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Evaluating technology transfer in the Clean Development Mechanism and Joint Implementation

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To what extent do the Kyoto Protocol's flexible mechanisms facilitate technology transfer to reduce greenhouse gas emissions? This analysis reviews the Clean Development Mechanism (CDM) and Joint Implementation (JI) project portfolios, sample sets of projects, and the technology transfer (TT) literature to address this question. Criteria were developed to assess whether TT occurred relating to the origin of technologies, whether they differ from business-as-usual (BAU), and whether knowledge to implement the technology was imported. For CDM projects, lower- and non-emitting energy technologies account for a large share of total projects in the portfolio, but a relatively low share of total emission reductions. For JI projects, lower- and non-emitting energy technologies play a somewhat stronger role than in CDM. Based on sample projects, approximately 50% of the CDM projects and 62% of the JI projects involved transfer of technology hardware from outside of the host country. The European Union accounted for 83% (JI) and 92% (CDM) of the value of technology exported for these projects. While the flexible mechanisms are facilitating TT, they are insufficient in themselves to allow key lower- and non-emitting technologies to overcome cost and risk barriers and become attractive for widespread deployment. The analysis suggests approaches to leverage the ability of the mechanisms to stimulate TT in key technologies.

Keywords: CDM; emissions reduction; flexible mechanisms; JI; mitigation; public policy; technology transfer

Dans quelle mesure les mécanismes de flexibilité du protocole de Kyoto facilitent-ils le transfert des technologies pour la réduction des émissions de gaz à effet de serre ? Cette analyse est une revue des portefeuilles de projets du mécanisme pour un développement propre (MDP) et de la mise en oeuvre conjointe (MOC), un échantillon de projets, et la littérature sur le transfert de technologies (TT) pour aborder cette question. Des critères sont développés pour évaluer si le TT a lieu en fonction de l'origine des technologies, s'il y a des variations par rapport au « business as usual », et si les connaissances nécessaires à la mise en œuvre des technologies sont importées. Pour les projets du MDP, les technologies à faible énergie ou sans énergie représentent une large part du portefeuille total de projets, mais une part relativement faible des réductions d'émissions. Pour la MOC, les technologies à faible énergie ou sans énergie ont un rôle plus important que dans le MDP. Sur la base d'un échantillon de projets, environ 50% des projets du MDP et 62% des projets de la MOC impliquent le transfert d'équipement provenant d'un autre pays que le pays hôte. L'union européenne est à l'origine de 83% (MOC) et 92% (MDP) de la valeur des technologies exportées pour ces projets. Bien que les mécanismes de flexibilité facilitent le TT, ceux-ci ne sont pas suffisants pour permettre aux technologies clés à faible émissions ou sans émissions à surmonter les barrières de coût et de risque, et pouvoir etre largement déployés. L'analyse suggère plusieurs approches pour faire valoir le potentiel des mécanismes à stimuler le TT pour certaines technologies clés.

Mots clés: atténuation; MDP; mécanismes de flexibilité; MOC; politique publique; réduction d'émissions; transfert de technologies

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1. Introduction

The transfer of technology to developing countries and economies in transition (EITs) will be critical to international efforts to address climate change. Developing countries are estimated to account for approximately 70% of the increase in global carbon dioxide (CO_2) emissions from 2002 to 2030 (OECD, 2002). Given that CO_2 emissions from fossil fuels account for the dominant share of anthropogenic greenhouse gas (GHG) emissions, transfer and deployment of lower- or non-emitting energy technologies will be required 'on an unprecedented scale' (IEA, 2005, p. 7).

The Clean Development Mechanism (CDM) is one means for lower-emitting technologies to be transferred to developing countries. The purpose of the CDM is to assist developing countries to achieve sustainable development, and to assist Annex I parties to achieve their national emissions limitations under the Kyoto Protocol (KP) (UNFCCC, 1997). While the KP does not indicate that CDM should also stimulate technology transfer (TT), there are clearly opportunities for TT to be achieved as GHG-reducing projects meeting host-country sustainable development goals are implemented. Similarly, Joint Implementation (JI) provides opportunities for climate-friendly technologies to be transferred to countries with economies in transition, such as Russia, Ukraine and Eastern European countries. However, while the scope for TT from the Kyoto Protocol's flexible mechanisms (CDM and JI) is significant, concerns have been expressed that the CDM is not living up to its promise in terms of TT. Previous studies in this field have established that TT is often claimed in Project Design Documents (PDDs) for CDM projects, but that the type of TT varies widely over different project types and technologies (Haites et al., 2006). It is also acknowledged that the transfer of low-carbon technology can and should be promoted through different policies, depending on the nature and maturity of the technology, and political and economic characteristics (Ockwell et al., 2006). Nevertheless, the mechanisms provide an important tool for TT. In this context, it is important to understand the extent to which they are contributing to investment in lower- and non-emitting energy technologies – which will be critical to meet long-term environmental objectives and to meet growing global energy demand – and how that contribution could be increased. This article reports on the first study that examines and evaluates JI and CDM projects based on their TT characteristics.

