Fruitful design: the **CDM**

As the famous Rolling Stone's song goes: "You can't always get what you want, but if you try sometimes, well you might find, you get what you need". What we want, and what we need are sometimes quite different things. In some ways, this may epitomize the United Nations' Clean Development Mechanism (CDM), a market based mechanism that creates a way for developed countries and companies to offset their emissions by investing in developing country projects that reduce emissions. The mechanism has certainly had its ups and downs in the decade it has been running. Many have *wanted* more than the mechanism has or could deliver, or *expected* less than it has actually achieved. Recent analysis by the UN Convention on Climate Change (UNFCCC) secretariat,[1] shows, however, that the CDM has provided what is really *needed* and has likely *delivered* more than it was initially designed to do in some areas.

Although the CDM is not perfect, it *is* driving low carbon transformation in developing countries by providing a channel for investment in cost-effective renewables. For example, new, clean renewable energy CDM projects account for more than 110,000MW of renewable electricity capacity, which is about the same as the total power generation capacity of Africa. Doing so has created technology transfer, catalyzed foreign and domestic investment and contributed to sustainable development. Given the need to shift energy production from fossil fuels to renewables to fight climate change, this international offset mechanism represents an important driver of a low emissions future for developing countries. This article examines several key areas of the CDM identified in the Benefits of the CDM 2012 report: finance, cost savings, technology, efficiency, size, potential, viability and sustainable development.

The Big Picture

The CDM is an example of how a complex international market mechanism can reduce emissions cheaply and efficiently and catalyze low carbon development in developing countries. The mechanism has provided carbon reductions equivalent to the emissions from about a fifth of the world's cars over one year[2] and saved at least USD3.6 billion in emissions reduction costs. It has mobilized USD215 billion of investment in developing countries. Of this amount, USD92.2 billion – roughly equivalent to the combined foreign direct investment in Denmark, France and Germany in 2007-2011 – is already invested, with the balance expected shortly.

To keep climate change within the agreed safe limit of 2°C, emissions need to be around 12 billion tonnes of carbon dioxide equivalent (tCO_2e[3]) less per year than

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[1] This article is based on a study of over 4000 CDM projects currently underway. The study, Benefits of the Clean Development Mechanism 2012, is available on the UNFCCC CDM website <https://cdm.unfccc.int/about/dev_ben/index.html>.

[2] Calculated by 5.2tCO_2e per passenger vehicle and about 1 billion cars on the road globally (EPA data and Wards Auto information). Other ways of looking at this are 'climate wedges', for example halving the number of car miles driven in a year is at least a billion tonnes of carbon dioxide equivalent emissions. See <http://cmi.princeton.edu/wedges/intro.php>.

[3] Given that some greenhouse gases are more potent in their effect on global warming, the standardized measure of emissions is tCO_2e, to make all gases commensurable with the effect of carbon dioxide. This 'global warming potential' (GWP) was developed to compare the ability of each greenhouse gas to trap heat in the atmosphere relative to another

business as usual by 2020.[4] In September 2012, the CDM passed the milestone of reducing 1 billion tCO_2e of greenhouse gases: roughly equal to the whole of Japan's emissions in 2009[5] or the yearly emissions of all the cars in six major EU economies.[6]

The CDM is the undisputed heavyweight carbon offset champion of the world. It is the first to explicitly create incentives for investment in clean technologies in developing countries at scale. It is the first policy instrument to operationalize over 200 quality-assured methodologies[7] that have been used to reduce emissions, monitor them and effectively price carbon globally. The CDM is also the first transparent international investment mechanism, enabling *local* and g*lobal* stakeholder consultation. Although some have noted that stakeholder consultation could be enhanced, through public disclosure the CDM has willingly spurred dialogue on key issues such as project type and location, investors, technology and dispute procedures allowing civil society to openly raise issues on integrity, human rights and sustainable development in global low emissions investments. In the decade since projects started generating carbon credits (aka 'Certified Emissions Reductions', or CERs), there has been a healthy and, sometimes controversial, debate about whether the CDM has achieved these goals. What is clear, however, is that there are few international mechanisms that are as open, transparent and engaging on a global level as the CDM.

