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Karen M. Sullivan

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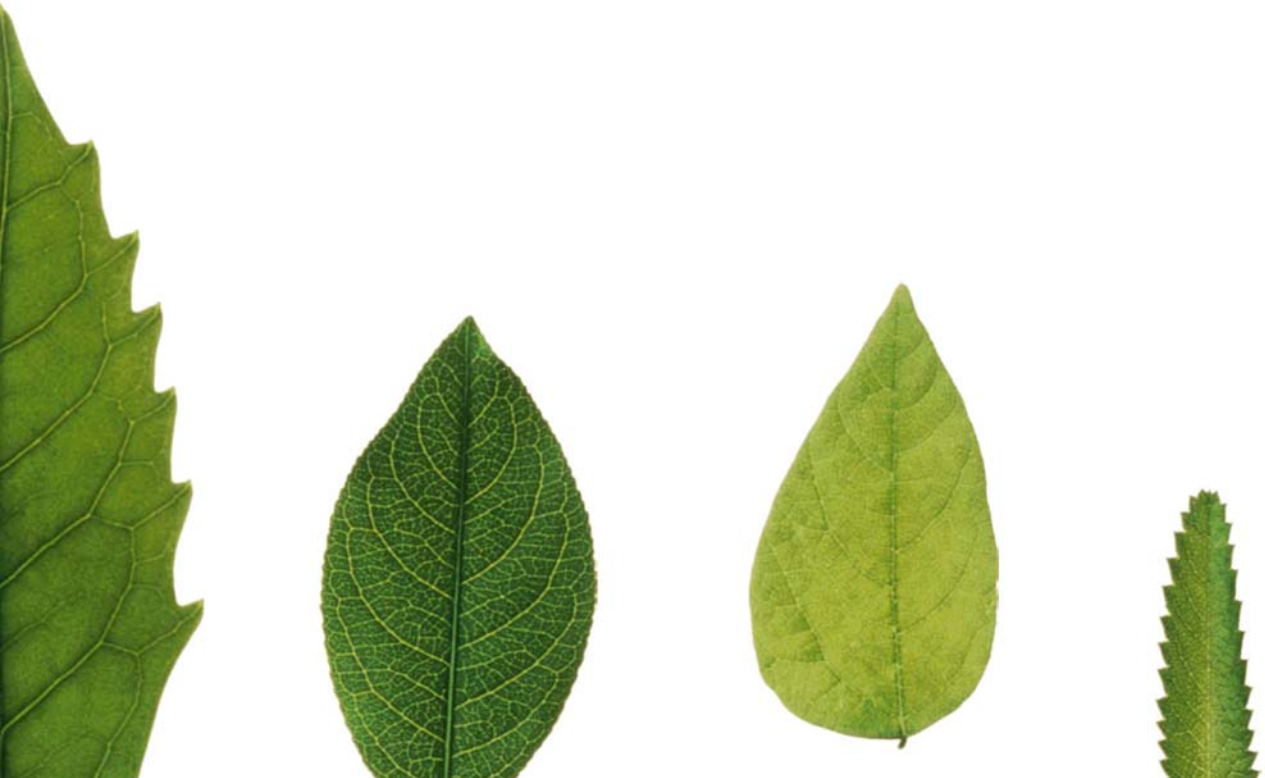

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1 INTRODUCTION

The concept of obligations on developed countries relating to the transfer of technologies for environmental protection under international law came into being with the Declaration of the United Nations Conference on the Human Environment in 1972. Principle 21 of that declaration stated that 'environmental technologies should be made available to developing countries on terms which would encourage their wide dissemination without constituting an economic burden on the developing countries'.[1] The next decade saw technology transfer become a central pillar of the Montreal Protocol on Substances that deplete the Ozone Layer in 1987, with developing countries demanding technology transfer 'as a condition of participation in the control measures of the Montreal Protocol'.[2] In common with other multilateral environmental agreements, the United Nations Framework Convention on Climate Change in 1992 (hereafter the UNFCCC)[3] also contains provisions pertaining to technology transfer. Since then, there has been increasing recognition of the importance of technology transfer as a hugely influential process in the global efforts to address environmental challenges. In 2005, a UN report from the Department of Economic and Social Affairs on sustainable forest management claimed that 'Policies promoting development and diffusion of technologies are probably among the most important factors affecting environmental protection. Moreover, technology transfer is one of the major factors shaping global income distribution'.[4] The centrality of technology transfer to international efforts towards environmental protection was further illustrated in 2007, when Anderson et al, found that of the nearly 270 environmental treaties extant at that time 'development, commercialisation and transfer of environmentally sound technologies are the crux of these treaties...'[5]

Increasing recognition and acceptance of the scale of the global threat posed by climate change has focussed international attention on the UNFCCC as the framework for interventions to limit climate change and adapt to its impacts on the human environment. As a result, the technology transfer provisions agreed under this convention are of significant international interest. Indeed, the transfer of technologies which may mitigate greenhouse gas (GHG) production in an attempt to limit climate change, or which are designed to aid the most vulnerable nation states in adapting to the effects of such change, is one of the central pillars of the Convention. Article 4 of the Convention sets out the commitments of the parties, and Art.4.1.(c) obliges parties to 'Promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases not controlled by the Montreal Protocol in all relevant sectors, including the energy, transport, industry, agriculture, forestry and waste management sectors'. Art 4.5. of the convention explicitly recognises the differentiated responsibility of the developed and developing parties and inter alia, requires the developed parties proactively to promote, finance and transfer environmentally sound technologies to developing states.

The ways in which the parties to the Convention may co-operate to give effect to the terms of these provisions have developed over time, and have been

1 P3 Stockholm Declaration (1972) <https://www.soas.ac.uk/cedep-demos/000_P514_IEL_K3736-Demo/treaties/media/1972%20Stockholm%201972%20-%20Declaration%20of%20the%20United%20Nations%20Conference%20on%20the%20Human%20Environment%20-%20UNEP.pdf>.

2 S Anderson, K Sarma and K Taddonio, *Technology Transfer for the Ozone Layer: Lessons for Climate Change* (Earthscan 2007) 5.

3 United Nations Framework Convention on Climate Change (1992) <https://unfccc.int/sites/default/files/conveng.pdf>.

4 Department of Economic and Social Affairs, United Nations Forum on Forests Secretariat, 'Transfer of Environmentally Sound Technologies for Sustainable Forest Management – Framework and Applications', December 2005, [hereafter the DESA Report] https://www.un.org/esa/forests/wp-content/uploads/2015/06/tests1205.pdf.

5 Anderson, Sarma and Taddonio (n 2)1.

articulated in greater detail through successive Conferences of the Parties (COPs),[6] and leading, amongst other technology initiatives, to Decisions on the Technology Mechanism, taken at the Cancun and Durban COPs.[7] The aim of the Technology Mechanism is to facilitate the implementation of enhanced action on technology development and transfer. Activities under this mechanism have, in turn, led to the establishment of a Climate Technology Centre and Network (CTCN),[8] the aim of which is essentially to assist developing countries in identifying their needs with respect to climate change related technologies, and via co-development or transfer, to allow them to successfully adopt such technologies, thereby helping such countries to mitigate or adapt to climate change to the maximum extent that technological solutions allow. The Technology Mechanism comprises the CTCN and the Technology Executive Committee, with the latter analysing and formulating policy interventions whilst the CTCN is the operational am of the Technology Mechanism, responsible for fostering climate technology development and transfer.[9] Whilst other mechanisms under the UNFCCC such as the Clean Development Mechanism, have the potential to effect climate technology transfers, there is much debate about how effective this has been, with evidence putting the percentage of projects resulting in such transfers being as low as 12 per cent in some countries.[10]

The transfer of a technology from one actor to another might seem on first consideration to be a simple task, begging the question of why such entities as the CTCN and associated interventions should be necessary. Given that free market economics are the dominant force in the majority of global economies,[11] providing appropriate funding is made available to poorer countries, should the willing seller/willing buyer principle not enable them to meet their technological needs without recourse to such intermediary organisations? Regrettably, the reality is far from being this simple. The area of technology transfer, particularly where some of the technologies required are yet to be developed or at least customised for the recipient, is a hugely complex field of activity. There are many factors contributing to this complexity, such as the nature of the technology – climate related technologies can range from environmentally cleaner cooking stoves costing a few tens of dollars, to hydroelectric dam installations costing in excess of a billion dollars. Some 'technologies' are more appropriately termed as 'practices', such as sustainable forestry management practice, and are in the public domain, whilst others, such as genetically modified seeds are largely private sector property and heavily IP protected. Some technologies may be completely new to the recipient market, presenting barriers of market education and creation, whilst other may need to displace less environmentally friendly alternatives that enjoy existing subsidies. There are also issues of standards, reliability in use, skills required by end users, maintenance costs and availability of spare parts, as well as connectivity to existing infrastructure where appropriate, or investment needed in new associated infrastructure in other instances. The list goes on, and many laudable endeavours have been made to examine the array of barriers to effective international technology transfer and the types of interventions which may help to overcome them.[12] The CTCN represents one such intervention, and is the result of the conduct of such assessments under the auspices of the UNFCCC.

