Enhancing the Role of the CDM in Accelerating Low-Carbon Technology Transfers to Developing Countries

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I. Introduction

At COP-3 (Kyoto, Japan, December 1997), the Clean Development Mechanism (CDM) was introduced in the Kyoto Protocol as a project-based emissions trading mechanism. Through this mechanism, industrialised countries can comply with their Protocol commitments by investing in greenhouse gas (GHG) emission reduction projects in developing countries for which they receive Certified Emission Reductions (CERs).[1] As per November 2008, the CDM project pipeline counts 4151 CDM projects (i.e. both officially registered and ongoing projects and projects in the process of validation by a designated operational entity).[2] The CERs can be used both by industrialised countries to comply with their Protocol commitments and by European installations to comply with their CO_2 emission caps under the EU emissions trading scheme.

According to the Kyoto Protocol, next to the objective of reducing GHG emissions, CDM projects shall also aim at supporting sustainable development in developing countries. The idea was straightforward: a CDM project enables the transfer of a low-carbon technology to a developing country which would be in accordance with that country's development needs and priorities. The present size of the pipeline indicates that the CDM has been successful in terms of numbers (projects and GHG emission reductions). However, analysing to what extent the CDM has contributed to host countries' sustainable development is less straightforward. For instance, a study carried out by the Ministry of Foreign Affairs of the Netherlands shows a mixed picture of the expected contribution to sustainable development by CDM projects with

[1] Kyoto Protocol to the United Nations Framework Convention on Climate Change, Kyoto, 10 December 1997, in force 16 February 2005, Article 12.
[2] Jörgen Fenhann, *"CDM Pipeline Overview"*, 2008, available on the Internet at <http://www.cdmpipeline.org> (last accessed on 21 November 2008).

Dutch government involvement.[3] A key conclusion from the study is that often there is no clear 'red thread' from countries' sustainable development strategies to the eventual technology selection for the CDM projects. Only a few countries in the Dutch study indicated that they select projects with a view to their development priorities and needs.

The EU funded study ENTTRANS took this 'red thread' as a key study objective.[4] For five case study countries – Chile, China, Israel, Kenya and Thailand – the study, first, explored energy service needs and priorities (e.g. electricity availability, heating, cooling, waste management, transport), followed by the identification of suitable low-carbon energy technologies to meet those needs and an analysis of countries' technology implementation circumstances and how to improve these. The second part of ENTTRANS consisted of an analysis of the role of the CDM in promoting the transfer of the low-carbon technologies identified to the case study countries and in general to developing countries. In particular, the question was asked to what extent the CDM could play a role in helping developing countries to follow the 'red thread' from energy service needs assessment to eventual technology identification.

The first results from ENTTRANS (energy service needs assessment and identification of low-carbon technologies) have been published earlier[5]. This paper has been derived from the second part of ENTTRANS and discusses procedural and institutional reforms related to the functioning of the CDM in order to make it a better suitable mechanism for ensuring that CDM project technologies are clearly embedded in host countries' national development strategies and derived from energy service needs assessments. Section 2 summarises the state-of-play with the CDM. Section 3 discusses possible improvements in the CDM in order to increase its suitability as a technology transfer mechanism. These improvements are addressed at the levels of both host countries' CDM institutional structures and the CDM Executive Board (EB). Section 4 contains the conclusions.

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[3] Netherlands Ministry of Foreign Affairs, *Clean and sustainable? An evaluation of the contribution of the Clean Development Mechanism to sustainable development in host countries*, no. 307 (The Hague: IOB Evaluations 2007), chapter 5.
[4] ENTTRANS, "Promoting Sustainable Energy Technology Transfers through the CDM: Converting from a Theoretical Concept to Practical Action", 2008, available on the Internet at <http://www.jiqweb.org/enttrans-final-report.pdf> (last accessed on 13 February 2009).
[5] Wytze van der Gaast, Katherine Begg, and Alexandros Flamos, "Promoting sustainable energy technology transfers to developing countries through the CDM", 86, *Applied Energy* (2009), pp. 230-236.

