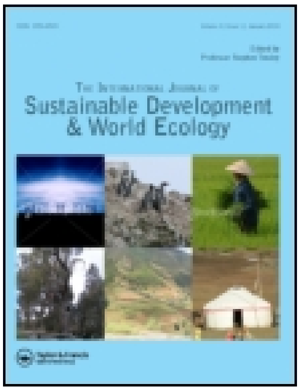

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CDM contribution to RES penetration in the power generation sector of China and India

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CDM contribution to RES penetration in the power generation sector of China and India

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The clean development mechanism (CDM) could play an important role in the power generation sector of developing countries and emerging economies by providing additional revenue to support the diffusion of renewable energy sources (RES). This paper investigates the contribution of the CDM to deployment of renewable electricity projects in China and India, and highlights the main potentialities and limitations of this mechanism for their support. The outcome of our analysis shows many differences and similarities in the way and scale of CDM projects for renewable electricity generation have been implemented in the two countries. In both cases, the CDM has made a contribution to greening investments in the power generation sector, which is still largely dominated by subcritical coal-fuelled power plants. Nonetheless, some major problems still remain and they are mainly related to the distribution of projects across different technologies and to the environmental integrity of the mechanism. In view of the likely revision of the CDM in the post-Kyoto period, we find that the differentiation of the credit generation rate of different project categories could bring some level of improvement without significantly altering the current system functionality.

Keywords: clean development mechanism; renewable electricity generation; emerging economies; technology transfer; climate change

Introduction

The clean development mechanism (CDM) is a market-based instrument designed to achieve the dual objective of providing cheaper greenhouse gas emission abatement options to developed countries while assisting developing countries to meet their sustainable development objectives. The CDM is a means for developed countries to offset their emissions at a cheaper cost, and for developing countries to finance the deployment of environmentally sound technologies (ESTs) or know-how. Although the CDM does not have an explicit technology transfer mandate, it may nonetheless achieve this result by financing emission reduction projects using technologies or know-how currently not available in host countries, helping them avoid becoming locked-in to high emissions growth patterns (Seres and Haites 2008).

The CDM could play an important role in the energy sector of developing countries and emerging economies, where it can provide additional revenues to support the diffusion of renewable energy technologies and know-how. Energy demand is growing everywhere worldwide, but in some emerging economies the speed and the magnitude of this process are unprecedented. In China and India, the two fastest growing emerging economies, energy demand has soared since the year 2000, and it is projected to be more than double by 2030 (IEA 2007). Power generation accounts for much of this increase, due to the booming electricity demand in all end-use sectors, driven by economic growth, growing population and increasing wealth levels. To meet present and future demand, huge investments are needed in power generation, which, in both countries, is still largely dominated by subcritical coal-fuelled power plants. Investments now being made will lock in technology for decades to come, making it more urgent to support the timely diffusion of ESTs.

The development of renewable energy sources (RES) could help China and India meet the rising demand for electricity, diversify the electricity mix, reduce the dependency on fossil fuels and increase energy security. Their development can also help mitigate air pollution, reduce greenhouse gas emissions, create employment opportunities and alleviate energy poverty in rural areas, thus contributing to sustainable development.

In the light of the approaching end of the first commitment period of the Kyoto Protocol, this paper seeks to investigate the contribution of the CDM to the deployment of renewable electricity projects in China and India and to highlight the main potentialities and limitations of this mechanism for their support. For this purpose, we have developed a CDM project database where we have gathered all the relevant information drawn from the project design documents (PDD).

