Technology Transfer in the International Climate Negotiations

Assessment of Proposals and Discussion of Open Questions

Dominic Marcellino
Christiane Gerstetter

With Contributions from

Elena von Sperber
Michael Marble

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Ecologic Institute, Washington DC
www.ecologic-institute.us

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Authors

Dominic Marcellino (dominic.marcellino@ecologic-institute.us) is a Fellow at the Ecologic Institute, Washington DC.

Christiane Gerstetter (christiane.gerstetter@ecologic.eu) is a Fellow at the Ecologic Institute, Berlin.

Elena von Sperber (elena.v.sperber@ecologic-institute.us) is a Transatlantic Fellow at Ecologic Institute, Washington, DC.

Michael Marble (michael.marble@ecologic-institute.us) is a Researcher at Ecologic Institute, Washington, DC.

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About Ecologic Institute

Ecologic Institute, Washington, D.C. ("Ecologic Institute") was established in 2009 and is a non-partisan 501(c)(3) think tank for applied environmental research and policy analysis. Ecologic Institute is dedicated to bringing fresh ideas to environmental policies and sustainable development. The Institute's work program focuses on obtaining practical results. Donations to Ecologic Institute are tax-deductible. Ecologic Institute works closely with Ecologic Institute gGmbH, a private, not-for-profit environmental policy think tank with offices in Berlin, Brussels, and Vienna. Ecologic Institute gGmbH was founded in 1995 and is a partner in the network of Institutes for European Environmental Policy. Ecologic Institute gGmbH acts in the public interest; donations are tax-deductible.

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Executive Summary

The following report, "Technology Transfer in the International Climate Change Negotiations: Assessment of Proposals and Discussion of Open Questions,"[1] is the culmination of a six-month research project conducted by the Ecologic Institute with the support of a grant from the Doris Duke Charitable Foundation. The Ecologic Institute reviewed proposals related to the transfer of climate technology to developing countries in the run-up to the UNFCCC climate negotiations in Copenhagen in December 2009 (COP 15). Preliminary outputs from the project led to the publication of a policy brief setting out a series of recommendations for negotiators and key stakeholders prior to COP 15.[2] These recommendations were presented in Washington, DC and Berlin as well as in Copenhagen during the negotiations.

This report is comprised of three sections of analysis. Section 2 takes a detailed look at the state of negotiations. It identifies areas of consensus and convergence in the negotiations, and it highlights continued sources of controversy. Section 3 evaluates several aspects of a prospective post-Copenhagen agreement on technology transfer against experience and insights contained in the academic literature. The results provide guidance for negotiators as they debate how to operationalize and implement an international framework for technology in the wake of the Copenhagen Accord and leading to COP 16 in Mexico. Section 4 delves deeply into two of the remaining areas that have not seen much progress and have led to significant disagreement between Parties – intellectual property rights and monitoring, reporting, and verification – and offers some suggestions for a constructive way forward.

Several key conclusions from the report stand out. First, current and pledged financing for technology transfer fall short of estimated needs and must be enhanced by additional policies, measures, and investment. Next, a new Green Climate Fund coming out of the Copenhagen Accord should learn from the experience of other funds. Further, the establishment of new institutions should be additive and focus on effective, measurable outcomes. Additionally, the Clean Development Mechanism can serve as a tool for technology transfer and can be crafted to encourage more. Moreover, while disagreement over the role of intellectual property rights remains the biggest obstacle to finalizing the technology transfer negotiations, the prominence of the issue appears to exceed its current importance. Lastly, the establishment of concrete commitments from Annex II countries for technology transfer should be combined with uniform reporting procedures to produce measurable data on compliance. Performance indicators will aid efforts to monitor, report, and verify compliance, but costs, context, and capacity building must be considered as well.

It remains clear, even with the creation of a new technology-related mechanism and new rules and commitments on technology, that the UNFCCC is only going to be one - albeit important – part of a multifaceted approach to technology transfer. The private and the public sector will be involved in crafting solutions, as will bilateral, regional and other multilateral institutions and funds. More importantly, one cannot lose sight of the fact that technological advances alone likely will not be sufficient to mitigate climate change and allow societies to adequately adapt to it – political will for large-scale economic and social transformation will be equally crucial.

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[1] Manuscripts based on portions of this study have been submitted to peer-reviewed journals.

[2] Gerstetter and Marcellino (2009)

1 Introduction

Technology transfer is an important part of current international climate change negotiations under the auspices of the United Nations Framework Convention on Climate Change (UNFCCC). A focus on transferring technology to developing countries was included in the so-called Bali Action Plan (BAP), which set out a path for negotiations to forge a climate agreement to follow the Kyoto Protocol. Technology transfer formed one of the four "building blocks" of the BAP to establish a new international climate framework. Despite the intentions of the BAP, the 15th Conference of the Parties to the UNFCCC (COP 15) in Copenhagen did not manage to conclude the overall negotiations process through a binding and ambitious international climate change agreement. What did come out of Copenhagen is the non-legally-binding and non-consensual Copenhagen Accord,[3] as well as a number of more or less advanced negotiation drafts on specific sub-issues, and a number of technical decisions on the improvement of existing mechanisms and structures. In addition, the mandate of the Ad-Hoc Working Group on Long-Term Cooperative Action (AWG-LCA), which is, inter alia, responsible for conducting the negotiations on technology transfer, has been prolonged until COP 16, to be held in late November and early December 2010 in Mexico.[4]

In part, the BAP placed specific emphasis on technology transfer because Annex II developed countries already have related legal obligations, as set forth in Art. 4.5 UNFCCC, to "promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties". The Copenhagen Accord also contains passages that have importance for technology transfer. Despite the fact that the Copenhagen negotiations did not result in a legally-binding agreement, all evidence points to a continuation of the technology negotiations in some form. Analyzing the outcomes of Copenhagen and discussing options for filling the remaining gaps is, therefore, an important and useful undertaking and will help inform negotiations in 2010 and beyond. This report sets out to analyze the outcomes from Copenhagen and, where possible, to begin filling in the outstanding gaps.

The international negotiations on technology transfer are based on a broad understanding of the phrase itself. 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 mitigating and adapting to climate change amongst different stakeholders such as governments, private sector entities, financial institutions, non-governmental organizations (NGOs), and research and educational institutions."[5] The first negotiations related to climate change (and technology transfer) took place in the early 1990s and were intricately linked with broader discussions of equity and sustainable economic development.

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[3] The Copenhagen Accord: http://unfccc.int/files/meetings/cop_15/application/pdf/cop15_cph_auv.pdf

[4] See overview of the decisions taken by COP15 at http://unfccc.int/meetings/cop_15/items/5257.php

[5] IPCC (2000) p. 4

At that time, the technological and economic position of a small number of developed countries – enshrined in Annexes I and II of the UNFCCC – vis-à-vis the rest of the world was marked by comparative dominance. These developed countries made up what is often termed the global North and all other countries – regardless of geography – made up the global South. In the early 1990s, negotiators operated under the working assumption that countries of the North would maintain their position of technological dominance and that technology transfer would be overwhelmingly dominated by a transfer of technology from North to South. Even though, by and large, players from the developed world still tend to dominate global markets, the economic and technological situation at the beginning of 2010 looks rather different from the early 1990s. New economic powers are emerging, and several non-Annex I countries (i.e. China, India, Brazil, and South Africa) played a leading role in crafting the Copenhagen Accord itself. Technology transfer is no longer solely a North-South issue. However, at the political level and in the context of the UNFCCC, technology transfer is still mainly framed as a North-South issue and for the purposes of this study attention will be paid only to technology transfer as it is considered in the negotiations themselves.[6]

When dealing with technology negotiations under the UNFCCC, it is important to note that the public and the private sector occupy different and – optimally – complementary positions in the field of climate technology. While nation-states, as Parties to the UNFCCC and the Kyoto Protocol, negotiate agreements on technology transfer, set goals for technology support, etc., private enterprises are the primary holders and developers of climate technologies. To optimize, facilitate, and enable the widespread transfer of technologies, countries and businesses must work in concert. States and companies should focus on the aspects in the development chain where they can act most effectively.

For example, public funds and public policy have an important role to play overcoming market barriers and leveraging private investment.[7] Public funds are not limitless and should be concentrated on those areas of the technology cycle that tend to be underfunded by capital markets. Moreover, clear and long-term public commitment, in terms of policies and financial support, are vital.[8] The need for public funding is particularly acute in three key areas.

First, significant public funds should be dedicated for fundamental research, development, and demonstration of new technologies.[9] Evidence from the academic literature indicates that public investments in the initial stages[10] of R&D encourage subsequent private

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[6] Brewer (2007), Brewer (2007a), and Brewer (2007b) provide a comprehensive overview to issues related to technology transfer.

[7] For a recent discussion of this issue, see Kaminskaite-Salters, Romani et al. (2009).

[8] Kaminskaite-Salters, Romani et al. (2009)

[9] Hattori (2007) and IEA (2001)

[10] This situation may be especially acute in the case of investment in R&D for energy technologies. Abbott (2009) underscores that R&D in energy technologies seem low basing this on the fact that R&D

investment in the later stages of development.[11] Public procurement[12] directed toward emerging climate-friendly technologies can create markets[13] and foster technology pull. Second, developing countries need human, organizational, and monitoring capacity[14] to successfully utilize technology, and, more importantly, to develop technologies of their own.[15] The private sector alone will not supply sufficient capacity building,[16] and projects lacking proper capacity tend to fail.[17] Further, some developing countries need assistance to develop enabling environments of regulations, policies, and institutions.[18] The IPCC and other observers underscore the need for dedicated public support of these areas to encourage technology transfer.[19] Third, states can and must enact policy changes to overcome persistent market barriers; energy efficiency, especially for commercial and residential buildings, is exemplary of the vital role that policies can play in enabling private sector investments that lead to real reductions in greenhouse gas emissions. Substantial mitigation options with negative cost at today's energy prices have been identified empirically,[20] though myriad barriers, especially for building efficiency,[21] restrict investment. Studies have suggested that even a carbon price of $40 per ton could not overcome these barriers.[22]

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investment in energy technologies is only a fraction of investment in pharmaceutical research. Increased public subsidies for research may be necessary (p. 23).

[11] Toole and Turvey (2007) tested the common position that public investment in the beginning stages of development is followed by private investment. Dividing the investment into two stages, Toole found that public support was most successful in Phase 1 and that larger support during Phase 1 made it more likely that venture capital and other private support would follow in Phase 2. Drawing on lessons from the non-energy sector, Avato et al., (2008) call for cooperative investment in R&D with private investment continuing the development of technology after initial research. See also Seligsohn et al. (2009)

[12] IPCC (2000); Tomlinson et al. (2008)

[13] Copenhagen Economics (2009) note that small market size in developing countries is also a barrier to technology transfer.

[14] IPCC (2000) p. 5. The report identifies three elements to technology transfer: absorptive capacity, enabling environment, and mechanisms for transfer. The private sector is expected to participate broadly only in the third of these elements.

[15] See for example Copenhagen Economics (2009) pp. 15-16 and de Coninck et al. (2007); Keller (1996).

[16] In the context of the Montreal Protocol, Andersen, et al. (2007) p. 266 provide examples of how capacity issues were addressed. Issues with lacking skills and capacity were addressed by capacity-building projects sponsored by implementing agencies, as well as training provided by technology suppliers, which was financed by Global Environment Facility and the Multilateral Fund. UNEP assisted with addressing information-based barriers. Diringer (2009) p. 47 suggests a new fund of public money to build developing country capacity.

[17] Burleson (2009)

[18] IPCC (2000) underscores this need.

[19] IPCC (2000); ICTSD (2008); Hutchison (2006); Tomlinson et al. (2008); Park and Lippoldt (2008); Cosbey et al. (2008)

[20] McKinsey (2009)

[21] Houser (2009)

[22] The World Business Council estimated that a willingness to accept a 10-year pay-back period on energy efficiency investments at today's energy prices would yield 52% of the reductions sought from

While the UNFCCC negotiations may certainly not be expected to address all of these aspects in detail, it is important to keep them in mind when assessing the progress that has been made in the international technology negotiations so far and developing recommendations for how outstanding controversies could be resolved.

The following report is comprised of three main analytical sections. Section 2 presents an overview of the technology transfer negotiations from the Bali Action Plan through the Copenhagen Accord and sets the stage for negotiations in 2010. Section 2.1 highlights areas of broad agreement in the latest draft negotiating text including: the establishment of a technology mechanism; the need for strategic planning; addressing the full technology cycle; creating enabling environments for private investment; and a general agreement on the overall level of effort for technology transfer. Section 2.2 underscores areas where considerable differences remain between Parties (intellectual property rights) or where the negotiating text is silent (monitoring, reporting, and verification). Section 2.3 briefly details other aspects of the climate change negotiations that are likely to have an impact on technology transfer (i.e. the Clean Development Mechanism, sectoral approaches, and nationally appropriate mitigation actions). Section 3 takes a closer look at several areas of importance following the Copenhagen Accord and leading to the negotiations at COP 16 in Mexico. Section 3.1 sets a baseline for action by comparing current levels of finance for technology transfer with assessments of needed financing over the coming decades. Section 3.2 draws lessons from existing funds for a new Copenhagen Green Climate Fund. Section 3.3 provides a preliminary appraisal of the proposed technology mechanism, while Section 3.4 looks specifically at the potential impact of the Clean Development Mechanism on technology transfer. Section 4 gives an in-depth evaluation of two of the major outstanding issues of the technology negotiations – intellectual property rights (Section 4.1) and monitoring, reporting, and verification (Section 4.2). To the extent possible, these sections lend guidance and outline suggestions for overcoming obstacles to agreement. Section 5 concludes.