II. The CDM pipeline

II.1. Overview of distribution of projects across host countries

Table II.1 summarises the present CDM project pipeline in terms of number of projects and CERs expected from these projects. It can be concluded from the table that the geographical distribution of projects is very unequal with China, India, Brazil and Mexico being the leading host countries with a combined share of 75% of the total project pipeline.[6] The table also shows that around three-quarter of all projects are located in Asia and the Pacific with one-fifth taking place in Latin America. The shares of the other regions, Africa (2%), the Middle East (1.3%), and Europe and Central Asia (1%), are very small. For most regions, the dominance of one or two countries is clear: China and India dominate the Asian region; Brazil and Mexico have most projects in Latin America; South Africa has most projects in Africa; and in the Middle-East Israel has three times as many projects as the runner-up United Arabic Emirates.

In Table II.1 also the shares of host countries in terms of expected CERs up to the year 2012 (until the end of the Kyoto Protocol) are given. From the Table it can be concluded that the share of Asian countries in the CDM pipeline in terms of CERs is even larger than in terms of number of projects (79.6 versus 76.5%), which is due to the relatively large number of projects in Asia that reduce emissions of GHGs with a high global warming potential.[7] For the Asia-Pacific region it is striking to conclude that China is expected to deliver about half of all CERs presently in the pipeline, whereas China's share in terms of number of projects is 'only' 36%.

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[6] Fenhann, *CDM Pipeline Overview*, *supra* note 2.

[7] For instance, there are only 22 Hydrofluorocarbon (HFC) emission reduction CDM projects in the pipeline which are responsible for 17% of the expected emission reductions up to 2012. These projects generally have a very large emission reduction potential since the global warming potential of HFC is 11,700 times larger than CO_2. The same holds for Nitrous oxide (N_2O) emission reduction projects in industrial sectors: there are 65 projects in the global CDM portfolio (1.5%) but since their global warming potential is 310 times that of CO_2, the emission reductions result in an expected amount of 9% of all expected CERs up to 2012.

Table II.1 Comparison of regions and selected countries (CDM projects and expected CERs by 2012)

	Number of projects		2012 kCERs	
Latin America	**789**	**19%**	**423,727**	**14.9%**
Brazil	321	7.7	189,424	6.7
Mexico	194	4.7	76,599	2.7
Chile	63	1.5	40,980	1.4
Argentina	30	0.7	31,824	1.1
Colombia	34	0.8	20,849	0.7
Peru	27	0.7	14,307	0.5
Honduras	25	0.6	3,635	0.1
Ecuador	22	0.5	8,344	0.3
Guatemala	19	0.5	7,190	0.3
Asia & Pacific	**3,174**	**76.5%**	**2,259,111**	**79.6%**
China	1,521	36.6	1,514,897	53.4
India	1,111	26.8	441,692	15.6
Malaysia	144	3.5	67,177	2.4
Indonesia	95	2.3	41,592	1.5
Philippines	77	1.9	13,881	0.5
Thailand	75	1.8	23,420	0.8
South Korea	50	1.2	100,484	3.5
Vietnam	45	1.1	14,688	0.5
Europe and Central Asia	**42**	**1%**	**19,670**	**0.7%**
Armenia	8	0.2	1,951	0.1
Cyprus	7	0.2	1,402	0.1
Uzbekistan	7	0.2	5,940	0.2
Africa	**84**	**2.0**	**98,074**	**3.5%**
South Africa	27	0.7	24,869	0.9
Egypt	11	0.3	16,053	0.6
Morocco	9	0.2	2,853	0.1
Uganda	8	0.2	867	0.0
Kenya	7	0.2	2,789	0.1
Middle-East	**53**	**1.3**	**37,525**	**1.3**
Israel	32	0.8	14,945	0.5
United Arab Emirates	13	0.3	3,087	0.1
Total	**4,151**	**100%**	**2,838,107**	**100,0%**

Source: Jörgen Fenhann, "*CDM Pipeline Overview*", 2008, available on the Internet at <http://www.cdmpipeline.org> (last accessed on 21 November 2008).

II.2. Discussion

From the analysis of the distribution of CDM projects across developing countries it can be concluded that only a few rapidly emerging economies have attracted a relatively large number of projects and that the CDM market has thus far not shown much interest in Central Asia, Africa and the Middle East, and neither in some of the countries in Latin America and Asia and the Pacific outside the group of emerging economies. This has limited the CDM's potential to provide an equal contribution to sustainable development across developing countries. However, within the 'leading' CDM host countries Brazil, China, India, and Mexico, the CDM's contribution to sustainable development could be large given that these countries generally have a large GHG abatement potential (after all, China and India have the highest energy-related GHG emissions among developing countries) and that the CDM might help them to install low-carbon technologies and prevent a lock-in into CO_2-intensive technologies. Moreover, within the emerging economies that presently dominate the CDM market large domestic differences can be found between rich and poor regions (e.g. the industrialised east coast of China versus the country's rural south-west regions) and the CDM projects could well support the sustainable development of the countries' poorer regions.