Rolling with the punches of critics, and constantly being improved through policy decisions of its Executive Board, the CDM has evolved in a fast-shifting political and environmental landscape. It has been under constant amendment, change and evolution to achieve its two major goals: cost effective emissions reductions and contributing to developing countries' sustainable development.

Delivering 'bang for buck'

Core to the design and viability of the CDM was its ability to reduce global greenhouse gas emissions in the most economically efficient way possible. Since there are, generally, more inefficiencies in developing countries and greater opportunities to meet rapidly growing energy demands with renewables, it makes sense to reduce emissions there, where the cost savings are greater. You can do a lot more for a lot less per tonne of GHG emissions reduced in New Delhi or Rio compared to Berlin.

In fact, the cost of mitigation can really be quite inexpensive. Even with the current low price of CERs in the market, CDM projects may still be viable; for example, for projects with longer crediting periods have an average mitigation cost over the project's full lifetime of around USD0.5t/CO_2e,[8] which is below even the current lows in the CER market. This means 1 tonne of CO_2e is roughly

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gas over 100 years in the atmosphere. E.g. 1 tonne of HFC-23=11,700 tCO2e <http://www.ipcc.ch/ipccreports/tar/wg3/index.php?idp=144 >.

[4] UNEP 2010, *The Emissions Gap Report – Technical Summary.* United Nations Environment Programme, Nairobi.

[5] http://www.guardian.co.uk/news/datablog/2011/jan/31/world-carbon-dioxide-emissions-country-data-co2

[6] The CDM has reduced the equivalent of 196 million passenger vehicles that emit on average 5.1tCO2e per year, which is approximately the same as the total cars in the UK, France, Germany, Spain, Italy and The Netherlands (194.4m vehicles)

[7] As of 26 November 2012, a total of 207 methdologies have been approved by the CDM <http://www.cdmpipeline.org/cdm-methodologies.htm#1>.

[8] See Benefits of the CDM 2012, p. 52.

equivalent to the price of a kilogram of maize;[9] or, for the price of a café latte[10] you can reduce 7.5 tonnes.

As a result, the CDM has saved developed country governments, and their institutions, at least USD3.6 billion in emissions reduction costs between 2008 and 2012. For comparison, this is just over what Toyota Motor Company made in profits in 2011.[11] Industrial factories in the European Union (EU) saved over USD1.5 billion between 2008 and 2011 because of cheaper emissions reductions, and the option to use their CDM credits in the EU Emissions Trading Scheme (EU ETS).

One of the original design goals of the CDM has been met: all project types require less money to implement under the CDM than they would in similar, non-CDM projects in developed countries. It *is* more economical to invest in a project in, for example, Kenya, than to invest in a similar project in the UK. For example, a solar photovoltaic project is 15% less capital intensive, while geothermal and solar thermal projects require 50% less capital to implement under the CDM, than similar projects in Europe.

Two things have made a big difference in achieving these savings: flexibility in using different project types and flexibility in timeframes for generating and selling carbon credits. Some projects are far more expensive than others. For example, solar photovoltaic and solar thermal energy projects cost the most to reduce emissions (at more than USD300 per tCO_2e); however this is where carbon finance is being channeled, and is needed most to overcome barriers to implementation. Solar cooking and water heating projects, on the other hand, are much cheaper, at around the price of a cup of coffee per tonne of emissions reduced (average mitigation costs of USD3/tCO2e and USD2/tCO2e[12]).

The flexibility of the CDM for generating carbon credits over different time frames has resulted in lower emission reduction costs. Projects with a 21 year window for credit generation are significantly more cost effective than those with shorter time frames.[13] These projects yield long-term low carbon benefits in host countries because the lifetime of the project can extend beyond the crediting period when CERs are created. The mechanism is providing the co-finance needed to get projects get off ground, and creating new emissions reductions that are less expensive than often thought and last over long project lifetimes. The maturing CDM market means that the 'carbon cowboy' days of windfall profit making[14] have been replaced with better information in the market and deals that reflect the more balanced interests of different project participants: developers, buyers, and communities.