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the building sector. Adding a carbon price of $40 per ton increased the achieved reductions from 52% to 55%.

2 Technology transfer in the climate negotiations

The following section contains an overview of the negotiations to date on technology transfer within the UNFCCC framework;[23] it also provides an assessment of some proposals made by non-governmental organizations.[24] The section takes account of Party submissions made in the post-Bali negotiation process and includes an analysis of the negotiations in Copenhagen. While the Copenhagen negotiations have – as a whole – not produced a binding and far-reaching international agreement, considerable progress was made in some areas, including the technology negotiations. The Copenhagen Accord, the central document coming out of the Copenhagen negotiations, states the following concerning technology:

> *"In order to enhance action on development and transfer of technology we decide to establish a Technology Mechanism to accelerate technology development and transfer in support of action on adaptation and mitigation that will be guided by a country-driven approach and be based on national circumstances and priorities."*

Compounding the negotiating situation, the Copenhagen Accord was only taken note of by the COP and, thus, is not a binding legal agreement. At the same time, a quite advanced draft on technology-related rules in a future agreement resulted from the negotiations under the auspices of the Ad-Hoc Working Group Long-term Cooperative Action (AWG-LCA).[25] As mentioned above, COP 15 decided to prolong the mandate of the AWG-LCA, which is responsible for the technology negotiations.[26] Thus, Parties may build on what has been achieved in Copenhagen in the future negotiation process, but the process for incorporating the Copenhagen Accord in these negotiations is not yet clear. It should also be noted that in Copenhagen a separate working group dealt with capacity building, which is closely linked to technology transfer. In contrast to the technology working group, the capacity building group

[23] This section is based on the official submissions by Parties to the UNFCCC AWG-LCA. When a Party has submitted more than one position an issue, in most cases only the most recent submission has been taken into account. Submissions included relate directly to technology issues; submissions that deal primarily with other issues, such as adaptation or funding, that are indirectly linked to technology issues have not been systematically reviewed.

[24] Statements on NGO positions are based on an analysis of the submissions of organizations that have UNFCCC observer status to the UNFCCC and some outside proposals. Submissions by intergovernmental organization with UNFCCC observer status are not mentioned here, because our review has shown that these hardly ever contain any specific proposals on technology transfer.

[25] Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention – Draft Conclusions proposed by the Chair, FCCC/AWGLCA/2009/L.7/Add.3,15 Dec 2009, http://unfccc.int/resource/docs/2009/awglca8/eng/l07a03.pdf

[26] See http://unfccc.int/meetings/cop_15/items/5257.php

failed to make significant progress. The draft text on capacity-building that resulted from the Copenhagen negotiations is heavily bracketed and contains various conflicting options.[27]

In the following section, the rules contained in the most recent negotiating draft are described, areas of emerging agreement are marked, and remaining controversies are highlighted. Additionally, an overview of developments in the broader negotiations on adaptation and mitigation is provided with special attention to those areas that will likely have an impact on technology transfer.

2.1 Areas of Agreement

The latest negotiation draft, the December 15th version of the AWG-LCA negotiating text, reflects consensus among Parties on several key issues. While this is certainly a significant step forward, it is also worth noting that the areas where the current draft reflects consenus are also the ones where consensus was relatively easy to find. The more challenging components of the negotiation – financing, intellectual property, measurement, reporting and verification (MRV), and compliance – have not yet been settled.

Consensus was reached on the following issues in Copenhagen:

Establishment of a technology mechanism

The latest draft includes provisions for the establishment of a technology mechanism. One component of the mechanism is a "Technology Executive Committee," which is to replace the Expert Group on Technology Transfer by COP 16. The other component is a "Climate Technology Centre," which includes a "Climate Technology Network".

The draft specifies the responsibilities and tasks of the respective institutions, but says little about the relationships between them, nor does it provide sufficient detail concerning the set-up of the institutions, membership, or modes of establishment. The position of the mechanism in the overall UNFCCC framework is also left open. Despite widespread consensus, the passage in the draft on the relationship of the mechanism to the COP (the mechanism is "under the authority and guidance of, and accountable to, the Conference of the Parties") remains in square brackets and marks a point of continued disagreement between negotiators.

According to the draft, the different parts and institutions of the mechanism will have the following functions:

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[27] Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention - Draft conclusions proposed by the Chair – Addendum: Enhanced action on capacity-building, FCCC/AWGLCA/2009/L.7/Add.4

- The main functions of the *Technology Executive Committee* will be, inter alia, to: deliver analysis and policy advice on relevant issues; prepare criteria on which mitigation or adaptation activities undertaken by non-Annex I countries should receive support; cooperate with other technology bodies and initiatives; facilitate the development of technology planning; monitor and assess technology-related action and the requisite financing for such actions (in line with rules on measurement, reporting and verification that are yet to be determined); and promote collaboration on technology. Cooperation is encouraged between the UNFCCC and other technology initiatives, between stakeholders and governments, as well as between the public and the private sectors.

- The *Climate Technology Center* is tasked with: providing advice to developing country Parties on technology needs and the implementation of technology practices; improving access to information on available technologies; engaging in capacity-building; developing tools for country-based technology planning; and several other charges.

- The *Climate Technology Network* is envisaged by the draft as a mechanism for harnessing the expertise of technology bodies, stakeholders, and experts and facilitating cooperation between them. The Network is subordinate to the Center, which may entrust the Network with additional tasks. In addition, the Network is, according to the text, already charged with facilitating public-private partnerships and providing in-country technical assistance and training.

In the run-up to Copenhagen, it had already become evident that many Parties favored the establishment of a technology mechanism. In particular, developing countries had supported the creation of such a mechanism throughout the negotiation process. This reflects the keen interest that developing countries have in an enhanced rate of technology transfer and their expectation that creating institutions with a specific responsibility for technology will increase the likelihood of more technology transfer and cooperation. Specifically, the G77/China proposed the establishment of a technology mechanism, comprising an Executive Body and a Multilateral Climate Technology Fund (MCTF), both subsidiary bodies to the COP.[28] The idea that a separate body for technology transfer *within* the UNFCCC framework should be created was re-iterated by a number of developing countries,[29] even though their proposals were sometimes less specific than that of G77/China; these other proposals also proposed different names for the prospective mechanism.[30] Moreover, some submissions were more

[28] G77/China, A Technology Mechanism under the UNFCCC, p. 6-9, in FCCC/AWGLCA/2008/MISC.5

[29] Argentina, p. 17, China, p. 66, Columbia, p. 77, Ghana, p. 97, Guyana, p. 102, India, p. 115, Indonesia p. 121 in FCCC/AWGLCA/2009/MISC.4 (Part I); Nicaragua on behalf of Guatemala, Dominican Republic, Honduras, Panama and Nicaragua, p. 36, 41, Saudi Arabia, p. 83, in FCCC/AWGLCA/2009/MISC.4/ (Part 2); Brazil, p. 30, in FCCC/AWGLCA/2008/MISC.5; Cuba p. 29, in FCCC/AWGLCA/2009/MISC.1

[30] The group of LDCs, for example, has proposed establishing a "Technology Committee" and a "Technology Panel", p. 16 in FCCC/AWGLCA/2009/MISC.6; China has proposed a "Subsidiary Body for Development and Transfer of Technology", p. 22 in FCCC/AWGLCA/2009/MISC.1

specific than that by the G77/China. For example, China, in an individual submission, made it clear that decision-making within a future body should be consensus-based.[31]

NGOs, both in their submissions to the UNFCCC and also in outside proposals, also supported the establishment of new institutions for technology development and transfer. Some NGOs proposed a mechanism dealing specifically with technology,[32] while others suggested the establishment of a general mechanism for mitigation, adaptation, and technology-related measures, including funding.[33] Among NGOs that expressed a position on this issue, there was wide agreement that such mechanisms should include bodies where – varying between proposals – scientific experts, government, business, NGOs, and other stakeholder were represented.[34]

Enhanced strategic planning on technology and improved cooperation

The latest draft reflects a joint political will by Parties to improve strategic planning for technology development and transfer; it also indicates a consensus that information regarding the types and scale of technology needed for mitigation and adaptation must be expanded and dissemination must be improved. The current draft repeatedly reiterates that assessment and other processes should be country-driven. Moreover, the draft places considerable emphasis on the improvement of cooperation on technology development and transfer. Cooperation is encouraged between the UNFCCC and other technology initiatives, between stakeholders and governments, as well as between the public and the private sectors. North-South, South-South, and triangular partnerships are explicitly mentioned and encouraged.

Addressing the full technology cycle

The draft also reflects consensus on the need for addressing all stages of the technology cycle. This is mentioned explicitly in the preamble of the text, which states that action concerning research and development, demonstration, deployment, diffusion, and transfer of technology, both for mitigation and adaptation must be addressed.

Creating enabling environments for private investment

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[31] China p. 22, in FCCC/AWGLCA/2009/MISC.1

[32] APRODEV (2009)

[33] Meyer et al. (2009) propose a “Copenhagen Climate Facility”. See also APRODEV (2009).

[34] Meyer et al. (2009); APRODEV (2009); WWF (2008)

The idea that policy reforms and enabling environments are of prime importance were reflected in several clauses of the pre-Copenhagen draft text.[35] Such policy reforms could relate, for example, to intellectual property rights, lowering tariffs for climate-friendly goods, providing subsidies for renewable energies and cutting subsidies for fossil fuels, or setting energy efficiency standards.

In the pre-Copenhagen negotiations, the aforementioned position has been supported more vigorously by developed countries,[36] but some developing countries[37] and NGOs[38] concur in principle.[39] Business associations have also highlighted the importance of favorable investment conditions.[40] In the present draft, reference is made to enabling environments, but they are given much less weight as compared to: cooperation on technology matters; improved access to information; the assessment of measures to be taken; and enhanced planning.

Overall efforts needed

In light of the lack of progress on overall commitments in other parts of the negotiations, it is remarkable that the latest negotiation draft contains an indication of the overall effort needed for technology issues.[41] The text stipulates that private and public energy-related investment in research, development, and demonstration should be doubled (or more) by 2012 and increased by four times by 2020 from current levels. However, as it is quite hard to come to a definitive assessment on how much is currently being spent on these purposes, only rough estimates are possible on the value of technology transfer to be reached by 2012 and 2020 respectively.

The Copenhagen Accord, in turn, mentions that developed countries will provide a sum of $30 billion in fast-track funding for mitigtation (including reducing emissions from deforestation and degradation (REDD)), adaptation, technology transfer and development, and capacity building for the period 2010-2012. In addition to the fast-track funding,

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[35] AWG-LCA (2009)

[36] New Zealand, p. 46, United States, p. 105, in FCCC/AWGLCA/2008/MISC.5; Australia, p. 91, Canada, p. 110FCCC/AWGLCA/2008/Misc.5/Add.2 (Part I); United States, p. 74, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part II)

[37] Alliance of Small Island States, p. 39, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part I); Bolivia, p. 105, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part I)

[38] Staley et al. (2009)

[39] Alliance of Small Island States, p. 39, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part I); Bolivia, p. 105, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part I)

[40] U.S. Chamber of Commerce (2009); Japan Business Federation (2009); ICC (2009)

[41] In a similar vein, during a panel discussion assessing the outcome of COP 15, Jonathan Pershing (Deputy Special Envoy of the United States on Climate Change) placed special emphasis on the fact that the Copenhagen Accord makes reference to a 2 degree global target – something he found a remarkable step in the negotiations.

developed countries pledged to jointly mobilize $100 billion a year by 2020 for similar purposes (which also includes support for other mitigation activities). These funds are to be "new and additional" to existing support provided through official development assistance, current public R&D support, and other international funds (e.g. the Global Environment Facility), etc. The proportional distribution of the new funds to the respective ends has not been determined. Therefore, the amount dedicated to technology development and transfer remains unknown at present. Controversial discussions pertaining to the distribution of the dedicated funds await negotiators, and the negotiations on distribution could pit the interests of different non-Annex I countries against one another.

2.2 Controversial issues

While the negotiations on technology development and transfer did result in the multiple areas of convergence outlined above, several areas of substantial disagreement remain, which helped to prevent the completion of the draft text in Copenhagen. Notably, the draft text does not yet contain any non-bracketed (i.e. consensus negotiated language) language on: the legal nature of the elements of the text; any measures or decisions with respect to intellectual property rights; the relationship between the Technology Mechanism and new financial arrangements under the UNFCCC; or measurement, reporting, and verification (MRV) and compliance.

Intellectual property

Disagreements over the role and treatment of intellectual property stand out in particular. In the latest negotiation draft, several rival options are listed. For example, the options to include the purchase of licensed technologies into the list of activities covered by the mechanism or to give the Technology Executive Committee the mandate to deal with intellectual property issues that arise are still in square brackets (i.e. unsettled). Overall, no progress was made in Copenhagen compared to the pre-Copenhagen drafts.