In addition, it is important to underline that looking at the actual number of projects only may not fully reveal the long-term sustainable development contribution by CDM projects in a country. For instance, as Ellis and Kamel (2007) argue, a country with a smaller share in the pipeline but with projects with a high replicability potential may in the longer run turn out to benefit more from their CDM projects than countries with a larger share but with more 'ad-hoc' projects.[8] In the first case, the projects could have spin-off effects towards the rest of the economy and function as demonstrations of new technologies; in the latter cases, projects just stop after their technical (or, worse, crediting) lifetime is over with little spin offs to the rest of the economy.

Finally, the reports by the Netherlands Ministry of Foreign Affairs (2007) and ENTTRANS (2008) have concluded that three factors have been crucial for the present distribution of CDM projects.[9] One factor is the potential for relatively cheap and large-scale GHG abatement options in the emerging economies (both in terms of replacing existing technologies by low-carbon technologies, and avoiding large-scale future use of fossil fuel-based energy technologies). A second factor for the success of a country as a CDM host country is the organisation of its designated national authority (DNA) for the CDM. Although many developing countries have now announced the establishment of a DNA (which is an eligibility criterion for participation in the CDM[10]), there are large differences between countries in terms of DNA office equipment (number of staff, their training background and professionalism); most Asian and Latin American DNAs are relatively efficient, although some of them have in the meantime had to reform and streamline their procedures, whereas

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[8] Jane Ellis and Sami Kamel, *Overcoming Barriers to Clean Development Mechanism Projects*, COM/ENV/EPOC/IEA/SLT(2007)3 (Paris: OECD 2007), at p.13.

[9] Netherlands Ministry of Foreign Affairs, *Clean and sustainable? An evaluation of the contribution of the Clean Development Mechanism to sustainable development in host countries*, *supra* note 3, at pp.84-87; ENTTRANS, *supra* note 4, chapter 7.

[10] Decision 17/CP.7, Modalities and procedures for a clean development mechanism as defined in Article 12 of the Kyoto Protocol, in: Report of the Conference of the Parties on its Seventh Session, held at Marrakesh, from 29 October to 10 November 2001, UN Doc. FCCC/CP/2001/13/Add.2, 21 January 2002.

several African DNAs are operated by a limited number of staff who are also responsible for other environmental issues and therefore do not have time to fully focus on the CDM.

A third success factor is that of domestic implementation circumstances. CDM projects add value to an investment through the CER revenues. However, some barriers to technology implementation cannot be removed by solely adding the hard-currency denoted CER revenues to the investment capital and by offering training programmes for operation and maintenance to local employees.[11] In such cases, a further assessment of the implementation chain of a technology in the country is needed in terms of finding blockages and incentives for low-carbon technologies. Once these blockages and incentives have been identified, strategies could be formulated to improve the implementation chain, including how the CDM could support this improvement.

III. The role of the CDM in accelerating low-carbon technology transfers

III. 1. Introduction

As explained in Section II the relatively large share of rapidly emerging economies in the CDM pipeline contains the risk that fewer projects will be available for other developing countries. It has also been concluded that the attractiveness of emerging economies as CDM hosts can be explained by their large-scale emission reduction opportunities (so that transaction costs can be spread across a larger range of CERs) and their relatively well-organized DNA and overall project governance structures. The current project patterns thus reveal that the CDM is in essence a market mechanism where CER purchasers, similar to general foreign direct investment patterns, are seeking relatively low-cost investment opportunities in countries with a relatively stable (CDM) investment climate.

