stated that rather than demand-tailored Poznan initiatives, some projects "had taken more of a technology-push approach, resulting in weakened relevance for country stakeholders and a difficulty in finding partners willing to invest in the technology."[86]

Similar trends as the Solarchill projects can be observed in the Poznan facilitated projects in Senegal and Cote d'Ivoire.[87] To varying extents, the projects actively engaged and involved local companies from the manufacturing/construction stage.[88] The issue of whether the projects are prioritised needs, however, surfaces again. If TNAs are indicators of prioritized EST needs of countries, the non-reference to the countries' TNAs in the projects' Project Identification Forms are suggestive of the non-priority status of these projects.

Overall, as shown in table 5, when appraised with the enablement metrics set out above, the Poznan strategy ticks most of the criteria apart from "compatibility". Most of the projects do not appear compatible with host states' priorities. As noted already, this finding aligns with

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80 *Ibid.*

81 *Ibid* at 12.

82 *Ibid.*

83 *Ibid.*

84 See generally, *Kenya's Climate Change Technology Needs and Needs Assessment Report Under the United Nations Framework Convention on Climate Change* (National Environment Management Authority, 2005) 56–64; *Technology Needs Assessment and Technology Action Plans for Climate Change Mitigation* (National Environment Management Authority, 2013) at 31–32.

85 Deepa Pullanikkatil, "Swaziland Technology Needs Assessment Report 1–Climate Change Adaptation" *(*15 June 2016), online (pdf): *Technology Needs Assessment* <tech-action.unepdtu.org/wp-content/uploads/sites/2/2019/03/swaziland-adaptation-tna-report.pdf>.

86 Kim, *supra* note 72 at para 66.

87 See *Technology Transfer: Typha-based Thermal Insulation Material Production in Senegal*, GEF Project ID 4055, online: <thegef.org/project/tt-pilot-gef-4-technology-transfer-typha-based-thermal-insulation-material-production>; See Global Environment Facility, "Construction of 1000 Ton per day Municipal Solid Wastes Composting Unit in Akouedo Abidjan" online: *Global Environment Facility* <thegef.org/project/tt-pilot-gef-4-construction-1000-ton-day-municipal-solid-wastes-composting-unit-akouedo>.

88 This is, however, less so in the case of the Ivorian composting unit projects, developed by Chinese company Tianjin Universal Machinery Import & Export Corporation as a turn-key project.

the conclusion of the TEC in its 2015 evaluation of Poznan.[89] Given its more holistic approach to technology transfer (hardware, software and orgware), emphasis on local cooperation, and adaptability of Poznan projects (like the Solarchill project), Poznan provides a better template for EST transfer initiatives than the CDM. This makes evident the difference between a programme specifically designed for technology transfer (Poznan) and an economic concept with an ancillary transfer component (CDM). Like CDM, Poznan projects were not without commercial returns to the private entities involved in them. The difference, however, was that the transfer requirement was made an essential component, and not a waivable condition like it was with CDM. Importantly, Poznan's location within the Financial Mechanism allows for a coordinated approach to project design and finance.

3.2. State EST Transfer Initiatives in Africa

A recurrent theme in the above analysis is the subject of compatibility of implemented projects under the CDM and Poznan. The effectiveness of a transfer project is, essentially, a question of compatibility: Is the project aligned with the prioritized need(s) of the recipient State? The tables below provide some informed response to this query. The first table contains the technological needs and barriers identified by Ghana, Mauritius and Kenya between 2003/2005 (1st TNA) and 2012/2013 (2nd TNA) as contained in their TNAs and project ideas. The second table contains the technology transfer initiatives of the European Union, the USA and Japan within the same timeframe. Reference is also made to the 1st (2006), 2nd (2009) and 3rd (2013) TNA synthesis reports of the UNFCCC. Ghana, Mauritius and Kenya have been selected as they are some of the few African States that submitted multiple TNAs to the UNFCCC. Using them as case studies, commonalities in their TNAs are identified. The identified needs are compared with the prioritized interventions of source States.

89 Kim, *supra* note 72.

Table 2 - Recipients' Needs[90]

Country	1st TNA	2nd TNA	Project Ideas	Barriers
Ghana	**Mitigation:** Energy efficient lighting using compact fluorescent lamps (CFL), Industrial energy efficiency, Landfill Methane Gas Recovery	**Adaptation:** Integrated Monitoring and Early Warning System, Integrated Nutrient Management, community-based extension agents	• Provision of 100 run-off storage facilities (1 million m^3 each) for 100 rural communities • Capacity building in post construction support for community managed water systems	Economic and financial barriers, inadequate technical capacity, institutional barrier (lack of community ownership, conflicting sectoral policies)
Mauritius	**Mitigation:** Demand side Management, bi-fuel vehicles and traffic lights coordination, landfills, treatment plans and composting/ recycling **Adaptation:** Extension of irrigation facilities, adoption of new agricultural techniques, composting and trash blanketing, setback distance enforcement, coral reef protection artificial growth, water recycling	**Mitigation:** Wind turbines (utility scale), PV (> 1 MW), EE Boilers **Adaptation:** Desalination, rainwater harvesting, hydrological model, upscaling local integrated pest management technologies, micro irrigation (gravity fed drip & mini and micro sprinkler irrigation), decentralized pest and disease diagnosis service, restoring coastal vegetation, wetland protection, dune restoration, rock revetment	• Desalination plant with production capacity of 300 m^3/ day, treating either seawater with salinity greater than 10,000 ppm or brackish water with salinity of 1000-10,000 ppm • Simply designed roof top rainwater harvester with complete piping, 600 L capacity tanks and absorption pit • Implement hydrological model technology within five years	Economic and financial (High cost capital, inappropriate financial incentives and disincentives), legislations, lack of skilled technical staff

90 The information contained here are synopses of the contents of TNAs, TAPs, project ideas and barriers submitted by Ghana, Mauritius and Kenya between 2003/2004 and 2012/2013. While an attempt is made to capture vital contents, the table is not a comprehensive representation of all the documents submitted by the countries.

Country	1st TNA	2nd TNA	Project Ideas	Barriers
Kenya	**Mitigation:** Power plant efficiency improvement, fuel switching, energy efficient appliances, improved live-stock manage-ment, improved rice cultivation, water recycling and composting **Adaptation:** Human capacity development and advanced technolo-gies in Global Atmosphere and Carbon Cycle Observation.	**Mitigation:** Solar Home Systems (SHS) and Solar Dryers, Methane capture from bio-digesters and wastepaper recycling **Adaptation:** drought resistant sorghum drip irrigation, hay preservation, roof rainwater harvest-ing, surface runoff water harvesting, and solar powered desalination	• Diffuse 165,000 SHS units by 2017, target 83,000 households annually in 24 counties, reach 332,000 households by 2018 and provide access to 1.5 million households by 2030At least 120,000 households should have access to biogas by 2030 • Introduction of 10,000 surface runoff water harvesting systems, 50,000 roof rainwater harvesting units and 500,000 drip irrigation for agriculture and household use • Introduction of drought tolerant sorghum varieties to 100,000 farmers in 10 selected Arid and Semi Arid Land (ASAL) counties by 2017	Economic and financial (high initial investment, lack of subsidies, high interest rates), inadequate information and awareness, lack of research and development, weak regulatory framework, inadequate skilled personnel, inadequate legal framework, lack of market links.