In the pre-Copenhagen negotiations, many developing countries have consistently held that the practice of and framework for intellectual property rights (IPRs) in the area of climate technologies needs attention and reform. In particular, they maintain in their UNFCCC submissions that new solutions are needed to enable developing countries to access technologies protected by IPRs; additionally, some propose keeping relevant technologies outside the current IPRs system.[42] Developing countries have proposed solutions including:

[42] Argentina, p. 18, Bangladesh, p. 29, China, p. 66, Guyana, p. 102, Indonesia, p. 119 in FCCC/AWGLCA/2009/MISC.4 (Part I); Bolivia, p. 9, LDCs, p.15 in FCCC/AWGLCA/2009/MISC.6; Brazil, p. 29, in FCCC/AWGLCA/2008/MISC.5; Alliance of Small Island States, p. 38, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part I); China p. 29, in FCCC/AWGLCA/2009/MISC.1; Ecuador, p. 38, in FCCC/AWGLCA/2009/MISC.1

compulsory licensing;[43] an international agreement similar to the Doha Declaration on Public Health for the climate sector;[44] or placing the "fruit of public financing for technology innovation and development" in the public domain.[45]

By contrast, intellectual property is only mentioned infrequently in developed countries' submissions, and the focus in these submissions is completely different. When mentioned, intellectual property protection is usually considered an incentive for further technology development, rather than a potential barrier to technology transfer.[46] In general, developed countries have given matters of technology transfer less formal consideration than developing countries.[47] Most, though not all, NGO proposals assert that intellectual property is a potential obstacle to technology transfer and hence some form of action needs to be taken concerning intellectual property; NGOs suggest various solutions, which are discussed at length in Section 4.1 below.[48] Many business representatives, in turn, advocate the establishment of appropriate institutional frameworks and strong protection of IPRs.[49]

Other areas of contention

IPRs receive significant attention, but there are several other areas of contention. One of these is finance. In the pre-Copenhagen negotiations, developing countries had stressed the need for additional financial and other resources to be provided by developed countries for technological support geared towards adaptation and mitigation measures.[50] Some developed countries were skeptical and expressed doubt about whether additional mechanisms and resources were really needed.[51] While the Copenhagen Accord mentions specific overall sums for mitigation and adaptation to be made available by developed countries and the negotiations draft on technology transfer sets forth targets for drastically increasing the amount or energy-related research, little has been achieved in terms of creating appropriate strcutures for distributing this money. The Copenhagen Accord makes

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[43] Brazil, p. 29, in FCCC/AWGLCA/2008/MISC.5; Pakistan, p. 47, in FCCC/AWGLCA/2009/MISC.4 (Part II); China p. 23, in FCCC/AWGLCA/2009/MISC.1

[44] Pakistan, p. 47, in FCCC/AWGLCA/2009/MISC.4 (Part II)

[45] Bolivia, p. 104, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part I)

[46] United States, p. 74, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part II); Japan, p. 46, in FCCC/AWGLCA/2009/MISC.1

[47] Japan, p. 42 in FCCC/AWGLCA/2008/MISC.5

[48] Meyer et al. (2009); APRODEV (2009); CAN-International (2009)

[49] U.S. Chamber of Commerce (2009); Japan Business Federation (2009); ICC (2009)

[50] Algeria on Behalf of the African Group, p. 12, Ecuador, p. 96 in FCCC/AWGLCA/2009/MISC.4 (Part I) Bolivia, p. 9, in FCCC/AWGLCA/2009/MISC.6; Nicaragua on behalf of Guatemala, Dominican Republic, Honduras, Panama and Nicaragua, p. 34, in FCCC/AWGLCA/2009/MISC.4/ (Part 2); China, p.34, FCCC/AWGLCA/2008/MISC.5

[51] See for example New Zealand, p. 61, in FCCC/AWGLCA/2008/MISC.5: "Parties … should consider… whether additional financing or institutional structures are required."; Australia, p. 92, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part I)

reference to a Copenhagen Green Climate Fund which shall be established as an "operating entity of the financial mechanism of the Convention". However, nothing is said about the institutional features of this Fund, the criteria for the disbursement of financial resources are not discussed at all, and myriad other issues related to the fund (for example, how the money for the fund would be supplied and by which countries) remain unaddressed. Developing countries have supported the establishment of a technology fund in the pre-Copenhagen negotiations;[52] the current state of the negotiations shows how difficult reaching consensus on this matter is. The draft of the respective working group contains almost no agreed upon text related to finance.[53]

Measurement, reporting and verification (MRV)

As with IPRs, the negotiations in the AWG-LCA contact group for technology transfer did not reach consensus on provisions for MRV and compliance with respect to technology transfer. This outcome is not wholly unexpected. MRV and compliance provisions will depend deeply on: the types of actions and measures that have to be measured and reported; how often they must be reported; by whom; how and by whom they will be verified; and what procedures will exist to determine and enforce compliance. As these other elements remain to be decided, the latest negotiating text, therefore, does not contain any options yet for MRV and compliance – in contradistinction from IPRs, for which there are divergent options.

This outcome reflects a more general controversy on MRV in Copenhagen. The AWG-LCA process did not produce momentum toward decisions on MRV and compliance for technology development and transfer, and this is not surprising. Though Annex II countries have obligations to support technology transfer under the UNFCCC, the obligations themselves are vague.

However, the Copenhagen Accord contains a specfic reference to MRV, in the context of action to be taken by developing countries:

> *"Mitigation actions subsequently taken and envisaged by Non-Annex I Parties, including national inventory reports, shall be communicated through national communications*

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[52] See in particular the proposal by G77/China, "A Technology Mechanism under the UNFCCC", p. 6-9, in FCCC/AWGLCA/2008/MISC.5., supported in later submissions inter alia by India, p. 114 in FCCC/AWGLCA/2009/MISC.4 (Part I); Brazil, p. 29, in FCCC/AWGLCA/2008/MISC.5; Panama on Behalf of Costa Rica, El Salvador, Honduras, Nicaragua, Panama, p. 78, in FCCC/AWGLCA/2008/MISC.5

[53] Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention - Draft conclusions proposed by the Chair, FCCC/AWGLCA/2009/L.7/Add.2/Rev.1 http://unfccc.int/documentation/documents/advanced_search/items/3594.php?rec=j&priref=600005636#beg

> *… every two years on the basis of guidelines to be adopted by the Conference of the Parties. Those mitigation actions in national communications or otherwise communicated to the Secretariat will be added to the list in appendix II. Mitigation actions taken by Non-Annex I Parties will be subject to their domestic measurement, reporting and verification the result of which will be reported through their national communications every two years.These supported nationally appropriate mitigation actions will be subject to international measurement, reporting and verification in accordance with guidelines adopted by the Conference of the Parties."* [54]

One should take note here of the use of the phrase "international measurement, reporting and verification" at the end of the preceding paragraph of the Copenhagen Accord. The international verification of NAMAs receiving external support is explicitly distinguished from domestic actions in non-Annex I countries that do not receive any external (from Annex I countries or otherwise) support. These unsupported measures are subject only to domestic MRV, and reports providing information on such unsupported measures will be added to the biannual national communications. Additionally, although the Copenhagen Accord does provide some direction for MRV and technology, there is no specific mention of or guidance for compliance procedures. Compliance procedures, then, are another of the outstanding issues.

Like the latest AWG-LCA text, previous draft versions do not provide details of what would actions would be subject to MRV, which groups would verify, what would be reported and when, etc. Throughout the pre-Copenhagen negotiations, developing countries had highlighted the importance of MRV for monitoring the actions taken by developed countries to fulfill their duties concerning technology transfer, as set forth in the UNFCCC. Proposals included the use of performance indicators.[55] In addition and related to MRV, developing countries had also emphasized that a compliance mechanism should be created that covers technology-related issues.[56] In contrast, compliance had played a smaller role in developed countries' submissions on technology transfer.[57]

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[54] Copenhagen Accord (2009) Paragraph 5.

[55] Algeria on Behalf of the African Group, p. 13, China, p. 66, India, p. 115 in FCCC/AWGLCA/2009/MISC.4 (Part I); Alliance of Small Island States, p. 38, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part I); Ecuador, p. 38, in FCCC/AWGLCA/2009/MISC.1

[56] Algeria on Behalf of the African Group, p. 14, Columbia, p. 74 in FCCC/AWGLCA/2009/MISC.4; Indonesia, p. 121 (Part I)

[57] An exception is Japan, p. 23, in FCCC/AWGLCA/2008/Misc.5/Add.2 (Part II)

2.3 Other negotiation issues with an impact on technology

The technology negotiations are the most obvious starting point for an analysis of how a future international climate agreement could contribute to enhanced technology transfer and cooperation; however, other segments of the negotiations are of relevance, too. The following provides a brief overview of these areas.

- *The Clean Development Mechanism (CDM):* As explained in more detail below, there are strong indications that the CDM has been successful at triggering technology transfer to non-Annex I countries – which is not to be read as an evaluation of the overall performance of the CDM. The Conference of the Parties serving as the meeting of the Parties to the Kyoto Protocol (CMP) agreed in Copenhagen on a document entitled "Further guidance relating to the clean development mechanism."[58] The guiding principles set forth therein relate to enhancing the transparency and consistency of the CDM's Executive Board and improving the performance of Designated Operational Entities (which play a major role in the evaluation of CDM projects for approval). There are also suggestions for improving methodologies and implementing measures to support CDM projects in host countries where fewer than 10 CDM projects have been registered to date. There are no rules relating specifically to technology transfer in the decision.

- *Sectoral approaches:* Sectoral approaches were also part of the negotiations in Copenhagen. However, Parties did to make substantial progress. This is reflected in the outcome of the negotiations, which is only two pages long and focuses on agriculture and contains few substantive items.[59] Before Copenhagen, sectoral approaches had been considered an instrument for developed countries to fulfill their technology transfer obligations.[60]

- *Nationally Appropriate Mitigation Actions (NAMAs*): Another hot topic in the run-up to Copenhagen were NAMAs. NAMAs are various types of mitigation measures to be taken by developing countries. They were conceived as an option for developing countries to make commitments to mitigating climate change while avoiding binding emission reduction targets. As a NAMA can be virtually anything from providing

[58] http://unfccc.int/files/meetings/cop_15/application/pdf/cmp5_cdm_auv.pdf

[59] Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention - Draft conclusions proposed by the Chair: Cooperative sectoral approaches and sector-specific actions in agriculture, FCCC/AWGLCA/2009/L.7/Add.9, http://unfccc.int/resource/docs/2009/awglca8/eng/l07a09.pdf

[60] UNFCCC, Non-paper No. 17 - 08/10/09, Contact Group On Enhanced Action On Mitigation And Its Associated Means Of Implementation - Subgroup on paragraph 1 (b) (iv) of the Bali Action Plan (Cooperative sectoral approaches and sector-specific actions), http://unfccc.int/files/meetings/ad_hoc_working_groups/lca/application/pdf/mitigation1bivnp17081009.pdf

subsidies for renewable energies over reducing deforestation to setting energy efficiency standards, NAMAs could contribute positively to technology development, transfer, and deployment.[61] The Copenhagen Accord includes an Appendix II, which will contain mitigation actions to be implemented by developing countries. Plans for respective measures were to be and have been submitted to the UNFCCC Secretariat by developing countries. During the Copenhagen negotiations, the working group on NAMAs did not successfully agree on a registry or other forms of measuring compliance with NAMA commitments.[62] As specified above, the Copenhagen Accord, however, provides for the international measurement, reporting, and verification of NAMAs that receive international support, while for unsupported NAMAs only national MRV with subsequent reporting via the National Communications is envisaged. As of the end of January 2010, over 25 non-Annex I countries have submitted lists with mitigation measures they plan to take.[63] Among them are Brazil, India, China, and South Africa. The NAMAs that developing countries propose vary widely in terms of their level of detail, the approach taken, and the sectors covered. In many cases, this makes it difficult to assess what technological impact might be expected from the implementation of different countries' NAMAs. For example, India announced that it will "endeavour to reduce the emissions intensity of its GDP by 20-25% by 2020 in comparison to the 2005 level,"[64] without specifying how it aims to attain this objective. Brazil, in contrast, will make strides on "energy efficiency" and increase the production of electricity from hydroelectric power.[65] Brazilian actions are, therefore, likely to involve a strong technological component.

In sum, other segments of the climate change negotiations (be they under the auspices of the Copenhagen Accord or the UNFCCC/Kyoto Protocol) are also likely to have some impact on the future development and use of climate technologies, even if the actual technology negotiations have not yet resulted in any new rules on technology transfer under the UNFCCC.

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[61] Thus, the last pre-Copenhagen draft on NAMAs reflected the understanding that that (financial) support for NAMAs is a method for developed countries to comply with their obligations on technology transfer. UNFCCC, Non-paper No. 26 - 20/10/2009, Contact Group on Enhanced Action on Mitigation and Its Associated Means of Implementation - Subgroup on paragraph 1 (b) (ii) of the Bali Action Plan: Nationally appropriate mitigation actions by developing country Parties - Non-paper by the facilitator, http://unfccc.int/files/kyoto_protocol/application/pdf/26mit1bii201009v01.pdf

[62] Outcome of the work of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention - Draft conclusions proposed by the Chair, Addendum: Nationally appropriate mitigation actions by developing country Parties: mechanism to record nationally appropriate mitigation actions and facilitate provision and recording of support, FCCC/AWGLCA/2009/L.7/Add.5

[63] See http://unfccc.int/home/items/5265.php, visited on February 2nd, 2010.