For the developing countries that are currently underrepresented in the CDM project pipeline, these lessons imply that they might attract more investors if they offered more large-scale project opportunities and improved their DNA and overall CDM governance. However, in many developing countries, the main potential for GHG emission reductions is in small-scale project opportunities only, such as heat pumps, micro-hydro projects and efficient cooking, so that large scale projects can be only be achieved through bundling of activities in CDM programmes. Moreover, improving the functioning of a DNA does not automatically imply a stable CDM investment climate. After all, while the project approval and CER generation process is governed by a host country's DNA, the bulk of the project consists of the

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[11] Ellis and Kamel, *Overcoming Barriers to Clean Development Mechanism Projects, supra* note 8, at pp. 30-32.

investment in the technology and for this investors require smooth and reliable technology implementation circumstances (in an average CDM project, the CER revenues make up only 10 to 15% of the overall investment capital, so that the main part of a CDM investment consists of technology hardware and is thus comparable to a regular foreign direct investment).

It can therefore be concluded that there are three main aspects that must be addressed for a successful promotion of low-carbon sustainable energy technologies to developing countries through the CDM. First, host countries must improve their domestic CDM organisation (including project identification and overall DNA supervision). Second, the overall investment climate in host countries must be reliable with smooth technology implementation chains. Third, the international CDM structure would need to increase the attractiveness of small-scale investment opportunities for CER purchasers. These three aspects will be addressed in the remainder of this section.

The insights in this section are to a large extent based on the discussions held in the context of the stakeholder workshops with energy and environmental policy and decision makers held in the five ENTTRANS case study countries during June-October 2007.[12] The following two questions were asked at the workshops:

1. How effectively does the CDM support technology transfer of low-carbon technologies that meet the energy service needs of a country?[13]
2. How can the CDM be improved to ensure that CDM projects are in line with energy services considered most needed and avoid *ad-hoc* CDM projects, and improve the efficiency of CDM host country operation to fast track projects?

The approach was to consider how well the CDM is performing on these issues and then what could be done about it and by whom. The country recommendations have been amalgamated and summarised below under three main activity headings: host country organisation of CDM procedures, improving implementation and diffusion circumstances for low-carbon technologies, and CDM procedural changes at the international level.

III.2. Host country organisation of CDM procedures

As explained above, the DNA plays a central role in a developing country's success as CDM host country. Each country that wants to become involved in a CER transaction must establish

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[12] ENTTRANS, "Promoting Sustainable Energy Technology Transfers through the CDM: Converting from a Theoretical Concept to Practical Action", *supra* note 4, chapters 4 and 7.

[13] For the methodology and application of energy service needs assessments in the ENTTRANS case study countries, see Van der Gaast, Begg and Flamos, *Applied Energy*, *supra* note 5, chapter 3.

a DNA for the CDM.[14] The DNA has regulatory tasks in terms of approving CDM projects (a host country DNA must have approved the project before it can be registered by the CDM EB; an investor/buyer country DNA must approve of the project before the CERs can be issued to that country), determining criteria for project selection and approval, reporting on a country's CDM involvement to the CDM EB, and ensuring that the projects have been implemented on a voluntary basis.[15] As explained above, the CDM practice has made clear that developing countries with well-designed and transparent procedures for project approval have been more successful in attracting projects than projects with long-lasting, complex and non-transparent DNA procedures. In the case of Thailand, for instance, the former DNA process required that each CDM project proposal had to be approved by the Cabinet of Ministers. In October 2006, this procedure was simplified by reducing the number of 'decision making layers' in the procedure and maximising the approval time for project design documents to 30 working days,[16] which led to an acceleration of Thai CDM projects during 2007-2008.

Most CDM host countries have a two-step approval procedure with screening of project ideas and a final approval of project design documents (PDD).[17] The initial screening is meant to inform project developers about the feasibility of a project as CDM activity in the country and therefore could help avoid wasting time and resources to fully develop a project idea that might not be approved in the end.[18] Some developing countries, however, such as Brazil, only consider a project after a designated operational entity has validated it, which implies an additional risk for project developers as they have to pay for the validation without knowing for sure whether the project will be approved by the Brazilian DNA.