The aim of this paper is to inform readers on the status of implementation of the CTCN and to provide insights into the degree to which the selected

6 The most comprehensive document in this regard is that 'Framework for meaningful and effective actions to enhance the implementation of Article 4, paragraph 5, of the Convention' FCCC/CP/2001/13/Add.1.

7 Decision 1/CP.16, paras 133-129 <https://unfccc.int/resource/docs/2010/cop16/eng/07a01.pdf#page=18>.

8 See <http://unfccc.int/ttclear/templates/render_cms_page?TEM_tcn>.

9 Technology Mechanism – Enhancing climate technology development and transfer available at https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEM/0e7cc25f3f9843ccb98399df4d47e219/174ad939936746b6bfad76e30a324e78.pdf.

10 The Department of Economic and Social Affairs (2009) Promoting Development, Saving the Planet: World Economic and Social Survey 2009, New York <https://www.un.org/en/development/desa/policy/wess/wess_archive/2009wess.pdf> 138.

11 As evidenced by a market freedom ranking of over 50 per cent in the 2019 global Index of Economic Freedom available from <https://www.heritage.org/index/ranking>.

12 Intergovernmental Panel on Climate Change Special Report 'Methodological and Technological Issues in Technology Transfer' (2000) ISBN92-9169-112-7.

mechanism addresses the known challenges and reflects lessons learned from previous work in the field of international technology transfer by international organisations ie the extent to which it is able to turn available knowledge into best practice. After an initial review of implementation status, 'Progress', the findings will be used to examine how well the operationalisation of the CTCN has addressed previously identified barriers to successful technology transfer under multilateral environmental agreements, namely the 'Practicalities' of implementation, 'Prioritisation' of objectives, recognition of technology or country specific 'Pathways' in technology transfer and the involvement of the 'Private sector' – hence the 'Five P's'

2 PROGRESS: IMPLEMENTING THE UNFCCC CTCN

The CTCN was initiated via a call for proposals from organisations wishing to establish and deliver the objectives of the new entity, in response to which bids from nine organisations and consortia were received.[13] After initial review the three top ranked bids, from a UNEP led consortium, GEF and Det Norske Veritas, were subject to a detailed and admirably transparent and well documented evaluation, against published assessment criteria. Details of the shortlist assessment were also published[14] and the chosen bid was from within the United Nations family, specifically a joint bid led by the United Nations Environment Programme (UNEP).[15] The Climate Technology Centre, that is the Hub of the Network (CTCN), was subsequently established in Copenhagen, to co-ordinate with the National Designated Entities (NDE's) from the state parties to the UNFCCC, as well as with other organisations from the private, public, or third sectors, wishing to contribute to the working of the CTCN. The CTCN became operational at the end of 2013 and was subject to an independent review of its initial performance in 2017 commissioned by the UNFCCC Secretariat (hereafter the 'UNFCCC Review'), the outcome of which was presented at COP23 in November 2017.[16] This was the first comprehensive review, as a previous review requested by the European Commission and conducted substantially by the UNEP Evaluation Office had only reviewed the CTCN as a Case Study as part of a broader evaluation of the CTCN host organisation (hereafter the 'UNEP Review').[17] The conclusions reached by Ernst and Young, the reviewers chosen to undertake the UNFCCC Review [18], were substantially positive, and three of their main findings were as follows:

- 'The beneficiaries have shown satisfaction regarding the services provided by the CTCN. Interviewees and survey respondents have acknowledged the value added by the CTCN, which is mainly due to the scope of technical assistance it provides and the time frame under which it operates. The CTCN fostered synergies with financial institutions and technical partners to avoid redundancy and leverage the impacts of its technical assistance;

- Overall, UNEP, UNIDO and the consortium partners have effectively implemented successive COP decisions and set up the CTCN accordingly, allowing it to respond effectively to the COP mandate and grow as a recognized institution, acting in a niche of the global climate support ecosystem. The CTCN has consistently adapted the prioritization of its services depending on its financial resources and revised its work programme to implement successive COP decisions;

- The operationalization of the CTCN took time but resulted in the establishment of a

13 'Matters Relating to the CTCN: Selection of the Host and Constitution of the Advisory Board' FCCC/SBI/2012/L.18 para 2.

14 'Report on the Evaluation of Proposals for Hosting the Climate Technology Centre' FCCC/SBI/2012/INF.4 paras 18-47.

15 ibid Annex 2 para 2.

16 'Report on the Independent Review of the Effective Implementation of the Climate Technology Centre and Network' FCCC/CP/2017/3.

17 Evaluation Case Study of the CTCN 2016 <https://www.ctc-n.org/resources/evaluation-case-study-ctcn-2016>.

18 FCCC/CP/2017/3 (n 16) para 3.

> quite efficient organization. The consortium provides a good mix of core and regional expertise, as well as knowledge of United Nations procedures, which have ensured the application of COP decisions and facilitated the deployment of CTCN services'.[19]

These findings confirm the results of the earlier UNEP Review which found that 'an effective, efficient and responsive CTC has been established'.[20] The UNFCCC Review was followed by the so-called 'DANIDA Review' of 2018 commissioned by the Danish Ministry of Foreign Affairs (as Copenhagen is the host location of the CTC in UN City). This review was explicitly based on the two earlier reviews and declared itself to be 'in general agreement with the findings' of those evaluations.[21]

Before proceeding with further findings, it is worth noting at this point that whilst these statements are positive about the early operations of the CTCN, there is an interesting choice of words in the second bullet point above, namely that the CTCN is 'acting in a niche of the global climate support ecosystem'. Given the strength of the statements quoted at the start of this article about the importance and centrality of technology transfer in tackling global challenges such as climate change, can it really be the intention of the UN that the CTCN should be viewed as a mere 'niche' component within the broader range of mechanisms seeking to mitigate or adapt to climate change?

That question may be answered indirectly by the UNFCCC reviewer's observations regarding the level and security of funding provided to support the operations of the CTCN, effectively citing it as a barrier to more effective achievement of its objectives. They state that 'The funding model and consequent limited availability of funding for the CTCN prevents it from delivering services at the expected level. Better predictability and security over financial resources will ensure that the CTCN can continue to successfully respond to its COP mandate and the needs and expectations of developing countries'[22] Referring to funding as 'limited' is diplomatic; the actual level of funding received from voluntary contributions over the operating period 2013-2016 was $38,470,000 (excluding cash and in kind contributions from consortium partners).[23] To put this in context, the amount of funding over the start up and first three years of operation of a mechanism intended to make a contribution of scale to a global challenge, attracted less than half the money from the entire developed world than was spent on building a new art gallery in Dundee.[24] Readers in countries with developed economies are invited to take a moment to think how similar, or even much larger sums are spent locally to them in new buildings, regional economic development schemes or local transport initiatives before reflecting on how realistic it is to expect this level of funding to support activities intended to meaningfully impact climate change. A new cycle path in Cornwall, for example, is attracting a £27 million cash injection from Highways England[25] and yet the world can muster barely more than this to support the operation of what should be a major mechanism for achieving climate change mitigation and adaptation measures. Add to this the fact that even this level of funding is insecure, it becomes yet harder to see that the CTCN is viewed, as the reviewer indicated, as anything more than a 'niche' component of the climate change intervention landscape. This level of funding must therefore be challenged and changed if technology transfer via the Technology Mechanism is to be a significant contributor to the efforts needed to achieve the limitation in global warming that the UNFCCC aspires to.

