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Perverse incentives under the Clean Development Mechanism (CDM): an evaluation of HFC-23 destruction projects

Abstract

The Clean Development Mechanism (CDM) under the Kyoto Protocol allows industrialised countries to use credits from greenhouse gas (GHG) abatement projects in developing countries. A key requirement of the CDM is that the emission reductions be real, measurable and additional. This article uses data from registered projects to evaluate the extent to which these objectives are met by projects that reduce hydrofluorocarbon-23 (HFC-23) emissions in the production of hydro¬chloro¬fluoro¬carbon-22 (HCFC-22). The data shows that HCFC-22 plants produced significantly less HFC-23 during periods when no emission credits could be claimed compared to periods when HFC-23 destruction could be credited under the CDM. Moreover, the total amount of HCFC-22 produced appears to be determined mainly by CDM rules. This suggests that the claimed emission reductions may partially not be real and that the CDM provides perverse incentives to generate more HFC-23. The accelerated phase-out of HCFCs under the Montreal Protocol on Substances that Deplete the Ozone Layer could worsen this situation. To address these issues an ambitious emission benchmark for the baseline HFC-23 emissions is proposed.

Introduction

The Clean Development Mechanism (CDM) under the Kyoto Protocol allows industrialised countries to use credits from greenhouse gas (GHG) abatement projects in developing countries. Article 12 of the Kyoto Protocol requires that emission reductions from CDM projects be real, measurable and additional. This article uses data from registered projects to evaluate the extent to which these objectives are met by projects that reduce hydrofluorocarbon-23 (HFC-23) emissions.

HFC-23 is a powerful GHG with a Global Warming Potential (GWP) of 11,700 for the first commitment period of the Kyoto Protocol. HFC-23 is an unwanted waste gas from the production of hydrochlorofluorocarbon-22 (HCFC-22) which is a GHG and an ozone depleting substance (ODS) regulated under the Montreal Protocol on Substances that Deplete the Ozone Layer. Hydrochlorofluorocarbons (HCFCs) were introduced as an alternative to highly ozone-depleting chlorofluorocarbons (CFCs) because of their lower ozone-depleting potential. However, they are currently being phased out under the Montreal Protocol and replaced by substances that do not deplete the ozone layer at all. HCFC-22 is mainly used as refrigerant in refrigeration and air conditioning appliances and as a feedstock in the production of polytetrafluoroethylene (PTFE). The production for emissive purposes, such as in the refrigeration and air conditioning industry, is regulated under the Montreal Protocol, whereas the production for feedstock purposes is not regulated under the Montreal Protocol.

In the absence of any regulation, the by-product HFC-23 is usually vented to the atmosphere. HFC-23 can be abated by reducing the by-product rate through process optimisation and by capturing the HFC-23 and installing a separate incinerator where it is thermally oxidised by burning a fuel together with air and steam. The HFC-23/HCFC-

22 ratio is typically in the range between 1.5% and 4%, depending on how the process is operated and the degree of process optimisation that has been performed (McCulloch and Lindley 2007). Process optimisation reduces but does not eliminate HFC-23 emissions. To reduce the HFC-23/HCFC-22 ratio below the 1% level, thermal oxidation in a separate incinerator is required (TEAP/IPCC 2005, page 410 and Irving and Branscombe 2002). For this reason all CDM projects abate HFC-23 by installing a new incinerator where it is thermally oxidised.

The destruction of HFC-23 has become the most important project type under the CDM. It is expected to provide the most significant emission reductions in the first commitment period of the Kyoto Protocol from 2008 to 2012; the 19 registered projects are expected to deliver a volume of 476 million Certified Emission Reduction Units (CERs) by 2012, which corresponds to about half of the emission reductions expected from all CDM projects (Pointcarbon 2010). 11 out of the 19 projects are located in China, 5 are in India, and South Korea, Argentina and Mexico each host one project.

The marginal abatement costs for destruction of HFC-23 are below 1 US$/t$CO_2$e and thus very low (UNFCCC 2005, Schneider et al. 2005, TEAP/IPCC 2005, page 427). In contrast, the revenues from CERs are huge. The Technology and Economic Assessment Panel (TEAP) under the Montreal Protocol concludes that "the net revenue per year for HFC-23 destruction could easily exceed the revenue from HCFC-22 sales" (TEAP 2007, page 57). This substantial revenue from CERs could provide perverse incentives for plant operators to produce more HCFC-22 and/or generate more HFC-23 than they would do without the CDM (Schneider et al. 2005, UNFCCC 2005, UNFCCC 2009, Wara 2006, Wartmann et al. 2006).

