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THE CLEAN DEVELOPMENT MECHANISM AS A VEHICLE FOR TECHNOLOGY TRANSFER AND SUSTAINABLE DEVELOPMENT – MYTH OR REALITY?

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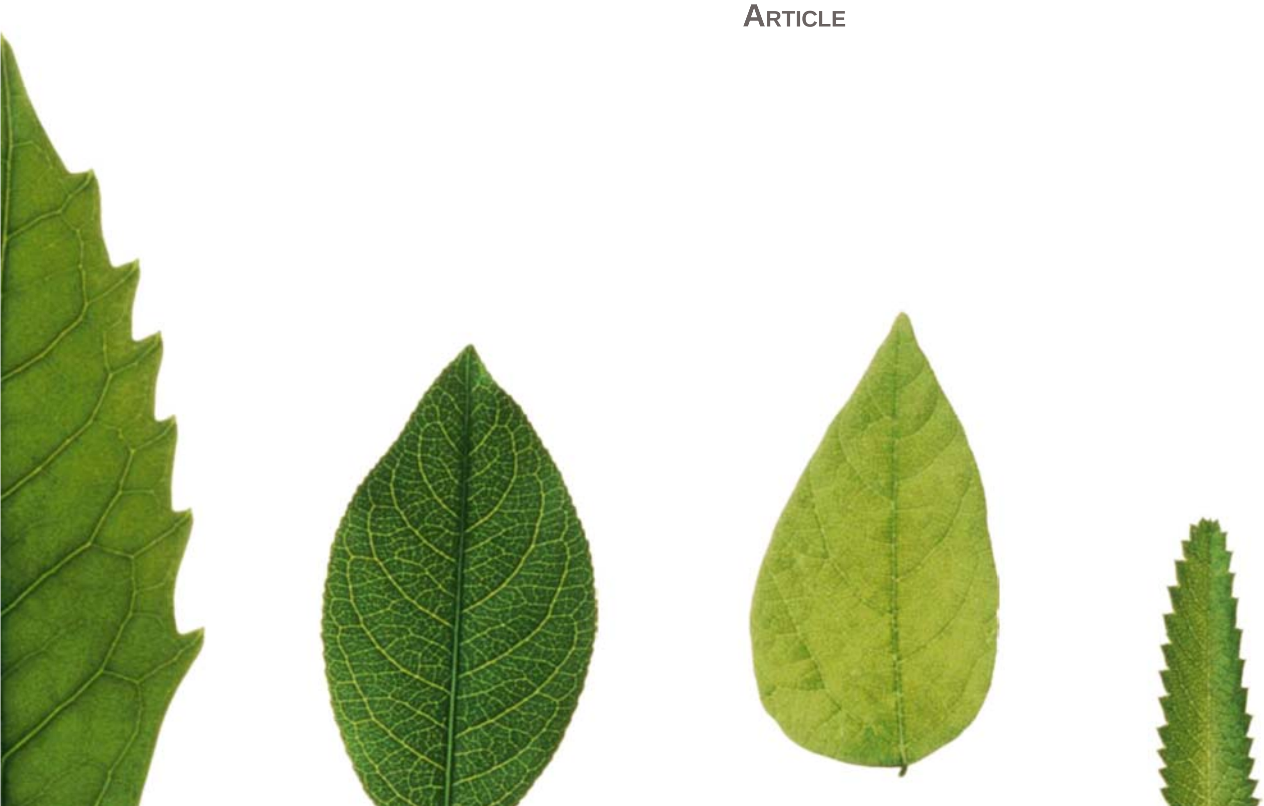

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1 INTRODUCTION

The aim of this paper is to examine the relationship between the clean development mechanism (CDM) established under the 1997 Kyoto Protocol to the United Nations Framework Convention on Climate Change (UNFCCC) and technology transfer. The link between environmental protection and the transfer of technology was established in the early 1970s and has evolved to become an important component of many multilateral environmental agreements. As the complexity and global reach of environmental problems has expanded, so too has the significance of technology transfer in obtaining full sign-up of states to comprehensive agreements to tackle these problems. Parallel to its emergence in international negotiations around environmental issues, technology transfer emerged as a major aspect of the international development discourse between countries of the North and the South.[1]

Part two of the paper will present a brief overview of technology transfer and current understandings of the scope of the term. Part three will examine the relevant Article 4 commitments of the UNFCCC relating to technology transfer and scientific and technical cooperation. Part four will explore the inclusion of the CDM in the Kyoto Protocol and its place within the so-called 'flexibility mechanisms'. This will encompass the basic modalities of the CDM and its procedural link with technology transfer. In part five, a number of recent studies that have analysed technology transfer in CDM projects will be reviewed followed by a more indepth analysis of five recent CDM projects. The project design documents (PDDs) and validation reports will be examined to understand how technology transfer is presented at an early stage of project development. Part six will offer some tentative findings on the benefits of CDM for technology transfer but also will point to some of the real limitations and obstacles to technology transfer in the context of sustainable development and some pointers as to how these might be addressed in future CDM guidance. The paper will conclude with some observations on the challenges evident in moving to low carbon sustainable development in countries of the South.

1 The terminology 'North-South' was popularised in the title of the 1980 Report of the Independent Commission on International Development Issues, North-South: A Programme for Survival (Brandt Commission).

2 TECHNOLOGY TRANSFER AND INTERNATIONAL DEVELOPMENT

The evolution of technology transfer needs to be viewed in the context of the New International Economic Order (NIEO) in the early 1970s, which aimed to restructure economic and political relations between North and South. This culminated in the 1974 UN General Assembly Declaration on the Establishment of a New International Economic Order.[2] Article 4(p) formulated the principle of 'giving to the developing countries access to the achievements of modern science and technology, and promoting the transfer of technology and the creation of indigenous technology for the benefit of the developing countries'. This had been preceded in 1972 by the establishment of an UNCTAD intergovernmental group of experts with the objective of drafting a code of conduct on international technology transfer.[3] However, the group did not succeed in publishing a draft. At this time, the North primarily viewed technology transfer as a business-to-business matter, whereas the South were convinced that if technology transfer were to succeed it would require active promotion by states in the North.[4]

2 Declaration on the Establishment of a New International Economic Order, 1 May 1974, UN Doc. A/RES/S-6/3201 (1974).

3 Established by the Third General Session of the United Nations Conference on Trade and Development (UNCTAD), 1972. *See also* K. Rissanen, 'The Draft International Code of Conduct on the Transfer of Technology and Standards of Fairness in Contract Relationships', 27 *Se.Si.I.* 142, 143 (1983).

4 B. Pavlic and C. Hamelink, The New International Economic Order: Links between Economics and Communications (Paris: UNESCO, 1985).

In the international environmental arena, technology transfer was first a major issue at the 1972 United Nations Conference on the Human Environment in Stockholm. Leaders of developing countries called on the international community to make available science and technology in order to progress their development.[5] Principle 9 of the Stockholm Declaration established the link between under-development and environmental damage:

> Environmental deficiencies generated by the conditions of under-development and natural disasters pose grave problems and can best be remedied by accelerated development through the transfer of substantial quantities of financial and technological assistance as a supplement to the domestic effort of the developing countries and such timely assistance as may be required.[6]

This principle was reiterated in Principle 9 of the 1992 Rio Declaration on Environment and Development as an obligation on states to cooperate to increase capacity building for sustainable development through the 'diffusion and transfer of technologies, including new and innovative technologies'.[7] The 1989 resolution of the UN General Assembly in preparation for the Rio Conference insisted on the specific needs of developing countries and the necessity of 'expeditious transfer of environmentally sound technologies'.[8] This commitment is elaborated in Chapter 34 of Agenda 21 relating to the transfer of environmentally sound technology, cooperation and capacity building. This stresses the 'soft' side of technology transfer, encompassing the transfer of technological know-how and local managerial capabilities in the context of long-term collaborative partnerships.[9]

Despite technology transfer being a component of many multilateral environmental agreements and international regimes more generally, there is no universally accepted definition of the term.[10] The UNCTAD draft International Code on the Transfer of Technology includes in its definition of technology transfer the provision of know-how and technical expertise, the provision of technological knowledge necessary for installation and operation of plant and equipment, and the provision of the technological contents of industrial and technical cooperation arrangements.[11] Such transfers may or may not take the form of contractual agreements.[12] This definition indicates that technology transfer is broader than merely the deposit of an innovative installation or equipment in a less developed country from a more developed one.[13] UNCTAD's definition emphasises knowledge dissemination of commercial technology. Maskus defines it as 'any process by which one party gains access to another's technical information and successfully learns and

5 S. Andersen, K. Madhava Sarma and K. Taddonio, *Technology Transfer for the Ozone Layer – Lessons for Climate Change* 6 (London: Earthscan, 2007).

6 Declaration of the United Nations Conference on the Human Environment, *in* Report of the United Nations Conference on the Human Environment, Stockholm, UN Doc. A/CONF.48/14 (1972) [hereafter Stockholm Declaration].