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[10] Based on average price of a Tall Starbucks Latte (USD3) and an average mitigation cost of USD 0.4 /t CO2 e (see Benefits of CDM up to 2012 report, p. 51.

[11] <http://money.cnn.com/magazines/fortune/global500/2012/full_list/>

[12] See Benefits of the CDM 2012, p. 51.

[13] The mitigation cost is the average cost of reducing emissions by one tonne of CO_2 equivalent for a project over its lifetime (p. 51) –i.e. Total mitigation beyond the crediting period, but not including calculations on the transaction costs for inclusion in the CDM. Flexibility in crediting period is important for security in containting costs (they go up for fixed, shorter crediting periods, although Rahman et al 2012 do not find this). See Benefits of the CDM 2012, p. 51.

[14] 'Carbon Cowboys' was a term used in the mid-late 2000s to describe people profiteering in the new carbon markets, both in the CDM and in the parallel voluntary carbon offset markets.
http://www.guardian.co.uk/business/2007/jun/18/consumernews.money

Size (and scope) matters

Key to making the CDM a success was catalyzing sizeable prospective investment from the private sector. The CDM seems to have achieved this: the total investment in registered or soon-to-be registered CDM projects as of June 2012 was estimated at USD 215.4 billion.[15] This is significant: it's approximately equivalent to the combined renewable energy investment of USA, India, Europe and China in 2011 (USD216bn).[16] In total, projects currently being checked for eligibility into the mechanism (i.e. validation) could also be worth around USD80 billion; close to the combined net worth of Microsoft Founder, Bill Gates and Google Co-Founder, Larry Page (US$79.9bn).[17] Although further scale up of these investments is still needed, the CDM has provided a start.[18]

It's not small fry: there are large numbers of capital-intensive projects that would not have happened without the mechanism. Investment is dominated by wind and hydro projects due to the large number of these types and the capital-intensive nature of these technologies. Total annual investment peaked in 2008 with USD40.4 billion being invested in all projects, including those undergoing validation. This is comparable to the total investment in clean energy in 2008 in Brazil, the Americas (excl. USA and Brazil), Middle East, Africa, China and India (USD50.8bn).[19] So, although the CDM has worked hard to include other small-scale projects, the mechanism has also created the right incentives to 'go big' in its emissions reductions, investments and ambitions. The CDM continues to contribute to a significant proportion of total investment in low carbon technologies. For example, global investment in renewable energy reached a record USD257 billion in 2011, a 17 percent increase from the amount invested in 2010.[20] 2011 investment in the CDM was around USD28 billion, representing 11% of total investment in renewables that year, and nearly a third of investment in renewables in developing economies.[21]

The size of CDM projects has also been important in generating efficient emissions reductions. For example, CDM projects are often three or four times larger than similar projects not created under the CDM (e.g. other renewable projects in developed countries). Geographic location plays an important part: because the CDM is focused on developing countries, investors can capitalize on the growing demand for electricity, and fill the gap with clean, renewable energy, taking advantage of the space and size of projects available. Such large renewable projects are difficult to implement in crowded areas, for example, in Europe where planning regulations are tighter.[22] Capitalizing on the size opportunities, the CDM has an average investment per project of USD45million. These projects are bigger, more cost effective and reduce more emissions than their developed-country counterparts.

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[15] See Benefits of the CDM 2012, p. 8.

[16] UNEP, 2012 *Global Trends in Renewable Energy Investment Data Pack, fig 13, p. 14* Link: fs-unep-centre.org/sites/default/files/attachments/unepglobaltrendsmasterdatapack2012.pdf

[17] REN21, 2011. *Renewables 2011 Global Status Report*, Paris: REN21 Secretariat. Pp. 35-37

[18] EU 2011, *Governance of the CDM Report*.

