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Focus on the economics of climate change

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Moving from the CDM to "various approaches"

The Clean Development Mechanism (CDM) facilitated the emergence and deployment of low-cost greenhouse gas (GHG) abatement technologies such as destruction of industrial gases and capturing methane from landfills and coal mines. Some of these technologies are now ripe to "graduate" from the CDM into other, more mainstream, economic tools. The first such step was taken in September 2013 when the G20 leaders agreed to phase out HFCs – highly potent greenhouse gases – including HFC-23 that was the focus of 19 CDM projects. A potential HFC-23 abatement fund under the Montreal Protocol could reduce up to 1.8 Gt CO_2e by 2020 at a cost of under US$0.2 per ton of CO_2e, i.e. much cheaper than the price paid to CDM projects through carbon crediting. The next potential candidate technology to "graduate" from the CDM is the abatement of nitrous oxide (N_2O) emissions in the chemical industry, which have already been placed on the agenda of the Montreal Protocol.

Background: the CDM reveals low-cost GHG abatement options

An efficient search engine for low-cost abatement technologies

The Clean Development Mechanism (CDM), established under the Kyoto Protocol in 1997, is the largest carbon offset standard in the world with over 7,000 projects registered and over 1.4 Gt CO_2e emissions reduced as of January 2014 (UNEP Risoe 2014). About half of these emissions reductions were achieved with capital investments of less than US$2 per ton of CO_2e through industrial gas projects. In fact, if other revenues, such as those from the sale of electricity generated, are taken into account[1], it turns out that almost 90% of all carbon credits issued under the CDM by January 2014 had been generated at an average cost below US$13 per ton of CO_2e, i.e. below the average market carbon price in 2008-2012. The CDM has thus successfully reached its primary goal of reducing the cost of compliance with emissions reduction commitments under the Kyoto Protocol. The cheapest GHG abatement options exploited under the CDM included such technologies as destruction of highly potent industrial gases HFC-23 and N_2O, capturing methane from landfills and coal mines and hydro power.

About a third of all Certified Emission Reductions (CERs) – CDM carbon credits – issued by January 2014 came from 19 projects destroying HFC-23 located mainly in China and India. HFC-23, or trifluoromethane, is a highly potent GHG with a warming potential 14,800 times higher than CO_2 over 100 years (IPCC 2007). HFC-23 is a by-product of manufacturing HCFC-22, another industrial gas that is in turn used in refrigerants and as a chemical feedstock for manufacturing synthetic polymers. The success of HFC-23 destruction projects comes from their large size – a single factory reduces on average 4.3 Mt CO_2e per year – and their small capital needs: based on the capital investment data available for two CDM projects (CDM00472 and CDM00473) the abatement cost over the 7-year lifetime – the duration of the first crediting period – can be estimated at US$0.1 per ton of CO_2e avoided. Since the 7-year crediting period can be renewed up to two times, the real abatement cost is probably even lower. Other estimates of the HFC-23 abatement cost are also very low at below US$0.2 per ton of CO_2e avoided (IPCC/TEAP 2005).

[1] Please refer to the Annex for details about the methodology behind our cost estimations.

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Not an efficient mass distributor of clean technologies

As long as the price of CDM credits remained driven by the marginal abatement cost of European industries – an average US$21 per ton of CO_2e over 2008-2012, these projects were extraordinarily profitable. The numerous criticisms of these profits are partly anachronistic since the technology would likely not have emerged in the absence of the CDM “search engine”. Yet, once the search engine has revealed a low-cost opportunity, the efficiency of market-based tools such as the CDM is clearly questionable: remunerating cheap abatements at the marginal abatement cost of all technologies combined is clearly not the best use of scarce “climate finance”.

The environmental risk of the CDM decline

Despite the large GHG abatement potential and unquestionable additionality of HFC projects – there is no incentive to reduce these emissions other than to earn carbon credits – their environmental integrity was considerably dampened. This happened due to legislative loopholes that created a risk of issuing carbon credits through artificially inflating production before destroying the HFC-23 byproduct. These loopholes were identified and subsequently closed by the CDM Executive Board via introducing conservative baselines and banning new installations – those that have not operated for at least three years in 2000-2004 – from entering the scheme (Shishlov and Bellassen 2012). Nevertheless, the European Commission decided to ban the use of carbon credits from HFC projects in the European Union Emissions Trading Scheme (EU ETS) – the principal source of demand for CDM credits – as of April 2013. Since the only source of revenue for these projects is the sale of carbon credits, these plants are now likely to stop destroying HFC-23, potentially releasing 80 Mt CO_2e in the atmosphere annually, unless the issue is addressed through introducing other economic incentives or direct regulations.