7 Rio Declaration on Environment and Development, *in* Report of the United Nations Conference on Environment and Development, Rio de Janeiro, UN Doc. A/CONF.151/26 (Vol.1), Annex I (1992) [hereafter Rio Declaration].

8 *See* United Nations Conference on Environment and Development, 22 December 1989, UN Doc. A/RES/44/228.

9 Agenda 21, Chapter 34, *in* Report of the United Nations Conference on Environment and Development, Rio de Janeiro, UN Doc. A/CONF.151/26 (Vol. III) (1992).

10 D. Shabalala and M. Orellana , Technology Transfer in the UNFCCC and other International Legal Regimes: The Challenge of Systemic Integration 2 (Geneva: International Council on Human Rights Policy, 2009). These multilateral environmental agreements include: LRTAP Convention, Article 8(c), 1982 UNCLOS, Articles 266(1) and (2), 2001 POPs Convention, Article 2 and 1992 Convention on Biological Diversity, Article 20(4).

11 United Nations Conference on Trade and Development, Draft International Code of Conduct on the Transfer of Technology, as at the close of the sixth session of the Conference on 5 June 1985, UN Doc. TD/CODE TOT/47 (1985).

12 Draft TOT Code cited in UNCTAD, Transfer of Technology – Issues on International Investment Agreements 6-7 (New York and Geneva: United Nations, 2001).

13 *See* Andersen, Sarma and Taddonio, note 5 above at 7.

absorbs it into his production process'. He elaborates that the technology may be codified in blueprints or be more loosely captured in the know-how of engineers. Thus, it may be embodied in products or disembodied in ideas.[14]

The Intergovernmental Panel on Climate Change in its Third Assessment Report emphasises the concept of technology diffusion, which encompasses the 'process of learning to understand, utilise, and replicate the technology, including the capacity to choose and adapt it to local conditions, and integrate it with indigenous technologies'.[15] In addition, the IPCC stresses the role of publicly funded environmentally sensitive technologies which, given they are in government control, should facilitate quicker transfer to the private sector.[16] This approach focuses on the pathways of transfer or diffusion. Though most technology transfer is private sector to private sector, other pathways may be government or public sector driven or even community sector driven.[17] Forsyth develops this theme and focuses on the requirement for technology transfer to be appropriate and useful to the needs of local people, 'in-tune with other local products and markets'.[18]

The final observation is that technology transfer is not exclusively confined to North-South transfers of technology. Transfer can and does occur South-South and even South-North. In his analysis of Research and Development transfers and intellectual property rights, Maskus concludes that Brazil, Mexico, Malaysia, and the export-intensive regions of China and India have graduated from the 'imitative stage' of technology transfer to that of 'creative imitation and implementation of knowledge-intensive inputs'. This so-called technology ladder was seen in the success of South Korea in the 1980s and 1990s, which involved significant transformation of initially imported technologies followed by increased local Research and Development and finally product differentiation in the host country. Maskus observes that many middle-income developing countries and economies in transition are now in the 'duplicative imitation stage', which is some way up the technology ladder. Most least developed countries, though, are barely at the first stage of the ladder.[19] The conclusion is that the varying conditions of technology development and market receptiveness amongst developing countries will significantly influence the effectiveness of CDM as an instrument of technology transfer.

3 TECHNOLOGY TRANSFER IN THE CLIMATE CHANGE REGIME

3.1 The Ozone Layer Protection Regime

It is useful to introduce the provisions for technology transfer within the climate change regime with a brief examination of the prior ozone layer protection regime. Negotiations leading up to the Vienna Convention for the Protection of the Ozone Layer took place over a period of some eight years.[20] During this period the now familiar model of a flexible framework convention to be followed subsequently with annexes and protocols was established. It was at the 1981 Ad-Hoc Working Group Meeting in Montevideo that technology transfer was first addressed.[21] This became Article

14 K. Maskus, Transfer of Technology and Technological Capacity Building, ICTSD-UNCTAD Dialogue, 2nd Bellagio Series on Development and Intellectual Property, University of Colorado 3 (18-21 September 2003).

15 Intergovernmental Panel on Climate Change, IPCC Third Assessment Report - Working Group III: Mitigation, para. 5.1 (Geneva: IPCC, 2001).

16 *Id.* para. 6.3.3.2.

17 *See* Andersen, Sarma and Taddonio, note 5 above at 11-14.

18 T. Forsyth, 'Enhancing Climate Technology Transfer Through Greater Public-Private Cooperation: Lessons from Thailand and the Philippines', 29 *Natural Resources Forum* 165, 166 (2005).

19 *See* Maskus, note 14 above at 8-9.

20 Vienna Convention for the Protection of the Ozone Layer, Vienna, 22 March 1985, 26 *Int'l Leg. Mat.* 1529 (1987) [hereafter Vienna Convention].

21 O. Yoshida, *The International Legal Régime for the Protection of the Stratospheric Ozone Layer* 49-52 (The Hague: Kluwer Law International, 2001).

4 of the Vienna Convention with the chapeau 'co-operation in the legal, scientific and technical fields'. The parties were urged to 'facilitate and encourage' the exchange of scientific, technical and commercial information. However, Article 5.2 was explicit in that this had to be 'consistent with their national laws, regulations and practices', which reflected developed countries' concern to protect patents and intellectual property.[22] Transfer of technology was specified as comprising the facilitation of acquisition of 'alternative technology', information, research and training.[23]

By contrast with the Kyoto Protocol, the 1987 Montreal Protocol on Substances that Deplete the Ozone Layer is a relatively short instrument focussed on control and compliance.[24] The preamble focuses on international scientific cooperation rather than technology transfer. It should be noted that Article 4 is specifically targeted at the control of trade of harmful technologies to non-parties to the protocol. Article 5 considers the 'special situation of developing countries'. Article 5.2 commits parties to 'facilitate access' for developing country parties to environmentally safe alternative substances and technology, with Article 5.3 being an undertaking for access to funding mechanisms to achieve this. By comparison with the more developed provisions in the climate change regime, these commitments to technology transfer are weak and fairly minimal but their inclusion is recognition of the necessity to incorporate such measures into regimes addressing complex global environmental problems.

3.2 UNFCCC Commitments

The UNFCCC aims to achieve the 'stabilisation of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system'.[25] The instrument is similar in structure to the 1985 Vienna Convention but it has a much more comprehensive treatment of principles and commitments. The guiding principles of the UNFCCC parallel Principles 3 and 7 of the Rio Declaration.[26] Thus, Article 3.1 states that the climate system should be protected for present and future generations on the basis of 'common but differentiated responsibilities'. The latter principle is reiterated at the commencement of Article 4 on commitments. This provides a fundamental justification for the obligations regarding technology transfer within Article 4. As a consequence, the commitments on technology transfer, as with many other of the convention's obligations, have to be viewed in terms of the different obligations this presents to Annex I parties and Non-Annex I parties.[27]

The main provisions on technology and technology transfer in the UNFCCC are Articles 4.1(c), 4.3 and 4.5. Article 4.1(c) requires all parties to 'promote and cooperate in the development, application and diffusion, including transfer, of technologies, practices and processes that control, reduce or prevent anthropogenic emissions of greenhouse gases'. The wording of the article, specifically 'control, reduce, or prevent', indicates that its application relates to mitigation only and does not encompass adaptation technologies. Yamin and Depledge take the view that the words 'practices and processes' refer to behavioural or lifestyle changes focussed on reducing carbon emissions, whilst the technologies themselves are aimed at business-as-usual policies but in a carbon free economic environment.[28] It is noteworthy that Article 4.1(c) applies to all parties. Reporting on this commitment by Annex I parties is within the context of policies and measures (PAMs) under Article 4.2(a) and (b), in accordance with Article 12 on communication of

22 *See* Yoshida, note 21 above.
23 *See* Vienna Convention, note 20 above, Article 4.2.
24 Protocol on Substances that Deplete the Ozone Layer, Montreal, 16 September 1987, 26 *Int'l Leg. Mat.* 154 (1987) [hereafter Montreal Protocol].
25 United Nations Framework Convention on Climate Change, New York, 9 May 1992, 31 *Int'l Leg. Mat.* 849 (1992), Article 2 [hereafter UNFCCC].
26 *See* Rio Declaration, note 7 above.
27 Annex I of the UNFCCC lists 40 developed country/economies in transition parties and the European Economic Community. Annex II lists 23 developed country parties, all OECD members, plus the European Economic Community. Non-Annex I parties are not separately listed but are developing country parties to the convention.
28 F. Yamin and J. Depledge, *The International Climate Change Regime: A Guide to Rules, Institutions and Procedures* 305 (Cambridge: Cambridge University Press, 2004).

information related to implementation. However, reporting on technology transfer has to date been very limited.[29]

Article 4.3 relates principally to financial resources and is linked to the financial mechanism established under Article 11. This is a highly significant link between the overall commitment to technology transfer and its implementation. It mandates Annex II parties to 'provide such financial resources, including for the transfer of technology, needed by the developing country parties to meet the agreed full incremental costs of implementing measures that are covered by paragraph 1 of this Article'. This refers to the ten commitments applicable to all parties under Article 4.1, including promotion of sustainable management, cooperation in preparing for adaptation to climate change impacts, and scientific and technological cooperation and exchange.[30]

Article 4.5 concerns the processes relating to technology transfer between Annex II parties and developing country parties. It mandates Annex II parties to 'take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies and know-how to other Parties, particularly developing country Parties'. The purpose of this is to enable non-Annex I parties to implement the provisions of the UNFCCC. The article expands the scope of the obligation to encompass 'the development and enhancement of endogenous capacities and technologies of developing country Parties'. Furthermore, it permits other parties and organisations to assist in facilitating the transfer of such technologies.