Table 3 - Sources' Initiatives

Source	1st National Communication	2nd National Communication	3rd National Communication
EU	• The Regional solar programme (phase II) (drinking water systems) – Sahelian countries • Capacity Building of Developing NGOs to implement Principle 10 – • Cameroon, Malawi, South Africa, Uganda, Zimbabwe • Framework for designing afforestation, reforestation and revegetation projects in the CDM – Kenya, Uganda • Clean Air Initiative – Sub-Saharan Africa • Tropical forests and climate change adaptation (criteria and indicators) – Burkina Faso, Mali, Ghana	• Development support for generating biomass from household waste – Rwanda • Community-based Natural Resource Management Enterprise Support – Namibia • Village Tree Enterprise Project – West Africa • Mobilization and reinforcement of the capacity of SMEs involved in forest related products – Central Africa • Installation of a steam engine powered generation set at Charter Sawmill – Zimbabwe • Hydro, Biopower projects – Ethiopia • The Regional Solar Programme – Sahelian countries	• Chololo Ecovillage (Integrated Approach to Adaptation and Resilience) – Tanzania. • Improving livelihoods and food security in rural Uganda • Mainstreaming of climate change into national systems and policies – Mozambique
USA	• Famine Early Warning System Network (assessment of vulnerability to food insecurity) – Kenya, Malawi, Mali, Mauritania, Niger, Mozambique, Rwanda, Somalia, Sudan, Uganda, Zambia, Zimbabwe • Methane recovery and use as a clean energy source (framework for encouraging investment in carbon capture) – Nigeria	• Establishment of SERVIR (a regional visualization and monitoring system) regional operational facility for East Africa – Kenya • Construction of Coalbed Methane power plant – Botswana • Geothermal Power Generation – Ethiopia	• Increased capacity to utilize geospatial information – East Africa. • Famine Early Warning System Network (assessment of vulnerability to food insecurity) – West, East and South African countries. • Forest carbon monitoring and measurement – Gabon, Congo.

Japan	• Group training course to develop National Inventories and Strategies against Climate Change – Senegal, Cote d'Ivoire and Sao Tome and Principe	• Community-based flood disaster management to adapt in the Nyando River Basin – Kenya • Zafarana Wind Power Plant Project – Egypt	• Desalination plan of groundwater – Tunisia • System of measures against illegal logging of tropical forest – Togo • Promoting sustainable forest management – Africa • Developing countermeasures against landslide – Ethiopia • Ground water development – Tanzania • Strengthening capacity of electric power pool – Eastern and Southern Africa

The following can be deduced from the above tables:

Recipient States

1. There is a marked difference between the technological needs of the recipient states surveyed under TNA 1 and TNA 2. While the first emphasized demand side mitigation technologies, the latter contains more supply side technologies.
2. Recipient States' technological needs primarily entailed community initiatives and/or simple (local) technologies. Except for few African States, like South Africa, highlighted needs were mostly subsistent rather than developmental.
3. Economic/financial and technical barriers were identified by all the recipient States.[91]
4. Most of the proposed projects by surveyed recipients were decentralised and often village or household based.
5. Water and agriculture were identified as the priority adaptation areas by the surveyed recipients.

91 The same finding was made by the UNFCCC in its 1st, 2nd and 3rd synthesis reports. See SBSTA, "Synthesis Report on Technology Needs Identified by Parties not Included in Annex I to the Convention" 2006, 24th Sess, UN Doc FCCC/SBSTA/2006/INF.1 at 24; SBSTA, "Second Synthesis Report on Technology Needs Identified by Parties not Included in Annex I to the Convention" 2009, 30th Sess, UN Doc FCCC/SBSTA/2009/INF.1 at 29; SBSTA, "Third Synthesis Report on Technology Needs Identified by Parties not Included in Annex I to the Convention" 2013, 39th Sess, UN Doc FCCC/SBSTA/2013/INF.7 at 25.

6. While identifying lack of capacity as a barrier, none of the sampled recipients listed collaborative research and development centres in their project ideas.
7. Despite the entrenched position of developing states that intellectual property rights constitute a barrier to EST transfer,[92] none of the sampled recipients identified patent or intellectual property rights as a barrier.

Source States

1. Most of the initiatives by source-States, focused on (soft) capacity building, as against transfer of hardware technologies or technology development know-how.
2. It is unclear in the national communications, whether the TNAs or proposed project ideas by recipient States played any role in the project undertaken by source-States.
3. Taking Kenya as an example, while all the surveyed source-States initiated transfer projects in the country, only the geospatial observation and information demand (in Kenya's 1st TNA) seems to have been responded to.
4. Although source-States referenced collaborative R&D projects in Asian and Latin American States, no such project was referred to in respect of the recipients sampled.

Locally accessible technologies are prevalent in the project ideas of recipient-States. Furthermore, none of them identified patent as a barrier. There are few likely reasons for the prevalent reference to locally accessible technologies. One is the TNA process which is structured to guide recipient-States to prioritise sectors and technologies from a pool of needs.[93] Sub-Saharan African States generally prioritise water and agricultural sectors, which reflect their immediate needs.[94] The relevant technologies in respect of these sectors are largely available in the recipient-States, whether by reason of traditional practices (e.g. rainwater conservation) or the commonness of the technology (e.g. water desalination). The main barrier faced by the States is lack of financial resources to provide the available technologies to their citizenry. Consequently, it is doubtful if the scenario described above constitutes technology transfer in its strict sense. International technology transfer essentially entails a home country, host country and transaction component (transferred technology hitherto unavailable in the host State).[95]

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92 See International Centre for Trade and Sustainable Development, "The Climate Technology Mechanism: Issues and Challenges" ICTSD Information Note Number 18 (2011) at 3, online (pdf): *International Centre for Trade and Sustainable Development* <ictsd.org/downloads/2011/04/technologymechanism.pdf>.

93 United Nations Development Programme (UNDP), "Handbook for Conducting Technology Needs Assessment for Climate Change" (2010).

94 According to the GEF, as of June 2012, 66% of adaptation projects under the Poznan long term program were carried out in Africa, this is as against 12% of mitigation projects. Hence, while the continent ranked the highest as per adaptation projects, it came near-last in respect of mitigation projects. See Aoki, *supra* note 75 at 24–25.

95 N Mohan Reddy & Liming Zhao, "International technology transfer: A review" (1990) 19:4 Research Policy 285 at 285.

The non-recognition of IPRs/patent as a transfer barrier is also tied to the foregoing analysis. Since the technologies are largely available in-State, the issue of patent/IPRs as a barrier is unlikely. This is however different for South Africa, which prioritised ESTs like solar power, clean coal technologies, wind power, new crop species and cultivars, information technology, vulnerability research, water efficiency technology and climate-sensitive building design.[96] Hence, although referencing the need for in-State capacity and "creation of an enabling environment and supporting systems" as crucial, intellectual property issues were ranked as a major barrier.[97]

As well, it appears that the more sophisticated the technological needs, the higher the possibility of patent and other market incidences constituting a barrier to transfer. This conclusion mirrors John Barton's finding that while basic approaches to solving technological problems have long been off-patent, improvements on or new features of such technologies are often patented.[98] Another point identified by South Africa is the need to co-develop technologies to aid more effective transfer. This is a subject not contained in other TNAs surveyed. Again, this can be attributed to the kind of uncomplex technologies prioritised by Ghana, Kenya, and Mauritius.

3.3. Non-State EST Transfer Initiatives in Africa

So far, examples of State to State transfer initiatives have been reviewed through the lenses of direct transfers by States or through specific UNFCCC programmes. Transfers through corporations and NGOs are vital mediums of transfer. Indeed, corporate channels—foreign direct investment, commercial lending and equity investment—are, according to the IPCC, some of the important channels of EST transfers.[99] This assertion is, however, largely anecdotal. This is partly because it is difficult to track the level of technology transfer in the normal course of a company's business, and even more so the software and orgware components of technology transfer. Having corporations as the dominant medium of transfer is a relatively recent trend. Until the early 2000s, States, through channels like the Official Development Assistance (ODA), were more dominant in the transfer venture. Such State interventions have "become relatively less important … given the dramatic increase in opportunities for obtaining private sector financing for technology acquisition."[100] Analyzing the transition from ODA to corporate channels, the IPCC identified three concerns: the selectiveness of the private sector given the unattractiveness of many developing countries' markets; private sector's involvement is comparatively low in sectors like agriculture, forestry, health and coastal zone management; and the volatility of private investment modes like foreign portfolio, equity investment and

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96 South African Department of Science and Technology, "South Africa's Climate Change Technology Needs Assessment: Synthesis Report" (2007) at 13, online (pdf): *UNFCCC* <unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TNR_CRE/e9067c6e3b97459989b2196f12155ad5/9ecba2a40fe04948859b9930a40be9f7.pdf>.