An important factor in the success of a DNA is that it finds a balance between speed and quality. The pressure on the DNAs in the host countries with the largest share in the CDM pipeline (e.g. China, India, Brazil) is very large, as they have to assess over 100 project plans per year on their suitability with CDM criteria and contribution to sustainable development. Assessing a PDD (with an average size of 50-60 pages) requires specialised knowledge of a range of technologies and how these have an impact on countries' sustainable development. Moreover, host countries are free to determine criteria for CDM projects' contribution to

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[14] Decision 17/CP.7, *supra* note 10, in annex, para 29.
[15] Marcos Castro and Christiana Figueres, "The functions of a National Authority", in: Christiana Figueres (ed.), *Establishing National Authorities for the CDM – A Guide for Developing Countries*, (Winnipeg and Washington, D.C.: IISD/CSDA, 2002), pp. 63-74.
[16] ERI, CEERD, and JIN, *Study on the Impact of the European Linking Directive 2004/101/EC (so-called CDM Linking Directive) for Thailand, EU-Thailand Economic Co-operation Small Project Facility* (Bangkok: Energy Research Institute, 2007), pp.71-72.
[17] ibid.
[18] Castro and Figueres, "The functions of a National Authority", *supra* note 15.

sustainable development, which could theoretically lead to procedures in which project approval is quickened by applying fewer criteria for sustainable development.

Next to their mandatory regulatory role, DNAs would also need to perform promotional functions in order to actively promote the country as an attractive CDM host country. Such promotional DNA functions could consist of:[19]

- Managing data on projects carried out in the country, so that these could serve as examples/demonstrations for other investors who might be interested in projects in the country.
- This database management activity could be supported by an active Internet site and a newsletter, as well as seminars and training.
- Building of market networks for the country and/or region, including actions to co-ordinate different policies and programmes related to sustainable development.
- Providing assistance to project developers in terms of providing data for baseline calculations, such as CO_2 emission factors for grids and data on existing plants and/or recently built plants.
- Support to the development of domestic project development support, as well as of domestic operational entities to be designated by the CDM EB for project plan validation and project performance verification.
- Design of model contracts and support to local entities in building negotiation capacity.
- Marketing of the project opportunities within the country, such as identification of potential projects and making this information available to potential investors, e.g., through participation in carbon fairs and exploring opportunities via the DNA Internet site.

Next to the mandatory administrative and promotional functions of the DNAs, a host country could also take a pro-active position by exploring what low-carbon technologies would contribute mostly to the country's sustainable development. The ENTTRANS study has suggested to base the selection of a low-carbon technology for the CDM on an assessment of a country's energy service needs (e.g. electricity availability, heating, cooling, waste management, transport). This would increase the likelihood that CDM projects are more clearly embedded in host countries' national sustainable development strategies instead of being on-off, ad-hoc projects mainly selected for their GHG abatement potential.[20] The advantage of this approach to CDM technology selection would be that a CDM project could

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[19] ERI, CEERD, and JIN, *Study on the Impact of the European Linking Directive 2004/101/EC (so-called CDM Linking Directive) for Thailand, EU-Thailand Economic Co-operation Small Project Facility*, *supra* note 16, chapter 4.

[20] ENTTRANS, "Promoting Sustainable Energy Technology Transfers through the CDM: Converting from a Theoretical Concept to Practical Action", *supra* note 4, chapters 3 and 4.

clearly serve as a demonstration activity for a technology that a country has not yet been familiar with and thus could support the spin-off of the technology to the rest of the economy.

Obviously, such a more strategic choice of technologies for CDM projects would require extra capacity support for the host country government (whether or not organized through its DNA). For instance, a technology selection based on energy service needs would require a participatory approach with involvement of energy and environment stakeholders in the country. This would require the formation of a network of stakeholders who are involved in energy, climate change planning, and adaptation activities as well as technology owners and practitioners, entrepreneurs and communities, sectors and their representatives. These stakeholders can be supported to form an integrated network which allows the exchange of expert knowledge, indigenous and tacit knowledge and a range of perspectives which can lead to the development of a shared vision to move forward.

At the ENTTRANS workshops it was recommended that the expertise in development co-operation projects would be a valuable input for supporting and managing this technology selection process for the CDM. In the current practice of the CDM, development co-operation activities and CER acquisition activities have been mostly separated in order to avoid that ODA funding is used for CER acquisition. However, the expertise of development co-operation in terms of organising networks and exploring developing countries' development needs would be a very useful input into the identification of strategic low-carbon technologies irrespective of whether used for CDM project development or technology needs assessments in general. Once, with the assistance of development co-operation expertise (e.g. DGIS in the Netherlands, DANIDA in Denmark, GTZ in Germany, etc.), a portfolio of preferred low-carbon technologies has been prepared, it could be presented to the CER acquisition agency of an industrialised country government, who could then decide to purchase the CERs originating from these projects. This would secure a strict division between ODA and CER budgets.