An important component of the UNFCCC architecture is the two subsidiary bodies. Article 9 establishes the Subsidiary Body for Scientific and Technological Advice (SBSTA). As might be expected, SBSTA has a role in promoting technology transfer. Under Article 9.2(c), it is charged with identifying 'innovative, efficient and state-of-the-art technologies and know-how' and also with advising on 'the ways and means of promoting development and/or transferring such technologies'. It has an important role in advising on international cooperation in research and development relating to climate change, which links with Article 4.1(g) on broad scientific cooperation. In reality, SBSTA is not a group of scientific and technical experts. Rather, it consists of appointees of governments who represent national interests. It thus serves a more political negotiating role. Consequently, the IPCC remains the primary source of scientific, technical and socio-economic advice.[31]

3.3 Kyoto Protocol Commitments

The Kyoto Protocol to the United Nations Framework Convention on Climate Change was adopted at the third Conference of the Parties (COP-3) in December 1997.[32] The negotiations for a protocol commenced after COP-1 in Berlin in 1995, which ruled that the commitments contained in Article 4.1(a) and (b) of UNFCCC were inadequate. As a consequence, the Berlin Mandate affirmed the priority to strengthen the Article 4 commitments and to 'set quantified limitation and reduction objectives within specified timeframes, such as 2005, 2010, and 2020, for their anthropogenic emissions'.[33] Sands describes these negotiations as perhaps the 'most difficult and complex ever conducted for a multilateral environmental agreement'.[34] There were deep divisions on just about every issue and consensus was only reached after arduous rounds of negotiations.[35] Much of the detailed rules and guidelines were left to subsequent meetings. These later agreements on implementation modalities and methodologies, known as the Marrakesh Accords, were endorsed by COP-7 in 2001.[36]

29 *Id.* at 305.

30 Respectively Articles 4.1(d), 4.1(e), and 4.1(g) and (h).

31 *See* Yamin and Depledge, note 28 above at 464-465.

32 Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, 10 December 1997, 37 *Int'l Leg. Mat.* 22 (1998) [hereafter Kyoto Protocol].

33 Decision 1/CP.1, Report of the Conference of the Parties at its First Session, Berlin, 28 March - 7 April 1995, UN Doc. FCCC/CP/1995/7/Add.1, para. 2(a).

34 P. Sands, *Principles of International Environmental Law* 370 (Cambridge: Cambridge University Press, 2nd ed. 2003).

35 For a detailed account of the negotiations, *see* S. Oberthür and H. Ott, *The Kyoto Protocol: International Climate Policy for the 21st Century* 77-91 (Berlin: Springer-Verlag, 1999).

36 The Marrakesh Accords are dealt with below in section 4.2.

Articles 10 and 11 refer to technology transfer, with the latter article relating specifically to finance for technology transfer on a full incremental cost basis.[37] They essentially incorporate the relevant provisions of the UNFCCC and in some instances strengthen the convention commitments. Yamin and Depledge observe that the provisions in the protocol were influenced by previous COP decisions designed to rectify gaps and limitations subsequently evident in Article 4.1(c).[38] While reaffirming the article does not introduce any new commitments for non-Annex I parties, Article 10(c) states that all parties shall 'cooperate in the promotion of effective modalities for the development, application and diffusion of, and take all practicable steps to promote, facilitate and finance, as appropriate, the transfer of, or access to, environmentally sound technologies, know-how, practices and processes pertinent to climate change, in particular to developing countries'. The reference to environmentally sound technologies (EST) is a departure from the UNFCCC, which simply nominates 'technology'. This is more in accord with the language of Chapter 34 of Agenda 21 and places emphasis on the qualitative nature of the new technologies and the necessity for their improved environmental performance.[39] Article 10(c) goes on to specify the development of 'policies and programmes for the effective transfer of environmentally sound technologies that are publicly owned or in the public domain and the creation of an enabling environment for the private sector'. This marks an evolution in thinking from the UNFCCC in that developing countries can utilise their own public sectors to create enabling environments for technological development.[40] Article 10(c) advances the position in UNFCCC Article 4.1(c) in that 'environmentally sound technologies, know-how, practices and processes pertinent to climate change, in particular to developing countries' are within the ambit of technology transfer. This is a clear indication of the permissibility of adaptation technologies as well as mitigation technologies. This recognises that for a number of highly vulnerable developing countries the implementation of adaptation measures will of necessity take precedence over mitigation.

Subsequent COPs, notably Marrakesh in 2001, progressed the implementation of technology transfer. After criticism from developing countries that Annex II countries were not doing enough to meet their obligations in this area, COP-7 agreed a Framework for Meaningful and Effective Actions to Enhance the Implementation of Article 4.5.[41] This focussed on improving the transfer of environmentally sound technologies to developing countries through a more country-driven approach with more engagement of local stakeholders. It also established a 20 member Expert Group on Technology Transfer (EGTT), which reports annually to SBSTA.

A final mention should be made of the Bali Action Plan from COP-13 in 2007 and the more recent Copenhagen Accord. The Bali Action Plan notably recognised the need for 'deep cuts in global emissions'.[42] In line with this renewed sense of urgency, paragraph 1(d) calls for 'enhanced action on technology development and transfer to support action on mitigation and adaptation' and the consideration of 'ways to accelerate deployment, diffusion and transfer of affordable environmentally sound technologies'. The Copenhagen Accord, 'noted' by COP-15 in December 2009, does not provide a new legally binding international framework for climate change.[43] However, a number of important measures were adopted through the Copenhagen Accord. It establishes a new funding mechanism, the Copenhagen Green Climate Fund, with a commitment from developed countries to provide $30 billion in funding for 2010-

37 *See* Kyoto Protocol, note 32 above, Article 11.2(b). Incremental cost is the difference between a baseline project scenario without environmental benefits or constraints and another way of delivering the same project with the additional environmental benefits of constraints factored in.

38 *See* Yamin and Depledge, note 28 above at 306.

39 *Id.* at 306.

40 *Id.* at 307.

41 Decision 4/CP.7, Development and Transfer of Technologies (decisions 4/CP.4 and 9/CP.5) UN Doc. FCCC/CP/2001/13/Add.1 (2002).

42 Decision 1/CP.13, Bali Action Plan, UN Doc. FCCC/CP/2007/6/Add.1 (2008), Preamble.

43 Decision 2/CP.15, Copenhagen Accord of 18 December 2009, UN Doc. FCCC/CP/2009/L.7 [hereafter Copenhagen Accord].

2012 and thereafter $100 billion per year to 2020.[44] The Fund will support a range of projects including technology transfer, REDD-plus, capacity building and adaptation. A separate Technology Mechanism is to be set up to assist in technology transfer. The Copenhagen Accord states the following:

> 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.[45]

The details of the Technology Mechanism and related arrangements are outlined in an advanced draft of the Ad Hoc Working Group on Long-term Cooperative Action, which also reported at COP-15.[46] This describes the Technology Mechanism as comprising three components: a Technology Executive Committee, a Climate Technology Centre, and a Climate Technology Network. The Technology Executive Committee's responsibilities centre on policy advice and analysis, monitoring and assessment of technology-related actions, and support and assistance to developing country parties.[47] The Climate Technology Centre has more of a capacity building role, including training, access to information, and the establishment of national and regional technology innovation centres.[48] Finally, the Climate Technology Network has a facilitative role, particularly in engendering partnerships between public and private sector stakeholders as well as possibly compiling a panel of technology experts.[49] However, as Gerstetter, Marcellino and Sperber point out, the position of the new mechanism in the overall UNFCCC framework has been left open.[50] Clearly, there remains disagreement amongst the negotiating parties as to whether or not the Technology Mechanism is established 'under the authority and guidance of, and accountable to, the Conference of the Parties'. This text remains in square brackets in the negotiating text.[51] At the time of writing, these issues had not been resolved through the Ad Hoc Working Group on Long-term Cooperative Action.[52]