The DANIDA Review made the limited funding of CTCN their first key observation, concluding that the underfunding and insecurity of budget due to the voluntary nature of donations were critical issues to be addressed. They concluded that 'unless funds are

19 ibid para 83 sub-sections (a) – (c) respectively.

20 Evaluation Case Study of the CTCN 2016 (n 17) Executive Summary, p 6, para iii.

21 Review of the Climate Technology Centre and Network, Review Report, 16 May 2018, DANIDA <https://www.ctc-n.org/sites/www.ctc-n.org/files/ctcn_danida_review_report_2018.pdf>.

22 FCCC/CP/2017/3 (n 16) para 84 (a).

23 ibid Para 64 Table 5.

24 See 'Everything you need to know about the V&A Dundee' *BBC News* (Scotland, 12 September 2018) <https://www.bbc.co.uk/news/uk-scotland-45197154>.

25 See Charlotte Becquart, 'Millions of Pounds to be spent on New Cycle Paths in Cornwall' *CornwallLive* (1 February 2019) <https://www.cornwalllive.com/news/cornwall-news/millions-pounds-spent-new-cycle-2564353>.

increased significantly, it will be difficult for CTCN to function as the intended Global Mechanism, being effective in facilitating the transfer, uptake and scaling of climate technologies and ensuring learning and impact'.[26]

Against this funding baseline, the achievements of the CTCN in its early years of operation are to be applauded. Any shortcomings in operation subsequently discussed in this paper must in fairness be viewed through the prism of the extremely limited level and insecurity of funding available, but it is nonetheless instructive to examine such limitations in performance as may exist, in the hope that they may be addressed should the funding situation be appropriately enhanced in future.

Further findings of the UNFCCC Review of performance were indeed less positive and are discussed below. Relevant to some of these issues, however, is one further fact relating to the availability of funding, namely that 44 per cent of such limited income as there is, is earmarked against specific projects by donors, thereby further constraining the ability of the CTCN to align activities and expenditures with core priorities.[27]

In terms of effectiveness, whilst the UNFCCC Review did note a number of significant achievements in terms of operational start up, network development and capacity building and support for NDE's,[28] it also identified a shortfall in the number of projects undertaken compared to projected Technical Assistance (TA) targets.[29] The DANIDA Review also raised concerns that in 2017, the number of TA requests actually fell compared to the previous year.[30] Whilst the Knowledge Management System and information provision, number of training events and participants trained all met or exceeded targets,[31] the number of technical assistance projects responded to in the first three and a half years of operation was well below that anticipated. Initial targets were based on the anticipation of a cumulative total of 356-515 requests from NDEs in the first four years of operation, and whilst these figures were revised downwards on the basis of successive annual operating plans to 266 – 410 over the same period, the cumulative total of requests was only 185 over the first three and a half years of operation, with only 105 projects completed or under active development or delivery during this period.[32] The report is explicit that this failure to meet target is 'owing to an absence of demand from countries'.[33]

The reasons behind this lack of demand are attributed to shortcomings in the NDE/CTCN axis as follows:

- Lack of resources or local governance issues preventing the NDE's from fully delivering their roles in originating and progressing their requests

- Capacity building programmes to enable and empower NDE's to fulfil their role being initially successful, but time limited due to high turnover of NDE staff, thereby requiring a rolling programme to maintain impact

- The initial guidance from the CTCN on the role of NDE's being insufficiently clear

- Longer than anticipated timelines to action requests due to the complexity of the CTCN structure and decision making processes and the aforementioned limitations of resources. Whilst only a small number of NDE's interviewed expressed dissatisfaction with the length of the process, it is not difficult to imagine that slow response times would negatively impact the flow of requests.

- Failures in extending the network and communicating effectively to necessary stakeholders to ensure greater engagement with the technical assistance function of the CTCN[34]

26 Review of the Climate Technology Centre and Network (n 21) Executive Summary, iii.
27 FCCC/CP/2017/3 (n 16) para 57,14.
28 ibid paras 59 and 60.
29 ibid para 60.
30 Review of the Climate Technology Centre and Network (n 21) 6.
31 FCCC/CP/2017/3 (n 16) para 62, Table 3, 15.
32 ibid para 60 and Table 2, 14.
33 ibid para 62, Table 3, 15.
34 ibid paras 72-74, 18-19.

The DANIDA Review further postulated that the small number of projects undertaken and the large number of developing countries, meant that each country may only have an active project with the CTCN every 5-6 years on average, making it difficult to either build routine or maintain the engagement of such countries.[35]

Whether these shortcomings are best addressed by greater funding of the 'business as usual' approach or an alternative strategy and operational model will be discussed below, but suffice it to say for now, that whatever approach is taken going forward, securing a meaningful flow of technological advice and solutions has to be a priority if the end result of achieving a positive impact on climate change mitigation and adaption is to be delivered on any meaningful scale.

This brings us conveniently to the topic of impact. Whilst there is acknowledgement by the UNFCCC Review of positive impacts on the broader ecosystem of climate change and development interventions, and qualitative examples of programmes which will undoubtedly bear fruit in the future, performance against all outcome targets falls significantly short – by an order of magnitude in some cases.[36] Clearly the longer than anticipated implementation timescale, and limiting finances are contributing factors,[37] as is the fact that technology transfer is a complex and time consuming process, with impacts not necessarily being realised for some time after the role of the CTCN has concluded. The DANIDA Review further recognised the challenge of monitoring and evaluating impact with many small activities over a wide range of themes and countries.[38] The UNEP review, the first conducted, simply felt it was too early in the operational cycle to assess depth of impact.[39] That said, it is only the achievements of quantifiable impacts on climate resilience or reductions in carbon intensity which are truly meaningful in terms of the raison d'etre of the CTCN. Two points are salient here for further consideration; firstly, that the UNFCCC Review notes there is no monitoring or evaluation system in place to capture such macro level impacts[40] and secondly, whether the impact targets as set out for the CTCN are even appropriate? In the absence of the former, targets are reduced to tick box indicators of numbers of various activities which collectively, are arguably indicative of 'the right kind of things being done' and 'things heading in the right direction'. The underlying assumption of this kind of evaluation is that the more of these things that you do, the better you must be doing and the greater impact you must be delivering. There are circumstances where that may be true. If the aim of your organisation is to treat wounded soldiers, then the more you can treat to a given standard of care, the more lives you are likely to save. However, if the aim of your organisation is to stop dams bursting, it is immediately clear that preventing one dam from bursting, if it were the Hoover dam, will have a far greater impact than securing 20 dams on minor rivers which power hydro turbines for individual farmers or home owners. Few projects of scale of impact then become far more meaningful than larger numbers of minor projects. It is clear, to this author at least, that addressing climate change should fall into the second category of operating model at least in relation to mitigation efforts. In this case, impact driven evaluation metrics make more sense than bare numbers of requests actioned.

2.1 Concluding Remarks on Progress

Anyone with experience of the challenge of starting a new entity, in the private, public or third sector, will have some level of understanding of the very many hurdles that need to be overcome to make a new venture operational. When that new entity has a global footprint, with a complex, multi-organisation centre and network, limited, often ringfenced and insecure funding and the objective of making a significant contribution to saving the planet, it is impossible not to feel tremendous admiration for the progress made by the implementing team. Have they achieved all of their targets? No. Have they made an impact of scale? Not yet. What they have done, is create an operating entity against considerable odds which is making

35 Review of the Climate Technology Centre and Network (n 21) iii.

36 FCCC/CP/2017/3 (n 16) para 79 including Table 6, 19-20.

37 ibid para 80, 20.

38 Review of the Climate Technology Centre and Network (n 21) iv.

39 Evaluation Case Study of the CTCN 2016 (n 17) 7.

40 FCCC/CP/2017/3 (n 16) para 81, 20.

progress towards many of the capacity and network building aspects that will be required to meet the future expectations of the organisation. They have also established technological assistance functionality to such a level as to enable detailed performance reviews, and to provide an evidence base of progress and obstacles to date on which analyses such as this one can be founded, in the hope that both can generate recommendations or suggestions that may enhance future operations and achievements.