China and India as main recipients of CDM projects

China and India are the two major recipients of CDM projects worldwide. As of 15 April 2009, they hosted about 33% and 27% of all registered projects, respectively, distantly followed by Brazil and Mexico, with 10% and 7%, respectively, and by a great number of countries with only a few projects. This uneven geographical distribution is influenced by many factors, the most important being the

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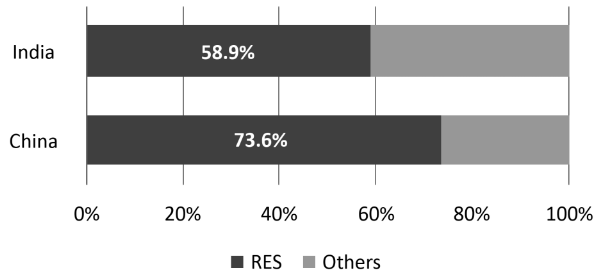

Figure 1. Share of RES projects in China and India as of 15 April 2009.

investment climate, the emission reduction potential and the institutional and legal framework. China and India score high in all these dimensions and have therefore attracted relatively more investment than other countries. Renewable electricity generation projects, in particular, have profited from overall favourable conditions for their development, as reflected by their share in the total number of projects developed to date (Figure 1). As for the investment climate, China is ranked second and India fourth in the Renewable Energy Country Attractiveness Indices (Ernst and Young 2009), which provide scores for national renewable energy markets, renewable energy infrastructures and their suitability for individual technologies.

As for the emission reduction potential, both countries have large unexploited renewable resources and a wide potential for emission reductions, since the generation mix of the electricity displaced by CDM project activities is mainly dominated by coal and therefore entails very high emissions. This implies that with the same level of investments, project developers in China and India can obtain a higher number of certified emission reductions (CERs) than in countries with a different baseline scenario (Blanco and Rodrigues 2008).

Finally, as for the institutional and legal frameworks, both countries have introduced an attractive legal framework for the establishment of renewable energy projects and have timely adopted all the necessary institutional arrangements to support the submission and registration of CDM projects. One particular feature of the Chinese legal framework is worth mentioning, as it can contribute to explain the particularly large share of renewable energy projects developed to date. The criteria used by the Chinese Designated National Authority (DNA) for approval of CDM projects favours renewable energy projects. The law on 'Measures for Operation and Management of Clean Development Mechanism Projects' considers them as priority projects and provides for a lower fee on their CER's revenues, only 2% compared to 30% levied on nitrous oxide (N_2O) projects and 65% levied on hydrofluorocarbon (HFC) and perfluorocarbon (PFC) projects. These favourable provisions are of particular importance for the development of renewable energy projects in China, since they diminish their comparative disadvantage with projects that deliver more credits (Schroeder 2009).

The Chinese example could actually be of some interest for other countries that wish to foster renewable electricity projects by giving the right investment message to project developers. The imposition of differentiated CER fees could steer the investors' decisions towards national development priorities and, at the same time, it could provide some extra revenues that could be used to finance national support schemes for RES development.

Methodology and database

To compare the impact of CDM projects for renewable electricity generation in China and India we have developed our own database, built on a series of assumptions that will be addressed in this section. For each project, the following data have been gathered: project type and scale; crediting period and starting date; average annual emission reductions (kt CO_2 eq./year); claims of technology transfer; installed capacity (MW); and expected annual output (GWh/year). To avoid a biased judgement based on projects that have been rejected or which remain uncertain, the paper only focuses on CDM projects registered as of 15 April 2009. An arbitrary date had to be chosen because the number of registered projects increases on a daily basis. We have taken into consideration all projects that generate electricity, even those where electricity production is not the main or only scope of the project, such as landfill gas or co-generation projects.

Project categories

The renewable energy category potentially covers all the technologies included in the definition of renewables adopted at European level.[1] As we will see in the next section, however, among these technologies, the only ones that have been effectively used in CDM projects in China and India are hydropower, wind, biomass, biogas and landfill gas. The information gathered for this study was mainly drawn from the PDD, while host-country energy data were obtained from the International Energy Agency (IEA).

Installed capacity

The data on installed capacity refer to the overall capacity achieved when the project is fully implemented. For some project categories, landfill gas and wind in particular, the implementation of the whole project as described in the PDD might require a few years, because the gas collection system and the wind turbines are implemented in successive stages. This means that the overall expected installed capacity by 15 April 2009 might not entirely reflect reality because a part of the capacity still has to be put in place. We have therefore decided not to compare the MW registered under the CDM scheme and the installed capacity by technology in each country, since the projects still under construction would not appear in the national statistics. Furthermore, some of the projects in the database are co-generation projects where part of the installed capacity is devoted to meet the facility's captive steam requirements or to generate heat for sale to third parties. The overall data on installed capacity by technology are nonetheless interesting to compare different trends in the Chinese and Indian markets.