4 THE EVOLUTION OF THE CDM

4.1 Article 12 of the Kyoto Protocol

'The Clean Development Mechanism (CDM) was the 'Kyoto Surprise', elaborated with little public debate in the final days of COP-3'.[53] The proposal was initiated by Brazil with US support and was worked out in informal contact groups so that many delegates did not even see the text until the final plenary.[54] Wilkins terms CDM as a 'masterpiece of compromise', as it reconciled two seemingly opposing positions.[55] It enables resource transfer from North to South while at the same time providing primarily Annex II parties greater geographical flexibility in meeting their greenhouse gas abatement targets.[56] Its attractiveness is that it provides a more cost-effective or lowest marginal cost approach to reducing emissions and so was

44 *Id.* para.8.
45 *Id.* para.11.
46 Ad Hoc Working Group on Long-Term Cooperative Action under the Convention, Enhanced Action on Technology Development and Transfer, Draft Conclusions Proposed by the Chair, UN Doc. FCCC/AWGLCA/2009/L.7/Add.3 (2009).
47 *Id.* paras 10(a), (g) and (h).
48 *Id.* paras 15(b), (c) and (g).
49 *Id.* paras 15(h) and (i).
50 C. Gerstetter, M. Marcellino and E. von Sperber, 'Technology Transfer in the International Climate Negotiations: The State of Play and Suggestions for the Way Forward', 1 *Carbon and Climate Law Review* 3, 5 (2010).
51 *See* Ad Hoc Working Group on Long-Term Cooperative Action under the Convention, note 46 above, para.7.
52 Report of the Ad Hoc Working Group on Long-term Cooperative Action under the Convention on its Tenth Session, held in Bonn from 1 to 11 June 2010, UN Doc. FCCC/AWGLCA/2010/7 (2010).
53 *See* Oberthür and Ott, note 35 above at 165.
54 F. Yamin, 'The Kyoto Protocol: Origins, Assessment and Future Challenges', 7 *Review of European Community and International Environmental Law* 113, 122 (1998).
55 H. Wilkins, 'What's New in CDM?', 11 *Review of European Community and International Environmental Law* 144 (2002).
56 *See* Oberthür and Ott, note 35 above at 166.

especially attractive to those developed country parties facing high costs to regulate their domestic industries.[57] Simply put, reducing emissions in developing countries is cheaper than in OECD countries.[58] Yamin and Depledge contend that there was an additional element in support of CDM. This is that it provides a means for non-Annex I parties, those without quantified emission limitation or reduction commitments (QELRCs), to gain a better understanding of emissions trading mechanisms and consequently 'learn by doing'.[59]

The CDM is one of three so-called 'flexibility mechanisms' established under the Kyoto Protocol, the others being Joint Implementation (Article 6) and Emissions Trading (Article 17). The CDM is defined in Article 12 of the protocol. The purpose statement is significant in establishing the critical balance between the achievement of sustainable development objectives in non-Annex I countries whilst assisting Annex I parties with compliance with their QELRCs under Article 3.1 of the Kyoto Protocol.[60] Overall, the purpose of CDM is to contribute to 'ultimate objective of the Convention'. Additionally, the project host country 'will benefit' from project activities 'resulting in certified emissions reductions'.[61] However, there is no explicit mandate in Article 12 that CDM projects contribute to technology transfer to non-Annex I parties. The certified emissions reductions (CERs) accruing from the CDM project activities can be used by Annex I parties to comply with their QELRC obligations, with the implication that they may also be 'banked' for future use.[62] There was a concern that because non-Annex I parties did not have QELRCs under Article 3.1, there might be an incentive to inflate the quantum of CERs claimed for individual projects, largely by manipulating the 'counterfactual' scenario (representing baseline emissions levels without the project).[63] Consequently, oversight is conducted by an Executive Board composed of 10 members from parties to the Kyoto Protocol, which together with 'certified operational entities' ensures that proposed CDM projects conform to guidance issued by the COP.[64] In the Kyoto Protocol, the identified criteria for certification of project proposals are: (i) voluntary participation by the parties involved, (ii) 'real, measurable, and long-term benefits' for climate change mitigation, and (iii) additionality.[65]

4.2 The Marrakesh Accords

Rules governing the CDM have been developed through the Bonn Agreement of July 2001 and the Marrakesh Accords of November 2001.[66] Both COPs emphasised the need for a 'prompt start' to the CDM. The Bonn Agreement initiated the 'simplified modalities' for small-scale CDM projects.[67] Rather ambiguously, it states that Annex I parties should 'refrain' from using CERs generated from nuclear projects to meet their Article 3.1 commitments. It specifies that only afforestation and reforestation projects are eligible for land use, land use change and forestry projects (LULUCF), thereby excluding projects aimed at avoiding deforestation or forest degradation. Importantly, the decision emphasises the requirement to ensure that official development aid is not diverted into CDM. Project funds have to be new finance.[68] Finally, two per cent of CERs issued under CDM are to be earmarked for adaption measures as provided by Article 12.8 of the Kyoto Protocol.[69]

The CDM Rules were developed at COP-7 in Marrakesh. The CDM Rulebook is now the

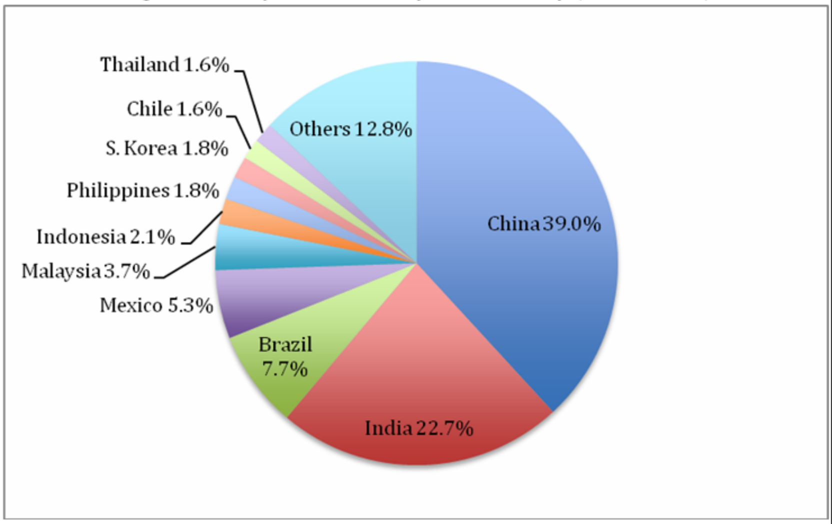
57 P. Nelson, 'An African Dimension to the Clean Development Mechanism: Finding a Path to Sustainable Development in the Energy Sector', 32 *Denver Journal of International Law and Policy* 615, 620 (2003-2004).
58 H. van Asselt and J. Gupta, 'Stretching Too Far? Developing Countries and the Role of Flexibility Mechanisms Beyond Kyoto', 28 *Stanford Environmental Law Journal* 311, 331 (2009).
59 *See* Yamin and Depledge, note 28 above at 160.
60 *See* Kyoto Protocol, note 32 above, Article 12.2.
61 *Id.* Article 12.3(a).
62 *Id.* Article 12.3(b). One CER credit is accrued for every 1 tonne of CO_2 equivalent abated through the CDM project.
63 *See* Yamin and Depledge note 28 above at 160.
64 *See* Kyoto Protocol, note 32 above, Articles 12.4 and 12.5. The certified or designated operational entities (DOEs) are generally large international consulting firms.
65 *Id.* Article 12.5.
66 COP-6, Part II and COP-7 respectively.
67 UNFCCC, Report of the Conference of the Parties on the Second Part of its Sixth Session, Held at Bonn from 16 to 27 July 2001, Article 12 (clean development mechanism), UN Doc. FCCC/CP/ 2001/5 (25 September 2001), 44. These include renewable energy or energy efficient projects up to a threshold of 15 GWh per year and greenhouse gas reduction projects emitting up to 15 Kt of CO_2 equivalent per year.
68 *Id.* at 43-44.
69 *Id.* at 42, para.10.

definitive guide to procedures for project initiation, verification and issuance of CERs.[70] Decision 17 of COP-7 provides the detail of the framework for implementation modalities and the CDM project cycle.[71] This includes the designation of a national authority for each participating country, applicant entities, project participants and crucially the CDM register.[72] It specifies the content of project design documents and terms of reference for further work to establish guidelines on baselines and monitoring methodologies.[73] It is in this decision that the precise quantum of a CER is defined.[74] The Marrakesh Accords reiterate a number of the policy objectives set out in the Bonn Agreement and in addition state that projects 'should lead to the transfer of environmentally safe and sound technology and know-how' beyond existing UNFCCC obligations.[75]

5 CDM PROJECTS AND TECHNOLOGY TRANSFER

The first CDM project was registered in November 2004. As of July 2010, there were 2,273 registered projects. The diagram shows that the majority of registered projects are based in China (39.0 per cent) and India (22.7 per cent). There are currently 171 projects in the process of registration with the CDM Executive Board and a further 2,879 in the pipeline being validated by designated operational entities.[76] Only 743 registered projects have had CERs issued to date, totalling 420,976 kCERs.[77]

Registered Project Activities by Host Country (Total: 2,273)



Source: UNFCCC, CDM Project Registry (as at 2 July 2010).