[64] India's domestic migitation action, http://unfccc.int/files/meetings/application/pdf/indiacphaccord_app2.pdf

[65] Brazil's Nationally Appropriate Mitigation Actions, http://unfccc.int/files/meetings/application/pdf/brazilcphaccord_app2.pdf

3 An assessment of existing proposals

In the following section, the technology-related outcome of the Copenhagen Accord is assessed and considerations are provided for the negotiations in 2010 leading to COP 16 in Mexico. In particular, this assessment focuses on the likely effectiveness of elements in the Accord and the UNFCCC process in terms of fostering technology transfer and cooperation. To this end, the academic literature is consulted and lessons are drawn from prior experience under other institutions.

3.1 Assessing the sufficiency of climate finance

The first scoping task for assessing technology transfer is to identify current investment flows to developing countries through existing financial and institutional mechanisms and then compare these current flows with needs assessments for technology transfer.[66] To address whether these funds are sufficient to meet estimated needs, the following looks at some of the challenges of arriving at a figure, then moves onto estimates of adaptation funding. From there, this section looks more closely at mitigation technology, the stages of its development, and projections of costs for mitigation technologies before finishing up with a comparison of current levels of funding in order to highlight the amount needed to bridge the gap.

Estimating the financing needs for technology transfer to developing countries presents several challenges. It is difficult to divorce the need for particular financing for technology transfer from considerations of total financing needed for mitigation and adaptation. While estimates exist for current levels of spending on energy and mitigation research and development, there is little data on present levels of funding for technology transfer relating to adaptation. This lack of information is due both to the dispersed nature of adaptation aid as well as the fact that most of the projects that involve the transfer of adaptation technologies were developed primarily for purposes other than climate adaptation. Consequentially, it is also difficult to formulate precise estimates of future levels of funding needed for adaptation technology transfer.

Despite these challenges, some estimates for adaptation needs exist. The World Bank forecasts that cumulative needs will be somewhere between $10 and $40 billion annually by 2030.[67] The United Nations Development Program (UNDP) offers a significantly higher estimate, putting the figure for adaptation technologies figure at $86 billion by 2015.[68] The UNFCCC has produced sectoral estimates for the amount of additional investments and

[66] See Brewer (2009) for an overview of general considerations on financial flows.

[67] World Bank (2006)

[68] UNDP (2007)

financial flows for adaptation technologies needed by 2030.[69] For adaptation of agriculture, for example, the UNFCCC assesses that an additional $12.9 billion will be needed. The treatment of diarrheal diseases, malaria, and general malnutrition will require between $4.8 and $12.8 billion. Additional resources of over $7 billion will be needed to address problems with water supply and the construction of sea dikes. The largest need, however, is in adapting infrastructure to climate change; estimates vary widely from $7.6 to $130.1 billion. In sum, the UNFCCC calculates between $32.6 and $163.1 billion will be needed annually for adaptation, although what portion would be related to technology transfer is not specified.

Turning to mitigation technologies, the financing and investment requirements are often broken down into the constituent stages of the technology development cycle. Additional funding will be required for each stage of the technology cycle, though the sources of funding (public vs. private) will differ depending on the particular stage. These differences will play an important role in terms of focusing public monies to the appropriate technology stages and setting policy and other incentives to ramp up private investment in other stages.

The technology cycle can be divided into the stages of: research and development; demonstration; deployment; and diffusion.[70] The first stage, research and development (R&D), occurs when the basic science of a problem is understood, but the associated technologies are at the testing and laboratory stage. A significant portion of R&D funding comes from public resources. The vast majority of R&D, both public and private, is concentrated in a few countries or regions: the US, the EU, Japan, South Korea, and China. The second stage is demonstration, which involves a scalable implementation of a technology in a limited number of commercial facilities or research institutions. Information is gathered on construction and operational costs, performance, and other pertinent factors. In the next stage, deployment, the technology is understood and available, but it costs more than comparable existing technology. For a technology to be adopted at this stage, consumers must be willing to pay a price higher than existing alternatives, technology producers must sell the product at a loss, or governments must provide subsidies or other incentives to ensure the adoption of the new technology. The final stage before widespread commercial maturity is diffusion. It is here that a technology is generally competitive with the alternatives, but it still faces barriers due to present norms, cultural issues, the current economic environment, and existing laws and regulations. In the diffusion stage, most financial support for technology comes from private sources; the public sector has a limited role through regulatory changes, subsidies, and other incentives. In earlier stages, public funding plays a larger role; while companies, individual investors, private equity firms, and venture capitalists support the early stages of R&D and demonstration, experience has demonstrated that direct public support is generally needed in the form of grants and government matching funds. Moreover, public support through loans, lines of credit, and

[69] UNFCCC (2009b)

[70] See UNFCCC (2009b). Similar descriptions of the technology cycle are ubiquitous.

guarantees often help during the deployment stage. The proportion of private sector support for technology development increases with each stage, and the public role declines.[71]

Returning to funding for climate change efforts to stabilize atmospheric levels of greenhouse gases, the Stern Review estimates the additional cost to be up to 1% of global GDP by 2050.[72] An estimate of additional investment flows to developing countries ranges from $95-150 billion between 2010 and 2020 – $15-30 billion annually for adaptation and $80-120 billion for mitigation.[73] For technology transfer in particular, a partial estimate of resources indicates that overcoming just some market barriers would require $1.9 billion in the next five years[74] and estimates of some capacity building and technical assistance needs start at $300 million.[75] Several NGO and Party proposals suggest total annual climate financing of up to $55 billion, of which a proportion would go to technology transfer. [76]

In terms of the development and deployment of mitigation technologies, estimates have been developed for the different stages along the technology pathway. For example, there are a number of estimates dealing specifically with the research and development of mitigation technologies. The previously mentioned Stern Review estimates $50 billion will be needed in public financing of R&D annually.[77] Other studies put that number at $10 billion.[78] An OECD study from 2008 estimates the necessary financing to be between $20 and $100 billion dollars annually.[79] Moving to the next stage, the UNFCCC estimates that $27-36 billion will be needed yearly to move new mitigation technology to the point it can demonstrate its viability.[80] Beyond demonstrating new climate mitigation technology, there are estimates on what it would cost to begin deployment of successful technologies. The UNFCCC puts the estimate for this between $25 and $94 billion annually.[81] Based on these figures, a UNFCCC

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[71] Ockwell et al. (2008a) investigate some of the policies and measures to hasten the development of particular climate-friendly technologies at different stages of the technology cycle.

[72] Stern (2005) p. xiii

[73] Kaminskaite-Salters, Romani et al. (2009); also Project Catalyst (2009) whose estimates are reported in Euro -- €65-100 billion total for developing countries, €10-20 billion for adaptation and €55-80 billion for mitigation. Converted to US dollars ($) using an exchange rate of 1.5 dollars to 1 Euro.

[74] UNFCCC (2009) p. 37-8, referring to this report: "Thoughts concerning technical assistance and capacity building to support the transfer of climate technologies: possible activities and their potential impact", http://unfccc.int/resource/docs/2008/smsn/igo/027.pdf

[75] UNFCCC (2009) p. 38

[76] In Meyer et al. (2009) a consortium of NGOs put forward their best estimate as to financial commitments required to meet the objectives of a new climate deal. Funding would be set at an annual rate of $160 billion of which $55 billion would go directly towards mitigation and technology. These were starting numbers with expenses expected to increase past 2017. See p. 50.

[77] Stern (2007) p. 371

[78] UNFCCC (2007) p. 7

[79] Doornbosch et al. (2008)

[80] UNFCCC (2009b)

[81] UNFCCC (2007b) pp. 6 and 90

formula assesses the investment costs in developing countries to be between $10 and $38.5 billion.[82] The final stage in the technology cycle is widespread diffusion. There are two projections for annual costs of diffusion. The first is by the McKinsey consultancy, which estimated the figure to be between $250 and $440 billion of which $150 to $264 billion would need to be invested in developing countries.[83] The UNFCCC makes a more modest estimation of between $200 and $210 billion annually, with the portion for developing countries forecast to be between $82 and $180 billion.[84] Combining these estimates, the overall estimate of funding for mitigation-related technology transfer falls between $262 and $670 billion per year. The portions specifically targeted at developing countries range from $92 to $302.5 billion per year.

These estimates of investment need contrast sharply with approximations of current global spending on technology and technology transfer relating to mitigation; current spending on mitigation technologies remains a small fraction of what is called for.

The main current mechanisms and funding sources for technology transfer are:

- Public sources: official development assistance (ODA), funding by multilateral development banks and export credit agencies, the World Bank, the CDM, Joint Implementation (JI) and the Global Environment Facility (GEF).[85]
- Private sources: domestic and international investment, including foreign direct investment (FDI).[86]

Current estimates state that there is between $118.5 and $168 billion currently being spent globally on an annual basis. Breaking this down, the IEA estimates that there is roughly $14 billion of public spending annually towards R&D.[87] The UNFCCC cites estimates of existing private investment in R&D between $40 and $60 billion.[88] Estimates for annual levels of deployment spending range from $33 billion[89] to $45 billion.[90] Present public expenditures on diffusion run between $19.5 and $27 billion, of which $8 to $15.5 billion are specifically in developing countries.[91] In terms of private spending on diffusion of climate mitigation

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[82] Levels of investment estimates come from the UNFCCC secretariat which sets the break at 40.9% in developing countries and 59.1% in developed countries; as found in UNFCCC (2007), Investment and Financial Flows to Address Climate Change, p.214, annex V, table 4).

[83] McKinsey (2009) pp. 8 and 17

[84] UNFCCC, (2007) p. 92

[85] UNFCCC (2009)

[86] Domestic investment in developed countries makes up by far the largest share of private investment in technology transfer. Source: UNFCCC (2009)

[87] International Energy Agency (2010)

[88] UNFCCC (2009b) p. 169

[89] Stern (2007) p. 347

[90] Doornbosch et al. (2008) p. 5

[91] UNFCCC (2009b) p. 19

technologies, approximately $12 to $22 billion is spent per year with $3.3 billion occurring in developing countries.[92]

Even dedicated efforts can be overwhelmed by the scale of total investment. For example, the GEF contributed over $1 billion to climate-related energy projects from 1997 to 2005, yet this made up only 1.6% of multilateral and bilateral financing for energy projects over that period.[93] Further, the UNFCCC has evaluated the functioning and contributions of its own mechanisms for technology transfer. Accordingly, the current mechanisms contribute less than 5 per cent of the total funding for technology transfer, support less than half of the needed technologies, require better coordination, and provide only limited support in the vital "valley of death" demonstration and deployment stages. [94]

To compare current financial flows with needs, one should also consider the addition of pledged funds under the Copenhagen Accord. According to the non-binding Copenhagen Accord, $30 billion in fast-track funding would be made available by 2012 and an annual $100 billion by 2020. The latest negotiation draft on technology transfer includes a provision stating that private and public energy-related research, development and demonstration should be doubled by 2012 and increased by four times by 2020 from current levels. (The compatibility of these two objectives is not clear – and neither is currently a binding commitment.) Assuming the commitment of new funding by 2020 through the Copenhagen Accord to be $100 billion annually and assuming all the funds went to technology transfer, these new funds plus current funds would make a significant contribution to meeting the estimated needs. (They begin to approach the low range estimate of needed financing.) However, the pledged funds of the Copenhagen Accord are not only for technology transfer, but also for REDD+, adaptation, and capacity building. Therefore, the commitment of new funds for technology transfer is not yet sufficient.

Thus, significantly larger (and targeted) funding and investment with specific attention to technology transfer is required to achieve the needed scale. A clear signal from national governments in terms of public financial support, the establishment of public policy frameworks, and short- and mid-term international coordination will be necessary to drive the private sector investments needed for technology development and transfer.

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[92] UNFCCC (2009b) p. 19

[93] UNFCCC (2007) pp. 164-165

[94] UNFCCC (2009) p. 62. An Adaptation Fund has been established to finance adaptation projects. The funds will come from a 2% surcharge on CDM projects. As of yet, no projects have been financed (see http://afboard.org/index.html).

3.2 The Copenhagen Green Climate Fund – lessons from existing funds

The Copenhagen Accord provides for the establishment of a Copenhagen Green Climate Fund. Though for the time being it is neither certain that the Copenhagen Accord will guide the future negotiations process nor have details of the Green Climate Fund been spelled out, it is still useful to take a look at the experience of already existing funds in the climate field in order to gain a sense of which aspects might facilitate the functioning of the Green Climate Fund, and which might not.

In the following, descriptions of the GEF, the World Bank's Climate Investment Funds (CIFs) particularly the Clean Technology Fund, and the Montreal Protocol's Multilateral Fund (MLF) will be given and lessons will be drawn from their functioning to date.