Generated electricity

The data on generated electricity take into consideration the project implementation schedule as outlined in the PDD and provide a yearly average production value over the crediting period. The reported values refer to the expected net electricity supplied to the grid or generated for in-house consumption, bringing a displacement of grid electricity. For most projects, the expected electricity output is one of the basic parameters upon which the project financial analysis is based and against which the project viability is tested.

Replaced fossil energy

Renewable energy projects generate electricity by means of non-fossil fuel sources, lessening the need to increase fossil fuel production or imports, thus contributing to national and international energy security. To calculate the contribution of CDM projects to reducing reliance on fossil fuels in China and India, we have computed the amount of primary energy that would have been necessary to generate an identical amount of electricity in a conventional thermal power plant, taking into consideration the transformation losses that take place during the generation process. The replaced primary energy can be estimated as:

$$E_p = \frac{E_f}{\eta_e},$$

where E_p represents the primary energy replaced by the project activity, E_f represents the final energy produced by the project activity and η_e represents the average efficiency of Chinese and Indian thermal power plants. Since coal provides about 80% of electricity generation in China and almost 70% in India (IEA 2009), we have assumed that electricity generated by CDM projects would replace electricity generated by coal-fuelled power plants.

The main base of China's and India's current generating fleet is made of subcritical power plants, whose average conversion efficiency is relatively low. According to the IEA, coal-fired power plants in China have an average efficiency of 30–36%, while India's plants are less efficient, with an average conversion efficiency fluctuating between 27% and 30% (IEA 2007). To calculate the primary energy equivalent to the CDM projects' electricity output, we have therefore assumed an average generating efficiency of 33% in China and 28.5% in India. To convert the electricity generated by CDM projects into the corresponding amount of primary energy, we have used the general conversion factor 1 TWh = 0.086 Mtoe, used by the IEA.

Emission reductions

Starting from the stated annual emission reductions, we have calculated the estimated emission reductions that each CDM project would bring about from the starting date of the crediting period until the end of the first commitment period in 2012. We have always assumed the renewal of the 7-year crediting period when the first period expires before 2012. When the crediting period starts after the 15th of any given month, we have counted the emission reductions from the following month. It needs to be pointed out that the emission reductions delivered by the CDM projects in the database are not entirely attributable to the displacement of grid electricity because, for some projects, the generation of electricity is not the main or the only objective.

Technology transfer

As aforementioned, CDM projects can contribute to technology transfer by financing emission reduction projects using technologies or know-how currently not available in host countries (Teng and Zhang 2010). In this study, we have considered technology transfer to have happened whenever the PDD claimed a transfer of equipment and/or know-how from other countries, including other developing countries. Our definition also includes foreign technology manufactured domestically under licensing agreements, technology manufactured domestically but with key parts imported from foreign countries, and joint ventures between foreign and domestic producers implying technological cooperation.

Results and discussion

In this section we use the database output to compare the results achieved by CDM projects for renewable electricity generation in China and India, highlighting the main potentials and limitations of this mechanism for their support. In examining the role of the CDM, however, we have to keep in mind that revenues from the generation of CERs are not the only reason for development of a RES project, but represent only one of the elements contributing to their profitability and attractiveness.

Both in China and in India, renewable technologies were in operation long before the introduction of the CDM scheme, supported in various ways by central and local government policies. By making these projects more attractive to investors through the revenues of the carbon trade, however, the CDM is further supporting their development, helping to overcome some of the barriers that still hinder their deployment and which are mainly related to their economic profitability and the availability of the technology domestically.