70 The CDM Rulebook is an online tool available at http://cdmrulebook.org.

71 Decision 17/CP.7, Modalities and Procedures for a Clean Development Mechanism, as defined in Article 12 of the Kyoto Protocol, UN Doc. FCCC/CP/2001/13/Add.2 (21 January 2002) Annex, 26-39.

72 *Id.* Annex A, Annex D.

73 *Id.* Annex B, Annex C.

74 *Id.* Annex, 26, 1(b). 'A 'certified emission reduction' or 'CER' is a unit issued pursuant to Article 12 and requirements thereunder, as well as the relevant provisions in these modalities and procedures, and is equal to one metric tonne of carbon dioxide equivalent, calculated using global warming potentials defined by decision 2/CP.3 or as subsequently revised in accordance with Article 5.'

75 *Id.* at 20.

76 CDM Pipeline Overview Analysis and Database, updated 1 July 2010, available at http://www.uneprisoe.org.

77 *Id.*

5.1 Empirical Reviews of Technology Transfer in CDM Projects

Empirical research is key to ascertaining the reality of technology transfer commitments by CDM project partners. A number of studies have recently been conducted to explore the linkage between CDM projects and technology transfer. These mainly use data on the UNEP-Risø database of CDM projects, which means that the information is likely to suffer from bias as project sponsors largely supply it. In addition, the short length of time CDM projects have been operating means that the longer-term technological impacts cannot be gauged.

The first study to be considered was conducted by Dechezleprêtre, Glachant and Ménière at MINES ParisTech.[78] This examined all 644 CDM projects registered up to 1 May 2007. The data revealed that in 44 per cent of projects some level of technology transfer occurred. These projects accounted for 84 per cent of CERs. Very few involved transfer of equipment only. Most included transfer of knowledge and skills. Project type was highly associated with likely transfer. The researchers identified end-of-pipe destruction of non-CO_2 greenhouse gases and wind power as the primary initiators of technology transfer.[79] Equipment transfers were mainly from EU suppliers. Private sector partnerships were investigated but showed only five per cent of projects involved a transfer from a parent company to a subsidiary in a non-Annex I country. However, the research revealed a small suite of companies who had become main players in the production and sale of CERs. These are termed 'CDM project designers' as they are able to manage the entire CDM project cycle from PDD preparation to the final sale of credits. Some of these companies directly transfer technology to local project partners. Others assist local firms to source technology suppliers and to assess project technologies.[80]

The study by Youngman, Schmidt, Lee, and Coninck sampled 63 CDM projects from the UNEP-Risø database.[81] The results mirrored those of the Dechezleprêtre study. External technology transfer occurred in around 50 per cent of projects, with 80 per cent of these using technology from the EU. The total value of CDM projects that transferred technology was estimated to be €470 million, with €390 million coming from the EU. In the main, non-CO_2 greenhouse gas projects, wind energy projects, and most hydropower projects used technology from outside the host country. By contrast, biogas, agricultural and biomass projects mainly used local technology. The most capital intensive projects involving technology transfer were wind power whilst non-CO_2 greenhouse gas projects had very low capital costs.[82]

The study by Seres and Haites is a comprehensive analysis of 3,296 projects registered or in the pipeline at June 2008.[83] The study found that 36 per cent of the projects, which comprised 59 per cent of CERs, claimed to involve technology transfer. Technology transfer was more common for larger projects and projects with external partners. For projects involving technology transfer, over half involved both equipment and know-how and a third equipment only.[84] Countries with internal CDM approval requirements for technology transfer as part of their own approval processes, such as South Korea, Brazil and China, had high rates of technology transfer, demonstrating that host countries have an important influence on the outcome.[85] In their update report, the authors reveal a decline in technology transfer for CDM projects

78 A. Dechezleprêtre, M. Glachant and Y. Ménière, The North-South Transfer of Climate-Friendly Technologies through the Clean Development Mechanism (Paris: Cerna, École des Mines de Paris, 2007), also reported in A. Dechezleprêtre, M. Glachant and Y. Ménière, 'The Clean Development Mechanism and the International Diffusion of Technologies: An Empirical Study', 36 *Energy Policy* 1273 (2008).

79 *See* Dechezleprêtre, Glachant and Ménière, note 78 above at 13-17.

80 *Id.* at 19.

81 R. Youngman et.al. 'Evaluating Technology Transfer in the Clean Development Mechanism and Joint Implementation', 7 *Climate Policy* 488 (2007).

82 *Id.* at 495.

83 S. Seres and E. Haites, Analysis of Technology Transfer in CDM Projects (Bonn: UNFCCC Registration & Issuance Unit CDM/SDM, December 2008).

84 *Id.* at 10.

85 *Id.* at 8-9.

in China, India and Brazil.[86] This they attribute to the diffusion of technology from initial CDM demonstration projects to later projects, which then rely on local knowledge and equipment.[87] This finding is indicative of the development of broader technological capacity in the host country. The Seres and Haites study observes this trend most prominently with landfill gas projects in both China and Brazil, and wind projects in China and to some extent similar projects in India. However, it should be noted that technology transfer has always been relatively low in India as a percentage of total CDM projects. Overall, this observation of technology diffusion is a significant finding and supports the view that CDM can lower a number of barriers to technology transfer as well as raising transfer quality.[88]

5.2 Examination of Five CDM Projects

Five CDM projects were reviewed by the author to ascertain in more detail how technology transfer is being presented in PDDs.[89] The projects were selected from a range of non-Annex I countries but it is recognised that those chosen are indicative only. However, these projects highlight some of the complexities and variations amongst CDM projects. In particular, the project review brings into focus aspects of technology transfer that may encourage diffusion or tend to militate against it. It should be borne in mind that the project review is based only on PDDs and Validation Reports; that is, pre-implementation reports. In the final analysis, only post-implementation evaluation would enable a true picture of the effectiveness of project initiated technology transfer to be made.

The first project is the Amurang Biomass Cogeneration Project. This is a small-scale project that aims to use copra in biomass boilers to generate heat and electricity. The project is situated in North Sulawesi in Indonesia. It involves local partner PT Cargill Indonesia and its Swiss affiliate, Cargill International SA. The UK partner is EcoSecurities Group plc, which is a wholly-owned indirect subsidiary of JP Morgan Chase. EcoSecurities specialises in sourcing, developing and trading carbon emission reductions as well as project specific development assistance. Provision of the biomass boilers and equipment is by an indigenous company, PT Weltes Energi Nusantara. PT Weltes will custom make the biomass boilers and train staff in operating the plant. The PDD states that this is a demonstration project with no explicit technology transfer from outside Indonesia.[90] The PDD highlights that cogeneration represents only five per cent of power production in Indonesia, with an even smaller fraction from biomass.[91] This claim is supported by the project's Validation Report.[92] The PDD catalogues a range of technical barriers to operations, including lack of comparable operational experience with cogeneration, uncertainties around supply and quality of feedstock, and lack of experienced staff. The Validation Report states that these problems are to be addressed through a 'local technology provider', PT EcoSecurities Indonesia, who will be engaged for the first year of operation to assist in transfer of operational know-how and staff training.[93] This role also includes technical advice around sources of alternative sustainable biomass, emission reduction estimation and monitoring, and reporting procedures. The project could therefore be classified as a local technology diffusion project. Even so, there is a fairly complex web of partners and suppliers involved. Critically, the specialist expertise of EcoSecurities alongside that of local supplier PT Weltes has been utilised to enable an important demonstration of renewable energy supply to be implemented.

The Tugela Mill Fuel Switching Project is a joint partnership between the South African Government

86 S. Seres, E. Haites and K. Murphy, 'Analysis of Technology Transfer in CDM Projects: An Update', 37 *Energy Policy* 4919, 4924 (2009).

87 *Id.* at 4926.

88 *Id.* at 4924.

89 Project Design Documents (PDDs) are available at http://cdm.unfccc.int/Projects/index.html.

90 Amurang Biomass Cogeneration Project, Clean Development Mechanism Simplified Project Design Document for Small-Scale Project Activities (SSC-CDM-PDD) Version 6, 6 December 2007, 9-10.

91 *Id.* at 9.

92 Det Norske Veritas, Amurang Biomass Cogeneration Project – Validation Report, Report No. 2006-0108, Revision 2, 11 December 2007, 11.