For technology suppliers, this approach would have the advantage that the technology choice and the CDM project are embedded in a country's sustainable development strategy which would enlarge the spin-off potential of the investment so that they might have further investment opportunities in the country beyond the CDM project. For CDM investor countries, it would create the advantage of broadening their CER supply to countries and sectors that are presently underrepresented in the CDM pipeline. Such broadening of supply would fit well within the ongoing discussion on differentiation between both CDM projects and host countries at the level of the UN climate policy negotiations in order to reduce the share in the CDM pipeline of emerging economies and increase the share of least developed countries.[21]

Finally, it has been recommended at the workshops that DNAs do not operate in isolation from other policies and decision makers at the government level (ministries of finance, development planning, energy, agriculture, trade, etc.) and that there are integration structures in place.

III.3. Improving implementation circumstances for low-carbon technologies

Next to the organisation of CDM governance structures, as with any other technology transfer, host countries need to improve the implementation and diffusion circumstances for new technologies. Within the scope of this paper it is not envisaged to address the overall investment climate in CDM host countries, but, instead, the results of an exercise undertaken within ENTTRANS to map the markets in a number of case-study countries for new, low-carbon technologies will be shown. Market mapping is a relatively new approach which was devised by Albu and Griffith (2005) in the context of extending a sustainable livelihoods framework for small-scale poor farmers in developing countries.[22] They considered that, although the sustainable livelihoods approach was powerful in considering some of the key constraints, objectives, and drivers for communities, it did not address the issues of developing markets for the local sustainable livelihood activities. The technique has since then successfully been applied to a number of developing country situations[23] with the main aim of creating networks to support the development of the markets for improved co-ordination and innovation.

Within the context of this paper, market mapping helps to explore what needs to be done to move a technology into the diffusion stage in a developing country. This application of the market mapping approach to technology transfer activities is novel and was used in ENTTRANS to explore the system into which the technology would be transferred in the developing country. In the market map, three levels are identified: enabling business environment, which describes, e.g., a country's tax regime, trade standards, contract

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[21] United Nations Framework Convention on Climate Change (UNFCCC), *Analysis of possible means to reach emission reduction targets and of relevant methodological issues*, UN Technical paper FCCC/TP/2008/2, (Bonn: UNFCCC 2008), at pp.16-17.

[22] Mike Albu and Alison Griffith, "Mapping the Market: A framework for Rural Enterprise development policy and practice", Practical Action report, 2005, available on the Internet at <http://practicalaction.org/?id=mapping_the_market> (last accessed on 13 February 2009).

[23] Alison Griffith and J. Edwards, "Lessons and Insights in Participatory Market Chain Analysis (PMCA) An action-research on PMCA applications in Bangladesh, Sudan, Peru, Sri Lanka, Zimbabwe, Working Document", Practical Action report, 2006, available on the Internet at <http://practicalaction.org/docs/ia2/DFID-PCMA_report_rev6.pdf> (last accessed on 13 February 2009).

enforcement practice, consumer trends, finance and fiscal policies, etc.; the market chain actors in a country and how their activities are interlinked; and supporting service providers in the field of finance, facilitation of linkages between market actors, etc. The final market map for a technology shows: who are the actors involved in the purchase, implementation, and operationalization of a technology; what is the relevant legislation for implementation of the technology and how does current legislation provide incentives or disincentives to a new technology, or both; what would be implications for the electricity grid; etc. This provides an overview of where in a country technology implementation system blockages occur that would need to be overcome for a successful technology implementation and diffusion.

From the market mapping exercises at the ENTTRANS case study workshops, the following general conclusions were drawn with respect to the implementation chain of CDM technology transfer activities.[24] With respect to the *enabling environment* it was concluded that policies to promote low-carbon technologies are generally weak in the countries concerned, and that governments need to provide local standards and better enforcements, as well as enabling policies, integrated regulations, and legal and financial supporting structures for technology transfer. Import procedures for new technologies were generally considered too complex (e.g. red tape, corruption, taxation) and these need to be simplified and incentivised for new technologies. Finally, it was generally concluded that governments would need to align existing policies and remove policy inconsistencies (some policies stimulating and other policies hampering low-carbon technology transfer, such as offering a renewable energy feed-in tariff while levying an import tax on the technology).