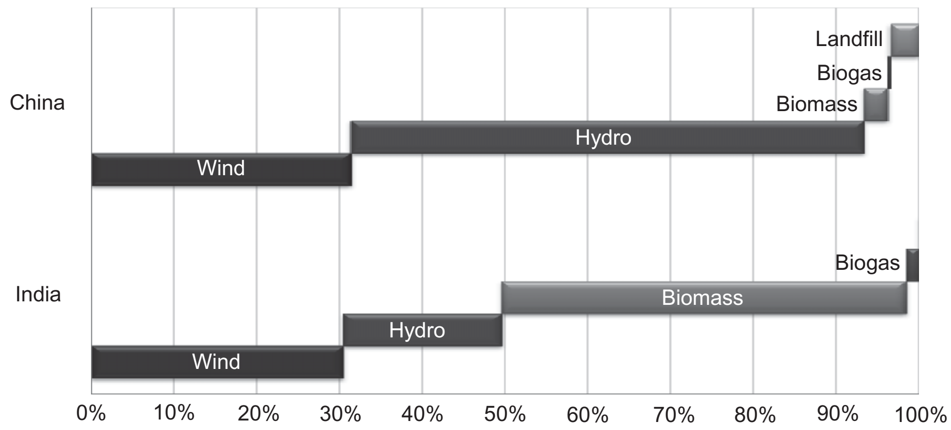

Figure 2. CDM project distribution across technologies.

CDM project distribution across technologies

As of 15 April 2009, CDM projects for renewable electricity generation in China and India accounted for 73.6% and 58.9%, respectively, of all registered CDM projects. Their distribution across different renewable technologies shows very strong differences. In China, the vast majority of projects are hydropower projects, followed by wind, landfill gas, biomass and biogas projects. On the other hand, in India, the vast majority of projects are biomass projects, followed by wind, hydropower and biogas projects. There are no landfill gas projects in India leading to the generation of electricity (Figure 2).

Besides these differences, one common feature between the two countries is the concentration of projects around only a few renewable technologies. There are several renewable technologies that are not benefiting from the CDM scheme, for example, solar photovoltaic (PV) in particular. The main explanation for this result probably lies in the fact that these projects are still far away from their financial viability threshold and, given their high capital costs and their reduced electricity output, the revenues from the carbon trade are not sufficient to bring them to financial closure. The high up-front investment costs would require stronger support mechanisms to ensure their financial viability. The high transaction costs associated with the CDM procedure constitute another disincentive.

In view of the likely revision of the CDM in the post-Kyoto period, this is a limitation of the current mechanism design that should be taken into consideration. One possible improvement, put forward in the CDM literature, proposes to make these projects more appealing by differentiating the credit generation rate of different project categories (Chung 2007; Schroeder 2009; Van Asselt et al. 2009). Technologies that are still at the development stage, and which do not reach a pre-determined level of diffusion in the host country, could be encouraged by the application of a full or enhanced credit generation rate compared to other technologies, like hydropower or wind, which have already reached a higher level of maturity, profitability and diffusion. The discounting or multiplication of the number of CERs from certain project activities should of course not be limited to the renewable sector but involve all project types. As we will see later, this approach would also partially address the additionality dilemma.

Installed capacity and project scale

When we compare the total installed capacity in the two countries, it appears clear that China has attracted the lion's share of renewable CDM projects. As of 15 April 2009, the total installed capacity in China reached 13.5 GW, while in India was only 3.8 GW. This result can be explained not only by the total number of projects in the two countries, which is much higher in China (376 against 246), but also by their average size. In China there is a much higher share of large-scale projects. The only category where we can find a substantial number of small-scale projects is hydropower, where they total 53% of all projects (Table 1). The higher share of small-scale projects in the hydropower sector is not only attributable to the exploitation of smaller streams but also depends on the doubts that CDM large-scale hydropower projects have raised in the international community with reference to their externalities and – as we will see in the next paragraph – respect for the additionality principle. Regarding their externalities, the resort to the CDM scheme to co-finance large-scale dams has been the subject of much criticism by non-governmental organisations, worried about their social and environmental impacts, such as permanent inundation of vast areas, fragmenting of wildlife habitats, reduction of biodiversity, displaced communities and water resource reallocation. The magnitude of these impacts varies with the location and size of the dams, implying much higher negative impacts for large projects.