Global Environment Facility

The Global Environment Facility was created in 1991 as an interagency partnership (between the United Nations Environment Program, United Nations Development Program, and the World Bank) to provide support to developing countries that have ratified global environmental conventions. Grant funding is provided for projects that help developing countries meet the objectives of the conventions, which produces global environmental benefits.[95] Projects addressing climate change make up the second largest group of GEF-funded projects after biodiversity.[96] As the financing mechanism for the UNFCCC,[97] the GEF follows the guidance given by the UNFCCC's Conference of the Parties (COP) with respect to policy, program priorities, and eligibility criteria related to the Convention.[98] Every four years funding is contributed by donor countries to the GEF Trust Fund through the GEF replenishment process.[99]

In the beginning, developing countries strongly opposed the GEF and demanded changes in its governance structure and operational principles. Agreement was reached after years of negotiations between donor and developing countries.[100] The GEF's main governing body, its

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[95] GEF (2010a) see: http://www.gefweb.org/What_is_the_GEF/what_is_the_gef.html

[96] GEF (2010a) see: http://www.gefweb.org/projects/focal_areas/focal_areas.html#cc

[97] The relationship between the Conference of Parties to the UNFCCC and the GEF Council was agreed in a memorandum of understanding (MOU) between the COP and the GEF Council (see UNFCCC Decision 12/CP.2 and Decision 12/CP.3) in accordance with Article 11.1 of the Convention, which defines 'a mechanism for the provision of financial resources on a grant or concessional basis, including for the transfer of technology'. Through the MOU, the GEF is entrusted with the operation of such a mechanism.

[98] UNFCCC (1996)

[99] GEF (2010) see http://www.gefcountrysupport.org/report_detail.cfm?projectId=140

[100] Porter et al. (2008)

Council, consists of representatives from developing countries (with 16 members), developed countries (14 members), and two members from countries with economies in transition. Decisions are made by consensus.[101] Civil society is involved in the GEF's decision-making process as well as project and program implementation through NGO participation in GEF NGO Consultations and Council Meetings. Here, NGOs voice concerns, state positions, and make interventions as observers. Roughly 600 NGOs are currently accredited to the GEF.[102] Scientific and technical advice is provided by the Scientific and Technical Advisory Panel (STAP).[103]

To date, the GEF is by far the most significant funding mechanism focusing on the acceleration of the development and diffusion of climate-friendly technologies in developing countries.[104] Since its inception in 1991, $2.5 billion have been allocated for climate-friendly technologies in more than 50 developing countries, generating roughly $15 billion in co-financing, according to estimates. Each year, $250 million are invested in projects in the areas of energy efficiency, renewable energy, low-carbon energy-generating technologies, and sustainable urban transport.[105]

Project examples range from biomass energy for rural India to solar water heaters for low-income housing in South Africa to promoting electric buses for the 2008 Beijing Olympics.[106] Additionally, the GEF is responsible for managing the Special Climate Change Fund (SCCF) and the Least Developed Countries Fund (LDCF), that both help countries in the field of climate change adaptation.[107]

Even though it is difficult to make any overarching claims with respect to the GEF's effectiveness, the institution clearly offers a number of benefits. Its framework makes collaboration between donor and developing countries and among different multilateral institutions possible. Its Secretariat reviews funding approaches without commercial considerations, and it delivers scientifically based policy guidance.[108] With respect to climate change in particular, the GEF is reported to have made solid progress both in the reduction or avoidance of greenhouse gas emissions and of sustainable market changes. This has been achieved by supporting projects mainly in energy efficiency and renewable energy.[109]

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[101] GEF (2010a) see http://www.gefweb.org/interior_right.aspx?id=38

[102] Heinrich Böll Stiftung (2010) see http://www.climatefundsupdate.org/listing/gef-trust-fund

[103] GEF (2010a) see http://www.gefweb.org/participants/Scietific___Technical/scietific___technical.html

[104] Miller (2007)

[105] GEF (2009a) http://www.gefweb.org/uploadedFiles/Publications/TechTransfer-FS-June2009.pdf

[106] GEF (2010c) Project Database http://www.gefonline.org

[107] GEF (2009) http://www.gefweb.org/uploadedFiles/Publications/TechTransfer-FS-June2009.pdf

[108] Porter et al. (2008)

[109] GEF (2009) Overall Performance Studies (OPS) are presented every four years to inform the donor countries about the results of GEF activities before funding for the GEF is replenished. They are

The GEF's energy efficiency portfolio has played a particularly important catalytic role in the development and transformation of energy and mobility markets in developing countries.[110] The GEF was also a key factor in supporting countries with the preparation of their national communications to the UNFCCC. These efforts have contributed to building national capacity and awareness in the area of climate change.[111] In China, for instance, the GEF and its Implementing Agencies were found to have contributed to raised awareness and technology development and to have boosted institutional capacity through project activities and training.[112]

However, the GEF's climate-related financing has also exhibited significant weaknesses and faces continuing challenges. The key weaknesses identified in the GEF's climate-related work are: its complex project cycle, particularly the lengthy approval periods; its slow response to new opportunities; and its need for additional funding.[113] The long and complex project approval process has been found to pose difficulties for recipient countries and discourage private sector participation.[114] Most GEF projects in the field of climate friendly energy technologies have been substantially delayed or even cancelled. In particular, the performance of projects addressing the reduction of long-term costs of climate friendly technologies has been evaluated poorly.[115] Also, the need to remedy legal and institutional rigidities has been emphasized in order for the GEF to become more adaptable, flexible and innovative.[116] Further suggested improvements include: better communication; the increased use of indicators for results; the transmission of learning between projects and countries; as well as the need for strategic directions, transparency, and increased private sector involvement.[117] In order to maximize the GEF's impact on global GHG emissions, it has also been recommended that emphasis should be placed on the replication of programs and effective knowledge management among the different actors in the GEF network.[118]

Some member states continue to criticize the GEF over the issue of adequate representation. Although the GEF Council has equal numbers of members from developing and developed countries, developing coastal nations and small-island developing states have disparaged the fact that they have little influence on where the funds are spent due to

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conducted by the GEF Evaluation Office, an independent entity within the GEF that reports directly to the GEF Council.

[110] GEF (2005)

[111] GEF (2002)

[112] Heggelund (2005)

[113] Porter et al. (2008)

[114] Porter et al. (2008)

[115] Miller (2007)

[116] Porter et al. (2008)

[117] GEF (2009) and GEF (2005)

[118] Hennicke (2007)

the internal structure of the GEF Council.[119] Others have criticized the fact that some Parties to the UNFCCC are not represented in the GEF decision-making structure. This lack of representation has been judged to create the risk that the GEF Council could produce decisions that were incompatible with COP decisions.[120] This problem is exacerbated by the fact that the guidance provided to the GEF by the COP has been "extremely general in nature,"[121] and while this generality reduces potential conflicts, it also makes it difficult for the GEF to implement the guidance given by the COP. In response to these criticisms, a recent GEF-internal call for reform seeks to improve communication by involving COP leaders and their Secretariats in GEF council meetings.[122]

Developing coastal nations and small island developing states (SIDS) are particularly frustrated by the GEF Council's system for allocating its climate change funds.[123] These countries underscore the shortcoming that the GEF has not funded adaptation projects[124] and resent the "difficulty of accessing GEF funding, the GEF's slow disbursement process and the problematic concept of incremental costs in the context of adaptation."[125] Even after several structural changes, reviews have rated the functioning of the GEF to be "technically inadequate," due to the "complex design of the funds and poor implementation of the guidance."[126]

The GEF has recently entered a process of reforms to move from its traditional project-based to program-based approaches, to involving the private sector and streamlining some of its procedures to access funding.[127] However, to maximize its effectiveness and to up-scale and increase its impact in the climate area, the GEF would need to be strengthened by a series of further far reaching reforms over the next few years.[128] As opposed to the World Bank, which is accustomed to large volume investments, a scaling up of financing to reduce

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[119] Mace (2005) p. 230

[120] Werksman (2003) p. 8

[121] Möhner and Klein (2007) p. 14

[122] Müller and Barbut (2009)

[123] Decisions are generally made by the consensus of the council members. However, when it has become clear that no consensus will be reached, members may call for a vote to reach a decision. The voting system inherently favors developed countries on the council by requiring not only a 60% majority among council members, but the voting majority contributed 60% of the GEF's funds. Therefore, developed countries, who provide the largest contributions at replenishments, have stronger influence during the voting process, substantially reducing the developing nations' voting power in the decision making process.

[124] Mace (2005) p. 228

[125] Mace (2005) p. 232

[126] Möhner and Klein (2007) p.16

[127] Heinrich Böll Foundation (2007)

[128] Porter et al. (2008)

greenhouse gas emissions in the GEF would require major organizational adjustments, according to experts.[129]

The Climate Investment Funds

The CIFs, including the Clean Technology Fund (CTF), were created in 2008 in a process driven mainly by developed countries.[130] The CIFs are administered by the World Bank and regional development banks are involved in their implementation. The CTF finances the demonstration, deployment, and transfer of low-carbon technologies for greenhouse gas reductions; it does not fund research and development.[131] Both states and private entities may submit proposals, which have to fit into country-level CTF Investment Plans that are drawn up by recipient countries in cooperation with multilateral development banks (MDBs).[132] The CTF Trust Fund Committee that oversees the operations and activities of the CTF is composed of an equal number of representatives from recipient and contributing countries.[133] Voting is by consensus. A "Partnership Forum", comprising a broad range of stakeholders, including MDBs, UN organizations, the GEF, UNFCCC, the Adaptation Fund, bilateral development agencies, NGOs, and the private sector, will meet annually for discussion on "the strategic directions, results and impacts of the CIF".[134] By January 2009, the 12 contributing countries had pledged $4.3 billion to the CTF.[135] CTF will disburse funds in the forms of grants, loans, and guarantees.[136]

The relatively short operation period of the CTF does not allow for an in-depth assessment of its functioning, in particular because the CTF is just starting to distribute funds. However, some preliminary observations can be made. First, criticism of the CTF is wide-spread, stemming partially from the fact that the CTF finances "clean" coal technologies.[137] Moreover, its incorporation into the World Bank structure has been assessed negatively, inter alia with respect to a perceived lack of transparency in the Fund's decision-making structure.[138] In addition, the fact that CTF financing is distributed in part in the form of loans has lead to criticism that the CTF will force poor countries to pay for climate change, a problem predominantly created by developed countries.[139] Observers have also warned of some

[129] Porter et al. (2008)

[130] CRS (2008)

[131] Herz (2009)

[132] World Bank (2008)

[133] World Bank (2008a) paragraph 19

[134] World Bank (2008a) paragraph 31

[135] World Bank (2009)

[136] World Bank (2008a) paragraph 11

[137] Herz (2009); Rooke (2009)

[138] Nakhooda (2009)

[139] Rooke (2009)

overlap between the funding areas of the CTF and the GEF.[140] Finally, a review of three CTF Investment Plans concludes that they give only a varying degree of attention to improving institutional capacities and the regulatory environment,[141] a formal assessment of which is required by the relevant guidelines.[142]

While definite conlusions cannot be made yet, the fact that the CTF faces significant criticism before distributing major sums of money is not a cause for optimism about its functioning.

The Montreal Protocol's Multilateral Fund

The performance of the Montreal Protocol, in contrast, has been evaluated positively. Moreover, its financial mechanisms, the MLF and the GEF,[143] are credited with being critical to the Protocol's success.[144] The MLF finances activities undertaken by developing countries in order to comply with their obligations under the Montreal Protocol to phase out the use of ozone-depleting substances at an agreed schedule. It operates within the Montreal Protocol framework and is governed by an Executive Committee comprised of an equal number of developed and developing countries. Voting procedures prevent either of the two country groups from dominating the decision-making. The MLF received $ 2.34 billion in funds from 1991 through July 2009.[145] Implementation is in the hands of various UN agencies and the World Bank.[146] Financing is generally made in the form of grants,[147] which is distributed on the basis of country programs for the phase-out of ozone-depleting substances.[148]

Several features of the MLF seem to have been instrumental for the Montreal Protocol's positive track record of technology transfer from developed to developing countries. First, developed nations committed to covering the incremental costs associated with technology transfer and compliance. Second, the mechanism offers flexibility to also fund non-listed incremental costs to meet the goals of the program. Third, duplicate activities are avoided as all projects related to the Montreal Protocol have to go through the Executive Committee. Fourth, all Party members are equally represented. Finally, and arguably most importantly, the fund itself goes through a replenishment process that takes into account current projects, future projects and goals for three year periods, and consequently provides developing

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[140] Porter et al. (2008)

[141] Nakhooda (2009)

[142] World Bank (2008)

[143] The GEF was used to provide financial support to countries with an economy in transition (CEITs), as they were not eligible to receive MLF. It functioned in a similar way as the MLF, including exhibiting the flexibility to fund a broad range of projects. See Anderson et al. (2007).