In terms of *market chain aspects*, the lack of technology transfer networks in the countries was generally considered an obstacle to technology transfer. Since several stakeholders in developing countries are not familiar with new technologies, or tend to perceive the costs of new low-carbon technologies as a problem while insufficiently being aware of positive economic and environmental externalities from new technologies, they tend to prefer existing technologies that they are familiar with.

Finally, with respect to market supporting services, lack of research and development support, insufficient market information, insufficient quality control, lack of capacity building to bridge expertise gaps between market actors domestically and internationally, and limited availability of finance for new technologies and small-scale technologies and measures to offset the additional risks associated with these new technologies were mostly mentioned as problems in the developing countries analysed.

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[24] For a detailed discussion on the market chain aspects of specific technology examples in the five countries, see ENTTRANS, "Promoting Sustainable Energy Technology Transfers through the CDM: Converting from a Theoretical Concept to Practical Action", *supra* note 4, chapter 5.

With the market mapping exercise a developing country could for different types of CDM technologies explore where in the market system blockages occur and what opportunities may arise from a transfer and implementation of a technology, e.g. knowledge transfer, trade opportunities, economic development and superior technology, electricity load balancing and security of supply, poverty alleviation, increased funding and new policy directions, and improved skills of engineers and financial experts. The output of a market map is a clear overview of the market system within a CDM host country for the implementation of a low-carbon technology. It also shows where host country governments can make improvements so that they increase their attractiveness in general for hosting investments from abroad and in particular for hosting CDM projects. The market mapping exercise could easily be combined with the actions explained in section III.2 to improve the domestic CDM structures within governments (incl. the DNA), including the recommended support from development co-operation expertise in industrialised countries. The market mapping would then fluently follow after the identification of low-carbon technologies in a host country, thereby supported by an improved CDM governance structure in the countries.

III.4. CDM procedural changes at the international level

As explained above, in many developing countries the scope for large-scale emission reduction projects is smaller than in emerging economies, such as China, India, South Korea, Brazil and Mexico. This, in combination with problems with the domestic CDM organisations and implementation chain inefficiencies, has resulted in these countries being underrepresented in the CDM project pipeline. The former two sub-sections have addressed what institutional and policy measures can or need to be undertaken in developing countries to enhance their chances of successfully hosting CDM projects. This sub-section discusses steps to be undertaken at the governance level of the CDM Executive Board in order to make the mechanism more accessible for investments in, *e.g.*, small-scale projects or energy efficiency activities across a range of installations in an industrial sector.
In order to make the CDM fit for technology transfer and for sustainable development it is recommended to use it *mainly* in the programmatic mode (officially, CDM Programmes of Activities are allowed and modalities for programmes have been determined by the CDM EB; as per 2008, only a few CDM programmes have entered the pipeline though[25]). Programmatic CDM is very suitable for energy efficiency improvement projects in households (e.g. cooking,

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[25] CDM Executive Board, “Procedures for Registration of a Programme of Activities as a Single CDM Project Activity and Issuance of Certified Emission Reductions for a Programme of Activities (Version 02)”, no date, available on the Internet at: <http://cdm.unfccc.int/Reference/Procedures/PoA_proc01_v02.pdf> (last accessed on 16 Febuary 2009).

lighting) and industry (e.g. one technology applied within an industrial sector at different locations but under similar circumstances), but its applicability needs to be improved by:

- Streamlined programme approval and registration procedures, and
- Allowing more than one methodology for baselines and monitoring for calculating the emission reductions of activities within the programme (e.g. methodologies for insulation and fuel switch within a built environment retrofit programme), which is presently limited to one methodology only.

In addition to the presently possible programmes of activities where activities are similar in terms of type and size, it is recommended that several CDM projects with the same technology, but carried out in different locations in a host country and at different scales should also be grouped to iron out problems that individual projects may encounter and adapt the projects to host country conditions.

The CDM in its programmatic form could also support programmes of demonstration projects covering a range of sizes, sectors, locations, implementation models and scales of country conditions to prove and adapt the technologies using a participatory process. As mentioned above, one-off projects, as has been largely the case under the CDM, can be useful but a portfolio or programme approach to projects should be preferred where possible. Finally, programmes enable project developers to save transaction costs for project development and implementation.