In 2005 the Conference of the Parties serving as the Meeting of the Parties to the Kyoto Protocol (COP/MOP) recognised "that issuing CERs for HFC-23 destruction at new HCFC-22 facilities could lead to higher global production of HCFC-22 and/or HFC-23 than would otherwise occur and that the CDM should not lead to such increases". The COP/MOP implicitly limited the crediting of HFC-23 to existing HCFC-22 production facilities and decided to continue deliberations on the crediting of new facilities. However, even four years later no conclusion was reached by the Parties.

The baseline and monitoring methodology for existing facilities aims to avoid perverse incentives to produce more HCFC-22 and/or HFC-23 through two safeguards:

1. The methodology caps the ratio between HFC-23 generation and HCFC-22 production used to calculate emission reductions. The methodology requires using the lower value between 3% and the lowest annual HFC-23/HCFC-22 ratio observed in a three-year historical period between 2000 and 2004. In the absence of historical data, a default value of 1.5% shall be used. The methodology implicitly assumes the plants would continue to operate during all crediting periods (i.e. up to 2030) at or above the historically observed HFC-23/HCFC-22 ratio.
2. The amount of HCFC-22 production that is eligible for crediting is limited to the maximum historical HCFC-22 production in the most recent three years within the period from 2000 to 2004, including an equivalent amount of CFC production in the case of swing plants that can produce both HCFCs and CFCs. This cap aims to prevent more HCFC-22 from being produced as a result of the incentives offered by the CDM than would be produced without the CDM. The implicit assumption behind this cap is that HCFC-22 demand will be increasing and that plant operators would, without the CDM, at least produce the historical production quantities.

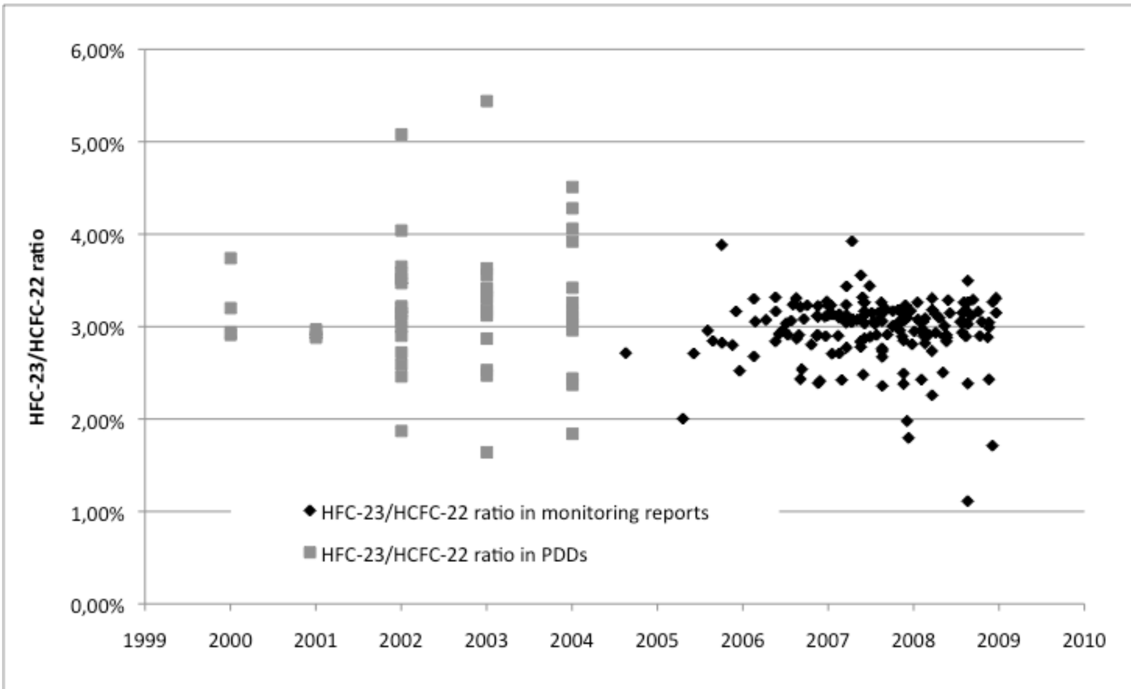
This article evaluates to what extent these provisions have fulfilled their objective of avoiding perverse incentives. The evaluation is based on quantitative information reported in Project Design Documents (PDDs) and monitoring reports published on the UNFCCC website.[1] The analysis covers all monitoring reports that contain information on HFC-23 generation and HCFC-22 production and for which CERs were issued up to 10 February 2010. This includes 163 monitoring reports.