[144] Andersen et al. (2007)

[145] MLF (2009)

[146] MLF (2009a)

[147] MLF (2009b) Section Concessional Loans, p. 58

[148] MLF (2009b) Section VIII. Country Program

countries with a high degree of confidence that actual funding will match projects.[149] Moreover, the governance framework (including project guidelines, preparation of periodic progress reports, tracking of project delays and finances) has also contributed to the Fund's effectiveness.[150]

While the example of the MLF is encouraging, it is important to also keep in mind that the environmental and economic challenges addressed by the Montreal Protocol are substantially less complex than those the UNFCCC process seeks to tackle. The Montreal Protocol was tasked with phasing out certain well-know substances that deplete the ozone layer, which were produced by a limited number of firms. Greenhouse gas emissions result from the vast majority of economic activities and addressing climate change will require massive economic and social transformations around the globe.

Lessons learned

Several core lessons can be learned from these examples for a technology fund under the UNFCCC. They are consolidated in Table 1 below.

Table 1: Lessons for a new technology fund

- Decision-making bodies should be composed of the same number of developed and developing country representatives; Different groups of developing countries should be represented adequately (e.g. AOSIS). Voting procedures should ensure that both groups have equal influence in the decision-making structure.
- The different needs of different developing country groups should be taken into consideration in the funding criteria.
- Overly complex project approval procedures should be avoided.
- Funding should only be approved on the basis of prior strategic planning at the country level, and should follow established and transparent criteria. The body itself should also have a mandate for strategic planning.
- Defining what technologies will be funded is essential. Funding the "wrong" technologies is not only likely to decrease environmental effectiveness, but also might undermine support for a future fund.
- Priority should be given to funding for projects with the potential for replication and appropriate knowledge management should enable effective learning processes between projects and countries.
- Under the UNFCCC, where developed countries have a legal obligation to engage in technology transfer funding must come in the form of grants, and not in the form of loans or guarantees.
- Adequate involvement of civil society, non-governmental organizations, and

[149] All points taken from Andersen et al. (2007).

[150] Kelly (2004), paragraph 15

the private sector should be ensured and procedures must be transparent.

- The provision of objective scientific advice should be ensured.

Additionally, given the complex landscape of existing funding mechanism in the climate technology field,[151] it is imperative that any future funds or funding mechanisms should be integrated smoothly with (and made additive to) existing funding mechanisms – especially with respect to procedures, technologies, and activities that are eligible for funding.

3.3 The proposed technology mechanism – an assessment

As outlined above, the technology negotiations in Copenhagen have not led to any final agreement on technology. However, the latest negotiation draft reflects consenus on the contours of a future technology mechanism. As important details have not yet been settled (such as the composition of the bodies envisaged as well as voting and reporting procedures), it is difficult to give a sound assessment of how this technology mechanism is likely to perform. Still, taking a look at existing institutions may give a sense of how effective one could expect the mechanism to be, should the draft eventually be adopted.

To measure effectiveness, the key criterion is determining the ability of an institution (or institutional framework) to achieve a specific end – in the present case, enabling and enhancing the diffusion of climate technologies. In international relations scholarship, there are only a few publications that single out specific institutional factors for the effectiveness[152] of different international organizations.[153] Moreover, measuring effectiveness is methodologically complex. In spite of these complicating factors, the following observations can be made:

- Institutions, including their organizational arrangement, matter for effectiveness. However, the effectiveness of a specific international regime depends on a large number of factors. Therefore, it is difficult to "tailor" institutions to be effective.[154]

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[151] The website http://www.climatefundsupdate.org/Home provides a good overview of the existing structures.

[152] Effectiveness of an international environmental regime is frequently defined in terms of output, outcome and impact. 'Output' refers to rules, programs and regulations emanating from the regime, while 'outcome' refers to behavioral change in the desired direction, by key target groups, as a result of the regime. Impact, finally refers to the environmental improvements in the relevant issue-area following from the regime in question (Andresen et al., 2007). Using this framework, "outcome" is the variable that is of relevance concerning technology transfer in this study.

[153] Biermann and Bauer (2004)

[154] Underdal (2002); Wettestad (1999)

- The openness of institutions to non-state actors tends to increase the effectiveness of environmental regimes or institutions.[155] The establishment and structure of a Technology and Economic Assessment Panel and the Technical Option Committees have contributed to success the Montreal Protocol. These bodies have competent members from industry and are allowed to publish their reports without governments' approval. Their reports are not based on published, peer-reviewed scientific literature exclusively, but also contain more forward-looking statements.[156]

- As can be learned from the experience of existing funds, institutional decision-making bodies should be composed of the same number of developed and developing country representatives; voting procedures should ensure that both groups have equal influence in the decision-making process. Moreover, it is also important that different groups of developing countries (e.g. small island states) are adequately represented.

- Failures of coordination and coherence resulting from the proliferation of institutions contribute to the lack of effectiveness of the international environmental governance system.[157]

In view of these insights, some positive aspects about the preliminary structure of the technology mechanism as contained in the latest negotiation draft can be highlighted. Notably, the Climate Technology Network, consisting of experts and stakeholders, is envisaged as a part of the technology mechanism. This is likely to facilitate technology transfer in terms of bringing in outside expertise to the process. In addition, the draft mentions the need to cooperate with exsting institutions. While this is not spelled out in substantial detail, it demonstrates an awareness of the problems inherent in creating multiple institutions and fora charged with similar tasks.

3.4 The Clean Development Mechanism

The CDM is one of the three market-based mechanisms of the Kyoto Protocol and has a high relevance for technology transfer to developing countries. The CDM will likely continue to exist, even if states fail to conclude a post-2012 climate change agreement. While the binding emission reduction commitments set forth in the Kyoto Protocol only cover the period until 2012, the CDM is not restricted to this period.[158] In its functioning, the CDM has been criticised from various angles, in particular with regard to its questionable impact on

[155] Kaasa (2007) p. 124; Biermann and Bauer (2004)

[156] Andersen et al. (2007) p. 300-303

[157] See Najam et al. (2006), Inomata (2008) for the climate field. See also Staley et al. (2009).

[158] See Art. 12 Kyoto Protocol

sustainable development in host countries.[159] Moreover, the use of the CDM by developed countries to meet their reduction commitments has been criticized as the use of an "escape ramp" through the purchase of offsets, instead of embarking on a path of serious changes in their patterns of production and consumption.[160]

In spite of these criticisms, there are strong indications that the CDM has contributed positively to technology transfer. Recent studies estimate that the CDM (with about 4700 registered projects[161]) is presently the strongest mechanism for technology transfer under the UNFCCC, contributing to the transfer of both equipment and know-how.[162] Studies on technology transfer in CDM projects estimate that technology transfer is occurring in 36%,[163] 44%,[164] and 46%[165] of the respective projects surveyed.[166]

Factors that have been singled out as decisive for the technology-transfer content of CDM projects are: the project's size; the particular technology; a country's general institutional framework; and a country's capacity to adopt new technologies and/or produce them domestically.[167] Accordingly, subsidiaries of companies in developed countries are the most likely to undertake projects that result in technology transfer to developing countries.[168] Moreover, it is also clear that only a few countries receive the bulk of CDM projects, with India, Brazil, and China being the most important host countries.[169] Experts, therefore, recommend that the CDM should be complemented with mechanisms for maintaining a high carbon price, improvements in investment conditions in recipient countries, and a focus on technologies with large local spillovers (i.e. energy efficiency and renewable energy).[170]

The changes to the CDM guidelines decided in Copenhagen are a step in the right direction in this regard, as they focus at achieving greater environmental integrity in CDM projects and look to facilitate a broader geographical distribution of CDM projects.

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[159] Schneider (2007), Olsen (2007)

[160] This point is made, for example, in Carbon Trade Watch (2007)

[161] This figure is provided by UNEP and includes projects in the course of registration, see http://www.cdmpipeline.org/overview.htm.

[162] Schneider et al. (2008) p. 2936

[163] Seres (2008)

[164] Dechezleprêtre et al. (2007)

[165] de Coninck et al. (2007) p. 35

[166] Differences in outcome likely are a result of slight differences in methodologies and in the number of projects reviewed. See also Haites et al. (2006).

[167] Schneider et al. (2008)

[168] Dechezleprêtre et al. (2008) or Schneider et al. (2008) p 2936

[169] Seres, (2008)

[170] Schneider (2008) p 2937

4 Controversial and open questions

In this section, two of the major outstanding issues will be addressed – the role of intellectual property in the climate technology field and review of factors for measurement, reporting and verification (MRV).

4.1 Intellectual property – trigger or barrier for the transfer of climate technology?

Disagreements over the treatment of intellectual property rights (IPRs[171]) for climate technologies engender the most contentious debates in the technology negotiations, specifically over the patenting of relevant, climate-friendly technologies.[172] Developing countries tend to advocate for changes and exceptions to existing IPR rules to encourage greater technology transfer, whereas developed countries mostly emphasize the role that current IPR frameworks have for encouraging and rewarding innovation and creating a predictable investment environment. NGO and industry proposals mirror this debate. The recent literature provides some limited conclusions about the validity of claims on both sides of the debate. The empirical research done so far lends support to the conclusion that intellectual property is not, currently and generally, a major obstacle to the transfer of climate technologies to developing countries;[173] this preliminary conclusion is based both sector-specific research and a broader analysis of patent data.[174] However, there are some indications that patents are or will be more problematic in specific sectors. For example, some researchers assert that patents in the biofuels sector may soon have a negative impact on future research and technology transfer.[175] At the same time, patents are not a major impediment to technology transfer in most other sectors.[176]

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[171] In what follows, the abbreviation "IPRs" will be used for "intellectual property rights" and "IPR" will stand for singular "intellectual property right" when necessary.

[172] For a studied consideration of the degree to which disagreements over IPRs are a result of conflicting narratives, see Ockwell et al. (2008).

[173] See Global Climate Network (2009) and Nanda and Srivastava (2009) for the consideration of these issues for an alternative perspective to the results reached in this study.

[174] Abbott (2009); Barton (2007a); Danish Church Aid (2008); Copenhagen Economics (2009); Dechezleprêtre et al. (2008) conclude that patent protection for the most relevant climate-technologies (e.g. solar, geothermal and biomass technologies) is requested and registered only in a small number of developed countries, in particular the US, Germany, Japan, Austria and Spain. This suggests that patents for such technologies are not often filed and registered in developing countries. Existing patents are thus unlikely to inhibit the use of climate-friendly technology in developing countries currently as they rarely exist in these countries. See also the literature overview in Collier and Mutugu (2009).

[175] Srinivas (2009), p. 12

[176] See Cannady (2009) for a careful consideration of barriers and structure.

A similar conclusion (i.e. that intellectual property has not been a major obstacle preventing technology transfer) has been drawn from the experience under the Montreal Protocol, where technologies to replace ozone-depleting substances were successfully diffused without any restrictions on intellectual property. Negotiations through the GEF and the Multilateral Fund initiated the transfer of protected technology, and there were only two instances where a patent owner refused to license a technology.[177]

Moreover, major developing countries have seen a rapid increase in the number of patents held in climate-relevant technologies, narrowing the – still large – gap vis-à-vis industrialized countries.[178] However, the cost of obtaining a license to use a patented technology – a related but different problem from access to patents themselves – remains an issue, especially for least developed countries.[179]

Scholars have identified some reasons for the relative lack of importance of IPRs in the climate sector. As opposed to pharmaceuticals, where a certain active ingredient is key in providing health benefits or curing disease, a broad range of alternatives for solving a problem exists in the climate field. The myriad options for electricity generation (i.e. wind, solar, geothermal with various vendors) are a prime example. Moreover, the fundamental concepts underlying many of these technologies (e.g. the functioning of windmills) tend to already be widely known.[180] Additionally, many solar, wind, and biofuels technologies are off-patent, unlike pharmaceuticals.[181] Even where patents exist, patent holders are more likely to license their patents in the face of competition.[182]

Those who are concerned that intellectual property will inhibit the flow of climate friendly technologies to developing countries have proposed that compulsory licensing should be utilized where intellectual property constitutes a barrier to the use of climate-related technology in developing countries. The frequency of such proposals is, however, inversely proportional to results of empirical research on the issue. Most of the evidence relevant to the North-South context comes from the pharmaceuticals sector. In that sector, compulsory licensing has been used by several countries.[183] Researchers have tended to agree that this

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[177] Andersen, et al., (2007) p. 256

[178] Barton (2007), p. 20; Copenhagen Economics (2009), p. 35

[179] Harvey (2008)

[180] Abbott (2009); Harvey (2008); Danish Church Aid (2008)

[181] Barton (2007)

[182] Abbott (2009) pp. 10-11

[183] See the list compiled by CPTech at http://www.cptech.org/ip/health/cl/recent-examples.html.

has not led lower rates of innovation[184] and have recommended the use of compulsory licenses by developing countries, at least under certain conditions.[185]

In contrast, there seem to be no empirical studies on whether states so far have used compulsory licensing on climate technologies in a cross-border context, and only very few estimates exist on the potential effect of using them. One study warns that tacit knowledge plays a larger role in the climate sector than in the pharmaceuticals sector; consequently, the study expects that compulsory licensing would be less effective in the climate than in the pharmaceutical field.[186] Moreover, it has been pointed out that compulsory licensing is only a solution where firms in developing countries have the capacity to manufacture technologies that have been made available via a compulsory license – which is much more problematic in the case of climate technologies than in the case of pharmaceuticals.[187]

A side-issue of the discussion on compulsory-licensing is a proposal that an agreement regulating compulsory licensing should be adopted in the context of the international climate change negotiations. The WTO Declaration on the TRIPS (Trade-related aspects of intellectual property rights) Agreement and public health[188] is frequently cited as a model for such an agreement. The public health declaration was adopted with the aim of facilitating the issuance of compulsory licenses for pharmaceuticals destined for export to developing countries. To this point, fewer than 30 of the 153 members of the WTO have accepted the pertinent change to the TRIPS Agreement;[189] and only two countries – Canada and Rwanda – have notified the WTO that they will make use of the rules established by the WTO public health declaration. This casts substantial doubt on whether an international agreement modeled on the WTO pharmaceutical deal would foster climate-related technology transfer.