[19] UNEP, 2012 *Global Trends in Renewable Energy Investment Data Pack. p. 15* Link: fs-unep-centre.org/sites/default/files/attachments/unepglobaltrendsmasterdatapack2012.pdf

[20] REN21, 2012. *Renewables 2012 Global Status Report*, Paris: REN21 Secretariat. P. 15.

[21] REN21, 2012. *Renewables 2012 Global Status Report*, Paris: REN21 Secretariat. P. 15.

[22] See Benefits of the CDM 2012, p. 45.

The mechanism has also contributed to so-called transition fuels and scenarios: natural gas (~27,000 MW) and high efficiency coal (~16,000 MW), although not renewable, are contributing to lower emissions in energy sectors. Improving the efficiency of these sectors is important, according to the International Energy Agency, because fossil fuel energy generation is likely to continue to play a significant role in energy generation in the decades to come.[23] For example, while coal-fired power generation will remain considerable, increasing the efficiency of existing and new plants could reduce CO_2 emissions through 30% more efficient power production than current global averages. To really bring change to low carbon energy systems, however, developing country fiscal regulation must also provide the necessary support to create incentives to improve efficiency and help international market mechanisms create shifts in energy infrastructure.[24]

While the CDM has catalyzed a significant amount of large projects, it is also driving the implementation of smaller projects to fit smaller investments. For example, high efficiency light bulbs and cookstoves have proven worthwhile investments that create emission reductions over entire regions and bring high local sustainable development benefits.[25] In addition, despite low CER prices, and the end of Kyoto's first commitment period for emissions reductions, there are still opportunities to see more low-carbon growth in developing countries, particularly in regions that have been under represented in the CDM. What is key to note here, however, is that any market relies on a healthy demand for its products: even though the low hanging fruit exists, there needs to be a demand for emissions reductions to enable them to be picked.

High potential, driving change

The CDM helped start turning the flywheel of international low carbon investment. The mechanism has catalyzed between USD21.5 and USD43 billion in foreign investment in projects to date. This is roughly equivalent to total foreign investment in France in 2011 (USD43bn)).[26] Although relatively small, this investment has grown over the life of the mechanism: foreign finance has started to play a bigger part in CDM investment, from only 5% in 2000 to around 30% in 2012.

Although technology transfer chains are complicated, analysis shows that the CDM has significantly affected technology transfer to developing countries. The mechanism helps develop local expertise by paving the way for local uptake of technologies, knowledge and understanding. Approximately one third of CDM projects claim to actively transfer technology, although in reality this is likely to be higher.[27] On average this means about one-third of all CDM projects bring equipment and/or knowledge to developing countries, but many more use technology already brought into countries as a result of the CDM.[28]

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[23] <http://www.iea.org/Textbase/npsum/ETP2012SUM.pdf>

[24] Hepburn, C., 2009. International carbon finance and the Clean Development Mechanism. In D. Helm & C. Hepburn, eds. *The Economics and Politics of Climate Change*. Oxford: Oxford University Press, pp. 409–432.

[25] Simon, G.L., Bumpus, A.G. & Mann, P., 2012. Win-win scenarios at the climate–development interface: Challenges and opportunities for stove replacement programs through carbon finance. *Global Environmental Change*, 22(1), pp.275–287.

[26] UNEP, 2012 *Global Trends in Renewable Energy Investment Data Pack. p. 15* Link: fs-unep-centre.org/sites/default/files/attachments/unepglobaltrendsmasterdatapack2012.pdf

[27] See Benefits of the CDM 2012, p. 29, 32.

[28] See Benefits of the CDM 2012, p. 27, 31, 37

Technology transfer is more common for larger projects. This can be seen as a win-win: the mechanism is reducing *larger* amounts of emissions by catalyzing transfer of technology that is also new to a country and, since this technology has not been implemented before, it shows that technology is not being transferred in non-CDM channels (e.g. foreign direct investment (FDI)). Secondly, technology transfer declines as the number of CDM projects of a given type in the country increases,[29] meaning that in-country knowledge specific to a project is more readily available and can be accessed domestically.