93 *Id.* at A-5.

and the local operator of a pulp mill, Sappi Trading Africa. Sappi is a large multinational paper and pulp company, which was originally founded in South Africa in 1936. This small-scale project involves switching fuel from coal to biomass for the steam generation phase of the production process. It uses bark from the adjacent sustainable timber plantations for fuel instead of coal. The PDD claims that no indigenous trees or trees from controversial sources will be used. The timber is grown on a commercial basis from pine and eucalypt species and there is a certification system for all production operations.[94] The climate benefits are twofold: firstly, eliminating the use of coal from the production process and secondly diverting the bark waste stream from landfill reducing the generation of methane. However, only the direct green house gas benefits are claimed, consequently the methane abatement is not included. There are also co-benefits from the reduction in transport of coal, which involves a 1000 km round trip by road and rail. The specific technology transfer is through the purchase and manufacture of technology new to the mill and through the training of Sappi managers, engineers, supervisors and operators.[95] The suppliers of equipment and technologies are the Babcock and Wilcox Company (USA) and Raumaster Oy (Finland). The Validation Report confirms that the type of technology proposed for the biomass boilers is the first time it will be used in South Africa.[96] The PDD cites other technology know-how benefits accruing to contractors by way of their involvement in the construction and civil engineering component of the project and the development of local capacity.[97] The PDD also makes reference to the project being a demonstration of the use of a new mechanism for funding environmentally friendly technologies. It should also be noted that the company reports on sustainability indicators internationally through the Global Reporting Initiative.[98]

The Lihir Geothermal Power Project in Papua New Guinea is a collaboration between the Government of Papua New Guinea and the operator of a local gold mine, Lihir Gold Limited. The scheme is designed to tap geothermal energy sources at the mine site. Though PNG is subject to major volcanic activity and consequently has a reserve of geothermal resources, the country has not yet developed any large-scale geothermal power projects. In 2003, a 6MW pilot project was initiated by a subsidiary of Lihir Gold, the Lihir Management Company Limited. The PDD for the Lihir Geothermal Power Project describes a 55MW grid-connected geothermal power plant with an initial capacity of 33MW. Geothermal discharges have to be managed currently as part of the gold extraction process. The project will harness a co-product of the operation to supply sufficient power for the whole of Lihir Island, thus displacing most of the existing diesel generated electricity. This project therefore has wide social, environmental and economic benefits to the local community. The PDD is explicit in stating that the project represents a demonstration of the use of renewable energy technology that could be applied on a larger scale throughout the Pacific. Also, by encouraging the use of renewable energy sources, rural access to electricity could be improved in the future, which is one of the objectives of PNG's Rural Electrification Policy. The PDD is explicit about technology transfer, both the hard technology involved and the development of the skills and expertise of employees through the company's localisation programme.[99] This has already been successful in the pilot stage with training local people in the operation of the new plant and this will reduce risks associated with the expansion of the plant in later stages. The Validation Report confirms that the Lihir Management Company have engaged expert engineering consultants to design and build the power plant, utilising design specifications and

94 Tugela Mill Fuel Switching Project, Clean Development Mechanism Simplified Project Design Document for Small-Scale Project Activities (SSC-CDM-PDD) Version 2, 18 July 2006, 8.

95 *Id.* at 13.

96 Det Norske Veritas, Tugela Mill Fuel Switching Project in South Africa – Validation Report, Report No. 2006-1188, Revision 1, 25 November 2006, 7.

97 *See* Tugela Mill Fuel Switching Project 2006, note 94 above at 13.

98 Sappi, Sappi and Sustainability 2009 – Prosperity, People, Planet (Johannesburg: Sappi, 2009).

99 Lihir Geothermal Power Project, Clean Development Mechanism Project Design Document Form (CDM-PDD), Version 2, 7 November 2005, 7.

techniques proven in geothermal power systems in New Zealand.[100]

The Guangdong Chaonan Chengtian Wind Power Project is a joint project between China and Switzerland, involving the China Resources Wind Power Company Limited and Vitol SA of Switzerland. This is one of many CDM wind power projects in the People's Republic of China. According to Schroeder, the Chinese Government has two over-riding objectives in relation to CDM: (i) to access the major commercial opportunities in greenhouse gas reduction, and (ii) to establish China as the world's leading CDM market. Related to this are its priorities to improve local energy efficiency and to provide energy infrastructure in remote and underdeveloped areas of the country.[101] Thus, China has adopted its own criteria for CDM projects, which emphasise these broader objectives. The proposed project is in Shantou City, Guangdong Province. It involves the installation of 66 wind turbines with capacities of 750kW each, totalling an installed capacity of 49.5MW. The wind farm will directly connect to the Guangdong Power Grid on completion. The turbines are to be supplied by Xinjiang Goldwind Science and Technology Company Limited. This is an established China-based company engaged in manufacture and distribution of wind turbine generator sets. It supplies both domestic and overseas markets. The company was first established in 1986 and is now one of the top five wind turbine suppliers in the world. It has had strong national policy support and has enjoyed 100 per cent annual market share increase for around 10 years. The project will achieve obvious greenhouse gas emission reductions through the displacement of the existing mainly fossil fuel dominated grid connected power. While the PDD for the project emphasises local sustainability benefits, it uses technology and practices available in the host country and consequently involves no technology transfer.[102] However, it is clearly a CDM project that meets the wider Government objectives, mentioned above. The Validation Report confirms that the project adopts commonly used technology with over 70 per cent of the equipment being manufactured domestically.[103] This is an example of where CDM has facilitated technology diffusion rather than international technology transfer but in a manner consistent with national sustainable development objectives.

The final project is a contentious one. The joint Brazil-Netherlands Reforestation as a Renewable Source of Wood Supplies for Industrial Use Project aims to establish eucalyptus plantations to supply biomass in the form of charcoal for Brazil's iron and steel industry. The project participants are Plantar SA Reflorestamentos of Brazil, the World Bank as a Trustee of the Prototype Carbon Fund, and Rabobank International of the Netherlands. The project PDD states that this project will be the first of its kind to have 100 per cent of its iron production based on renewable charcoal. The first eucalyptus plantations were established in 2000 and cover an area of 11,711 hectares in the State of Minas Gerais. These are harvested on a seven-year rotating basis. This is a reforestation scheme permitted under the current CDM modalities.[104] The first harvest was anticipated in 2007/08 and the whole project was expected to extend for 30 years, with a single 30-year crediting period being adopted for tCERs. The PDD claims no specific international technology transfer and this is confirmed in the Validation Report.[105] However, the PDD claims that development of its indigenous

100 Det Norske Veritas, Lihir Geothermal Power Project in Papua New Guinea – Validation Report, Report No. 2006-0235, Revision 2, 24 March 2006, A-5.

101 M. Schroeder, 'Varieties of Carbon Governance: Utilizing the Clean Development Mechanism for Chinese Priorities', 18 *Journal of Environment & Development* 371, 378-379 (2009).

102 Guangdong Chaonan Chengtian Wind Power Project, Clean Development Mechanism Project Design Document Form (CDM-PDD), Version 3, 14 July 2009, 6.

103 TÜV Nord, Guangdong Chaonan Chengtian Wind Power Project – Validation Report, Report No. QT-EC0701-08 - 08/285, Revision 3, 4 March 2010, A-59.

104 *See* UNFCCC 2001, note 67 above at 44 and UNFCCC, Report of the Conference of the Parties on its Seventh Session, held at Marrakesh from 29 October to 10 November 2001 Addendum Part Two: Action Taken by the Conference of the Parties, Annex: Definitions, Modalities, Rules and Guidelines Relating to Land Use, Land-use Change and Forestry Activities under the Kyoto Protocol, UN Doc. FCCC/CP/2001/13/Add.1 (2002), 60.

105 TÜV Nord, Reforestation as Renewal Source of Wood Supplies for Industrial Use in Brazil Project – Validation Report, Report No. 1030115, Revision 1, 24 August 2009, A-8.

technology may result in transfer to non-Annex I countries.[106] It boldly asserts that this is 'pioneer activity within its sectoral scope and it possesses a substantial potential to be replicated by other organisations in Brazil, in Latin America and the Caribbean' and even other developing countries.[107] The specific technology relates to the project's system of producing cloned eucalyptus sprouts in large-scale nurseries with highly water efficient irrigation systems. The project also comprises a research and development programme aimed at providing high-yielding eucalyptus clones using advanced scientific protocols. This should be an example of potential South-South technology transfer; however, the reality has been somewhat different. Gilbertson and Reyes present a detailed account of the progression of the project through a number of rejections by the CDM Executive Board, ostensibly due to additionality problems and categorisation issues about whether the project was in fact 'avoided deforestation'.[108] On closer inspection there was evidence of wider negative social and environmental impacts emanating from a monoculture plantation, conflicts over land distribution, and negative effects on the livelihoods of the local communities.[109] In a recent review of CDM in Brazil, Friberg comments that no single CDM projects have failed due to lack of contribution to sustainable development, given the generality of the test itself.[110] The Plantar SA project indicates the problem of viewing technology transfer within a narrow frame of reference without assessing the broader environmental and social impacts of the project and its longer-term sustainability.