News: the G20 summit agrees to phase down HFCs

A meeting of leaders of 19 major economies (plus the EU as a bloc), which took place on 5-6 September 2013 in St. Petersburg, Russia, led among other results to a commitment to a global phase down of HFCs using the mechanism of the Montreal Protocol, an international agreement aimed at protecting the ozone layer. Adopted in 1987, the Montreal Protocol aims at phasing out the production and consumption of ozone-depleting substances (ODS), notably chlorofluorocarbons (CFCs), halons, carbon tetrachloride, methyl chloroform and later hydrochlorofluorocarbons (HCFCs). The Protocol includes a dedicated financing tool – the Multilateral Fund – that assists developing countries with projects to phase out ODS. Since its creation in 1991 the Fund has disbursed over US$3 billion contributing to a complete phase-out of CFCs and halons by 2010 (UNEP 2013).

The decision of the G20 summit came three months after a bilateral agreement between the presidents of the USA and China to work together on phasing down HFCs. Earlier in 2013, the USA, Canada and Mexico submitted a proposal to amend the Montreal Protocol to include HFCs. The North American proposal included a target of achieving 15% of the baseline level by 2033 for developed countries and by 2043 for developing countries (A5 parties under the Montreal Protocol). If implemented, this proposal could phase down HFCs at the global level, and reduce on average 2.8 Gt CO_2e per year by 2050, including about 330 Mt CO_2e per year from HFC-23 emissions reductions only (UNEP/OzL.Pro.WG.1/33/3).

Analysis: HFC-23 phase-out can reduce up to 1.8 Gt CO_2e at under US$360 million by 2020; can other sectors join?

Abatement potential for HFC-23: large, cheap and readily available

The decision of the G20 summit potentially opens the door for financing the phase-down of HFCs, particularly HFC-23, through the Montreal Protocol Multilateral Fund. Curiously enough, HCFCs were initially seen as an intermediary replacement of ozone-depleting

CFCs. The Montreal Protocol already mandates the gradual phase out of HCFC-22 used for refrigerants by 2040, whereas the production for feedstock purposes is not regulated.

Nevertheless, fourfold increase in HCFC-22 production in developing countries in 2000-2008 resulted in a steep growth of HFC-23 emissions, which were estimated to be around 200 Mt CO_2e in 2007-2008, with 80% occurring in developing countries, mostly in China (Montzka et al. 2010). 19 registered CDM projects – including 11 in China and 5 in India – reduce around 80-90 Mt CO_2e per year, while another 8 Mt CO_2e are avoided by two Joint Implementation projects in Russia (UNEP Risoe 2014). Without Kyoto offset mechanisms, global HFC-23 emissions would thus most likely be 50% higher. The remaining plants were not eligible to enter the CDM scheme due to the aforementioned restrictions on new production facilities. The Environmental Investigation Agency (EIA 2013) estimated that 17 Chinese HCFC-22 production plants that are not covered by the CDM vent around 140 Mt CO_2e of HFC-23 by-products per year. Given the rapid increase in the production of HCFC-22 throughout the 2000s, this figure appears compatible with the latest available data from the Chinese national communication (2012) that reported HFC-23 emissions of 106 Mt CO_2e in 2005.

Tackling HFC-23 emissions through the Montreal Protocol Multilateral Fund could thus potentially reduce up to 300 Mt CO_2e per year if all HCFC-22 production was covered and up to 1.8 Gt CO_2e until 2020. Even at the high estimate of abatement cost of US$0.2 per ton of CO_2e, this would cost US$60 million per year, which appears to be feasible taking into account the Multilateral Fund’s 2012-2014 triennium budget of US$450 million.