In India, the ratio between large- and small-scale projects shows a completely different and more homogeneous pattern. In all project categories, the majority of registered projects are small scale. In the biogas sector such a share reaches 100%, while in the biomass field, where we find the highest number of projects and installed capacity, the share of small-scale projects is as high as 78% (Table 2).

One of the main reasons for this difference in project scale is represented by the different kinds of investor in the two countries. In China most of the projects are developed

Table 1. Summary of main results – China.

Technologies	Scale	Tech. transfer	Registered projects	MW	GWh/yr	ktoe/yr[a]	kt CO_2 eq. by 2012
	Large	No	1	1.1	2.2	0.6	552
		Yes	0	0	0	0	0
Biogas	Small	No	0	0	0	0	0
		Yes	0	0	0	0	0
	Total		1	1.1	2.2	0.6	552
	Large	No	6	210.0	704.7	189.4	5005
		Yes	5	130.0	669.0	179.8	3541
Biomass	Small	No	0	0	0	0	0
		Yes	0	0	0	0	0
	Total		11	340.0	1373.7	357.9	8546
	Large	No	108	5503.5	21162.6	5686.4	103084
		Yes	2	208.0	801.6	215.4	1975
Hydro	Small	No	123	1314.8	5347.5	1436.9	19659
		Yes	0	0	0	0	0
	Total		233	7026.2	27311.7	7116.3	124719
	Large	No	0	0	0	0	0
		Yes	1	19.0	77.0	20.7	3639
Landfill gas	Small	No	2	5.5	27.1	7.3	1069
		Yes	10	36.0	216.1	58.1	8972
	Total		13	60.5	320.2	83.4	13680
	Large	No	47	2815.8	7175.9	1928.2	26460
		Yes	68	3217.2	7240.6	1945.6	37388
Wind	Small	No	0	0	0	0	0
		Yes	3	36.4	70.9	19.1	382
	Total		118	6069.3	14487.4	3774.8	64229
All projects			376	13497.1	43495.2	11333.1	211725

Note: [a]In the text the values are expressed in Mtoe. 1 ktoe = 0.001 Mtoe.

Table 2. Summary of main results – India.

Technologies	Scale	Tech. transfer	Registered projects	MW	GWh/yr	ktoe/yr[a]	kt CO_2 eq. by 2012
	Large	No	0	0	0	0	0
		Yes	0	0	0	0	0
Biogas	Small	No	4	7.2	29.4	8.9	908
		Yes	0	0	0	0	0
	Total		4	7.2	29.4	8.9	908
	Large	No	23	413.5	1855.3	559.9	15094
		Yes	3	63.0	228.6	69.0	1503
Biomass	Small	No	90	624.6	3460.7	1044.3	20448
		Yes	4	22.8	77.0	23.2	976
	Total		120	1123.9	5621.6	1696.3	38021
	Large	No	15	640.5	2340.1	706.1	8866
		Yes	1	22.0	113.4	34.2	487
Hydro	Small	No	30	169.9	739.0	223.0	4054
		Yes	1	5.0	23.6	7.1	96
	Total		47	837.4	3216.0	970.5	13502
	Large	No	7	307.3	579.6	174.9	2931
		Yes	16	1082.6	2126.2	641.6	14084
Wind	Small	No	28	240.7	485.2	146.4	2726
		Yes	24	184.2	377.2	113.8	2102
	Total		75	1814.7	3568.2	1076.7	21843
All projects			246	3783.2	12435.2	3752.4	74274

Note: [a]In the text the values are expressed in Mtoe. 1 ktoe = 0.001 Mtoe.

by state-owned companies ready to make large upfront investments, while in India they are mostly developed by mid-sized private companies that prefer lower risk projects not requiring high capital (Gorina 2007).

Generally speaking, small-scale projects are assumed to entail a higher positive sustainable development impact as they are often community-based and can therefore help meet the needs of rural people, promote electrification of remote areas and alleviate poverty. According to the sustainability assessment carried out by Olsen and Fenhann (2008), small-scale projects tend to deliver more economic and social benefits than large-scale projects, even if differences are often more likely due to the nature of the projects than to their scale. Small-scale projects' high transaction costs, however, together with the relatively low CERs flow they can achieve, make participation in the CDM scheme less appealing.