3 PRACTICALITIES

Amidst the enormity of the task of operationalising the CTCN, it is easy to lose focus on the mandate of the Technology Mechanism of the UNFCCC, namely that of 'enhancing action on climate technology development and transfer'.[41] Rimmer expressed the view that 'the Technology Mechanism is meant to play a pivotal role in encouraging research, development and diffusion of clean technologies to address climate change mitigation and adaptation'.[42] A UNFCCC Expert Working Group anticipated that the CTCN, the operational arm of the Technology Mechanism, would be 'an important part of the UNFCCC climate change architecture'[43]. The mandate agreed by the parties in the Cancun agreement in 2010 set out the context of these operations, requiring that;

- Technology needs must be nationally determined, based on national needs and priorities
- Accelerated action should occur at all stages of the technology cycle from research to transfer and deployment and
- Parties to the agreement able to do so, should enter into bi- or multi-lateral co-operative actions to deliver the country-led defined technological needs to mitigate or adapt to climate change.[44]

Prima facie, it would seem incomprehensible that this process should be anything other than demand led. Surely, no one is better placed to understand the climate change technology needs than the would be recipient country itself. However, experience tells us that it is unwise to leave any assumption unchallenged and there are a number of bases upon which an argument to test this assertion may be founded. The first of these relates to the fact that the cost of development and transfer of the technologies will be supported by the financial mechanisms of the UNFCCC or contributions from donor states or the private sector, so that the recipient state in many cases, is not substantially bearing the full cost of the transaction. On that basis, which of us, if asked what car we needed, would cite the most basic option that would get us from A to B, if we were not paying the full cost of the vehicle ourselves? This is not meant in any way to impugn the integrity of less developed countries – it is purely an observation of human conduct which is applicable to all. The practicality is therefore a need to understand at what part of the process are demand led technology specifications subject to the differentiation between 'best available option' and 'best practicable option, considering cost of delivery' and does that role fall to the CTCN?

The UNFCCC Review indicates that responding to Technological Assistance requests has been more time-consuming than anticipated. Some contributing factors have been discussed above, but in addition, the organisation collaborates with those parties submitting requests for Technical Assistance to 'fine tune' them, but there is no indication whether this applies to the level of technical specification.[45] If not, it is hard to imagine that there is not a stage during implementation where the responding party or funding mechanism, has input to at least refining the technical request to ensure value for money in the balance of impact versus cost.

Another relevant issue in seeking to rely solely on demand led technology transfer is the aforementioned

41 Decision 1/CP.16, paras 133-129 (n 7) paragraph 117.
42 M Rimmer , 'Beyond the Paris Agreement: Intellectual Property, Innovation Policy and Climate Justice' (2019) 8,7 Laws 11.
43 Expert Workshop on the Technology Mechanism FCCC/AWGLCA/2011/INF.2 para 39 p 11.
44 Decision 1/CP.16, paras 133-129 (n 7) paras 114-116.
45 'Report on the Evaluation of Proposals for Hosting the Climate Technology Centre' (n 14) para72, 19.

complexity of the technology transfer process itself. There are excellent and comprehensive works, some by UN agencies, which examine the many barriers to international technology transfer. It is beyond the scope of this article to revisit them all in detail, but they cover matters such as:

- poor macroeconomic conditions associated with uncertain stability of tariffs or subsidies, investment risk, under-developed financial sectors and lack of availability of capital
- Lack of manufacturers
- Poor market confidence in technical performance
- Lack of appropriate industry standards
- Lack of technical skills in recipient industry
- Inappropriate incentivisation of carbon energy sources
- Lack of information on partners
- High transaction costs
- Lack of supporting legal frameworks[46]

Whilst this list is far from exhaustive, it amply illustrates the challenges associated with the technology transfer process. In addition, Sullivan has previously demonstrated that different technologies place hugely varying requirements on the innovation systems between which they are transferred in order for the transfer process to succeed.[47] If technology requirements are specified in the absence of a detailed and sophisticated understanding of what barriers may exist to adoption, and sustainable utilisation, there is a chance that a technological solution is requested that would deliver 100 per cent of perceived demand for carbon mitigation but which has only a 10 per cent chance of successful transfer and adoption. A completely different technological solution may be capable of delivering lower mitigation benefits but have a 90 per cent chance of successful long term adoption. Less developed countries in particular may lack appropriate expertise in the NDE or relevant government department to make such assessments. This rationale presents the case for such expert external review of country specified technological needs prior to attempted technology transfer, but it is unclear whether the CTCN has the capacity or mandate to fulfil such a role. This point was also raised as a concern by the DANIDA Review which expressed the view that isolated technology transfers undertaken in the absence of addressing the relevant enabling factors could have only limited impact.[48]

Moving along to the mandate to engage at all stages of the technology cycle, from R and D to full deployment post technology transfer. Once again this seems eminently sensible. Some technology needs of less developed country may have 'off the shelf' solutions needing little or no modification, which can be provided by the private sector of other parties. Other challenges may have no immediate solution and require innovation of the highest level to meet desired technical performance criteria. The processes necessary to procure these are vastly different, with completely different risk management challenges, time scales and deliverables. As the response mechanisms of the CTCN appear to be a standard tender process or reaching out to the wider Network for solutions, it is not clear, especially in the light of their financial constraints, how well equipped they are to manage both the practical processes and risk across such a broad spectrum of engagement.

This leads conveniently to the third strand of the mandate – enhancing the bi-lateral or multilateral arrangements that will deliver the technological solutions. Whilst the Network has an increasingly large number of subscribers, the extent to which they are active was a matter of concern in the performance review. The UNFCCC Review noted that 'Interactions among Network members and the engagement of local stakeholders have been limited' and 'The CTCN

46 Intergovernmental Panel on Climate Change Special Report (n 12) Section 1.5.

47 K Sullivan, 'Technology Transfer Provisions in Multilateral Environmental Agreements: a Commercial Perspective' (2010) 22(6) *Environmental Law and Management* 290-295.

48 Review of the Climate Technology Centre and Network (n 21) 5.

experienced difficulties in engaging the private sector'.[49] Further, it was stated that 'While the CTCN managed to gather a sufficient number of diversified partners within its Network, it did not manage to create a real community. The majority of members are not active within the Network, providing no contribution to the KMS and no technical assistance' and 'Some Network members are dissatisfied with the commercial opportunities and networking activities provided by the CTCN. During the review, several interviewees questioned the sustainability of and value added by the Network if its level of engagement is not increased.'[50] This exemplifies the huge challenge faced by the CTCN in trying to provide a global service, on limited funding in the absence of a strategic framework that prioritises either territorial or technological focus. The importance of private sector engagement is discussed further below in Section 6. This review further identified that the role of the NDEs in developed countries has not been clear.[51] A lack of understanding of the role of developed countries in certain technology transfers was cited as a barrier by the aforementioned IPCC report on technology transfer nearly twenty years ago, which illustrates the necessity of integrating prior learning in this arena into practical operations.[52]

3.1 Concluding Remarks on Practicalities

The mandate for the Technology Mechanism and CTCN sets out three guiding principles of practical activity which in many ways appear to be unimpeachably sensible. Their combined effect, however, is to cast the CTCN in a role which is both passive and strategically unfocussed. They are to respond to an unlimited technological range of third party requests, across the full spectrum of development stages, and rely upon third party interactions across the global panoply of state and private sector actors to meet such needs. Couched in these terms, the mandate and resulting mission seems far less reasonable and even less achievable. A pertinent recommendation about the requirement for better focus was made by the DANIDA Review which stated that 'Currently, the CTCN provides support to all aspects of adaptation and mitigation, support for small as well as larger interventions: support for readiness activities as well as more focussed TA (Technical Assistance). This carries a high risk of diluting the interventions and makes it difficult to draw replicable lessons learned'.[53]

4 PRIORITIES

The overriding priority of any activities pursued under the auspices of the UNFCCC is clearly stated in Article 2 of that convention: 'The ultimate objective of this Convention and any related legal instruments that the Conference of the Parties may adopt is to achieve, in accordance with the relevant provisions of the Convention, stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'.[54]

The logical progression of this mandate is that where interventions intended to reduce greenhouse gas production are limited by capacity or finance, then those with the greatest potential for mitigation should be prioritised. It is widely accepted that our climate is now at a point where such mitigation is a matter of utmost urgency.[55] As a result, it is now all the more important that scale of potential impact should be the prioritising factor in ranking possible interventions. However, in 2013 the Advisory Board of the CTCN set out guidance on how the organisation should prioritise which requests to support. Seven prioritisation criteria were

49 Report on the Evaluation of Proposals for Hosting the Climate Technology Centre (n 14) para 63,16.

50 ibid para 71, 18.