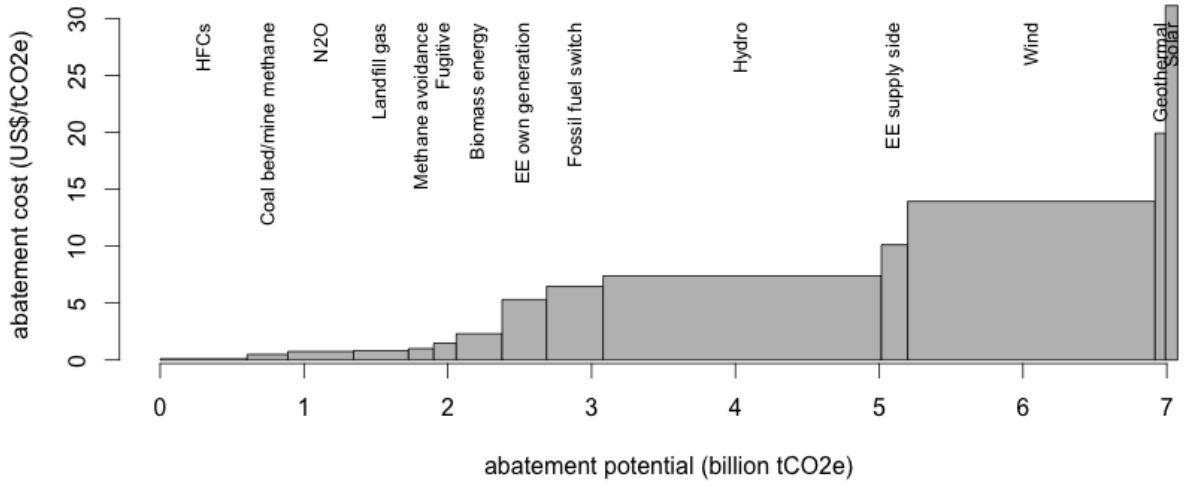
Now that the CDM has revealed the opportunity and low cost of HFC-23 abatement, the Multilateral Fund would be a much more efficient tool: it allows establishing an economic incentive closer to the actual cost of reducing emissions, thus improving the efficiency of environmental finance. Moreover, given the current CDM crisis, HFC project developers are likely to trade an improbable upturn in the price of carbon credits for the security of the Multilateral Fund. Hence, HFC projects are now ready to “graduate” from the CDM and to be tackled in a more cost-effective manner through such instruments as the Montreal Protocol.

The “CDM University” could produce more “graduates”, which would doubly help international climate negotiations

The bottom-up project-based approach of the CDM helped identify new GHG abatement technologies and provide information on their costs. The total emissions reduction potential of all registered CDM projects for 2013-2020 is about 7 Gt CO_2e according to the project design documentation. According to our estimates, about 5 Gt CO_2e of these reductions can be achieved at a median abatement cost of US$10 or less per ton of CO_2e. Low-cost GHG abatement comes mainly from projects focused on industrial gases HFC-23 and N_2O, coal bed/mine methane, landfill gas, biomass energy and hydro power (Figure 1).

The CDM Policy Dialogue that took place in 2012 already acknowledged that some technologies have matured enough to “graduate” from the CDM and pass to other forms of regulation. Taking into account the marginal abatement cost curve of the CDM, the most obvious next candidate technology for “graduation” after HFC-23 is the reduction of nitrous oxide (N_2O) emissions from the production of nitric and adipic acids. These projects offer large and concentrated emissions reduction potential at the marginal abatement cost of US$0.75 (Annex). Similar to HFC credits, CERs originating from 4 adipic acid CDM projects were banned from the EU ETS as of April 2013 posing a risk of 29 Mt CO_2e per year being released in the atmosphere should the projects cease their operations.

Figure 1 – Marginal abatement cost curve in 2013-2020 for registered CDM projects[2]



Source: authors' calculation (Annex) based on data from UNEP Risoe (2014).

The emissions of nitrous oxide have already drawn the attention of the Montreal Protocol, as the gas was also found to contribute to the ozone layer depletion (Portman et al. 2012). A similar approach could theoretically be applied to other low-cost abatement technologies, e.g. capturing landfill gas and coal mine methane, although their scattered nature would increase transaction costs compared to highly concentrated HFC-23 and N_2O emissions reduction projects. In addition, they would be difficult to relate to the ozone layer, and would thus have to find a different vehicle other than the Montreal Protocol.

As the HFC-23 case demonstrates, greenhouse gas mitigation can take other routes than the United Nations Framework Convention on Climate Change (UNFCCC) at the international level. While climate finance is at a standstill, these "CDM graduations" can be doubly helpful by quickly engaging new climate mitigation actions and by helping international climate negotiations to focus on the gases which are most important to mitigate climate change in the long-run, namely CO_2, CH_4 and N_2O.

To find out more…

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[2] Please refer to the Annex for details about the methodology behind the MACC.