The article summarizes our assessment, both quantitative and qualitative, of the extent to which the flexible mechanisms facilitate TT. Section 2 reviews technology types in the 'pipeline' of CDM and JI projects under development. Section 3 assesses in detail the origin of technology in the 63 registered CDM projects and 53 JI projects in the project pipeline as of January 2006, and evaluates whether TT took place. In addition, and based on the results on technology transfer assessment, a rough analysis of the size of technology exports to the CDM and JI host countries is given. Section 4 looks more qualitatively at how and whether the flexible mechanisms are facilitating TT, and considers various barriers to the transfer of lower-emitting technologies. Section 5 provides some ideas on how barriers to TT may be addressed. Section 6 presents conclusions.

2. Review of technologies in CDM and JI projects

In order to better understand the role of CDM and JI in technology transfer, this article reviews technologies in the CDM and JI pipeline. We consulted UNEP's Risø database (UNEP Risø, 2007), which provides data for all projects using methodologies that have been approved by the CDM Executive Board, and JI projects for which PDDs are available for public comment on the websites of Designated Operational Entities (DOEs). As of 1 November 2007, the database included a total of 2,647 CDM projects and 197 JI projects, which would generate an estimated 2,288 Mt of Certified Emission Reductions (CERs) and 207 Mt of Emission Reduction Units (ERUs) up until 2012 (Table 1).

TABLE 1 The UNEP Risø database: technology shares by number of proposed projects and by volume for CDM and JI

Type	CDM			JI			CDM average project size	JI average project size
	Number	1,000 CERs	2012 CERs (1,000s)	Number	1000 ERUs	2012 ERUs (1,000s)	1,000 CERs	1,000 ERUs
Afforestation	2	327	1,789	1	82	410	895	410
Agriculture	175	6,678	44,282	0	0	0	253	0
Biogas	150	7,690	40,676	4	433	2,272	271	568
Biomass energy	460	25,662	158,019	19	2,063	10,210	344	537
Cement	28	3,953	29,845	0	0	0	1,066	0
Coal bed/mine methane	42	19,141	106,682	13	3,945	19,725	2,540	1,517
Energy distribution	4	129	1,053	9	1,734	8,774	263	975
EE households	7	186	988	1	70	350	141	350
EE industry	111	3,603	20,918	13	3,608	17,323	188	1,333
EE own generation	249	41,608	220,956	1	1,557	7,787	887	7,787
EE service	4	38	216	0	0	0	54	0
EE supply side	27	3,493	18,082	13	2,029	10,144	670	780
Fossil fuel switch	84	30,581	161,347	9	2,324	11,558	1,921	1,284
Fugitive	20	8,694	55,227	24	11,897	59,487	2,761	2,479
Geothermal	11	2,002	11,802	3	159	794	1,073	265
HFCs	19	81,792	501,209	0	0	0	26,379	0
Hydro	654	58,516	289,044	28	1,381	6,936	442	248
Landfill gas	203	38,416	223,128	25	2,622	13,112	1,099	524
N_2O	44	43,034	247,499	9	5,775	26,882	5,625	2,987
Others	0	0	0	0	0	0	0	0
PFCs	2	166	944	0	0	0	472	0
Reforestation	10	658	4,213	0	0	0	421	0
Solar	10	251	1,455	0	0	0	146	0
Tidal	1	315	1,104	0	0	0	1,104	0
Transport	7	593	3,464	0	0	0	495	0
Wind	323	25,925	143,582	25	2,408	11,313	445	453
Total	2,647	403,453	2287,521	197	42,087	207,078	864	1,265

For CDM, the largest technologies in terms of volume of reductions are HFC-23 destruction (22% of total), hydro (13%), N_2O (11%), landfill gas (10%), energy efficiency from own generation (10%), fossil fuel switching (7%), biomass energy (7%) and wind (6%). The leading categories by number of projects are hydro (25%), biomass energy (17%), wind (12%), landfill gas (8%), agriculture (7%) and biogas (6%). Hydro, biomass energy, wind, agriculture and biogas projects, which accounted for approximately two-thirds of all projects, accounted for only approximately 30% of total volume.