51 ibid para 88, 22.

52 Intergovernmental Panel on Climate Change Special Report (n 12) Section 1.5.

53 Review of the Climate Technology Centre and Network (n 21)18.

54 See 'United Nations Framework Convention on Climate Change' <https://unfccc.int/sites/default/files/conveng.pdf>.

55 'UK Government Declares Climate Change Emergency' *BBC News* (1 May 2019) <https://www.bbc.co.uk/news/uk-politics-48126677>, UNFCCC 25th Anniversary: Climate Action is More Urgent than Ever <https://unfccc.int/news/unfccc-25th-anniversary-climate-action-is-more-urgent-than-ever>.

set out, ranging from projects that 'promote endogenous and most appropriate technologies and processes' to those that 'promote and demonstrate gender equality, and empowerment of vulnerable groups, including women and youth'.[56] Whilst intrinsically admirable, neither of these criteria, or any of the others specified, explicitly prioritise the level of impact on GHG mitigation as a prioritising factor. Sullivan has previously noted the challenge UN agencies face in seeking to resolve the tension between equity in development and timely stabilisation of climate change, and this is evident once again in these prioritisation criteria.[57] Given that the level of project requests has been lower than expected, an argument could be made that the need for prioritisation on this basis is obviated to some extent. The failure in this line of reasoning is that is misses the broader point – the Technology Mechanism and the CTCN needs to maximise the important impact that technology transfer can make on addressing climate change. If there is a dearth of high impact requests coming forward, then perhaps there needs to be a strategic change in the operational model of the organisation, from passive/responsive to proactive, where territories, technologies or a mix of both, are prioritised by the CTCN. This is exactly the kind of focussed strategic approach adopted by the Medicines Patent Pool (MPP), a UN backed international organisation founded in 2010 'to increase access to, and facilitate the development of, life-saving medicines for low- and middle-income countries'.[58]

The sole strategic objective of the MPP at the outset of operations was 'Increasing access to HIV treatment through strategic use of intellectual property' driven by an unprecedented demand for HIV medicines.[59] Whilst the founding UN organisation, Unitaid,[60] had additional healthcare priorities of tackling Hepatitis C and tuberculosis, these were not adopted by MPP until it had established and embedded its operational model. Furthermore, even within this first clearly defined priority area, target drugs for licensing were divided into Levels 1-3 in terms of priority of acquisition, depending on a combination of their clinical priority and the scale of market/IP factors that would otherwise present barriers to acquisition by low and middle income countries.[61] As the name of the organisation suggests, this is not a straightforward purchasing model of intervention, but a model based on technology transfer, where IP rights are secured from patent holders and then on-licensed to generic manufacturers to increase lower cost availability of therapeutics in target recipient countries. This combination of strategic clarity and priority of acquisition has led to rapid interventions of substantial scale of impact. In the six years from January 2012 to December 2017, 6.2 billion doses of medicine were delivered via MPPs generic partners, and 553 million $US in savings were delivered to the international community via MPPs licenses.[62]

In many ways, this mirrors the 'Want, Find, Get, Manage' process of open innovation or technology acquisition utilised in the private sector by large industrial actors such as pharmaceutical or food companies.[63] This is widely acknowledged as a well road-tested and effective method of acquiring third party innovation for the benefit of the adopting company ie utilising technology transfer to fill unmet technical need to further the interests of the undertaking concerned. It works for industry, it clearly works for MPP and it has the potential to work more effectively for the CTCN. As things stand, the state parties are determining the 'Want' and CTCN is assisting with the 'Find and Get' on an ad hoc basis. The question has to be asked: If CTCN determined the 'Want' in the same was as the MPP, would it not offer the potential for far greater impact than responding to diverse ad hoc requests for technical

56 CTCN Prioritisation criteria for responding to requests from Developing Country Parties, September 2013 <https://www.ctc-n.org/sites/www.ctc-n.org/files/240bcf259a814482a6b0b3d0f73932a4.pdf>1-2.

57 K Sullivan, 'Technology Transfer and Climate Change: Additional Considerations for Implementation under the UNFCCC'(2011) 7(1) Law, Environment and Development Journal13.

58 See <https://medicinespatentpool.org/>.

59 MPP Annual Report 2010/11 <https://medicinespatentpool.org/uploads/2017/07/Medicines-Patent-Pool-Annual-Report-2010-2011-RevFinal.pdf> 6-7.

60 Unitaid is a global health initiative hosted by the World Health Organisation focussed on ending the world's tuberculosis, HIV/AIDS, Malaria and Hepatitis C epidemics.

61 ibid 24.

62 MPP Annual Report 2017 <https://annual-report-2017.medicinespatentpool.org/pdf/MPP_Annual_Report_2017_global.pdf> 4.

63 M G Martinez, 'The "Want Find Get Manage" (WFGM) Framework for Open-innovation Management and its Use by Mars, Incorporated' Open Innovation in the Food and Beverage Industry (2013) 315 – 331.

assistance? In support of this approach, one might suggest that the state parties have already iterated the demand side of the equation by the preparation of country specific Technology Needs Assessments. The UNFCCC has already undertaken the work of generating synthesis reports that very effectively collate the technology needs of a large group of non-Annex I parties to the UNFCCC (that is countries not considered to be industrialised and hence developing or low income states). By way of example, the third such synthesis report covering 31 non-Annex 1 countries was presented to the UNFCCC Subsidiary Body for Scientific and Technical advice back in 2013, and helpfully included the most commonly required areas of technological need for both mitigation and adaptation, as well as the most commonly stated barriers to technology transfer for each of these.[64] Whilst this would need to be updated and refined, it certainly provides a reasonable evidence base on which to make prioritisation assessments in respect of technology transfer to these countries. What may be far less comfortable for a UN agency, would be the prioritisation of assistance to states where the transferred technology would have the greatest scope for mitigation or adaptation, which, with respect to the former, would almost certainly be the larger developing countries. The DANIDA Review, suggests that due to the limited funding and consequent scope of support the CTCN can realistically provide, it should consider altering it's operating modality of operation to, amongst other options, 'focus on specific countries or sectors'.[65]

Prioritisation sceptics may still feel that comparisons to the private sector are inappropriate given the broader responsibilities of UN agencies, and that the MPP, whilst UN-founded, operates in the healthcare space which is fundamentally different in structure and objectives to the environmental sphere. To address those who may hold such perceptions, it may finally be useful to briefly consider technology transfer under the Montreal Protocol. The phasing out of ozone depleting substances to save the ozone layer from further damage and to allow it to recover, is widely held up as an outstanding environmental success story.[66] Commentators note that this success is in part attributable to the clearly defined nature of the technological challenge, namely a clear priority for technical intervention.[67]

4.1 Concluding Remarks on Prioritisation

Nothing in this section is intended to question the general utility of CTCN operations – only time and appropriate monitoring and evaluation will determine the added value of these activities to the international efforts to mitigate or adapt to climate change. What is questioned, however, is whether, on the basis of limited funding and human resource, the current operating model and resultant activities offer the greatest potential impact in these respective areas. China, India and Russia are respectively the first, third and fourth highest global producers of greenhouse gases.[68] According to its own progress report of CTCN performance thus far, there is no indication that it has provided any technical assistance to any of these countries even at the sub-national level, even though China and India are non-Annex I countries and the Russian Federation is an Annex I Economy in Transition.[69] Only just over 4 per cent of the 137 received requests are for multi-country activity[70] although the report explicitly recognises the benefits of scalability of impact via multi-country requests.[71] Under the current responsive model, the CTCN is largely unable to change these limitations, but if it

64 United Nations, Third synthesis report on technology needs identified by Parties not included in Annex I to the Convention, FCCC/SBSTA/2013/INF.7 <https://unfccc.int/resource/docs/2013/sbsta/eng/inf07.pdf> 5-6.