97 *Ibid* at 40.

98 John H Barton, "Intellectual property and access to clean energy technologies in developing countries: An analysis of solar photovoltaic, biofuel and wind technologies" (2007) 2 ICTSD Programme on Trade and Development 17.

99 IPCC, *supra* note 6 at 17.

100 *Ibid.*

commercial lending.[101] In the IPCC's words: "[m]any developing countries have found to their distress that private investment can quickly dry up if investors perceive more attractive—or less risky—opportunities elsewhere."[102]

About two decades after the above findings, little has changed. The preference of EST companies for BASIC (Brazil, South Africa, India, and China) States, particularly China and India, is supported by research.[103] Table 4 gives an idea of this disparity between 2000 – 2006:[104]

Table 4 (*Billions of USD*).

Region	Total Capital Inflows	Total Equity Inflows	Total Debt Inflows
Developing Asia	145.53	116.33	27.20
Europe and Central Asia	108.50	49.43	59.07
Latin America and Caribbean	69.41	68.90	0.51
Middle East and North America	10.78	10.35	0.43
Sub-Saharan Africa	16.81	16.91	-0.3

In some ways, it is not farfetched to attribute the low level of EST transfers to Africa to the level of private investment, since such investment is the dominant pathway for technology transfer.[105] It has been shown above that African countries surveyed under the review of State transfer initiatives prioritise water and agriculture technologies. These projects generally do not attract investment. The IPCC points out that investment has been generally directed towards niche (e.g. solar and wind power) and protected markets.[106] Even when African countries prioritise energy related technologies, like solar, the need to adapt the technology to suit the unique terrain of such countries, vis-à-vis the financial incapacity or market prospects of these countries, does not incentivize investment.[107] Another valid concern is that political instability and regulatory gaps in many African countries disincentivize investment.[108] This, in part, exposes the anomaly of subjecting ESTs to the vagaries of the marketplace. It brings to the fore the dangers of a marketized EST regime in lower tier developing States, particularly in some African countries. Due to demographic and economic factors, these countries might not have markets as attractive as China, India and Brazil, and their political terrain might remain

101 *Ibid* at 18.

102 *Ibid.*

103 See generally Barton, *supra* note 99.

104 Bilal Keskinsoy, "A Data Survey on International Capital Inflows to Developing Countries" (5 May 2017) at 19, online (pdf): *Munich Personal RePEc Archive* <mpra.ub.uni-muenchen.de/78957/1/MPRA_paper_78957.pdf>.

105 See generally Olawuyi, *supra* note 15.

106 IPCC, *supra* note 6 at 244.

107 Dalindyebo Shabalala, "Technology Transfer for Climate Change and Developing Country Viewpoints on Historical Responsibility but Common but Differentiated Responsibilities" in Joshua D. Sarnoff, ed, *Research Handbook on Intellectual Property and Climate Change* (Cheltenham: Edward Elgar Publishing, 2016) 174. See also UNFCCC, Technology Executive Committee, *Enhancing Access to Climate Technology Financing*, TEC Brief #6 (2015), online (pdf): *UNFCCC* <unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEC_documents/204f400573e647299c1a7971feec7ace/ea65db0ca9264cdbaefeb272dd30b34c.pdf>.

108 See Olawuyi, *supra* note 15.

unstable, though the needs of their people remain. It is important that the needs of persons in developing States, rather than the economic and/or regulatory structures of the recipient-State become the chief driver of EST investment decisions. Climate technology needs in African countries experiencing climate induced drought and acute energy poverty are human rights needs.[109] The transfer of ESTs should, therefore, be done in the same way humanitarian interventions are made in countries without the condition precedent of regulatory reforms. This does not mean internal reforms are not necessary, it only means that transfers should not be made contingent on them.

The inability of African States' markets to attract EST transfer investments make the non-market transfer initiatives of corporate entities important EST acquisition channels.[110] As shown in the Eco-patent commons example, however, the effectiveness of non-market initiatives is contingent on its design and adaptive implementation.[111] The objectives of the initiative included providing an avenue through which environment-protective innovations and solutions can be shared easily and lead to other innovation and the promotion of collaboration between "businesses that pledge patents and potential users to foster further joint innovations."[112] However, eco-patent, like other similar initiatives, while removing some restrictions to the use of patented ESTs, stopped short of contributing them to the public domain for open access.[113] Further, technologies contributed by participating companies were those which had no impact on "business advantage".[114] This resulted in the contribution of low quality patents by the companies.[115] Contreras et al, also found that the pooling of patents for complex technologies, without technical assistance for the adaptation and use of

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109 Oche Onazi, "Access to Essential Environmental Technologies and Poor Communities: Why Human Rights should be Prioritized" in Abbe EL Brown, ed, *Environmental Technologies, Intellectual Property and Climate Change: Accessing, Obtaining and Protecting* (Cheltenham: Edward Elgar, 2013) at 191–194; Baskut Tuncak, "The 'new normal': food, climate change and intellectual property" in Abbe EL Brown, ed, *Environmental Technologies, Intellectual Property and Climate Change: Accessing, Obtaining and Protecting* (Cheltenham: Edward Elgar, 2013), 223–241; International Council on Human Rights Policy (ICHRP), *Beyond Technology Transfer: Protecting Human Rights in a Climate-Constrained World* (Geneva: ICHRP, 2011) at 3–4.

110 See Anna Davies, "Partnership and Sharing: Beyond Mainstream Mechanisms" in Abbe EL Brown, ed, *Environmental Technologies, Intellectual Property and Climate Change: Accessing, Obtaining and Protecting* (Cheltenham: Edward Elgar, 2013) 108.

111 Eco-Patent was established by IBM, and before it folded up in 2016, had 11 companies (Bosch, Dow, Fuji-Xerox, HP, IBM, Nokia, Pitney Bowes, Ricoh, Sony, Taisei and Xerox) which contributed about one hundred patents. See also Wayne Balta, "Welcome to the Eco-Patent Commons" (2019) online: *Corporate Eco Forum* <corporateecoforum.com/welcome-to-the-eco-patent-commons/>.

112 Kevin Greenleaf & Michael Byrne, "Triumph of the Eco-Patent Commons" (2011) 4 Landslide 43.

113 Jorge L Contreras, Bronwyn H Hall & Christian Helmers, "Assessing the Effectiveness of the Eco-Patent Commons: A Post-mortem Analysis" (2018) at 1, online (pdf): *CIGI Papers* <cigionline.org/sites/default/files/documents/Paper no.161_3.pdf>. Hence, "to pledge a patent to the EcoPC, the owner was required to make an irrevocable covenant not to assert the patent—or 'any worldwide counterparts' (EcoPC 2013)—against any infringing machine, manufacture, process or composition of matter that 'reduces/eliminates natural resource consumption, reduces/eliminates waste generation or pollution, or otherwise provides environmental benefit(s)'"; *ibid* at 3–4.

114 *Ibid* at 7.

115 *Ibid* at 17.

the technologies by local users, undermined initiatives like EcoPC.[116] They further note that EcoPC was designed by the suppliers of technology without demand side consultation. [117] Hence, whereas the eco-patent initiative might be said to meet the availability and affordability requirements of an effective transfer project, it fails to meet the conditions of cooperation, compatibility and adaptability.