For JI, the largest technology categories by volume of reductions are fugitive (29%), N_2O (13%), coal bed/mine methane (10%), energy efficiency in industry (8%), landfill gas (6.3%), fossil fuel switching (6%), wind (6%), energy efficiency supply-side (5%), biomass energy (5%) and hydro (3%). By number of projects, the largest categories are hydro (14%), wind (13%), landfill gas (13%), fugitive (12%), biomass energy (10%), energy efficiency in industry (7%), coal bed/mine methane (7%), energy efficiency supply-side (7%), fossil fuel switching (5) and N_2O (10%).

3. Technology transfer, technology origin and technology exports in sample CDM and JI projects

For this study, which was undertaken as part of the TETRIS Project for the European Commission in 2006, CDM and JI projects were reviewed and evaluated to determine the origin of the technology involved and whether TT took place. For CDM, 63 projects that had been registered with the CDM Executive Board by 1 January 2006 were evaluated, while for JI all projects – 53 in total – in the pipeline as of 17 January 2006 were examined. These projects are currently being implemented. In addition, a rough analysis of the size of technology exports to the CDM and JI host countries was also performed.

The TT assessment required the development of practical criteria to distinguish projects that would achieve a transfer of technology, given the absence of a consistent definition of TT in the literature. The criteria are incorporated in the following three tests for TT.

1. Do the technologies deployed originate from outside the host country?
2. Are the technologies new or improved (i.e. are they technologically different from business-as-usual (BAU) in the host country)?
3. Was the knowledge and/or capacity to implement the technology in the project imported from outside the host country?

Additional details on the methodology for assessing and categorizing TT, and of the results for the CDM analysis, is provided in another article in this issue of *Climate Policy* (de Coninck et al., 2007). Results for JI are presented below, followed by a summary of results for CDM.

3.1. Results for JI

The 53 JI projects were undertaken in the energy sector (60% of projects), the industrial sector (21%), and the waste sector (19%). Landfill gas capture, fuel switching and wind power each accounted for 15% of projects. In terms of total GHG emissions reductions, N_2O destruction (21%) and energy distribution (19%) were the two most dominant technologies, followed by methane capture (16%) and fossil fuel switching (13%). Poland, Russia and Ukraine each hosted eight JI projects, followed by Hungary (7), Romania (6), the Czech Republic (2) and Slovakia (2) (Table 2).

It was concluded that 62% of the JI projects (33 out of 53) involved technology transfer from outside of the host country. Seven projects were considered not to involve TT because the technology

TABLE 2 Summary of number and emission reductions by technology in 53 JI projects in Eastern Europe as of 17 January 2006

Technology	Number of projects	Share of total number of projects (%)	Emission reduction (kt CO_2e/year)	Share of total emission reduction (%)
Biomass	5	9	612	8
Energy distribution	3	6	1,557	20
Energy efficiency	4	9	409	5
Fossil fuel switch	8	13	1,056	14
Fugitive	2	4	124	2
Geothermal	3	6	159	2
Hydropower	6	11	724	9
Landfill gas	8	15	440	6
Biogas	2	4	254	3
Coal bed/Mine methane	1	2	87	1
N_2O destruction	3	6	1,798	7
Wind power	8	15	543	8
Total[a]	53	100	7,763	100

[a] Totals may differ slightly from sums due to rounding.
Source: UNEP Risø (2007).

originated from the host country itself, and 13 projects had insufficient data to determine the status of technology transfer (Table 3).

We define 'hard' TT as occurring in projects that utilize new or improved technology that is not 'business-as-usual' within the host country, and that originates from outside the host country.[1] 'Soft' technology transfer is defined as occurring in projects requiring capacity-building and knowledge from outside the host country to install the technology.