Both the survey of empirical studies and the indepth examination of projects have revealed that the CDM does have positive benefits in terms of international technology transfer. However, it should be borne in mind that there is often very little detail provided in the PDDs regarding technology transfer. A recent report published by WWF and the Institute for Applied Ecology, Berlin, casts doubt on both the independence and competencies of designated operational entities, the organisations that validate the project PDDs.[111] In particular, the report finds that there is a lack of independent technical review of projects.[112] When examining both PDDs and Validation Reports, information and analysis relating to both technology transfer and sustainability of projects is often scant and unsubstantiated. Some PDDs mention programmes to train and transfer know-how to locals. In most of the projects, transfer was assumed merely through installation of the project plant and equipment. As the CDM evolves in the next phase of the climate change regime, it will be essential to assess and evaluate both the technology transfer aspects of projects and their broader impacts, particularly on livelihoods and biodiversity. The five projects examined here reveal the complexities involved with webs of companies and agencies participating in technology transfer and diffusion. Also, the case studies demonstrate the importance of host governments steering CDM projects through national sustainability and energy policies, as was the situation with China and PNG.

6 OUTCOMES OF CDM AND TECHNOLOGY TRANSFER

This section summarises the main findings regarding whether CDM achieves technology transfer and what are the limitations and obstacles to its success.

106 Reforestation as Renewable Source of Wood Supplies for Industrial Use in Brazil, Clean Development Mechanism Project Design Document Form For Afforestation and Reforestation Project Activities (CDM-AR-PDD), Version: 03a, 16 February 2009, 14.

107 *Id.* at 3.

108 T. Gilbertson and O. Reyes, Carbon Trading: How It Works and Why It Fails, (Uppsala: Dag Hammarskjöld Foundation, 2009).

109 *Id.* at 82-83.

110 L. Friberg, 'Varieties of Carbon Governance: The Clean Development Mechanism in Brazil – A Success Story Challenged', 18 *The Journal of Environment & Development* 395, 418 (2009).

111 L. Schneider and L. Mohr, 2010 Rating of Designated Operational Entities (DOEs) Accredited Under the Clean Development Mechanism (CDM) – Report for WWF (Berlin: Institut für angewandte Ökologie/ Institute for Applied Ecology, 28 June 2010).

112 *Id.* at 5.

6.1 Benefits

The studies that have been reviewed evidence the impact of CDM in terms of technology transfer to developing countries. Certainly, the size of the CDM market has grown since the implementation of the Kyoto Protocol. In addition, CDM has provided opportunities for more international cooperation in climate change mitigation and awareness.[113] The Schneider review expresses confidence that 'CDM is currently the strongest mechanism for technology transfer under the UNFCCC'.[114] This study recognises that the performance of CDM varies in terms of geography, type of technology, project size and the involvement of foreign project participants.[115] These findings are broadly confirmed by the survey of CDM projects in section 5.1. The studies reviewed indicate technology transfer occurs in 36 to 50 per cent of projects, representing between 59 and 84 per cent of total CERs generated through CDM. Seres, Haites and Murphy observe that technology transfer has occurred in the major emerging economies through CDM and overall represents up to 39 per cent of projects.[116] These authors conclude that technology transfer is very heterogeneous across CDM projects. Moreover, projects differ widely in terms of whether equipment only is transferred or whether knowledge transfer forms part of the process. The key appears to be developing indigenous technological capability in the host country. There is growing evidence that this is occurring in the emerging economies, particularly China.[117] This is apparent in the Guangdong Chaonan Chengtian Wind Power Project case study and to some extent the Tugela Mill Fuel Switching Project examined in the previous section.

The Youngman study concludes that CDM is facilitating technology transfer by addressing cost barriers to new environmentally sound technologies being introduced in developing country settings.[118] However, it asserts that the mechanism as it currently operates is insufficient to induce widespread diffusion of low and non-emitting technologies in most developing countries. This is largely due to on-going market failure in developing countries which makes the widespread deployment of these technologies uncompetitive on cost grounds.[119] Clearly some technology transfer is occurring through CDM but there remain concerns about its sustainability and diffusion. It can be concluded that to some degree the Article 4 commitments of UNFCCC regarding technology transfer are being met through CDM. However, significant doubts arise over the relationship with the broader UNFCCC principle of the right to sustainable development in Article 3.4, which is reiterated in Article 12.2 of the Kyoto Protocol. Indeed, achieving sustainable development is fundamental to the purpose of CDM. It was never conceived of as being simply an offset mechanism, pure and simple.

6.2 Limitations and Obstacles

Article 12 of the Kyoto Protocol states that one of the purposes of CDM is to assist non-Annex I parties achieve sustainable development.[120] However, the economic driver of CDM is not technology transfer but the generation of CERs to assist Annex I parties to close the gaps in Kyoto commitments and in the EU Emissions Trading Scheme.[121] A persistent criticism of CDM is that it encourages Annex I parties to claim the 'low-hanging fruit' in developing countries, particularly non-CO_2 greenhouse gas destruction projects, without contributing to a long-term strategy of transforming these countries into low carbon economies.[122] The Dechezleprêtre, Youngman and Wilkins' studies all recommend the bundling of projects in order to exploit increasing returns on technology transfer and to promote

113 G. Boyle et.al., 'Transitioning from the CDM to a Clean Development Fund', 1 *Carbon and Climate Law Review* 16, 24 (2009).

114 M. Schneider, A. Holzer and V. Hoffman, 'Understanding the CDM's Contribution to Technology Transfer', 36 *Energy Policy* 2930, 2936 (2008).

115 *Id.* at 2930.

116 *See* Seres, Haites and Murphy, note 86 above at 4923.

117 *Id.* at 4924, 2926.

118 *See* Youngman et.al., note 81 above at 498.

119 *Id.* at 498.

120 *See* Kyoto Protocol, note 32 above, Article 12.2.

121 P. Castro and A. Michaelowa, Empirical Analysis of Performance of CDM Projects – Final Report 1-2 (Zurich: University of Zurich Institute of Political Science and Center for Comparative International Studies, 2008).

122 *See* van Asselt and Gupta, note 58 above at 349.

technology transfer within non-Annex I subsidiaries of Annex I companies.[123] Consequently, transfer of projects to domestic operators should be a long-term goal of the CDM.[124]

A number of recent reviews highlight some of the institutional barriers to what might be termed 'sustainable technology transfer'. That is, technology transfer that is more than a one-off transfer of equipment, know-how or both to the host developing country but generates indigenous and lasting embedding of this technology in the host country. Olawuyi examines the particular challenges facing CDM in Africa. Specific barriers include the absence of a dedicated Designated National Authority for CDM, the lack of a well-defined CDM master plan to guide investment, and additionally the need for capacity building.[125] Similarly, Van der Gaast and Begg focus on the issues of CDM technology transfer in the under-represented developing countries in the CDM pipeline.[126] This paper reviews the EU funded ENTTRANS study conducted in 2007 focussing on Chile, China, Israel, Kenya and Thailand.[127] The conclusion centres on the finding that there is no 'red thread' connecting a country's sustainable development strategy to the eventual technology selection for CDM projects.[128] Van der Gaast and Begg argue for the bundling of small-scale projects to enable them to be more attractive to large investors as well as for smooth and reliable 'technology implementation chains'.[129] The ENTTRANS study recommended basing CDM project selection on what it terms a country's energy service needs, which would ensure that CDM is integrated into national sustainable development strategies. Thus, low carbon technology CDM projects would serve as demonstration projects that could fully support spin-off technology transfer to the wider economy.[130]

It is evident that increased transfer of technology does not necessarily result in improved sustainable development outcomes. Diffusion of environmentally sound technology in the broad terms envisaged by the IPCC involves replication of technology and absorption of know-how locally, ultimately with integration of indigenous technologies.[131] This would necessitate the embedding of what Maskus describes as 'technology ladders', with key steps being the duplicative imitative stage, creative imitation and implementation of knowledge-intensive inputs stage, and finally an implied autonomous technology development stage.[132] It is too early to state whether this is being achieved with CDM outside of the large emerging economies, such as China, India and Brazil. There is evidence that environmentally sustainable technologies transfer and diffuse less quickly than other technologies.[133] More broadly, Cullet states that the current CDM rules fail to provide sufficient guidance for host countries on effective choice in terms of long-term energy strategies and this results in negative impacts on the poor and the vulnerable.[134] He argues that CDM should 'become a vehicle for technology transformation' and not just cheap compliance.[135] Cullet develops this reasoning further in proposing a 'basic human entitlement to a certain level of emissions'.[136] This would enable

123 *See* Dechezleprêtre et al, note 78 above 27; Youngman et.al., note 81 above at 497; and Wilkins, note 55 above at 149.

124 *See* Wilkins, note 55 above at 157.