Although complex, it seems that the CDM significantly contributes to both equipment and know-how transfers.[30] By creating a proxy price on carbon in developing countries it makes previously unappealing technologies commercially viable, and helps improve the *quality* of technology transfer through partnership with international intermediaries and technology providers.[31] For example, technology and know-how for CDM projects tend to come from a relatively small set of countries: Germany, USA, Denmark, Japan and China are the top suppliers. The global links created by the CDM are helping support green growth programmes using low carbon technologies to bridge countries and share knowledge on effective emissions reductions. In addition, technology transfer also tends to be less common for larger, wealthier countries as measured by population, GDP and GDP per capita. This demonstrates that the CDM could play an important role in bringing new technologies to smaller, developing countries, supporting the fourth key pillar of the Bali Action Plan, created by the Parties to the Climate Convention in 2007.[32] Reform, however, may be needed to overcome barriers to implementation in these smaller economies.

Despite differences in uptake, the CDM *is* oiling the wheels for wider low emissions pathways in developing countries by creating examples of how foreign capital focused on low emissions technology can work in new countries. Key to a thriving international economy is the ability for investors to invest across borders. For example, the USA is both the highest source, and recipient, of foreign direct investment.[33] FDI outside of member countries of the Organisation for Economic Co-operation and Development increased to 47% in 2010 (from 23% in 2000) illustrating that the CDM is part of, and potentially helping to catalyze, investment and innovation across borders. By creating an economic asset – a CER – domestic country investors are able to prove the value of investments, sell credits to the developed world and show that investment patterns can change.

Sustainable Development

Understanding sustainable development (SD) in the CDM has always been a tough nut to crack, especially in trying to prove the CDM's contribution to this

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[29] See Benefits of the CDM 2012, p. 31.

[30] Renssen, S. van, 2011. Driving technology transfer. *Nature Climate Change*, 1(6), pp.289–290.

[31] Schneider, M., Holzer, A. & Hoffmann, V.H., 2008. Understanding the CDM's contribution to technology transfer. *Energy Policy*, 36(8), pp.2930–2938.

[32] Christoff, P., 2008. The Bali roadmap: Climate change, COP 13 and beyond. *Environmental Politics*, 17(3), pp.466–472.

[33] <http://www.oecd-ilibrary.org/docserver/download/3011041ec038.pdf?expires=1353907230&id=id&accname=guest&checksum=4A61D2F84C3A4F98F66D3FDDA9362618>

important, but elusive, goal. Many critics have noted that the CDM has contributed to SD, but perhaps not significantly. One problem in measuring SD is the difficulty in obtaining data 'on the ground' at a scale large enough to examine the sustainable effects of CDM projects. Most studies use the information given by project developers in their project design documents (PDDs), in which case almost all CDM projects claim multiple SD benefits, but these change according to project type. SD indicators noted in the PDDs of nearly 4000 CDM projects show that stimulation of the local economy, including job creation and poverty alleviation, has consistently been the most cited benefit, followed by reduction of pollution and promotion of renewable energy and energy access.

An important conclusion of the UNFCCC study, however, is that the CDM may have more SD benefits than are typically claimed. For example, the development and diffusion of technology and know-how might be reported less often than it actually occurs: technology transfer is being understated in project claims. Analysis shows that more than half of projects that do not claim tech transfer do, in fact, use technologies from other CDM projects or imported knowledge and/or equipment. It is, therefore, likely there are other SD benefits, technology development or otherwise, that occur 'on the ground', but which are not currently reported.

The indicators provided in the PDDs are, however, only a reflection of what a project is expected to contribute at the time it is being validated. Because project participants need a letter of approval from the host country government to register their project, the SD benefits tend to reflect the direct sustainable development policies of those governments. Actual SD benefits may, therefore, be different.

A UNFCCC survey of project participants *after* projects had been registered showed that for 63% of the projects up to at least half of the indicators matched; a reasonable amount of overlap, but far from absolute in the types and amounts of SD benefits created by the CDM. In addition to claimed versus actual benefits, it is also difficult to assess the additional SD benefits of what would have happened in the baseline scenario – e.g. a renewable energy project created *without* CDM carbon finance. There also may be a trade-off between how additional a project is and its contribution to SD – a challenge that future market mechanisms may need to address.