TABLE 3 TT evaluation for JI projects in Eastern Europe

Criterion	Result indicator	Number of projects	Share of projects (%)
I. Origin of technology used – technology from outside host country?	Technology transfer	33	62
	No technology transfer	7	13
	Insufficient information	13	25
II. New or improved technology, new in the country ('Hard TT')	Technology transfer	18	34
	No technology transfer	15	28
	Insufficient information	20	38
III. Capacity-building or knowledge transfer required ('Soft TT')	Technology transfer	15	28
	No technology transfer	26	49
	Insufficient information	12	23

TABLE 4 Origin of technology transferred in JI projects in Eastern Europe

Origin		Number of projects	Share of projects (%)	GHG reduction ($ktCO_2$-eq)	Share of GHG reduction (%)
EU-25	Germany	14	26	2636	51
	Denmark	9	17	424	8
	Austria	6	11	394	8
	UK	5	9	443	9
	Other European Countries	10	19	10	13
Other	USA	9	17	538	10
	Canada	1	2	4	0
Total		54	100	5126	100

Based on the assessment, approximately 34% of the projects implemented new or improved technology that was not 'business-as-usual' in the host countries, while 28% did not meet this test. In terms of 'soft' technology transfer, a smaller number of JI projects were identified as requiring capacity-building or knowledge transfer from outside the host country, accounting for 28% of the total JI projects.

For the 33 JI projects with TT, 19 projects implemented technologies which originated from one country, and 14 projects implemented technologies which originated from more than one, and up to five, countries. As a result, technologies from 54 countries were utilized in the 33 JI projects with TT.

European Union Member States accounted for 81% of the 54 countries that transferred technologies. All were members of the EU-15, with the exception of two EU-10 countries that transferred technologies (see Table 4). Germany was a source of technologies for the largest number of projects with TT, accounting for 26% of the total technologies transferred. German technologies also accounted for 51% of the GHG reductions from projects with TT, primarily from three N_2O destruction projects and other projects ranging from energy distribution to wind. Denmark, Austria and the UK were next, supplying technologies accounting for 17%, 11% and 9% of the number of projects with TT, and for approximately 8% (each) of total GHG reductions from projects with TT. Sweden and Switzerland each accounted for two projects with TT; and Finland, France, the Netherlands and Spain each accounted for one project. After Europe, the USA accounted for the next largest share of projects (17%), followed by Canada (1%).

TT was pronounced in energy distribution, fugitive emission reduction, N_2O destruction, and fugitive emission utilization. In addition, more than half of biomass, energy efficiency, hydropower, landfill gas and wind power projects involved TT. More TT took place for non-CO_2 GHG (i.e. N_2O, CH_4 and a combination of gases) reduction and avoidance projects than for CO_2 reduction projects (including energy-sector projects).

To estimate the size of investment flows directly related to the 33 projects in which technology was transferred, we used investment information provided in the various projects' PDDs. In cases where PDDs did not provide investment-related information (i.e. in coal bed/mine methane, hydropower and landfill projects), we used project development documents, investment costs per unit of power capacity (i.e. €/kW) or investment costs per unit of greenhouse gas reduced (€/tCO_2e) from projects with similar size and location in order to estimate the size of investment (Table 5).

TABLE 5 Investment costs per exporting country and per technology (€million)

	Biogas	Biomass	Coal bed / Mine methane	E-distribution	EE	Fuel switch	Fugitive	Geo-thermal	Hydro-power	Landfill gas	N_2O destruction	Wind	Total investment costs	
Austria (6)[a]			3.8						338.8	0.1			342.7	44%
Denmark (9)		13.1						1.7		2.9		164.0	181.7	23%
Finland (1)					5.3								5.3	1%
France (1)											0.8		0.8	0%
Germany (14)	4.8		3.8	31.8	0.6		3.1	1.7	19.5	0.1	1.6	31.5	98.6	13%
Netherlands (1)										1.1			1.1	0%
Spain (1)												26.6	26.6	3%
Sweden (2)		6.5						1.7					8.2	1%
Switzerland (2)					5.3				19.5				24.8	3%
UK (5)	4.8				13.1		3.1				0.1		21.1	3%
Czech Republic (2)		3.4					4.5						7.9	1%
EU-25 Total (44)	9.5	22.9	7.6	31.8	24.3	0.0	10.7	5.2	377.9	4.1	2.5	222.1	718.7	92%
	100%	100%	67%	74%	95%	0%	70%	75%	100%	98%	100%	89%	92%	
USA (9)			3.8	11.4	0.6	8.0	4.5	1.7		0.1		28.3	58.5	8%
Canada (1)					0.6								0.6	0%
Total (33)	9.5	22.9	11.4	43.2	25.6	8.0	15.2	7.0	377.9	4.2	2.5	250.4	777.8	100%
Share per technology	1%	3%	1%	6%	3%	1%	2%	1%	49%	1%	0%	32%	1%	

[a]Numbers in parentheses are the total number of JI projects in which the country transfers technology hardware.