125 Damilola S. Olawuyi, 'Achieving Sustainable Development in Africa through the Clean Development Mechanism: Legal and Institutional Issues Considered', 17 *African Journal of International and Comparative Law* 270, 293-300 (2009).

126 W. van der Gaast and K. Begg, 'Enhancing the Role of the CDM in Accelerating Low-Carbon Technology Transfers to Developing Countries', 1 *Carbon and Climate Law Review* 58 (2009).

127 ENTTRANS, Promoting Sustainable Energy Technology Transfers Through the CDM: Converting from a Theoretical Concept to Practical Action, Final Report of Specific Support Action under EU FP-6, January 2006–December 2007 (Groningen, The Netherlands: Foundation JIN, 2008).

128 *See* W. van der Gaast and K. Begg, note 126 above 59.

129 *Id.* at 62.

130 *Id.* at 64.

131 *See* Intergovernmental Panel on Climate Change, note 15 above para. 5.1.

132 *See* Maskus, note 14 above at 8-9.

133 *See* Schneider, Holzer, and Hoffman, note 114 above at 2932.

134 P. Cullet, 'The Global Warming Regime after 2012: Towards a New Focus', 43/28 *Economic and Political Weekly* 109, 112 (2008).

135 *Id.* at 116.

136 P. Cullet, 'The Kyoto Protocol and Vulnerability: Human Rights and Equity Dimensions', *in* S. Humphreys ed., *Human Rights and Climate Change* 183, 204 (Cambridge: Cambridge University Press, 2010).

the poor in developing countries to have a right to benefit from emission reduction policies, which Cullet reasons would demand that future CDM projects provide only zero carbon emissions whilst at the same time becoming a vehicle for technology transformation and progress towards zero carbon development pathways.[137]

To overcome obvious market barriers, Youngman, Schmidt, Lee and de Coninck recommend a premium should be applied to CERs generated from low-emitting technologies as well as more use of programmatic CDM.[138] Similarly, Asselt and Gupta argue for a much more focussed approach to CDM and sustainable development outcomes. They suggest that CDM could be reformed to focus exclusively on renewable technologies and energy security for poorer communities.[139] Macdonald emphasises the need to improve the 'sustainable development dividend' of CDM and properly value technological benefits to future generations.[140] This could be achieved through an internationally agreed set of criteria to guide the assessment of sustainable development in a more precise way. Taking this notion further, projects that have no tangible sustainable development outcomes for the host country could have the number of CERs issued proportionately reduced. However, Macdonald recognises that defining sustainability criteria for CDM would involve complex and politically difficult value judgements.[141]

Finally, there is the issue of intellectual property rights and how this presents a further obstacle to broad technology transfer and diffusion. There is anecdotal evidence from India of refusals to issue voluntary licenses for climate friendly technologies.[142] This may become an increasing problem under the climate change regime. Hutchison discusses the likely effect of the TRIPS regime on technology transfer under climate change.[143] TRIPS imposes minimum standards of patent protection on environmentally sound technology. This limits technology development in countries that do not have the benefit of increased flows of licensed technology or of significant foreign direct investment. Fundamentally, the climate change regime is a 'push factor' in increasing environmentally sound technology transfer to developing countries. However private sector competition, restrictive business practices and refusal of licensing may limit this potential.[144] Hutchison concludes that overly restrictive intellectual property rights regimes may stifle precisely the type of local follow-on innovations that are desired from environmentally sound technology transfer in developing countries.[145]

7 THE CHALLENGE OF LOW CARBON SUSTAINABLE DEVELOPMENT

The CDM should not be seen as a 'cure all' for the ills of the climate change regime.[146] However, it is now an important and widely accepted part of the flexibility mechanisms to promote mitigation and to embed low carbon technologies in developing countries. Since Article 12 of the Kyoto Protocol, the COPs have strengthened the link between technology transfer and the CDM. This is recognised as an important element in achieving sustainable development in countries of the South while

137 *Id.* at 205.
138 *See* Youngman et.al, note 81 above at 497.
139 *See* van Asselt and Gupta, note 58 above at 365.
140 A. Macdonald, 'Improving or Disproving Sustainable Development in the Clean Development Mechanism in the Midst of a Financial Crisis?', 6/1 *Law Environment and Development Journal* 1, 15 (2010).
141 *Id.* at 10.
142 Third World Network, Brief Note on Technology, IPRs and Climate Change (Penang: Third World Network, 2008). S*ee also* Shabalala and Orellana, note 10 above at 12.
143 Agreement on Trade-Related Aspects of Intellectual Property Rights, Annex 1C to the Marrakesh Agreement Establishing the World Trade Organization, 14 April 1994, in force 1 January 1995, 1869 UNTS 299, 33 ILM 1197 (1995) (TRIPS Agreement).
144 C. Hutchison, 'Does TRIPS Facilitate or Impede Climate Change Technology Transfer into Developing Countries?', 3/2 *University of Ottawa Law and Technology Journal* 517, 537 (2006).
145 *Id.* at 528.
146 *See* Macdonald, note 140 above at 20.

realising the ultimate objective of the UNFCCC in stabilising the concentrations of greenhouse gases in the atmosphere. The Copenhagen Accord establishes a new Copenhagen Green Climate Fund and 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'.[147] This statement encapsulates some of the concerns identified in this paper, particularly that CDM be more focussed on and strategically driven by host countries themselves. This would better accord with one of the central principles of the UNFCCC, that of 'common but differentiated responsibilities and respective capabilities'.[148] In order to achieve this, more support and assistance should be given to developing countries for the development of CDM master plans and national energy service needs strategies.

CDM has led to technology transfer of significant proportions in many developing countries. This is a reality not a myth. However, this paper has demonstrated that there is more to be done to enable CDM to effectively transfer environmentally sound technology and know-how to the South whilst ensuring that these countries' sustainable development goals are realised. Firstly, there is a pressing need to move beyond 'carbon reductionism'; that is, the notion that sustainable development can be simply defined in terms of reduction in carbon emissions.[149] The Plantar SA case study from Brazil starkly reveals not only the complexities of the CDM modalities, but also what might be termed the 'co-negatives' of seemingly beneficial projects, in this case relating to effects on the livelihoods of local communities and on biodiversity. Unless mandated by the national legislation of host nations, there appears to be a lack of effective project level environmental impact assessment for CDM projects. Furthermore, there is little evidence of strategic environmental assessment being conducted for a host country's overall CDM programme. Fundamentally the linkages between technology transfer or diffusion and broader social and environmental impacts are poorly understood. All the PDDs and Validation Reports examined in this paper give such dimensions scant attention – if any at all. As Russell, Vanclay and Aslin assert, social impacts are not side effects of technology but are core dimensions.[150] Technologies affect societies and environments in profound ways. These authors' proposition for a new framework of Technology Assessment in Social Context has resonance as a tool for a renewed focus for CDM on its primary purpose in achieving sustainable development in non-Annex I countries.

There will need to be a more intense focus in future CDM arrangements for, not only the transfer of technology on a one-off basis, but for the long-term diffusion of sustainable environmentally sound technologies. This should aim to address local market failures, build capacity and transfer know-how, and permit 'creative imitative' technology development in the host country. In so doing, issues of intellectual property rights as they relate to low carbon technologies will need to be addressed. Last but by no means least, the full dimensions of sustainable development must be captured in CDM project outcomes. This will entail addressing negative impacts on the poor and also using CDM to improve the lives and livelihoods of the most vulnerable. It will demand a wider view that encompasses impacts on biodiversity as well as on future generations. In addition, as Voigt points out, any assessment of the CDM's contribution to sustainable development must recognise the wider role that projects can play in catalysing sustainable development within host countries.[151]

It is highly likely that a post-2012 climate change regime will incorporate CDM. However, the CDM's exemplification of a 'broader contemporary turn in environmental policymaking' towards flexible market mechanisms urgently needs redress towards

147 *See* Copenhagen Accord, note 43 above para. 11.
148 *See* UNFCCC, note 25 above Article 3.1.
149 *See* Macdonald, note 140 above at 9.

150 A. Russell, F. Vanclay, and H. Aslin, 'Technology Assessment in Social Context: The Case for a New Framework for Assessing and Shaping Technological Developments', 28 *Impact Assessment and Project Appraisal* 109, 112 (2010).
151 C. Voigt, 'Is the Clean Development Mechanism Sustainable? Some Critical Aspects', 7 *Sustainable Development Law & Policy* 15, 17 (2008).

the right to sustainable development as embedded in the UNFCCC.[152] That technology transfer occurs through CDM is undisputed. The myth of CDM is that this technology transfer in and of itself leads to sustainable development. The ultimate challenge for CDM remains the promise of delivering a low carbon sustainable future and one that respects the rights of the most vulnerable across the globe.

152 T. Rindefjäll, E. Lund and J. Stripple, Wine, Fruit and Emissions Reductions: CDM as Development Strategy in Chile 5 (Norwich: University of East Anglia, Working Paper 004, 2010).

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