In some cases, a partial solution could be to resort to a special CDM category, the Programme of Activities (PoA), which allows the bundling and registration of several projects together under one organisational umbrella. As of 15 April 2009, there were only three PoAs in China and two in India, all of them still at the validation stage.

The additionality principle

Additionality is the concept used to verify that emission reductions due to CDM projects would not have resulted from business-as-usual investments. The additionality check is of particular importance for the environmental integrity of the Kyoto Protocol, as non-additional carbon offsets rewarded under the CDM scheme increase global emissions and deliver a negative result in the global effort to combat climate change. Furthermore, investing substantial financial resources in projects that are non-additional results in a diversion of funds from projects that really need assistance.

Several observers have pointed out that the CDM is financing many non-additional projects worldwide. Some renewable electricity project categories, hydropower and wind in particular, have attracted much criticism, as they are often deemed to be already economically viable without help from sale of the carbon credits. In China, in particular, many large-scale hydropower projects were already either under construction at the time of requesting registration or already planned by the government or developers regardless of the extra financing (Haya et al. 2002). Furthermore, the CDM Executive Board has recently challenged the additionality of many Chinese wind projects, claiming that the Chinese government has lowered subsidies for wind power in an effort to make them qualify for the CDM. Additionality concerns have been raised also with reference to many Indian projects, particularly hydropower and wind projects (Michaelowa and Purohit 2007; Haya 2009).

The respect of the project additionality is crucial for the credibility of the CDM and will have to be carefully considered in negotiation of the future climate regime. Currently, there are many options under consideration for reforming the structure of the CDM or to adapt it to new arrangements in the post-2012 climate framework (Michaelowa 2005; Chung 2007; Schroeder 2009; Van Asselt et al. 2009). As already mentioned, while waiting for a more structural reform of the CDM, a partial solution could be to lower the credit generation rate of those technologies that have already reached a certain level of deployment or profitability in the host country. This adjustment would reduce the negative impact of non-additional projects without significantly altering the current functionality of the CDM.

Generated electricity

The results in terms of electricity produced reflect the overall capacity installed in the two countries and the different performances across technologies. If all the registered CDM projects analysed in this study were duly implemented, their contribution to national electricity generation would amount to 43.5 TWh in China and 12.4 TWh in India. Just to give an idea about the size of this contribution, CDM projects' electrical output up to 15 April 2009 represented 1.6% of 2007 total electricity generation in India and 1.3% in China. Even if this result is still very limited, it is relevant in countries where electricity supply does not always succeed in keeping pace with rapid demand growth, and where power shortages still occur frequently. Their contribution is also important as an alternative to the expansion of fossil fuel-based generation at a time where huge investments are needed to meet rising demand. Furthermore, some project categories, biomass and micro/mini hydropower in particular, can help promote electrification of remote areas through the generation of electricity at the point of demand, with minimal transmission and distribution costs. In so doing, they can also help to reduce energy poverty and create direct and indirect employment opportunities during the project construction and operation.

In India the project category with the biggest contribution in terms of electricity generation is biomass (5.6 TWh), mainly bagasse generated from the crushing of sugarcane and rice husks from the milling of paddy. In China the main contribution to the national electricity supply comes from hydropower projects (27.3 TWh). The amount of China's hydraulic resource ranks first in the world and the installed hydropower capacity to date only uses a fraction of the national technically exploitable potential (Chang et al. 2010). As already pointed out, however, additionality and social/environmental impact problems will pose a limit to the exploitation of this huge potential through the CDM.

Replaced fossil energy

CDM projects for electricity generation from RES displace the electricity generated by fossil-fuelled power plants, saving primary energy sources and contributing to national and international energy security. In terms of energy produced, if all the registered CDM projects analysed in this study were duly implemented and if they delivered the results claimed in the PDDs, they would replace about 11.3 Mtoe of fossil energy per year in China and 3.8 Mtoe in India, equal to about 0.6% of both countries' total primary energy supply in 2007. The savings in the two countries together would exceed the combined total primary energy supply of Lithuania, Luxembourg and Malta in 2007.