Approximately €777.8 million was invested in technologies transferred in the 33 projects, of which €719 million (92%) was from the EU. Austria, which exported hydropower to all four hydropower projects, had the largest share of total investment – €342.7 million (44%). Denmark, which exported wind technology to four of the six wind JI projects, had the next largest share – €181.7 million (23%). Germany was the third largest, at €98.6 million (13%). Together, hydropower and wind technologies accounted for €628.3 million, or 81% of total investment. Hydropower technologies accounted for almost half of total investment, and wind power accounted for approximately one-third.

3.2. Results for CDM

For CDM, it was concluded that technology originates from outside the host country in almost 50% of the evaluated projects (de Coninck et al., 2007). In the projects in which the technology originates from outside the host country, 80% use technology from the European Union. Technologies used in non-CO_2 greenhouse gas and wind energy projects, and a substantial share of the hydropower projects, use technology from outside the host country; but biogas, agricultural and biomass projects mainly use local technology. The associated investment value with the CDM projects that transferred technology is estimated to be around €470 million, with about €390 million (83%) coming from the EU. As the non-CO_2 greenhouse gas projects had very low capital costs, the investment value was mostly in the more capital-intensive wind-energy and hydropower projects.

3.3. Comparison of JI and CDM results

Based on the sample projects, a slightly higher share of projects in JI (62%) involved TT from outside the host country than in CDM (almost 50%). TT in the JI sample was pronounced in energy distribution, fugitive emission reduction, N_2O destruction, and fugitive emission utilization; while in the CDM sample, TT was pronounced in non-CO_2 GHG, wind and hydro projects. In terms of the value of transferred technologies, Spain (mainly wind) and France (mainly hydro) had the leading shares for the CDM sample, followed by the USA, Germany and Japan. Austria (hydro), Denmark (wind) and Germany (N_2O and other) were the leading exporters for JI projects.

From the analysis of both JI and CDM projects, as well as other findings, it can be seen that the EU dominates the technology market in JI and the CDM. Some have attributed this to the strong policies that Europe has implemented in order to increase the amount of renewable electricity in its power mix (see, e.g., Steiner Brandt and Tinggaard Svensen, 2006). It appears possible that Europe's policies to increase the amount of renewable electricity in its power mix are at least partly responsible (as postulated by Steiner Brandt and Tinggaard Svensen, 2006) for this technology market dominance and related benefits in terms of market development and exports. The first-movers appear to be in a better position to benefit significantly from TT in the context of the flexible mechanisms.

We did not attempt to extrapolate from the findings for the sample JI and CDM projects to estimate future technology exports in 2010 and beyond, given the significant change in the portfolios that has occurred in terms of the number and types of projects and the uncertainties of future climate policies. Among other changes, hydro projects have become more prevalent in CDM; as of 1 November 2007, they accounted for 13% of CDM pipeline volume (up from 6% in May 2006), and 25% of CDM projects (up from 17%). JI has seen the reverse occurring; hydro's share of volume has declined from 9% to 3%, and its share of projects has declined from 21% to 14%.

Wind's shares have seen a smaller decline, from 9% to 6% of total volume, and from 14% to 13% of total projects. These changes may mean greater opportunities through the CDM for European hydro exporters, but fewer through JI. In any case, there is reason to expect that the European Union will remain a leading supplier of technologies, as their domestic policies to promote renewable energy use continue, and as their industries currently dominate the wind turbine and hydropower markets. At the same time, developing countries' share of technology exports for CDM and JI projects may be expected to increase, as domestic industries develop there and local technologies may become available in other countries in the region. Additional analysis of TT under the mechanisms in future years will be needed to provide insights into TT trends over the full first commitment period of the KP.