Since for some developing countries there are no other projects which would be undertaken in the absence of the CDM project and since it is important that country circumstances are recognised when assessing additionality of emission reductions, it would be better to have a more positive approach to the concept of additionality. The CDM Executive Board could, for instance, agree on waiving the additionality test for all projects from least developed countries, or projects from certain categories that are considered to contribute strongly to sustainable development, or consider a project additional if it has been derived from an assessment of strategic sectors and/or energy service needs followed by a selection of suitable low-carbon technologies to meet those needs and a domestic process of mapping the technology implementation chains (see above). For this purpose, the CDM EB could apply a differentiation between both host countries and project types and only apply the positive additionality approach for particular project types from particular countries.

Differentiation is presently discussed at the level of the UNFCCC[26] in order create a CDM modality to facilitate more projects in sub-Sahara African and least developed countries in

[26] United Nations Framework Convention on Climate Change (UNFCCC), *Analysis of possible means to reach emission reduction targets and of relevant methodological issues*, *supra* note 21, at pp.16-17.

Latin America and Southeast Asia. Differentiation could take many forms, such as imposing quota on the number of projects that a developing country could host at maximum or multiplying CO_2-eq. emission reduction from CDM projects in least developed countries so that these projects can generate more CERs and the countries become relatively attractive CDM host country partners. The above-mentioned positive approach towards additionality is another example of how one could differentiate the supply of CDM projects.

IV. Conclusions

Although the CDM has grown strongly since 2005 in terms of number of projects in the pipeline and estimated amount of CERs to be generated from these projects, around 75% of the projects are (planned to be) located in only four emerging economies. It has been concluded that CDM project selection has been mainly driven by the scale of the project and the amount of CERs in combination with how CDM structures in these host countries have been organised. Moreover, given that the bulk of an average CDM project consists of the hardware or technology investment with the CER revenues adding, e.g., 10 to 15% to the required capital, CDM project patterns have thus far tended to resemble those of foreign direct investments. This tendency implies that the CDM contribution to sustainable development is not equally distributed across all potential CDM host countries, while a focus on CER scale contains a risk hat CDM projects become largely one-off projects, without being clearly embedded in a sustainable development strategy of the host country.

Therefore, this paper has argued that for a more equal geographical distribution of CDM projects and thus a stronger role of the CDM in promoting the transfer of low-carbon energy technologies to developing countries, three main aspects need to be addressed.

First, developing countries presently underrepresented in the CDM project pipeline must improve their domestic CDM structures in order to become more attractive CDM host countries. A key element of this improvement would be a streamlining of the functioning of DNAs in terms of project identification and approval and in terms of promoting the country as CDM host. In order to increase the likelihood that CDM project technologies will be embedded in countries' national energy strategies, it is recommended that technologies are selected through an assessment of priority sectors or energy services. This process could be supported by using the development co-operation expertise in industrialised countries.

Second, developing countries would need to improve their technology implementation circumstances in order to offer a more stable investment climate to foreign CDM investors. ENTTRANS (2008) has applied the market mapping tool in five potential CDM host countries which clearly reveals blockages and opportunities within a country's market system for technology transfer, implementation and diffusion and offers valuable information to host countries about improvements to be made. It has been recommended that the technology selection and market mapping be combined for identification of CDM project opportunities in host countries, so that foreign investors are provided with clear CDM investment profiles for the countries. Again, this process would require capacity building support, preferably from the development co-operation expertise in industrialised countries. It must be observed though that ODA budgets are not used for the actual acquisition of CERs.

Third, with a view to the international governance level of the CDM EB, it has been concluded that in order to make the CDM fit for technology transfer and for sustainable development it is recommended to use it *mainly* in the programmatic mode. Programmatic CDM is very suitable for energy efficiency improvement projects in households (e.g. cooking, lighting) and industry (e.g. one technology applied within an industrial sector at different locations but under similar circumstances). Furthermore, it has been concluded that a more positive approach toward project additionality testing would support CDM project development in developing countries that are presently underrepresented in the CDM pipeline. Finally, through differentiation between project types and categories of host countries, the CDM Executive Board could 'steer' the market mechanism of the CDM towards a larger share of lower-income developing countries and more small-scale sustainable energy projects.

This paper has shown that in the current CDM practice there is a trade-off between fostering sustainable development objectives and seeking relatively cheap GHG abatement opportunities for CDM projects. The recommendations made in this paper are aimed at providing input for CDM host country actions and CDM EB measures to make this trade-off less pronounced and increase the attractiveness of CDM projects that are clearly embedded in host countries' sustainable development strategies.