Not-for-profit organizations have also been involved in EST transfer initiatives in Africa. For instance, Greenpeace (with UNEP) originally conceived the Solarchill project.[118] Shell Foundation was established in 2000 to create and scale business solutions for the enhancement of access to energy and affordable transport with a focus on low-income communities.[119] They seek to achieve this by supporting start-ups like Envirofit and d.light.[120] Collaborating with the U.N. Foundation, the Global Alliance for Clean Cookstoves was established in 2010 to facilitate the distribution of clean stoves to one hundred million households by 2020.[121] According to the Shell Foundation, as of 2019, its initiatives have improved about 164 million livelihoods, supported 362,547 jobs, and resulted in a reduction of about 31 million tonnes of carbon.[122] With presence in Sudan and Uganda, *Potential Energy* is another example of a not-for-profit organization with the mission to "improve access to efficient stoves to improve lives."[123] Its Berkeley-Darfur Stove claims to have been "designed by engineers at Lawrence Berkeley National Lab using the knowledge and input of Local Darfuri women."[124] 270,000 people previously exposed to toxic carbon monoxide are said to have been impacted through the use of the stoves.

While NGO led initiatives are diverse, they share some common features. First, projects are generally designed to directly impact people in developing countries. This differs from other transfer channels, like the CDM and Poznan, which focus on an agency of government for the execution of centralized projects. This feature also speaks to the kind of technologies dealt with by these NGOs (i.e. decentralized technologies like solar panels, clean stoves and improved seedlings). This appears to be an apt approach, particularly for the sub-Saharan Africa energy

116 *Ibid* at 8.

117 *Ibid* at 16.

118 SolarChill, "GEF Solarchill Project" <www.solarchill.org/english/about/>.

119 Shell Foundation, "About Us" (2020), <shellfoundation.org/about/>.

120 *Ibid.* Envirofit is a social enterprise which develops high performance cookstoves for customers in emerging and underdeveloped markets who lack access to electricity and clean cooking solutions. See "About Us" (2019), online: *Envirofit* <envirofit.org/our-story/#our-story>. d.light provides affordable solar energy solutions to households and small businesses in the 'developing world'. See "Learn More About d.light" (2019), online: *d.light* <dlight.com/about/>.

121 See "Scaling Up Adoption of Clean & Efficient Cookstoves" (2019), online: *Clinton Foundation* <clintonfoundation.org/clinton-global-initiative/commitments/scaling-adoption-clean-efficient-cookstoves>.

122 Shell Foundation, "Impact" (2020) <shellfoundation.org/impact/>.

123 Potential Energy, "Enabling the Adoption of Improved Cookstoves Potential Energy" (2019), online: *Potential Energy* <potentialenergy.org/>.

124 Potential Energy, "In Uganda, We're Increasing Access to Improved Stoves" (2019), online: *Potential Energy* <potentialenergy.org/uganda-project/>.

sector.[125] Second, most projects are designed and the technologies are manufactured outside recipient States.[126] Hence, these initiatives primarily entail the transfer of hardware. Third, entities involved in such transfer projects are styled as social enterprises or entrepreneurship.[127] In all, affordability and availability of hardware are the strengths of NGO-led transfer initiatives, but the projects have inherent sustainability limitations. For example, while provision of environment-friendly stoves at low cost is laudable, it is not sustainable in itself. The sustainability of such a project can only be ensured if the capacity to reproduce and/or re-invent it exists in the community and country. The eco-patent commons example instructs that even the most well-intentioned and supported non-profit initiative can go extinct, as can NGO-led initiatives. Taking the case of *Potential Energy* in Sudan as an example, the Sudanese have only been trained on how to assemble the stoves. The survival of the initiative, in the event *Potential Energy* ceases operation in Sudan, is doubtful.

Using the enablement-centred metrics highlighted earlier, the table below provides a summary of the level of effectiveness of transfer initiatives in Africa in the light of the examples reviewed.

Table 5 – Effectiveness of Transfer Channels

ENABLEMENT			
Accessibility		**Sustainability**	
Availability	**CDM**: Partial(hardware) **Poznan**: Full **Corporate Initiatives**: Partial **Not-for-profit**: Partial	*Compatibility*	**CDM**: Partial or Nil **Poznan**: Partial **Corporate Initiatives**: Partial or Nil **Not-for-profit**: Partial
Affordability	**CDM**: Partial **Poznan**: Partial **Corporate Initiatives**: Nil **Not-for-profit**: Full	*Adaptability*	**CDM**: Partial or Nil **Poznan**: Partial **Corporate Initiatives**: Nil or Partial **Not-for-profit**: Partial
Cooperation	**CDM**: Partial **Poznan**: Full **Corporate Initiatives**: Nil **Not-for-profit**: Partial	*Maintenance*	**CDM**: Partial **Poznan**: Partial **Corporate Initiatives**: Partial **Not-for-profit**: Partial

125 See Power for All, "Decentralized Renewables: The Fast Track to Universal Energy Access" (May 2016) at 4, online (pdf): *Power for All* <powerforall.org/application/files/3015/3308/8270/Power-for-All-Fast-Track-Universal-Energy-Access-160523.pdf>; Shadreck Situmbeko, "Decentralised Energy Systems and Associated Policy Mechanisms–A Review of Africa" (2017) 7 J of Sustainable Bioenergy Systems at 98–116.

126 For example, the Berkeley-Dafuri stove was designed in the United States, manufactured in India and assembled in Sudan. Shell Foundation, *supra* note 119.

127 Envirofit, for example, is described as "a social enterprise that innovates smart energy products and services that improve lives on a global scale." See Envirofit, "Envirofit", online: <envirofit.org>. These ventures have been described as combining the "characteristics represented by Richard Branson and Mother Teresa", focusing "first and foremost on the social and/or ecological value creation." See Hilde Schwab & Katherine Milligan, "What is a Social Entrepreneur?" (2015), online: *Schwab Foundation* <schwabfound.org/content/what-social-entrepreneur>.

While a more comprehensive study of transfer channels is necessary for a more authoritative conclusion, from the above it is evident that the Poznan strategy is the most enabling transfer framework, while the CDM and other corporate initiatives rank last. In the next section, the current technology mechanism and framework is considered and compared to some of the transfer initiatives considered above.

3.4. The Technology Mechanism and Framework

Article 10 of the Paris Agreement provides that the Technology Mechanism (TM) will serve the Agreement and further establishes a technology framework (TF) to provide "overarching guidance to the work of the Technology Mechanism." The TM and TF were proposed by developing States further to their position that existing transfer initiatives are ineffective.[128] The TF was finally adopted in Katowice, Poland in 2018.[129] In its original form, the technology mechanism was proposed as comprising an Executive Body on Technology and the Multilateral Climate Technology Fund.[130] To developing states, this mechanism will provide substantial answers to the problems plighting the global EST transfer regime. After years of negotiation, countries agreed to the current mechanism which, while being a two-tier structure like the initial proposal, is essentially a division of the formerly proposed Executive Body on Technology, with the Multilateral Climate Technology Fund totally rejected.[131] The Technology Mechanism is made up of the Technology Executive Committee (TEC) and a Climate Technology Centre and Network (CTCN). As will be seen shortly, the failure to embed a financial facility has been one of the flaws of the mechanism. It will also be shown that the Technology Mechanism, while structurally different from the transfer initiatives earlier reviewed, is also bedevilled by the flaws which limited the effectiveness of earlier initiatives. The operation, successes and foibles of the TEC and CTCN are reviewed below.

3.4.1. The Technology Executive Council

The TEC is the policy arm of the TM. It "focuses on identifying policies that can accelerate the development and transfer" of ESTs.[132] This is, however, only part of its terms of reference. While providing assistance on climate friendly policies is a key part of TEC's mandate, it

128 See UNFCCC, *Proposal by the G77 & China for A Technology Mechanism under the UNFCCC*, online (pdf) *UNFCCC*: <unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/technology_proposal_g77_8.pdf>.