However, it has also been pointed out that the WTO Declaration on the TRIPS Agreement and public health has sometimes been used as a bargaining chip by developing countries to acquire medicines cheaply.[190] In addition, the Declaration has also received a lot of political attention, a reflection of which is the fact that it is mentioned in the context of the UNFCCC negotiations. The upshot of the Declaration may prove to be long-term and political rather than immediate and legal.[191] Still, the assumption that an agreement on compulsory licensing adopted within the framework of the UNFCCC will not be of much use to foster technology

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[184] Chien (2003)

[185] De Morais (2009)

[186] Danish Church Aid (2008)

[187] Nanda (2009)

[188] Implementation of paragraph 6 of the Doha Declaration on the TRIPS Agreement and public health, Decision of the General Council of 30 August 2003, http://www.wto.org/english/tratop_e/trips_e/implem_para6_e.htm

[189] http://www.wto.org/english/tratop_e/trips_e/amendment_e.htm

[190] De Moiras (2009)

[191] Abbott (2009)

transfer is supported by the highly questionable legal effect of such an agreement adopted by the Parties to the UNFCCC. Such an agreement would not directly modify the norms of the WTO TRIPS Agreement, which already allows compulsory licensing, albeit only for the supply of domestic markets.[192]

While IPRs do not seem to present an obstacle to technology transfer, another question to address is whether they are necessary to foster innovation and foreign direct investment. Unsurprisingly, the evidence here mixed. Some studies find that there is a positive correlation between strong intellectual property protection and levels of foreign direct investment.[193] In particular, evidence has been found that imported technology is more sophisticated where strong intellectual property protection exists.[194] Other scholars disagree. Notably, some evidence has been found that trade flows to the poorest countries did not respond to stronger patent protection.[195] In light of these conflicting findings, intellectual property is, at most, one factor among many that influences investment decisions. Other important factors are the size and certainty of markets, the rate of turnover, and the number of competitors.[196]

In sum, the evidence relating to the protection of intellectual property does not appear to match the prominence this issue has achieved in the UNFCCC negotiations. Based on existing research, a pressing need to change existing rules on intellectual property to increase technology transfer in the climate field cannot be identified. Concurringly, developing mechanisms for compulsory licensing is currently not the most urgent missing element of a future climate agreement. Some scholarship indicates that the innovation rate in the climate sector may increase in the future, if the carbon price increases and stricter environmental standards are enacted.[197] This may also change the picture with regard to the role of IPRs and the need for compulsory licensing or other instruments for securing developing countries' access to climate technologies. Provisions on funding to cover the cost of licensing, in particular for poor developing countries, should thus be part of a future deal, if and where licensing becomes an issue.

4.2 Measurement, reporting, and verification (MRV)

MRV is an area where Parties did not make substantial progress in Copenhagen. This holds true for general questions of MRV related to emissions limits, as well as for more specific

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[192] See Art. 31 lit. f WTO TRIPS.

[193] See Park and Lippoldt (2008), Kanwar and Evenson (2003).

[194] Maskus (2004)

[195] Hutchison (2006) p. 528

[196] Tomlinson et al., (2008) p. 15

[197] Hutchison (2006)

instances of MRV like technology transfer. As of this writing, the establishment of new mechanisms for the measurement, reporting, and verification of technology-related obligations and commitments for Annex II developed countries has yet to be completed.

MRV rules – enhancing compliance and effectiveness?

As with intellectual property, it is legitimate to ask the question whether – beyond the dynamics of a multi-lateral negotiation process – improved and additional MRV provisions are necessary in the international climate change agreement. Obviously, this would be the case if MRV rules could be expected to enhance compliance with a future international climate agreement and thus also affect the agreement's effectiveness in terms of mitigating and adapting to climate change. Experience from other international agreements, in particular in the environmental field, would be useful in this regard.

Yet, literature specifically addressing the extent to which MRV mechanisms enhance effectiveness and compliance is somewhat limited. However, a substantial literature has been compiled over the past few decades related to the features of environmental agreements that tend to produce effective results. From a particular perspective, the technology transfer negotiations inside the UNFCCC context can be viewed as a negotiation within a negotiation. In this way, extending the criteria of an effective agreement to the technology transfer negotiations and MRV is appropriate.

Many international environmental agreements include compliance mechanisms. Raustiala (2001) provides an overview of the reporting, review, and compliance institutions of several environmental agreements. Many of the agreements exhibit low compliance rates and several have neither regular reporting requirements nor compliance procedures. The Montreal Protocol is exemplary in terms of reporting and performance; its best features have been outlined above. More interesting for technology MRV and climate change are some of the procedures and success from the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). CITES regulates the trade of endangered species are requires that Parties compile lists of traded species and issue permits for those who wish engage in international trade of the species.[198] For MRV purposes, Parties compile data the trade of listed species and the number of permits made available – each country is responsible for issuing permits. Parties can limit the trade of some species by enacting domestic laws that are stricter than CITES's provisions. The capacity for stricter domestic rules has "become critical to the effectiveness of the system of compliance review" [199] under CITES; whether this would be possible with technology transfer and climate change is

[198] See Raustiala (2001) p 24 for the following.

[199] Raustiala (2001) p 24

unclear.[200] Further, standardized reporting procedures have led to improved (but not perfect) reporting compliance. Also, capacity-building and compliance-promotion sponsored by the Secretariat has strengthened domestic capacity and contributed to compliance. To assess implementation, CITES evaluates the implementation of a Party's commitments through a regular review of domestic legislation by way of the National Legislation Project. Reviewed legislation is compiled in a searchable database and changes to legislation are reviewed as well – the Secretariat or external consultants perform the review.[201] Such reporting and review could be very effective in assessing compliance and building confidence in terms of technology transfer. Flexibility in interpreting and administering the provisions and commitments under CITES has positively influenced compliance as well. As the general nature of current technology commitments have created problems in assessing compliance to this point, it is unlikely that additional flexibility will achieve the desired results for technology transfer.

Using a more theoretical approach, a multi-year research project attempted to identify the contributive components of effective international environmental agreements.[202] These scholars tested a number of environmental agreements against their model variables. The researchers found important factors contributing to effective regimes. Problems of small controversy (benign), for example, are simpler to solve than those involving significant controversy (malign); the better understood a problem is (which contributes to it being benign or malign), the easier it is to solve. The problem-solving capacity of the system established to address the environmental issue was the other major contributor (or impediment) to effectiveness. The higher the capacity, the better solutions the system tends to propose, and, therefore, the greater the chances of success.

More concretely, types of problems that are effectively addressed tend to be benign (or at least limited) in terms of the controversy they raise between countries and the state of scientific knowledge on the issue should be relatively well established. Effective problem-solving systems, moreover, tend to exhibit: leadership by a small number of delegates; power accumulation in the hands of those pushing for action; decision rules in the convention or agreement being made by a (qualified) majority; and the sound integration of the community of experts. Lastly, a favorable political context can contribute to effectiveness. A positive political context was most often found for problems associated with other benign problems and where ulterior motives for cooperation exist.[203] Following these criteria, The Vienna Convention (with its Montreal Protocol), tuna fisheries management in the Pacific, the Oslo Commission (prohibiting the dumping of waste in the North Atlantic), and the prohibition

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[200] Discussions over the possible use of domestic border adjustment measures to force higher standards on certain countries than they have agreed to internationally are a prime example. Whether such a measure would be a violation of WTO rules or start a trade war remains unclear and untested.

[201] Raustiala (2001) p 26

[202] Miles et al. (2002)

[203] Adapted from Table II.1 on p. 64 in Miles et al. (2002).

of the dumping of radioactive waste in the North Sea were determined to be effective regimes.

Academic research has also investigated the extent to which external support can contribute to effective regimes. It is important to keep in mind that international agreements do not have an enforcer, as domestic law does (compliance cannot be enforced in the same way that domestic law can be). Therefore, the simple act of ratifying an international agreement – binding or non-binding – is not sufficient to ensure results. International agreements require support and reinforcement from a host of social actors – corporations, NGOs, individuals, and governments – who must create a supportive structure that encourages the desired change in behavior. International environmental agreements with a strong support network behind change will tend to be effective, even if the terms of the agreement are not legally-binding.[204]

Altogether, there are a number of factors that influence whether an international agreement is likely to be complied with. When looking at the criteria above and applying them cursorily to the international climate agreements, the likelihood of strong compliance is not initially high – though the experience with Annex I national communications on the whole has been surprisingly positive. If the question of technology transfer quickly devolves into discussion of IPR and related issues, it would be difficult to judge the type of problem as benign (or non-controversial) – and climate change itself involves a series of complex economic issues. Without attempting to evaluate all criteria with respect to technology transfer, other impediments are evident: the UNFCCC/Kyoto regime requires unanimous decision-making; ulterior motives for cooperation are not clear for many countries; and power has not yet accumulated in the hands of those pushing for action. A point on the positive side may be, in turn, the strong support from international civil society for an ambitious climate change agreement and general agreement of experts in the field on the need for action. In the absence of clear objectives and reporting procedures, this cursory overview indicates that strong MRV rules concerning technology by themselves are likely to have a limited effect in terms of fostering compliance.

Lessons can also be drawn from other international issues. An entire scholarly volume[205] explores the issue of verifying compliance with international treaties related to weapons of mass destruction. Drawing on over fifty years of verification and compliance experience, the authors attempt to draw lessons for climate change negotiations, due to several key similarities. Among the similarities were: the need for intrusive (even sovereignty-breeching) verification; concerns over proprietary information for national security and businesses; significant costs of data collection; and imperfect information.[206] Like international weapons treaties, MRV has an important role to play in an international climate change agreement and

[204] Mitchell (2007) p. 920

[205] Avenhaus et al. (2006)

[206] Avenhaus et al. (2006) p. 3

for technology transfer in particular; not only is compliance needed to address the environmental problem, but nations need to be seen to be complying with provisions and commitments to build confidence in the process.[207] Procedures and rules that help to identify non-compliance and assist non-complying states to comply increases the possibilities for cooperation and can enable stronger treaty provisions, as free-riders can be identified. This can only be done if some MRV structure exists.

Experience from weapons treaties also offer two lessons of caution, especially when considering MRV for technology transfer. First, it is not possible to gather complete information, so every consideration of compliance (or non-compliance) involves a degree of uncertainty. Therefore, thresholds for compliance may have to be set that fall short of the ideal of 100% compliance. Secondly, the MRV provisions for technology transfer are commitments made by countries in addition to the primary commitments of the climate change treaty (emission reductions and related goals), which will also be subject to MRV. Treaties that have multiple commitments will have to rank the importance of the different goals, and compliance will inevitably be determined by some combination of adherence to all commitments considered as a whole. It is unclear where technology commitments rank on the scale of all commitments in the climate change agreement – and the preferred ranking may differ between countries. However, it is unlikely that technology commitments will be considered the most important. If this is true, determinations of compliance can quickly become complicated. For example, would an Annex II country that fully met its reduction commitments but did not meet all of its technology transfer commitments be deemed non-compliant? Problems of this nature will have to be addressed in a learning-by-doing process over the years of the agreement.[208]

While the above may seem to indicate that the (pre)-Copenhagen discussion on MRV for technology transfer is over-rated, given the number of other factor that influence compliance with an international agreement, the MRV discussion and making progress on the issue is still politically important in the current situation. For many developing countries, developed countries willingness to take seriously their existing commitments under the international climate change agreement, including those under concerning technology transfer, seems to be a pre-condition for their own willingness to make commitments. The paucity of data on technology transfer has led to assertions on the part of developing countries that Annex II countries have not met their treaty obligations to provide support for and access to climate-friendly technologies. Thus, coming up with a credible solution on how to verify action and to what extent developed countries are fulfilling their obligations is likely to be politically vital for arriving at an agreement at all – and for building and maintaining trust over time. Moreover, Section 3.1 above, pertaining to the extent of finance for technology transfer, highlights one of the major problems for technology transfer to date: the value and degree of technology

[207] MacFaul (2006) p. 171

[208] Preceding arguments in Kryiakopulos (2006).

transfer occurring currently is unclear. Annex II countries do not report their efforts following comparable reporting procedures and the technology-related commitments that Annex II countries currently have are vague. Better MRV for technology-related matters under the UNFCCC – by providing clear commitments with simple and uniform reporting rules that result in the production of verifiable data – would thus contribute significantly to a determination of compliance with technology commitments.

Proposals for rules on technology-related MRV

The question of how rules on technology-related MRV in a future regime could be structured has received some attention, but Party submissions have not been very specific. Suggestions from other corners are illustrative.