65 Review of the Climate Technology Centre and Network (n 21) Review, 17.

66 Anderson, Sarma and Taddonio (n 2)XIX.

67 I Rae, 'Saving the Ozone Layer: Why the Montreal Protocol Worked' *The Conversation* (Australia, 9 September 2012) <https://theconversation.com/saving-the-ozone-layer-why-the-montreal-protocol-worked-9249>.

68 'Each Country's Share of CO2 Emissions', *Union of Concerned Scientists* <https://www.ucsusa.org/global-warming/science-and-impacts/science/each-countrys-share-of-co2.html>.

69 CTCN Progress Report (2018) https://www.ctc-n.org/files/resources/ctcn-ar18-book-final.pdf >50, 55 and 60.

70 ibid 68-69.

71 ibid 45. https://unfccc.int/ttclear/misc_/StaticFiles/gnwoerk_static/TEM/0e7cc25f3f9843ccb98399df4d47e219/174ad939936746b6bfad76e30a324e78.pdf.

were to take the approach of the MPP and prioritise technology development and acquisition, and states or regions for implementation, still driven of course by state determined Technology Needs Assessments, it could have far greater control over impact than is currently the case. The progress report already states that a key lesson learned to date is that the measurement and communication of impact is vital to the success of the CTCN.[72] Surely being in a position to more actively maximise that impact is also vital.

5 PATHWAYS

Technology transfers, both domestic and particularly international, are not transactions which are easily achieved. Perhaps this article should have articulated a sixth 'P' for 'Problems' in technology transfer, but to keep to more commonly used parlance, there are often many so-called 'barriers' to both the initial transfer, and it's sustainable adoption and wider diffusion. Many researchers and organisations, of which the UN and its agencies are at the forefront, have made tremendous progress in understanding the barriers to technology transfer, in particular in relation to climate change technologies.[73] [74] This understanding has translated into what is often referred to as 'capacity building' efforts, particularly in recipient territories, in order to reduce these perceived barriers. This addresses a very long list of factors, many of which are articulated well in documents already mentioned here, including availability of finance and skills, compatible infrastructure, technical performance requirements, policy issues such as inappropriate incentives for high carbon alternatives, legal framework and so on.[75] Elevating skills or other interventions in capacity building approaches seek to improve the 'innovation system' of human capital, financing, networks, and infrastructure, and the CTCN is making good progress on this front with respect to education and training provision in support of human capital development.[76] However, there is an additional complicating factor in play with respect to climate change technologies. Not only are innovation systems territorially specific, they are also industry sector specific and, in many instances, they are technology specific as well. Climate change technologies encompass the full breath of sectors; energy, transport, food and agriculture, transport, housing, waste management and health, and even within a single sector, such as forestry, innovation needs may range from improved forestry management practices to genetically modified trees, which may have completely different demands of the innovation system into which they are transferring. On this basis it is clear that the variety and combinations of barriers to the transfer of the full spectrum of climate related technologies is on a scale which can initially at least, appear overwhelming. In the absence of technological or territorial focus, the only reasonable approach is to seek to undertake generic capacity building measures – build skills at least in policy makers and provide information on technology and finance – which is exactly what the CTCN has done.[77]

Whilst this approach is undoubtedly useful, it may not significantly assist in removing barriers to the most impactful mitigation or adaptation related technologies in any specific territory. The only way to understand the barriers that may exist to the transfer of any particular innovation or technology, is to generate a transfer pathway, covering development to transfer stage in the donor territory, the transfer itself, then the modification (if any), adoption, diffusion and sustained establishment in the recipient territory, and examining the barriers or hurdles that may come into play at any point in that life cycle. Because individual transfer pathway mapping is not widely undertaken, barriers which may not be encountered until late in the life cycle are often overlooked with the result that the transfer fails or is never utilised. Sadly, some climate change technology transfers have fallen into this category, with failure to address cultural or regulatory barriers in the recipient country until lack of adoption makes such barriers self-evident.[78]

72 ibid 45.

73 J Boldt and others, 'Overcoming Barriers to the Transfer and Diffusion of Climate Technologies' (UNEP 2012).

74 Sullivan (n 47) 288-302.

75 Intergovernmental Panel on Climate Change Special Report (n 12) Section1.5 and (n 55) 15-34.

76 'Report on the Evaluation of Proposals for Hosting the Climate Technology Centre' (n 14) paras 12-13, 4.

77 ibid para 11.

78 Anderson, Sarma and Taddonio (n 2) 7-8 and 17.

If the information on barriers is available in the literature, perhaps the solution is to find better ways to visualise and interpret such information, not only to help practitioners and enablers to foresee obstacles in time to find ways over, or innovate a way round, but also to enable the user to make meaningful comparisons between different options. To those of us experienced in technology transfer, the term 'transfer pathway' makes the whole process sound too easy – quite literally like a walk in the park. In reality, it is far more like a steeple chase – a long process with numerous hurdles, some of which appear initially to be insurmountable. Using this analogy, this paper proposes a means of visualising the transfer pathway by visually mapping the number and scale of hurdles or barriers, and their proximity to the donor or recipient side of the transfer. The following diagram shows a representative transfer pathway for a generic adaptation technology. It shows the barriers identified in the third TNA Synthesis report for adaptation technology transfers; economic and financial; policy, legal and regulatory; institutional and organizational capacity; and technical.[79] The most commonly encountered barriers are shown to be higher to reflect this.

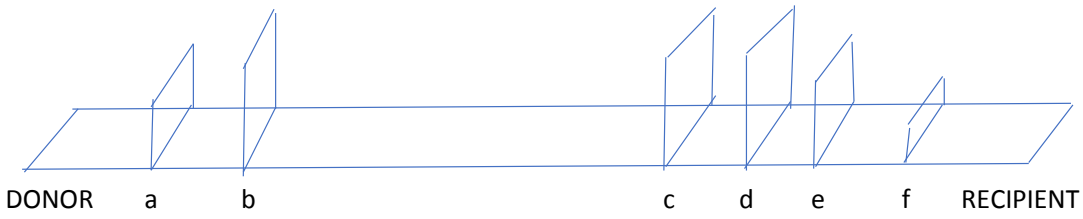

Fig. 1. The transfer pathway shows access to finance and technical issues as barriers for both supply and demand side actors (a and c and b and d respectively) whereas organisational capacity/infrastructure and legal issues (e and f respectively) as relevant to the recipient territory only.

This hypothetical example shows that barriers such as finance or technical standards issues can present a barrier on the supply as well as demand side and in some instances a domestic 'fix' to overcome the donor side barrier may be required in addition to an international community intervention on the recipient side of the transfer. If the supply side company is an SME, for example, they may be unable to accept the financial risk of slow or non-payment and need a domestic government indemnification such as the Export Loan Guarantee Scheme run in the UK to overcome that barrier. Alternatively, they may need investment to scale up to meet increased demand. This is a completely different type of financial barrier and solution to that experienced on the demand side of the equation where financial support from the international community may be required to offset costs of acquisition in whole or in part. Once again, the IPCC report nearly two decades ago, was explicit on the fact that supply side barriers in developed countries should not be overlooked and were particularly relevant to SMEs.[80] Even on such a very simplistic level, this visualisation approach makes the appreciation of the number, scale and the effective 'ownership' of barriers far easier to grasp. Whilst the Technology Needs synthesis report quite rightly suggests a barrier analysis for each technology, with identification of 'enablers' for each, within each country, the implication is that barriers are all demand side based.[81] As noted above, this is not necessarily true, and it is important that at the domestic level in technology supply side countries, an assessment is made of barriers to technology transfer and appropriate policies or interventions implemented to reduce or obviate these. This would appear to be a natural role for the NDEs.

If this approach may have utility for demonstration purposes, is that necessarily transferable to real world transfers? As previously mentioned, technology transfer under the Montreal Protocol to reduce levels of ozone depleting substances (ODS's) was a remarkably successful example of environmental technology transfer, and it provides very helpful demonstrators of the potential utility of this type of visualisation. It demonstrates that the first wave of

79 FCCC/SBSTA/2013/INF.7 (n 64) para 12,6.

80 Intergovernmental Panel on Climate Change Special Report (n 12) Section 1.5.

81 FCCC/SBSTA/2013/INF.7 (n 64) Table 1,5.

innovation and technology transfer occurred within developed countries, with uncertainty about regulatory and private sector (eg insurance industry) standards being a principal barrier along with securing appropriate technological performance of alternatives.[82] This can be illustrated by the following pathway profile.