4. The role of flexible mechanisms in facilitating TT, and barriers to transfer of lower-emitting technologies

As noted by the Intergovernmental Panel on Climate Change (IPCC), a prerequisite for TT is that 'price and conditions must provide incentives to [the] seller' (IPCC, 2000). There must be sufficient incentives and assurances to sell technology in order for TT to occur. In the context of CDM and JI projects, one aspect of 'price and conditions' is the carbon value of the transaction (i.e. the value derived from emission reductions created from the project). In many cases, carbon value does not have a large impact on project economics. However, it often helps to increase a project's internal rate of return (IRR), which in turn can help a project developer to obtain financing and thereby overcome a major obstacle to project development. In this sense, carbon value in CDM and JI projects plays a contributing role in project development and the TT that accompanies it.

On the other hand, the dominant technologies in the CDM pipeline are such end-of-pipe technologies as HFC-23 destruction (40% of total GHG emission reductions), landfill gas (12%) and N_2O (12%) (see Table 1). Wind (13%), hydro (17%), biomass energy (23%) and industrial energy efficiency (12%) accounted for approximately 65% of all projects, but only 22% of GHG emission reduction volume.

This disparity is due to the various and significant cost and risk hurdles facing lower- and non-emitting energy technologies. For example, compared to HFC-23 destruction, N_2O abatement, landfill gas fugitive methane destruction (flaring) and landfill gas capture and utilization (electricity generation), lower- and non-emitting energy technologies are more expensive, more capital-intensive, and (with the possible exception of some landfill gas projects) have longer lead times. They tend to be small, and therefore face higher transaction costs on a per-tonne abated basis. Given these characteristics, they are at a particular competitive disadvantage as there is very little time remaining to develop projects that could create sufficient volumes of CERs by 2012 to make such projects economically viable. They also must compete with fossil-fuel-based energy technologies, which continue to achieve cost reductions, and which are seen as having less performance risk (IEA, 2003).

In addition to these cost and risk barriers, any lower- and non-emitting energy technology that is implemented outside of its normal circumstances faces a set of barriers related to the specific conditions in the host country. For example, local technical capacity and expertise may not be sufficient to ensure effective implementation and operation of the technology (Kline et al., 2004). The institutional framework may not provide sufficient regulatory or legal transparency for investors, and may not be reliable enough to protect against intellectual property rights (IPR) violations and fraud (Hoekman et al., 2004). The costs of integrating a new technology into the host country's industrial or electricity infrastructure may be high (IEA, 2005). Finally, the host country's trade policies may make some investments uneconomic (Hoekman et al., 2004).

Market barriers create yet another set of obstacles for lower- and non-emitting technologies. They include information and behavioural barriers that result in under-investment in technologies that will be needed in the future. For example, firms may seek to address only short-term requirements, and may reject options that deliver emission reductions over a longer period, even if they are cost-effective (IEA, 2005). A post-2012 international agreement on national emission targets would address part of this problem by providing firms with more regulatory certainty. But this may not be sufficient to spur certain investments. Additional policies (incentives and/or standards) may be needed to direct investment to buildings and transportation, efficient appliances and equipment, and other technology categories which may resist investment despite their longer-term cost-effectiveness (Haites, 2004).

Given that cost and risk barriers to key new technologies are major impediments to their widespread deployment, the cost signal provided by the flexible mechanisms is simply not enough to overcome these barriers. Even if cost barriers were somehow addressed, non-financial barriers would still present major challenges to the deployment of new technologies, as suggested by efforts to date to promote TT in GHG-reducing technologies. These barriers require actions that go beyond changing the flexible mechanisms to send a stronger price signal or greater regulatory certainty, although such actions are certainly important. In addition, the existence of market failures suggests that GHG markets will not always behave as efficiently and rationally as intended. In order to significantly increase TT, the flexible mechanisms must be supplemented with other policies and efforts to address host country barriers and market failures, and to bring down the costs of key technologies.

5. Potential approaches for improving on the ability of the flexible mechanisms to facilitate TT

In general, two questions are asked in the context of CDM and technology transfer. The first is: 'How do we induce more technology transfer?' The second question relates to the type of technology that might be transferred: 'Is it possible for CDM to facilitate a significantly greater level of TT for energy technologies, such as renewable energy and energy efficiency technologies?'