A first important observation is that data gaps and lack of information have resulted, at least in part, from the absence of specific actions that Annex II countries are supposed to take. Issues with respect to technology transfer, in some ways, mirror those of GHG reductions overall: Annex II technology commitments are quite general; the reporting guidelines are vague and have led to incomparable data; there is no assurance of consistent measurement; and therefore, there is no space for independent verification.[209] In this regard, a general finding from the literature proves instructive: "review institutions are most developed where MEA [multilateral environmental agreement] commitments are most specific. The Montreal Protocol, with the most elaborate review institution, contains detailed commitments that are amenable to careful review."[210] Based on this rationale, one pre-condition for detailed MRV provisions would be spelling out detailed and specific technology-related obligations in a future climate change agreement.

Second, those Annex II countries that report actions taken on technology transfer in their national communications do not follow a uniform procedure, making comparisons across countries challenging.[211] The development of a common reporting format – followed by Annex II countries in their national communications – would be a preliminary success in terms of technology transfer. Moreover, capacity building and enabling environments in developing countries to produce reliable data should be supported.

Third, in terms of data collection, evidence of compliance with technology transfer commitments may prove significantly simpler to provide than other areas of MRV in the climate change regime. The Chair of the Expert Working Group on Technology Transfer (EGTT) produced a study of possible performance indicators for technology transfer that could be used to monitor and assess the effectiveness of Parties' implementation of a

[209] Breidenich and Bodansky (2009) pp. 16-17

[210] Raustiala (2001) p. 63

[211] Breidenich and Bodansky (2009)

technology transfer framework (Article 4, paragraph 5 of the UNFCCC).[212] This study identified 40 possible indicators in six subsets (see examples in Table 2 below). Data collection and reporting were some of the key barriers identified to utilizing these indicators. As data collection and reporting (and the building of capacity to achieve both) will incur significant costs, especially for developing countries, the collection of data for all possible indicators does not seem likely. Choices will have to be made to focus on obtaining the most pertinent information.

Table 2: A Brief list of performance indicators for technology transfer proposed by the EGTT

1. Technology needs and needs assessments
   a. Total resources provided for TNAs
   b. Number of completed TNAs or updated
2. Technology information
   a. Number of national communications with information on technology transfer activities
   b. Number of training programs for capacity building to provide technology information
3. Enabling environments
   a. Establishment of tax incentives to import and export climate technologies
   b. Programs to assist developing countries to use and transfer climate technologies
   c. Proportion of budgets for public procurement of climate technologies
4. Capacity building
   a. Number of participants in training programs
   b. Number of excellence centers to develop and transfer technology
5. Mechanisms for technology transfer
   a. Number and volume of public-private finance mechanisms and instruments

Many other constructive suggestions about MRV from outside the UNFCCC have also been put forward – though most pertain to MRV related to emission mitigation targets. Ellis and Moarif (2009) provide an overview of the experience with MRV under the UNFCCC and the Kyoto Protocol and offer ideas for improving the regime,[213] while Fransen (2009) takes a closer look at the role national communications and inventories play in producing and enhancing compliance.[214] Specifically with respect to MRV and technology transfer, a Pew Center study proposes that the verification process for reported technology transfer be expanded to allow verifiers to check reported data against other sources.[215] Winkler (2008) recognizes the inherent difficulties of monitoring and reporting the transfer of each individual

[212] UNFCCC (2009a)

[213] Ellis and Moarif (2009)

[214] Fransen (2009)

[215] Breidenich and Bodansky (2009) p. 27

technology and proposes that MRV of technology transfer focus on financing initially.[216] Public sources of funding should be distinguished from private sources, which will predominate in later parts of the technology cycle. Non-financial aspects of technology transfer – the building of institutional capacity, collaborative R&D, etc. – will prove significantly more challenging, but metrics to measure them should be established eventually.[217]

Lessons learned

While the establishment and use of specific indicators to assess technology transfer will likely aid verification, the list of indicators should not be exhaustive and be chosen carefully. Even Annex II countries do not currently have the capacity to collect and report some of the indicators supported by the EGTT; many developing countries will have even less capacity. These capacities and the related monitoring systems will have to be created and implemented rapidly.[218] Simply building capacity to collect and report data will require some of the technology transfer funds. Cost of data collection and reporting are another criterion to consider for effective regimes. If the cost of collecting necessary information becomes too high, states may be unwilling to bear it.[219] The time required to build appropriate capacities, build new systems, collect data, and begin reporting must also be evaluated. The higher the time demands, the longer it will take before the production of reliable data and reports. Further, technology transfer-related MRV obligations for Parties will be added to other data-collection, monitoring, and reporting requirements that Parties will have under a future climate change agreement. Increasing the number of indicators and types of targets being assessed will increase "the complexities involved in establishing a transparent and robust international system."[220] An early focus on uniform reporting on the finance of technology transfer should be a good first step: this would provide measurable and comparable data; claims from developed countries could be verified against receipts in developing countries; and both of these outcomes would build early confidence in the process.

Regardless of the chosen metrics for MRV of technology transfer – be it finance, indicators, or some combination of metrics – the need for more specific commitments, uniform reporting requirements, and the capacity to review reported data is evident. However, while the inclusion of detailed technology-related rules, especially with respect to MRV, is desirable, a "rule-overload" should certainly also avoided. Too many commitments and too many indicators will also be undesirable. Some trial and error will be needed; initially the need to establish some specific measurable commitments and to start measuring and reporting them

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[216] Winkler (2008) pp 544-545

[217] Winkler (2008) p 545

[218] MacFaul (2006) p. 205

[219] Avenhaus et al. (2006) p. 3

[220] MacFaul (2006) p. 205

is clear. There is, however, too much of a good thing with respect to reporting. After all, the main thrust of states' efforts should be directed at substantive action to technology transfer, rather than to monitoring and reporting.

5 Conclusions

Technology transfer is one of the topics in international climate change politics that is likely to remain high on the agenda as negotiations on the future of the climate regime resume after Copenhagen. While developing countries are – justifiably – demanding from developed countries the fulfillment of the latter's technology-related commitments under the UNFCCC, developed countries (and private firms) are eager to find new markets for their clean tech industries. While the weak outputs of the Copenhagen negotiations have also prevented a successful conclusion of the technology negotiations, there is thus reason to believe that the issue will receive further significant attention. This will likely be the case both within the UNFCCC – with the mandate of the AWG-LCA, responsible for the technology negotiations, having been extended in Copenhagen – and outside of the UNFCCC.

Section 2 of this study provides an overview of technology transfer in the context of the climate change negotiations starting from the Bali Action Plan and going through the Copenhagen Accord. Unlike other aspects of the climate change negotiations, significant progress has been made on creating a consolidated negotiating text for technology transfer. Parties have been able to reach general agreement in several areas including: the establishment of a technology mechanism with an Executive Committee, a Technology Center, and a Technology Network to provide advice and expertise on technology issues and the recognition of the importance of enhanced strategic planning for technology cooperation.

Despite increasing consensus, however, obstacles remain before the technology negotiations can be concluded. Intellectual property rights remain the largest obstacle, having become a highly politicized and thus controversial issue. The latest draft discussed in the Copenhagen negotiations had three competing and significantly opposed options that reflect wide disagreement on the issue. Moreover, some major issues with systemic significance for the overall negotiations are still unresolved; these also affect the technology negotiations. These systemic issues are finance, MRV and NAMAs.

In Section 3 of this study, previous experience and the academic literature were consulted to assess the potential effectiveness of several options under negotiation to determine their contribution to actually fostering technology development and transfer. A scoping exercise was conducted to compare existing levels of funding (including potential new funds through the Copenhagen Accord) with estimates of needs for technology transfer. Even if all the funds pledged under the Copenhagen Accord were allocated to technology transfer – and they specifically are not – the resulting financial flows would not yet meet estimated needs. Additional policies and measures will be needed to foster greater investment from the private sector; more public funds for research and development and other early stage technology development is also needed.

The Copenhagen Accord mentions the establishment of a Copenhagen Green Climate Fund. Not all the details of the functioning of the Fund have been settled yet, but many pertinent lessons can be gleaned from the experience with other funds. The most important recommendations drawn from the experiences under the Global Environment Facility, the World Bank's Climate Investment Funds, and the Montreal Protocol's Multilateral Fund were

drawn upon to provide a series of suggestions for the functioning of the Green Climate Fund. These include: avoiding an overly complex approval procedure; achieving a balanced membership between developed and developing countries in decision-making bodies; basing funding decisions on prior strategic planning; funding those projects that are most likely replicable; and ensuring the participation of civil society and the private sector.

The goal of a new technology mechanism should be maximized effectiveness; here, too, lessons from previously established mechanisms can help enhance the success of a new technology mechanism. Effectiveness will be enhanced by creating institutions that do not have competencies that overlap with existing institutions. Openness to input from non-state actors can increase effectiveness as well.

Though the Clean Development Mechanism (CDM) was not conceived primarily as a means of technology transfer and has been criticized widely for its frequent lack of contribution to wider sustainable development objectives, projects under the CDM have provided an important contribution to technology transfer between developed and developing countries. Those aspects of CDM projects that contribute to technology transfer (i.e. project size, types of technology, institutional framework, and domestic capabilities) should be underscored to maximize the technology transfer potential of the mechanism. Additional technology transfer could also be encouraged by widening the geographical range of CDM projects.

The landscape of funds and initiatives to foster the wider use of climate-friendly technologies is, already today, diverse and complex. At the same time, knowledge about available technologies, replicable solutions, and overall needs, as well as coordination between different actors, seems to be lacking. This is exacerbated by scientific uncertainty about the impacts of climate change in different regions of the world and the adaptation technology needs resulting from these impacts.

Section 4 takes a closer look at the largest remaining area of controversy (intellectual property rights) and a major open question (the formulation of measurement, reporting, and verification criteria for technology transfer). Disputes over the role and range of intellectual property rights have roiled international negotiations on climate change, trade, and development for decades. Developing countries and developed countries often take diametrically opposed positions on the treatment of IPRs based on completely different understandings of the issue. The literature survey conducted for this study suggests that IPRs are not at present the prime obstacle to technology transfer, as has been claimed by many developing countries, academics, and a large number of non-governmental organizations. Currently, IPRs are not acting as a barrier due to several factors: the existence of many alternatives; a number of technologies are off-patent; and licenses for most technologies are readily available. However, this situation may change in the future. At the same time, actual evidence for the claim that the adoption of stricter IPR laws will increase FDI and technology transfer remains mixed. An examination of both claims – that IPR impedes technology transfer and that it enhances it – leads to the conclusion that IPR should not receive the prominence in the negotiations that it currently does.

The latest draft negotiating text on technology transfer does not contain any language on measurement, reporting, and verification (MRV), but it remains one of the largest,

unanswered issues of the negotiations. Examining the experience of other environmental agreements demonstrates that MRV provisions in and of themselves will not guarantee compliance. However, evidence in this area remains sparse. Still, developing MRV provisions on technology under the UNFCCC is a politically important element of current negotiations; developing countries expect developed countries to fulfill their technology-related commitments in a credible and verifiable manner and developed countries will require that funding for technology projects actually achieve reductions in emissions. The biggest current obstacle to overcome is the gathering and reporting of uniform and comparable data in national communications – this is the monitoring flip side of developing concrete commitments for Annex II countries. More and reliable data will allow for compliance verification and help build confidence in the process. A good place to start will be common definitions for differentiating, monitoring, and reporting financial contributions to technology transfer. Other measures can be added later. Additionally, the EGTT and others have suggested a series of performance criteria to measure progress. This is a positive step forward, but the number of indicators should be kept to a useful yet small number. Too many indicators would detract from compliance and effectiveness. Data collection and building the capacity to monitor and report is costly, and countries do not have unlimited budgets. Technology commitments are not made in a vacuum, but have to be considered in light of all commitments made in the climate change process.

The technology challenge is complex. There are multiple channels of action and a diversity of actors, both private and public. The channels and actors must come together to produce consistent, consensual, and well-designed policies and institutions to promote R&D for the development of new technologies and the widespread adoption of these technologies around the world. New policies and institutions must be soundly integrated into the existing landscape. Moreover, the emergence of some developing countries as major players in the climate technology field is likely to result in changed political dynamics and may bring up new issues on who will provide technologies to whom and under what conditions. On the other hand, the UNFCCC negotiators can also draw lessons from previous experiences – which will potentially make their task significantly easier. For example, it is quite obvious that the UNFCCC rules as they currently stand are much too general to allow any meaningful assessment of whether developed countries are doing enough and by which standards “enough” should be measured. Moreover, experience with existing funds and with the CDM points to the need of transparent and representative decision-making structure in technology funding mechanisms and institutions, as well the usefulness of integrating expertise from the non-governmental sector.

However, it is also clear that no matter if a new technology-related mechanism will be created under the UNFCCC and new rules that have a positive impact on technology use will be crafted, the UNFCCC is only going to be one - albeit important – part of a huge mosaic. The private and the public sector will be involved, as will bilateral, regional and other multilateral institutions and funds. More importantly, it should not be forgotten that “technological advances” alone will likely prove insufficient to mitigate climate change and allow societies to adequately adapt to it. Deep changes in consumption patterns of the richer parts of the world population and a transformation of global production structures will be equally needed – and this presupposes considerable political will on the part of all actors.

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