129 See Dec 15/CMA. 1, "Technology framework under Article 10, paragraph 4, of the Paris Agreement" in *Report of the Conference of the Parties Serving as the Meeting of the Parties to the Paris Agreement on the third part of its first session, held in Katowice from 2 to 15 December 2018,* UN Doc FCCC/PA/CMA/2018/3/Add. 2 at 4–10 (Technology Framework).

130 While the EBT was to be recognized as a subsidiary body of the Convention to be supported by a Strategic Planning Committee, Technical Panels, Verification Group and Secretariat, the MCTF was to "provide technology related financial requirements as determined by the Executive Body." See *Proposal by the G77 & China for A Technology Mechanism under the UNFCCC*, online (pdf): <unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/technology_proposal_g77_8.pdf>.

131 *Outcome of the Work of the Ad Hoc Working Group on Long-Term Cooperative Action under the Convention: Draft Conclusions Proposed by the Chair,* Draft Decision -/CP.15, UNFCCCOR, 2009, FCCC/AWGLCA/2009/L.7/Add.3, paras 7 - 20.

132 See TEC, "Technology Executive Committee: Strengthening Climate Technology Policies (Overview)" online: *TT:Clear* <unfccc.int/ttclear/tec>.

is also responsible for promoting collaborations between governments, the private sector, non-profit organizations and academic and research communities, cooperating with other technology initiatives, stakeholders and organizations, and catalysing the development and use of technology road maps or action plans.[133] The mandate of the TEC was further enlarged in 2015 to include technology research, development and demonstration, and "the development and enhancement of endogenous capacities and technologies."[134] This list borders more on implementation than policy making. The CTCN has similar responsibilities. This raises questions on the necessity of a dual structured TM. However, TEC's mandate to "promote coherence … across technology activities under and outside the Convention" is commendable given the disarray and uncoordinated state of the current global EST structure.

The TEC is comprised of twenty expert members elected by the COP.[135] Unlike the Expert Group on Technology Transfer, the TEC has no position for non-state parties.[136] This seems to ignore the role played by private companies, NGOs and other multilateral bodies in EST transfer. It appears more efficient to involve these non-state parties at the policy crafting stage, rather than merely seeking their participation to enforce such policies. It should, however, be noted that a new inclusion, as per the TEC, is the opening of TEC meetings to attendance by accredited observer organizations.[137] It also allows the TEC to seek input from "intergovernmental and international organizations and the private sector and may seek input from civil society."[138] While this is undoubtedly laudable, it falls short of the level of participation that will give these non-state parties an actual stake in the decision-making process. More so, it is the prerogative of the TEC whether to allow the attendance of observers or the participation of non-state parties. The point here is that if non-state parties, particularly private entities, are actively involved with the TEC in its policy works, it is more likely that they will be more open to complying.[139] There is, however, the risk that the involvement of private entities, which are more interested in profit-making, might be antithetical to the interest and position of developing States.

Although it had its first meeting in 2011, the first two years of the TEC's existence were focused on operationalization of the committee. In 2012, among other initiatives, the TEC

133 See *The Cancun Agreements: Outcome of the Work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention*, 2011, 1/CP.16, UNFCCCOR, UN Doc FCCC/CP/2010/7/Add.1, para 121(d)(f)(g).

134 See *Adoption of the Paris Agreement*, 1/CP. 21, UNFCCCOR, 2015, UN Doc FCCC/CP/2015/L.9/Rev. 1 at para 67.

135 See "Composition and Mandate of the Technology Executive Committee" Appendix IV to the *Cancun Agreement*, *supra* note 134 at para 1.

136 Like the composition of the TEC, the EGTT was comprised of twenty members. Of the twenty members, three are from "relevant international organizations." See *Framework for Meaningful and Effective Actions to Enhance the Implementation of Article 4, paragraph 5, of the Convention*, UNFCCCOR, 2001, 7th Sess, UN Doc FCCC/CP/2001/13/Add. 1 30 at para 26(d).

137 "Composition and Mandate of the Technology Executive Committee", Appendix IV to *The Cancun Agreements*, *supra* note 134 at para 11.

138 *Ibid* at para 10.

139 It can, however, be argued that having private companies as members of the TEC will not only be complicated considering the diverse companies concerned, but might also encumber the TEC, as such companies will not unlikely refute proposals which are seen as against the economic interest of companies.

published its modalities on linkages with other EST institutions and rolling workplan for 2012–2013.[140] The preference for a rolling workplan is to "allow for flexibility and adjustments in response to guidance from the COP."[141] With the exception of relatively new issues like south-south and triangular cooperation and loss and damage which were referenced in its 2016 and 2017 reports to the COP,[142] the TEC's activities in the past years focused on organization of workshops, collaborative meetings and publication of briefs on issues bordering on TNAs, climate finance and national systems of innovation (NSI). In detailing its performance activities in 2017, the TEC referred to the number of users and views of the TT:CLEAR (online) platform, its social media presence, stakeholders engaged in its events, countries receiving TNA assistance, and a number of publications.[143]

What is apparent from TEC's list of achievement is that they are not result based. They only focus on the projects purportedly done (e.g. trainings, advisories), and not how such projects informed effective transfer and dissemination of EST. From its 2017 account, it is difficult to discern which countries benefited from TEC's advisories and programmes, as none of its reports to the COP contains this information. Again, TEC's workshops and publications are largely on generic subjects, with the implication of non-consideration of regional and national distinctness.[144] The relevance of local realities in policy formation can hardly be over emphasized. While it may be near impossible to conduct a state-by-state analysis of technology policy needs, there are cross-cutting themes and common realities in African countries that could validly inform region specific reviews. As it stands, it can be fairly concluded that the TEC's activities are too general to be effective for States that need its policymaking expertise the most.

Again, although the provision of coherence in EST Research, Design and Development initiative is one of its mandates, there is nothing to indicate TEC's progress in this aspect. Given the lopsidedness of transfer initiatives to African States under the transfer channels

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140 See *Report on the Linkage Modalities and the Rolling Workplan of the Technology Executive Committee for 2013–2013 – Note by the Chair of the Technology Executive Committee*, SBSTA & SBI, 36th6 Sess, UN Doc FCCC/SB/2012/1.

141 *Ibid* at 6.

142 See *Joint Annual Report of the Technology Executive Committee and the Climate Technology Centre and Network for 2016*, SBSTA & SBI, 2015, 45th Sess, UN Doc FCCC/SB/2016/1 at para 9; *Joint Annual Report of the Technology Executive Committee and the Climate Technology Centre and Network for 2017*, SBSTA & SBI, 2017, 47th Sess, UN Doc FCCC/SB/2017/3 at para 21.

143 Technology Executive Committee, "Technology Executive Committee: Performance Activities" (2017), online (pdf): *UNFCCC* <unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEC_tab_1/ce6da98b6eb048dc9a4458bb08ddd502/eb5fa42ab8224402ad9a035520d7aeb3.pdf>.

144 See UNFCCC, Technology Executive Committee, *Using Roadmapping to Facilitate the Planning and Implementation of Climate Technologies* (2013), online (pdf): *UNFCCC* <unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEC_column_L/3aaf07d4cf1d4d51998b57771759880a/f427db90b3c54f2d979f984db5af18ce.pdf> (an example of one of TEC's ten publications); See UNFCCC, Technology Executive Committee, *Industrial Energy Efficiency and Material Substitution in Carbon-Intensive Sectors*, (Delivered at the Thematic Dialogue on Industrial Energy Efficiency in Bonn, Germany, 29 March 2017), online (pdf): *UNFCCC* <unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEC_documents/4541b2b5ea704911b74bed9b17cd96dc/fded7988bc1740cc844cd3dd705a9336.pdf> (another example of one of TEC's ten publications); See generally "Documents", online: *TT:Clear* <unfccc.int/ttclear/tec/documents.html> for TEC's publications.

considered above, a coherent structure for transfer initiatives is crucial. This has the potential to provide a map of where initiatives are being implemented and where they are lacking. With such a map, State and non-State parties can work together to effectively and efficiently deploy transfer programmes. After about six years of operation, the TEC, for the first time in 2017, reported its challenges to the COP. It noted, in part, that it "recognises that a key challenge it faces is how to monitor and evaluate the impacts of its work," and that "a key challenge remains in reaching out effectively to its target audiences, including policymakers, the private sector and international organizations."[145] As hinted above, TEC's challenges are more deeply rooted than it has identified. It is important that its fairly long list of activities is not mistaken for actual impact. Despite the self-confessed shortcomings, it is unclear why the independent review conducted in 2017 was limited to the CTCN.