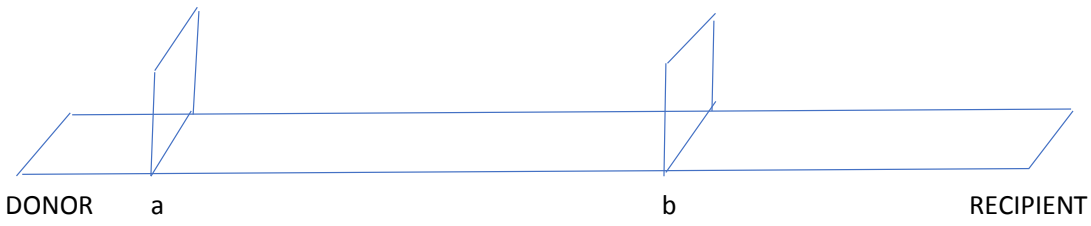

Fig 2a. This illustrates the early principal barriers to transfer. Despite involvement of the US Military research infrastructure, as well as global public and private sector research, the technical barriers were challenging (a) and massive international efforts were needed to identify replacement compounds for ODSs. Even when such compounds were developed, a significant barrier to their adoption was that of regulatory standards lagging behind, so that the use of the new compounds was not reflected in legal standards required of manufacturers (b).

Subsequent transfer of ODS alternatives to countries with economies in transition (CEIT's) identified a completely different profile of barriers. Analysis of over a thousand completed technology transfers under the Montreal Protocol revealed that barriers to technology transfer in CEITs were experienced in a number of categories.[83] Even though these barriers are not ranked, when visualised below, it becomes instantly clear that the transfer process is completely different at this stage.

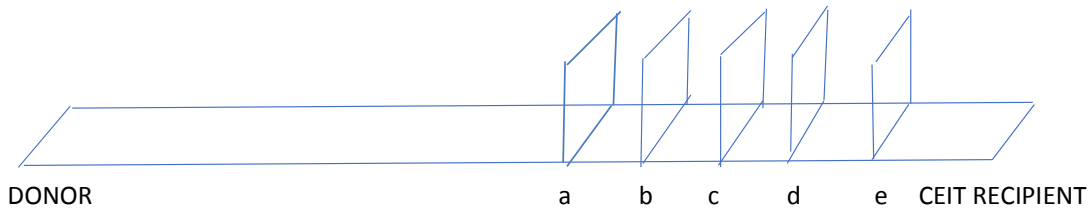

Fig 2b. This shows the transfer pathway for exactly the same technology, but at this stage of the process, the profile is completely different with multiple barriers experienced on the demand side including poor infrastructure and utilities (a) poor regulatory standards and implementation (b), skills shortage (c), weak supporting industry, for example, components production (d) cumbersome financing and high cost of agreements (e).

This emphasises the need to examine the whole life cycle of innovation development, transfer and diffusion to ensure that the most appropriate technological solutions flow as effectively as possible to their required point of use.

5.1 Concluding Remarks on Transfer Pathway Analysis

There are two basic points to be made on this topic. The first is that each innovation and transfer pathway is highly individual, potentially with multiple transfers occurring between different public and private sector actors as well as different territories, possibly in differing stages of development. Each of those transfer stages may face very different profiles of potential barriers, and the better they are understood, the greater the chance of adopting strategies to

82 Anderson, Sarma and Taddonio (n 2) 45.
83 ibid 257.

overcome or circumvent them and achieve efficient and successful transfers. Transfer pathway mapping to identify and quantify those barriers, particularly with tools to assist visualisation of what is often a complex process can only help enablers and policy makers to apply their interventions more effectively. It may also assist in making comparisons regarding the potential ease of transfer of competing options. This leads appropriately into the second point, which is that things are not always as difficult as they look. The same article that identified the numerous observed barriers to transfer of ODS technology to CEITs above, stated that 'It should be noted that many projects were executed without problems, and this study relates only to the projects that mentioned specific problems in their completion reports'.[84] The fact that each transfer is individual, does not mean that many elements of challenge are without parallel, and transferability of learning is still hugely important. Research into the 'without a hitch' projects should progress in parallel with the considerable efforts made to understand the barriers and ways to address them, in those transfers that progress less effectively. Additionally, such research should not overlook the supply side barriers which may be addressed at domestic level to stimulate the willingness and ability to engage in international technology transfer.

6 PRIVATE SECTOR

Sullivan has previously highlighted the disconnect between the facts that whilst states are the signatories to multilateral environmental agreements such as the UNFCCC, and hence the actors making the commitments to technology transfers, the majority of technologies are owned or controlled by the private sector.[85] As such, the role of organisations such as the CTCN must be to actively engage the private sector and the role of the state parties whose private sectors will act as technology donors is to implement policies or public sector support which will incentivise companies to give effect to their technology transfer commitments. There is a long history of such interventions; early regulatory approaches were criticised for having the opposite of the intended effect and actually inhibiting technology transfers and so were replaced by market-based approaches.[86] Whilst this is showing more promising results for some technologies, the OECD has concerns that it may not be a broadly advantageous approach in the field of environmentally sustainable technologies as the latter is aimed at delivering environmental impact rather than fulfilling an unmet market demand – essentially delivering a public good, albeit a much needed one. Their view is therefore that public funding may be essential in stimulating the necessary research and development and subsequent transfers by the private sector.[87] The result is that whilst it is accepted that the private sector is key to delivering climate technology transfers, there is still debate about how to do this most effectively which makes it an even greater challenge for entities such as the CTCN.

The UNFCCC Review stated that 'The private sector appears as a critical partner for the CTCN with regards to developing an enabling environment for climate technology development and transfer and in particular with regards to enabling the scaling up of climate technologies'.[88] It went on to express concern, however, that whilst the CTC had attracted a number of private sector members to the network (some 40 per cent of membership at that time), the feedback from those interviewed was that there had been insufficient engagement with the private sector or industry involvement in the operations and activities of the CTCN.[89] The DANIDA Review was even harsher in it's criticism on this point. It not only rated the level of private sector involvement as 'currently weak' but also raised the issue of the need to address the different roles of the private sector as 'technology provider, technology user, investor and possibly potential funder of climate technology transfer solutions'.[90] They went on to say that whilst there was significant focus on the role of the NDE's, they

84 ibid.
85 Sullivan (n 57) 14-15.
86 Anderson, Sarma and Taddonio (n 2) 8-9.
87 ibid.
88 FCCC/CP/2017/3 (n 16)para 29, 50.
89 ibid para 29, 51
90 Review of the Climate Technology Centre and Network (n 21) iii.

may not have sufficient technical knowledge or landscape awareness to ensure a successful outcome, whereas the project owner should have such capability and should be a the centre of technology transfer programmes.[91] In many instances the project owner will be from the private sector, as the owner or controller of the technology to be transferred, or as the primary recipient.

This issue is further complicated by the long-standing debate around whether conventional technology transfer from foreign companies to developing countries is an appropriate or successful approach. Ockwell et al propose that 'Building up eco-innovation capabilities in developing countries requires a shift away from the current focus on large project based approaches which emphasise the transfer of the hardware aspects of clean technologies, towards approaches that emphasise flows of codified knowledge (know-how and know-why) and tacit knowledge'.[92] This sits uncomfortably with the findings of earlier empirical studies which identify trade and foreign direct investment (FDI) as primary routes of international technology diffusion.[93] More recent work by Pueyo and Linares used quantitative analysis to generate helpful insights into this topic and demonstrated that when it comes to renewable technology transfer to developing countries, one size does not fit all.[94] Analysis of a number of enabling factors amongst technology recipient countries identified four groupings or categories of country:

- Technology Developers
  Countries such as India, China, Mexico, Brazil and Thailand that are able to attract inward transfers of foreign technology, operate and maintain the equipment and use the knowledge gained to drive endogeneous innovation

- Technology Implementers
  Countries such as Jordan, Tunisia, Panama and Lebanon that are small economies with low levels of fossil fuel production so that demand side pull is strong. However, the lack of scale hampers the 'learning by doing' driver of internal innovation, although the relatively high income per capita still drives foreign transfers of clean technologies which the domestic industry base is capable of implementing

- Structural Changes
  Large countries such as Russia, Algeria, Egypt and Oman with abundant domestic fossil fuel supplies, need structural changes to elevate the demand side pull for clean technologies over cheap domestic carbon based fuels. Additionally, their economies do not provide conducive environments for private investment.