Emission reductions

Reducing greenhouse gas emissions is the main objective of CDM projects, as they aim at generating emission credits for the carbon market. If expectations and projects' performance match up, by the end of 2012 China and India will have delivered about 286 Mt CO_2 equivalent emission reductions, surpassing Turkey's CO_2 emissions from fuel combustion in 2007.

Technology transfer

Both in China and in India, the overall share of projects involving technology transfer is quite limited (23.7% and 19.9%, respectively), and it varies significantly across different project categories (Figure 3). Hydropower projects rely almost completely on domestic technologies: in both countries technology transfer was claimed in only two projects out of 47 (4.3%) and 233 (0.9%) projects, respectively. Wind projects rely more on foreign technology. The share of projects claiming some form of technology transfer reaches 53.3% in India and 60.2% in China. Biomass is the only project category that shows a relevant difference between India and China. While in India biomass projects rely mainly on domestic technology, with only 7 projects out of 120 claiming some form of technology transfer, in China 5 projects out of 11 use an imported boiler. Biogas projects, on the other hand, rely completely on domestic technology in both countries. Landfill gas projects are only present in China, where the share of projects using a foreign technology reaches almost 85%.

As for the relation between project scale and technology transfer, our results confirm the findings of previous studies, according to which technology transfer is more common for large-scale projects (Dechezlepretre et al. 2008, 2009; Seres and Haites 2008; Teng and Zhang 2010). However, while in India the share of large-scale projects involving some form of technology transfer is always consistently higher than that of small projects, in China this difference is less pronounced. The only exception is represented by small-scale wind projects in China, all of which entail technology transfer.

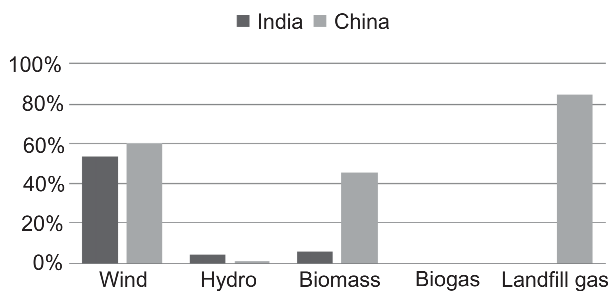

Figure 3. Share of technology transfer by project category.

Conclusions

Our analysis has highlighted many similarities and differences in the way CDM projects for renewable electricity generation have been implemented in China and India. China has attracted the lion's share of these projects, which total 73.6% of all registered projects against 58.9% in India. Their distribution across technologies varies significantly in accordance with the different exploitation potentials, the national economic structures and the development priorities set by the respective governments.

China dominates in large-scale projects, while in India the ratio between large- and small-scale projects shows a more homogeneous pattern. Both in China and India, the overall share of projects involving some form of technology transfer is quite limited and varies significantly across different project categories. In both countries, however, large-scale projects usually entail a higher share of technology transfer, even if this difference is more pronounced in India than in China. In terms of electricity production and replaced primary energy, the results achieved by CDM projects in both countries, however limited, can still make an important contribution to diversification of the electricity mix and to reducing the dependency on fossil fuel resources.

In conclusion, so far the CDM has been an important driver for investments in the renewable energy sector of China and India, where it has co-financed a substantial number of projects. The revenues from the carbon trade have contributed to renewable projects' profitability and attractiveness, adding a further incentive to the existing national supporting environment. The case of China and India can provide a useful lesson for the development of CDM projects in the renewable energy sector of other developing countries that still lag behind in the use of this international mechanism.

Some major problems, however, still remain and they are mainly related to the distribution of projects across different technologies and to the environmental integrity of the mechanism. These issues need to be properly addressed in the post-2012 climate regime. Among the many different solutions proposed by the CDM literature, we find that the differentiation of the credit generation rate of different project categories could bring some level of improvement without significantly altering the current system's functionality.

Note

1. Directive 2009/28/EC of the European Parliament and of the Council of 23 April 2009 on the promotion of the use of energy from renewable energy sources and amending and subsequently repealing Directives 2001/77/EC and 2003/30/EC.

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