At the very least, the standard through which TEC's performance must be measured is whether it is fulfilling its mandate of "enhancing the implementation of article 4(5) of the Convention" and, by extension, article 10 of the PA.[146] With TEC's current modalities, it is difficult to answer this question in the positive. More so as it has no database showing how its initiatives have improved the policy making capacity of target countries.

3.4.2. The Climate Technology Centre and Network

The CTCN was established as the operational arm of the Technology Mechanism, with the responsibility to facilitate a network of networks, organizations and initiatives to provide support in identifying needs, and to facilitate the provision of information, training and capacity building programmes for developing countries.[147] It also facilitates prompt deployment of existing technology.[148] Another key function of the CTCN is the facilitation and stimulation of the development and transfer of "existing and emerging" ESTs through collaboration with the "private sector, public institutions, academia and research institutions."[149] It is also established to provide in-country technical assistance and training, stimulate "the establishment of twinning centre arrangements to promote North-South, South-South and triangular partnerships" to encourage collaborative R&D, and help with the design of analytical tools and best practices for the dissemination of ESTs.[150] In a way, save for the non-reference of facilitation of transfer of publicly owned technologies, the CTCN's terms of reference are the closest the UNFCCC has come to the Agenda 21 standard. In its design, the CTCN substantially responds to developing States' previous complaints about the non-implementational role played by previous arrangements, particularly, the EGTT. However, beyond the terms of reference are the actual operations of the CTCN.

The CTCN renders technical assistance to developing countries through a network of organizations and experts drawn from eleven consortium partners (the technical resource

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145 2017 Joint Annual Report, *supra* note 142 at paras 54–55.

146 See *The Cancun Agreements, supra* note 135 at para 119.

147 *Ibid* at paras 123 (a)(i)–(iii).

148 *Ibid*.

149 *Ibid* at para 123(b)(c).

150 *Ibid* at para 123(c)(iii)–(v).

pool (TRP)).[151] It is accountable to the UNFCCC Conference of Parties through an Advisory Board.[152] Importantly, the CTCN operates on the request of developing States. Developing States are expected to make their requests through National Designated Entities (NDEs).[153] By its five year (2013 to 2017) rolling plan released in 2013, the CTCN projects, by 2017, to have facilitated the investment of $600 million in ESTs, assisted with 50 to 75 national and sectoral technology plans, and facilitated 100 new country-driven technology projects.[154] The CTCN has a multi-level process which includes a request to the centre, determination whether the request is consistent with (prioritization) criteria approved by the Board,[155] and determination of whether request can be handled by the CTC staff or requires elaborate support through a quick support by the TRP or larger response by a network member.[156] After response is delivered, a review of the assistance and its impacts is conducted and communicated by the Center through its Knowledge Management System (KMS).[157] While the establishment and processes of the CTCN is laudable, there are a few downsides. One is that the complexity of the organization could discourage least developed countries (LDCs), most of which are in Africa. The prioritization criteria also might also potentially either discourage LDCs (and many developing States) or make their proposals ineligible for support, or eligible but unprioritized. For example, it is required that a proposed project must demonstrate project readiness and potential for replication or scaling up, promote multi-country approach and leverage public and/or private financing.[158] While project readiness is undefined, the public funding condition makes proposals from African States less competitive.[159]

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151 See Climate Technology Centre and Network, "Draft Programme of Work" (2013) at 3, 11, 13, online (pdf): *Climate Technology Centre and Network* <www.ctc-n.org/sites/www.ctc-n.org/files/f2137b4434244bdeafe3a24bad2c5273.pdf>.

152 See *Ibid* at 13 (the Board is made up of 25 members and has the responsibilities of prioritising requests from developing countries, approving reports and criteria for prioritizing requests and membership of the Network, and "monitors, assesses and evaluates the performance of the CTCN" at 13).

153 See *Ibid* at 12–13.

154 See *Ibid* at 24.

155 See Climate Technology Centre and Network, "Climate Technology Centre and Network – Prioritization Criteria for Responding to Requests from Developing Country Parties" (Approved at the Second Meeting of the Advisory Board of the Climate Technology Centre and Network, Bonn, Germany, September 2013) at 1, online (pdf): *Climate Technology Centre and Network* <ctc-n.org/sites/www.ctc-n.org/files/240bcf259a814482a6b0b3d0f73932a4.pdf>. Prioritization criteria includes that the proposed project promotes "endogenous and most appropriate technologies and processes; demonstrate 'project readiness' and the potential for replication or scaling up nationally, regionally and internationally; promote collaboration among between stakeholders; promote multi-country approaches and regional bundling of requests; leverage public and/or private financing; promote and demonstrate multiple benefits, as well as social, economic and environmental sustainability; and promote and demonstrate gender equality, and empowerment of vulnerable groups, including women and youths" [CTCN 2]

156 CTCN, *supra* note 151 at 20, 26.

157 *Ibid,* 25–26.

158 CTCN 2, *supra* note 155.

159 The examples of Indonesia and Ethiopia have been referred to. While a state-owed geothermal developer in the former was given $160 million grant co-financed with $325 million loan from the World Bank, the latter struggled to gain approval for $45 million (as against the $99.6 million grant applied for). Indonesia's ability to generate income and attract financiers as against Ethiopia's inability put the former at an advantage. See Sennan Mattar et al, "Global Climate Finance is still not

In 2018, the CTCN had completed or initiated 137 projects in 79 countries, 33 (41.8 percent) of which were African countries.[160] Of the 137 projects, six were technology, research and development initiatives, while 14 were technology pilots.[161] Only one of the 14 pilot projects is reported to be ongoing in an African country: Zimbabwe.[162] There is no identifiable EST research and development project located in any African country. Projects in Algeria and Tunisia have explicit objectives on the transfer of ground-up development and replication of projects.[163] The majority of the projects carried out in African countries relate to soft skills like how to prepare feasibility studies, mainstreaming gender, developing information and communication systems, and development of climate change strategy.[164] The distribution of projects in Africa under the TM repeats the same trend under the other transfer channels already considered. Arguably, CTCN only intervenes in response to requests by NDEs. Hence, it is further arguable that the domination of soft projects in Africa is reflective of the requests by the countries. This argument is, however, difficult to maintain as the CTCN report does not provide a record of rejected projects and the reasons for their rejection. The bankability of African projects has, however, been flagged. For example, while Mali proposed a crop drying and storage technology development project, the project now focuses on capacity building on making a compelling case for investment, showcase of bankability of initiatives, and development of business model.[165] As noted by Shabalala and as seen in the Ethiopian example, LDCs, generally, lack market conditions which attract investments or financial backing by financial institutions for climate projects.[166]

Weighed against the sub-criteria of cooperation, compatibility, and adaptability in table 1, the enabling prospect of the CTCN operational structure is doubtful. Both by its original mandate and COP 21's reiteration, collaborative Research, Design and Development and "the development and enhancement of endogenous capacities and technologies," are key responsibilities of the CTCN. The current set-up emphasizes a project-by-project implementation approach. As shown in its report, only 3.1 percent of CTCN's project

Reaching those who need it the most" (9 May 2019), online: *The Conversation* <theconversation.com/global-climate-finance-is-still-not-reaching-those-who-need-it-most-115268>.