The CDM is also underrepresented in many countries with small economies and low emissions, including many countries in Africa, the Least Developed Country (LDC) group and some in Asia. For example, over half the LDCs currently eligible for CDM do not have a single project. A lack of underlying project finance – especially early stage and seed funding for CDM and other transaction costs – is preventing projects from being established in these countries. Opening the door just a little, however, may help provide conditions to scale up investment: one or two CDM projects implemented provide a good foundation for additional CDM activities by building awareness and private sector capacity that can help develop more projects.[34] Policies may change this distribution, for example the

[34] Okubo, Y. & Michaelowa, A., 2010. Effectiveness of subsidies for the Clean Development Mechanism: Past experiences with capacity building in Africa and LDCs. *Climate and Development*, 2(1), pp.30–49.
Burian, M. et al., 2011. Analyzing CDM Implementation Barriers. Available at: http://jiko-bmu.de/files/english/application/pdf/ssa_barriers.pdf [Accessed December 2, 2012].

EU's decision to only allow credits from CDM projects in Least Developed Countries (LDCs) from 2013 onward, but underlying finance is key to supporting this redistribution of green growth through the mechanism.

Looking to the future

The CDM has been one of the world's largest policy experiments attempting to deal with two of the most pressing and difficult challenges of our time: climate change and sustainable development. It is no wonder it has not achieved everything that stakeholders wanted. On balance, however, it seems it has achieved what was *needed* by largely fulfilling its original design objectives: efficiency in emissions reductions and contributing in different ways to sustainable development. The CDM has kick-started new low carbon, green growth and decarbonisation of rapidly growing economies.

But perhaps it even achieved a little more with benefits not envisaged when it was originally designed. It has created cheaper and larger renewable energy production than in developed countries; it has led to new investment, know-how, technology and expertise transfer; and it has created new jobs and green economic growth in developing countries. The CDM contributes to creating this capacity over time providing wider value than 'just' individual project implementation.

There are still questions to be answered on the CDM. Total contribution to SD is still largely unknown. Including SD reporting in the CDM may help create a wider and deeper understanding of SD benefits, as will defining a set of international indicators on the CDM – single case studies tend to show extremes of 'good' and 'bad' projects obscuring the big picture. Much of the untapped potential for cost efficient emissions reductions also still exists. It is essential, as the mechanism develops, to better engage in dialogue on the potential merits of scaling up processes, the role of the private sector in implementing them, and engaging developed and developing countries in the early stage of designing mechanisms to gain their confidence in the process that follows.[35] Indeed, 'new' market mechanisms are currently being discussed to assist with future emissions reductions. This analysis shows that the CDM has helped provide the building blocks for some of these future schemes: methodologies for counting carbon, capacity-building in developing countries, accounting rules for emissions reductions, international transaction logging and governance, and transparency structures at local and global levels.

There are significant opportunities for building on the success of the CDM, supporting cost efficient developed country emissions reductions and promoting green growth in developing countries. So, although all the wants may not have been achieved, the CDM has given the world what it might have needed: an example of an international project creation and trading mechanism for reducing emissions at scale, catalyzing renewable investment where it previously didn't exist, creating technology transfer and contributing to sustainable development. Not bad for a mechanism created in a few lines of text back in 1997.

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[35] Nyaoro J, and Chaterjee B. 2011, *Briefing Paper "Governance of Clean Development Mechanism"*, AEA Technology. <http://ec.europa.eu/clima/policies/ets/linking/docs/governance_en.pdf> .

This article was written by Dr. Adam Bumpus based mainly on the Benefits of the Clean Development Mechanism 2012 report published by the UNFCCC secretariat https://cdm.unfccc.int/about/dev_ben/ABC_2012.pdf. Dr. Bumpus, a specialist in international development and carbon markets, lectures at the University of Melbourne on sustainable development and the environment. He is co-founder of Apidae Development Innovations, a provider of climate and development research, advisory, implementation and communication services to help communities respond to climate change.