- Aid Recipients
  Countries such as Bangladesh, Honduras, Kenya and Madagascar need foreign aid to create the basic conditions for successful technology transfers. This group lacks the technological capacity to implement foreign technologies or to develop their own. Some countries in this group show scarcity-induced innovation within local communities, however, which needs to be nurtured at grassroots level.

This analysis goes a long way towards resolving the apparent discord between the proponents of widely different roles for the private sector in giving effect to technology transfers to developing countries and shows there is not 'right or wrong', but simply 'horses for courses'. This piece of research also provides a stark demonstration of the very different capacity building measures and public policy interventions needed to support and incentivise technology transfer in each category of recipient country.[95] There is recognition

91 ibid

92 D Ockwell and others, 'Enhancing Developing Country Access to Eco-Innovation: the Case of Technology Transfer and Climate Change in a Post-2012 Policy Framework' (2010) OECD Environmental Paper 12 <https://www.oecd-ilibrary.org/docserver/5kmfplm8xxf5-en.pdf?expires=1563286736&id=id&accname=guest&checksum=BF5B4CA1921FB34384524225A0B87F51>.

93 W Keller, 'International Technology Diffusion' (2004) 42(3) J Economic Literature 752-782.

94 A Pueyo and P Linares, 'Renewable Technology Transfer to Developing Countries: One Size Does Not Fit All' (2012) Institute of Development Studies Working Paper 412. https://www.ids.ac.uk/publications/renewable-technology-transfer-to-developing-countries-one-size-does-not-fit-all/.

95 ibid 25-27.

that some countries in the Structural Change and Aid Recipient groups do not provide environments that inspire confidence in the private sector: that the increased levels of risk act as a supply side barrier to FDI for example. Sullivan has previously recommended the use of the insurance asset by technology transfer donor side countries as a possible policy intervention to underwrite risks such as political instability or IPR abuse in the recipient country, in order to incentivise domestic industry to give effect to international technology transfer commitments.[96] This point has been touched on by Pueyo and Linares with respect to the private sector need to rely on long term stability of regulatory environment in technology recipient countries. Specifically, they suggest that guarantees by international insurance entities could provide comfort in respect of commercial reliance on things like long term power purchase agreements.[97]

6.1 Concluding Remarks on the Private Sector

There is a clear evidence from both reviews of CTCN performance and from the broader literature on International technology transfer, that there needs to be greater private sector engagement in the operation of the CTCN and particularly in giving effect to the technology transfers of scale required to make a meaningful impact on climate change mitigation and adaptation. As mentioned previously, incentivising such private sector engagement and mitigating any associated business risks, will require supply and demand side public policy interventions and demand side capacity building measures which are both technology specific and target country specific. This re-enforces previous calls for a greater degree of prioritisation of both technologies and recipient countries.

7 CONCLUDING REMARKS

Evidence indicates that despite the usual challenges of any start-up undertaking, significant organisational complexity and limited financing, the CTCN has made demonstrable progress in implementing its mandate as the operational arm of the Technology Mechanism of the UNFCCC. Those individuals and organisations behind this progress should be heartened by the outcomes of their combined efforts, the positive aspects of which have been recognised in several reviews, in addition to the UNFCCC review referenced most widely in this paper. These reviews have also delivered a series of recommendations for improving the efficiency and effectiveness of future operations and these are helpfully summarised and responded to by the CTCN in a single document.[98] The ten recommendations include the standard fare for such reviews; the need for improved awareness raising of CTCN activities and NDE function, enhanced governance and transparency, strengthening Network engagement and of course, several relate to various aspects of the financing and the need to identify additional sources of secure financial support. Of particular relevance to this article is the need to increase the efficiency of the CTCN's provision of Technical Assistance (Recommendation 6). In responding to this point, the CTCN indicate adoption of a regional approach to deliver higher impact, and the adoption of 'priority themes' allowing replication among countries with common needs. Whilst this approach still falls short of the active strategic priority/ procurement model advocated in this paper, it could certainly be viewed as movement in that direction.

An examination of the mandate of the CTCN and the practicalities this imposes on the operations of the organisation, has revealed that it was structured in such a way as to inevitably cast the organisation in a purely responsive mode in terms of its technical assistance role. There is evidence above of a recognition of the need for greater impact and efficiency in this aspect of operations and perhaps it is time to review the mandate accordingly. The practice of open innovation in industry, and the operating model of the Medicines Patent Pool, a UN founded international organisation, both point to a 'want, find, get, manage' active procurement model. Whilst the 'want' is initially specified in state parties Technology Needs Assessment and associated action plans, there could be a role for

96 Sullivan (n 47) 300.

97 Pueyo and Linares (n 94) 28.

98 CTCN Response to Review Recommendations October 2018 < https://www.ctc-n.org/sites/www.ctc-n.org/files/item_7_-_ctcn_response_to_recommendations.pdf>.

the CTCN in identifying commonly required, high impact technologies and the best practicable option for meeting identified needs. The 'best practicable option' approach can assess all relevant categories of risk as well as value for money considerations. Such prioritisation of a small number of technologies would allow far greater evaluation of the technology transfer pathway for high priority recipient states, ensuring that specific barriers can be identified and addressed via targeted capacity building measures. This is essential if the barriers to large scale private sector engagement are to be addressed. Such focus also allows the bandwidth to apply the extensive knowledge and previous experience of the UN agencies and their partners with respect to technology transfer, to more projects of scale.

The knowledge of barriers to technology transfer, both generically and in respect of specific technologies is extensive but challenging to apply anew with every technology transfer attempted. Tools to visualise the barriers, in terms of their number, nature and proximity to supplier or recipient is a potentially useful approach to ensuring that these matters are meaningfully and timeously considered. Software tools to generate such pathway schematics could easily be constructed to suggest barrier options relevant to specific technology sectors, as well as being underpinned by a database that would suggest enablers or mechanisms via which they have been historically and successfully addressed. Even the very basic schematics illustrated in this article serve as a useful reminder that barriers are not always on the demand side and a useful role for developed country NDEs could be ensuring that where they are acting as the supply side of technology transfers, all domestic endeavours have been made to ensure that any such barriers are addressed by national policies or public sector interventions where necessary.

Whilst this paper advocates consideration of a change in strategic focus and operating mandate, it will inevitably be hampered by limiting funding, if that issue remains unresolved. However, if the centrality of technology transfer to addressing climate change mitigation and adaptation is better acknowledged by the international community and a more appropriate level of secure funding is achieved, there is no reason why a strategic focus on CTCN led technology acquisitions cannot operate alongside the generic, responsive activities undertaken to date, thereby ensuring the widest impact of both approaches. There is a time pressure to achieve this, however, not simply due to the pressing nature of addressing climate change, but due to the fact that the limited scale of operations and potential impact to date is clearly causing concern: Rimmer reported that in response to such perceived limitations 'there has been consideration of alternative mechanisms for technology transfer'. He further stated that despite declarations at the Bonn Climate Conference in 2017 aimed at enhancing technology development and transfer via the Technology Mechanism, developing countries remained unsatisfied that this matter was appropriately resolved.[99] Urgent progress is therefore needed on reviewing the mandate and associated practicalities of operation of the CTCN, allowing prioritisation of technologies and target countries for technology transfers. This will allow for greater focus on the transfer pathways for the chosen technologies, and more targeted capacity building or policy interventions to incentivise more wholesale engagement of the private sector. Addressing the 5 'P's' will increase the potential for the CTCN to make a greater contribution to the global technological response to climate change mitigation and adaptation, but only continued monitoring and evaluation will determine whether this entity occupies nothing more than a niche role in climate technology transfer or evolves to be at the forefront of international transfer and adoption of the technological responses to climate change.

99 Rimmer (n 42) 9.

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