Some actions could be taken within the context of a flexible mechanisms policy which would improve the ability of the flexible mechanisms to facilitate TT. For example, at COP-11 (also referred to as the first Meeting of the Parties to the Protocol – COP/MOP-1), it was decided that 'project activities under a programme of activities can be registered as a single clean development mechanism project activity' (OECD/IEA, 2006, p. 6). Programmatic CDM could be expanded to allow host country governments to submit as a single project all of the emission reductions resulting from the non-BAU imposition of emission-reducing policies. This would facilitate the use of policy-based reductions, thereby expanding potential volumes of reductions that could occur through CDM, and potential levels of TT that could occur through the implementation of such policies. Discount factors could be applied to estimates of creditable emission reductions in order to address possible additionality concerns.

Another means of increasing TT would be for governments to support priority technologies by applying a premium to their purchases of CERs and ERUs using those technologies. This would help make projects economic and sustainable (e.g. through training and capacity-building), and help make the technology more competitive in the host country (e.g. through funding ongoing learning to reduce costs).

In the longer term, we believe there could be benefits to linking the flexible mechanisms with funding mechanisms supporting investments beyond 2012 in lower- and non-emitting energy technologies. For example, governments could consider a coordinated effort to purchase post-2012 emission reductions. They could target priority technology categories and thereby ensure that the closing CDM window does not lead to a cessation of investment in these areas until a post-2012 international climate agreement is established. This approach would also have the advantage of providing governments with access to low-cost reductions, as prices and costs for pre-2012 reductions are probably lower now than they will be in the future.

Alternatively, a pooled government purchasing vehicle could pay only for the incremental cost for post-2012 CERs that would make a transaction viable. For example, a buyer may be willing to pay $2/tonne for post-2012 CERs, and to take on the risk that those CERs will not have value after 2012, while a seller may require $4/tonne for those CERs to execute the transaction. Governments could provide the $2/tonne incremental funding to ensure that the transaction occurs. By only funding incremental costs, governments would leverage available private sector funding and help achieve a higher level of purchases for a given budget. If an auction were utilized to award incremental funding to the most competitive bids, this would maximize investment in post-2012 reductions and minimize cost. It would also reduce the possibility that subsidies would be abused or would create perverse behaviour (Hoekman et al., 2004).

A similar approach could be used to support specific lower- and non-emitting energy technologies in order to help overcome their cost and risk disadvantages. For example, a government fund could establish tranches devoted exclusively to specific priority technologies. This would help to ensure increased levels of deployment for these technologies. In addition, such an approach could be applied to address inequities in geographical distribution of CDM projects and investment by subsidizing TT in least developed countries (LDC).[2] For example, a separate government cooperative fund could be established to pay for the incremental cost needed to make a project viable in an LDC. This support may be needed both for technology costs, capacity-building, and follow-on learning. In order to ensure that technology deployment is increased in specific countries or regions, the geographical fund could establish separate tranches for those areas.

6. Conclusions

Based on our review of 53 sample JI projects and 63 sample CDM projects, over half of the projects involved some level of technology transfer from outside the host country. Approximately €777.8 million was invested in technologies transferred in the 33 JI projects, of which €719 million was from the EU. The associated investment value with the CDM projects that transferred technology is estimated to be around €470 million, with about €390 million coming from the EU.

As suggested by these results, we conclude that CDM and JI are indeed facilitating technology transfer. They do so by helping to address cost barriers to those technologies that are best placed to benefit from the valuation of GHG emission reductions. While lower- and non-emitting technologies were transferred in a number of projects we reviewed, the mechanisms are not nearly sufficient in themselves to make these technologies competitive in most developing-country settings and attractive for widespread deployment, due to significant cost and other barriers. In order to significantly increase TT, the flexible mechanisms must be supplemented with other policies and efforts to address host country barriers and market failures, and to bring down the costs of key technologies.

We also conclude that Europe, in particular, is benefiting from the flexible mechanisms, as it is the dominant exporter of the technologies used in JI and CDM projects. It may be the case that Europe's strong policies to increase the use of renewable energies have helped place it in a good position to benefit from TT in CDM and JI.

Notes

1. This approach differs from the approach in de Coninck et al. (2007), but it was only relevant for one JI project in Russia, in which project developers utilized new and improved technology that originated from Russia. We determined that this project does not qualify as 'hard' technology transfer, because the technology did not come from outside of the country.
2. Hoekman et al. (2004) makes the case that LDCs require subsidies or differential pricing in order to reduce the high costs of imports of goods protected by intellectual property rights (IPR), and thereby overcome a market failure in international TT.

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