160 See Climate Technology Centre and Network, "2018 Progress Report" (2018) at 3, 5, online (pdf): *Climate Technology Centre and Network* <ctc-n.org/sites/www.ctc-n.org/files/resources/ctcn_report_2018.pdf>.

161 *Ibid* at 47–65.

162 See Climate Technology Centre and Network, "Piloting Rapid Uptake of Industrial Energy Efficiency and Efficient Water Utilization in Selected Sectors in Zimbabwe" (2019), online: *Climate Technology Centre and Network* <ctc-n.org/technical-assistance/projects/piloting-rapid-uptake-industrial-energy-efficiency-and-efficient-water>.

163 See Climate Technology Centre and Network, "CTCN Technical Assistance Response Plan - Algeria" (2016) at 1, online (pdf): <ctc-n.org/system/files/response_plans/response_plan_signed_algeria_1.pdf>. See also "Capacity Building to Gain Expertise in Efficient Lighting Systems" (2016), online: *Climate Technology Centre and Network* <ctc-n.org/technical-assistance/projects/capacity-building-gain-expertise-efficient-lighting-systems>.

164 CTCN, *supra* note 162, 47–65.

165 CTCN, "Design and Financing for Crop Drying and Storage Technologies to Strengthen Food Security in the Face of Climate Change" (24 April 2015), online: *Climate Technology Centre and Network* <ctc-n.org/technical-assistance/projects/design-and-financing-crop-drying-and-storage-technologies-strengthen>.

166 Shabalala, *supra* note 107; Mattar, *supra* note 159.

focuses on research and development, while multi-country projects were about 4 percent.[167] As designed, network members are existing organizations with "demonstrated capability in initiatives aimed at development, transfer and deployment of climate technologies applicable for developing countries."[168] While such an arrangement allows developed States with private and public establishments with required competencies to participate, it disfavours developing States, particularly in Africa, with limited technical capacities. Hence, of the 466 network members, only 47 are in Africa.[169] The CTCN noted this imbalance in its 2015 report to the COP, but it concluded by stating that "the reach of the Network in Africa was comparable with other regions since many institutions, although not based in Africa, were providing their services to African countries."[170] This conclusion misses the mark. Ultimately, the Technology Mechanism is not about provision of project-level services but enabling States to provide their own solutions. It is interesting that the CTCN's Network is dominated by private sector organizations.[171] While the involvement of private entities is positive, there is the risk of the over-commercialization.[172]

3.4.3. The Technology Framework

The technology framework (TF) emanates directly from the Paris Agreement, and it is expected to provide "overarching guidance" to the TM.[173] Consistent with the enablement criteria developed in this work, the TF is undergirded by principles including collaboration and stakeholder engagement, result oriented, transparency, and transformational approaches, innovation, and implementation.[174] Implementation was described in the 2017 TF Informal Note to mean "to carry out work on the ground, helping economic growth, and sustainable energy pathway, not focusing on barriers, capacity building etc."[175] An initial draft of the TF further recognized that the framework should "facilitate the delivery of the on-the-ground

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167 CTCN, *supra* note 163 at 69–70.

168 "Guiding Principles and Criteria for Establishment of the Climate Technology Network" (19 September 2013) at 1, online (pdf): *Climate Technology Centre and Network* <www.ctc-n.org/sites/www.ctc-n.org/files/fb910bb9b3394dff99a2be617f244ec4.pdf>.

169 "Network Members List and Profiles" (2020), online*: Climate Technology Centre and Network* <ctc-n.org/network/network-members?f%5B0%5D=field_country%253Afield_region%3A28>. The three regions with the highest number of members are Western Europe (83), Eastern Asia (81), and Northern America (58) [*CTCN Network Members*].

170 *Joint Annual Report of the Technology Executive Committee and the Climate Technology Centre and Network for 2015*, SBSTA & SBI, 43rd Sess, UN Doc FCCC/SB/2015/1 (2015) at para 73.

171 The network has 242 private organizations, with research and academic institution coming a distant second at 95. See *CTCN Network Members*, *supra* note 169.

172 One of the guiding principles of the CTN is that network members "provide value for money." See *CTCN*, *supra* note 172.

173 See *Paris Agreement, supra* note 1, art 10(4).

174 Technology Framework, *supra* note 129 at 6.

175 "SBSTA agenda item 6(b): Technology framework under Article 10, paragraph 4, of the Paris Agreement (Informal Note by the Co-Facilitators)" (13 November 2017), at 2, online (pdf): *United Nations Framework Convention on Climate Change* <unfccc.int/files/meetings/bonn_nov_2017/in-session/application/pdf/sbsta47_6b_informal_note_v2.pdf> [*Informal Note by the co-Facilitators*].

implementation of mitigation and adaptation actions."[176] This, however, did not make it into the adopted framework. Given that successive transfer channels have been more input oriented, and that preceding programmes had emphasized barriers and capacity building with little effect, the exclusion of this understanding of implementation from the framework is a potential drawback.

In what appears to be a first since Agenda 21, the TF, under the enabling environment theme, recognises the need to enable access to ESTs in the private sector through the incentivization of the private sector,[177] but unlike Agenda 21, there is no specific mention of the party responsible for the provision of such incentives.[178] Further, in expounding on article 10(6) of the PA, the TF notes that "the understanding of support under this key theme (support) is broader than just financial support, as it may include all aspects of support to implement article 10 of the Paris Agreement."[179] However, the adopted TF failed to include the previous inclusion in the initial draft that support will be "new and additional, adequate and predictable in a transparent manner."[180] This exclusion is key in the light of CTCN's financial challenges and complaints of lack of predictable source of funding. Despite the valid point made in the TF that support transcends financial support, funding and willingness to transfer technology in a wholesale manner still represent the most essential forms of support needed for the success of the TM. Developing States have, however, unsuccessfully clamoured for a hard link between the Technology Mechanism and Financial Mechanism over time.[181] While the TF referred to the "enhancement of the linkages" between the TM and FM, it gave no direction on how this knotty issue can be resolved.

Although the TM-FM relationship is outside the purview of this article, the earlier conclusion that the Poznan strategy, which is operated by the GEF under the FM, is one of the most successful transfer initiatives over the years, raises the question on whether a stand-alone TM is necessary. Under the 1992 UNFCCC, finance and technology transfer were considered together.[182] It is, indeed, difficult to conceive of a project financed by the UNFCCC which has no technology transfer prospect, even if it is only in its most basic form (hardware transfer). It seems inefficient to detach the TM from the FM. While projects can be specifically designed for the purposes of transferring technology, a more effective appreciation of technology transfer is to engage it as a principle that underscores every project financed under the climate regime.

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176 *Initial Draft of the Technology Framework,* SBSTA, 2018, 48th Sess, UN Doc SBSTA48.Informal.1 at para 16.

177 Technology Framework, *supra* note 129 at 7.

178 *Agenda 21, supra* note 16 ("creation and enhancement of developed countries, as well as other countries which might be in a position to do so, of appropriate incentives, fiscal or otherwise, to stimulate the transfer of environmentally sound technology by companies, in particular to developing countries, as integral to sustainable development" at para 34.18(e)(i)).

179 Technology Framework, *supra* note 129 at 10.

180 See *Initial Draft*, *supra* note 176 at para 40.

181 See Heleen de Coninck & Ambuj Sagar, "Technology Development and Transfer (Article 10)" in Daniel Klein et al, eds, *The Paris Agreement on Climate Change: Analysis and Commentary* (Oxford: Oxford University Press, 2017) 263. See also India, *Views from the Government of India on SBSTA Agenda Item No 4: Technology Framework under 10(4) of the Paris Agreement*, (2016) SBSTA, 45th Sess, UN Doc FCCC/SBSTA/2016.MISC.4 at 12.

182 See *UNFCCC*, *supra* note 2, art 4(3), 4(5), 4(7).

Rather than proposing a stand-alone TM or accepting a TM without a financial component, developing States, having failed in actualization the original TM proposal, should have pressed for the consolidation of Poznan into a technology development and transfer component or submechanism under the FM. Considering that the GCF is the key FM operating entity under the Paris Agreement regime, a consolidated Poznan would have been more efficiently situated within the GCF. This speaks, in part, to the inefficiency of proliferated bodies under the UNFCCC.[183]

3.4.4. Comparing the Technology Mechanism, Clean Development Mechanism and Poznan Strategy

Regardless of its defects, the TM represents a marked departure from the previous ad hoc arrangements under the UNFCCC. However, the question that remains is whether the TM is more enabling than the previously considered transfer channels, particularly the CDM and the Poznan strategy. As no specific project under the TM arrangement has been considered here, it is difficult to appraise the TM using the same metrics previously deployed. Nevertheless, it is reiterated that the ultimate objective of any technology transfer programme must be to enable the recipient. The comparison attempted underneath is done with this enablement objective in mind.

Table 6 – Comparing TM, Poznan and CDM

	Technology Mechanism	Poznan strategy	CDM
1	Technology development and transfer specific.	Technology transfer specific.	Incidental technology transfer objective.
2	Considerable market involvement.	Minimum market involvement.	Major market involvement.
3	Strong connection between recipient's technology needs and implemented projects.	Fairly strong connection between technology needs and implemented projects.	Weak connection between technology needs and implemented projects.
4	Focus on transfer of soft skills.	Transfer of hard ESTs and soft skills.	Transfer of hard ESTs.
5	Inadequate funding.	Relatively adequate funding.	Relatively adequate funding.
6	Relative connection between design and implementation.	Strong connection between design and implementation.	Strong connection between design and implementation.
7	Even distribution of projects.	Lopsided distribution of projects.	Lopsided distribution of projects.
8	Substantial involvement of local entities.	Partial involvement of local entities.	Low involvement of local entities.

The TM introduces a different institutional construct than what has been experienced under the UNFCCC. However, bout nine years after the establishment of the mechanism and after over six years of its full operationalization, trends experienced under preceding transfer

183 The UNFCCC has multiple bodies that carry out similar tasks. The Paris Committee on Capacity Building, for example, operates separately from the TM. Again, TNAs are conducted under the auspices of the GEF (Poznan), TEC and the CTCN. While the CTCN is a core component of the TM, *Poznan* has distinctly established Climate Technology Centres and a Climate Technology Network.

initiatives persist. Apart from the new institutional arrangement, in terms of implementation and results, the TM is not substantially different from previous arrangements. From table 6, there is no major difference between the TM and Poznan based on the criteria employed in this article. If anything, Poznan represents a more concerted approach than the TM considering its embeddedness within the Financial Mechanism. As already shown, this disconnect between the TM and Financial Mechanism is a major flaw in the current design. While progress has been made in the attempt to align the operations of the TM and Financial Mechanism, the initiatives taken have fallen short of the hard link needed between both mechanisms. The initiatives are not only ad hoc but, as in the case of the CTCN, the core issues in respect of finance are unresolved. The CTCN's core need, according to its 2017 independent review, for instance, is a predictable and properly structured mode of funding which will allow for medium- and long-term planning.[184] Further to this decoupling, there is a disconnect between the design and implementation components under the TM, as while there is a high possibility that projects are designed, the implementation is less likely due to unavailable funds. This is less so under Poznan, and mostly unexperienced under the CDM since companies under the latter identify, design and implement the projects.

Transfer channels also have their varying levels of market-involvement. As shown in table 6, while Poznan has the least market involvement, the CDM has the highest and the TM is somewhere in between. This trend seems to affect the transfer potential of each pathway, with CDM the least prolific, Poznan the most effective and the TM, again, somewhere in between. The involvement of private entities in the research, development and transfer of ESTs are vital. But this is quite different from subjecting transfer, particularly to developing States, to the vagaries of the market. Subjecting the mechanism to market forces will not only further skew the distribution of transfer projects in favour of more viable emerging economies, it also impacts on the relevance and effectiveness of the projects which will be implemented in these countries. It is, therefore, important that the involvement of businesses in the TM is carefully reappraised. For example, the objective of companies involved in the CTCN must not and cannot be profit maximization. There should also be a deliberate attempt to involve more public research entities which are less profit propelled.[185] The TM appears to have a stronger connection with local entities and, consequently, aligns its priorities more with the technology needs of developing countries when compared to Poznan and the CDM. There is, however, a need to extend the engagements at the local level to other research and development institutions other than the National Designated Entities (NDEs). As noted by Ockwell and Bryne, the nurturing of national systems of innovation, like universities, has not been prioritised in the CTCN's activities.[186] This falls short of the overarching enablement objective of the UNFCCC transfer regime which has been argued in this article. Compared to other developing countries, African countries have had a fairer share of projects than other transfer channels.

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184 CTCN, "Report on the Independent Review of the Effective Implementation of the Climate Technology Centre and Network" (2017) FCCC/CP/2017/3, para 84(a).

185 See generally Martin Dietrich Brauch & Aaron Cosbey, "Vehicles, Availability, and Governance of International Public Finance for Climate-Friendly Investment" (2012), online (pdf): *International Institute for Sustainable Development* <iisd.org/sites/default/files/publications/vehicles_availability.pdf>.

186 David Ockwell & Rob Byrne, "Improving Technology Transfer through National Systems of Innovation: Climate Relevant Innovation-System Builders (CRIBS)" (2016) 16:7 Climate Policy 836 at 847.

4. CONCLUSION

This article has compared how African countries fared under various EST transfer regimes. It compared the more recent Technology Mechanism, to previous UNFCCC, State, and non-State initiatives. Table 6 summarises this comparison. It shows that the TM differs in various aspects including the inclusion of research and development in its mandates, stronger connection between recipient's technology needs and intervening projects, involvement of local entities, and importantly, a more even distribution of projects. Similarities with earlier transfer channels, however, abound. The TM, like other channels, in its implementation has focused more on the transfer of soft skills in the African context, rather than more backend research, development and manufacturing competence. The TM, through the dominance of private entities as network members, is also subject to similar market-based challenges faced by African countries under earlier channels. These perennial challenges fester under the TM. Although no pathway qualifies as the ideal, they provide lessons for the improvement of the current regime. The integration of Poznan in the Financial Mechanism and the relative success recorded under the programme enforces the argument for a hard link between the TM and the FM. While article 10(5) of the PA encourages support for collaborative Research, Design and Development initiatives, neither the TEC nor CTCN seem structured, equipped or funded to facilitate the implementation of this mandate. State and non-State entities must summon the needed will to address these fundamental issues. However, as already seen with the watering down of the initial definition of "implementation" in the technology framework and the re-centering of TNAs over more important indexes, it appears that the same absence of political will that characterized previous regimes subsists under the TM.[187] This gap of will is, perhaps, the most limiting flaw of the global EST transfer structure.[188] The case studies in this work are limited by the available and accessible documents mostly obtained through the UNFCCC TT.CLEAR platform. A more robust empirical work on the effects of the UNFCCC technology transfer initiatives in Africa is needed to help in the effective operationalization of the technology mechanism and framework. Beyond state-centric transfer initiatives and metrics of measuring effectiveness, further research is needed on the impact of EST transfer on people, particularly those in developing countries.

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[187] See *Informal Note by the co-Facilitators*, *supra* note 175.

[188] As concluded elsewhere, "In the end, while the Paris Agreement takes a welcome step forward on the technology front, the enormous magnitude and timeframe of the challenge requires much more. However, the limited nature of the technology provisions is a reflection of a deeper undercurrent – the continuing lack of political will to support climate technology actions adequately and the lack of consensus on how to do it best. It is not enough to insert obligations into the text – their effectiveness and utility will depend on how seriously the parties translate them into action and build on these in the future." See Heleen de Coninck & Ambuj Sagar, *supra* note 181 at 276.