The article is structured as follows: the following two sections assess the adequacy of the caps on the HFC-23/HCFC-22 ratio and on the amount of HCFC-22 production that is eligible for crediting. Then implications of the accelerated phase-out of HCFCs under the Montreal Protocol are briefly discussed. Finally, options to avoid perverse incentives are discussed and conclusions are drawn.

Adequacy of the HFC-23/HCFC-22 ratio

The HFC-23/HCFC-22 ratio varies significantly among plants. 18 out of the 19 projects document the historical HFC-23/HCFC-22 ratios in their PDDs. The historical values for the period 2000 to 2004 vary between 1.64% (project 1105 in 2003) and 5.44% (project 193 in 2003). The weighted average historical HFC-23/HCFC-22 rate for all 18 projects and all years was 3.21% and the mean was 3.15%. This shows that the IPCC default value of 3%, which is used in the methodology as a cut-off value, represents a reasonable average estimate but that the variations among plants are considerable. Apparently some plants managed to reduce their HFC-23/HCFC-22 ratio significantly without any incentives offered by the CDM or any form of regulations while other plants had a relatively high ratio. Figure 1 illustrates the HFC-23/HCFC-22 ratios before and after the implementation of the CDM projects as documented in PDDs and monitoring reports.

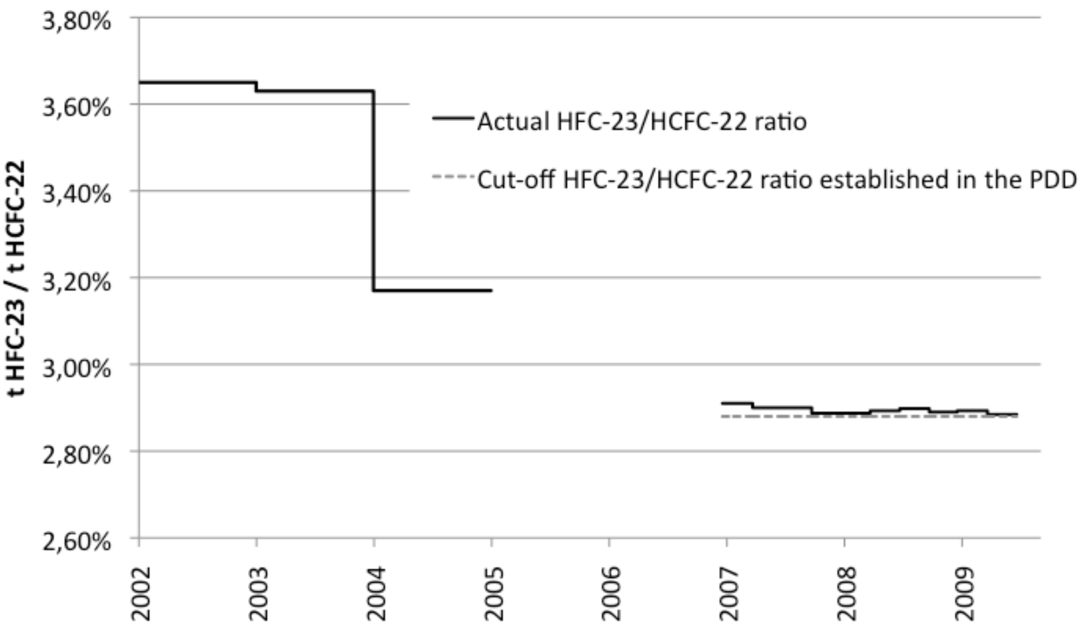
Figure 1: HFC-23/HCFC-22 ratios documented in PDDs and monitoring reports



The fact that the HFC-23/HCFC-22 ratio varies considerably among plants and that some plants achieved significantly lower values than others raises the question of the extent to which historical data is a reliable proxy for how the plants would operate in the future, in particular if the historical data is not only used for one crediting period but for three crediting periods (i.e. up to 21 years).

Whereas the HFC-23/HCFC-22 ratio varied significantly for many projects in the historical period between 2000 and 2004 (see Figure 1), during the crediting period many plants operated at relatively constant HFC-23/HCFC-22 ratios that just met or slightly exceeded the cut-off value established in the PDD. Figure 2 illustrates this for plant 306. In this plant the HFC-23/HCFC-22 ratio varied between 3.17% and 3.65% in the 2002 to 2004 period and stayed in a rather narrow range between 2.88% and 2.91% after the implementation of the CDM project – just above the cut-off value of 2.88% established in the PDD.

Figure 2: HFC-23/HCFC-22 ratio during the crediting period for project 306

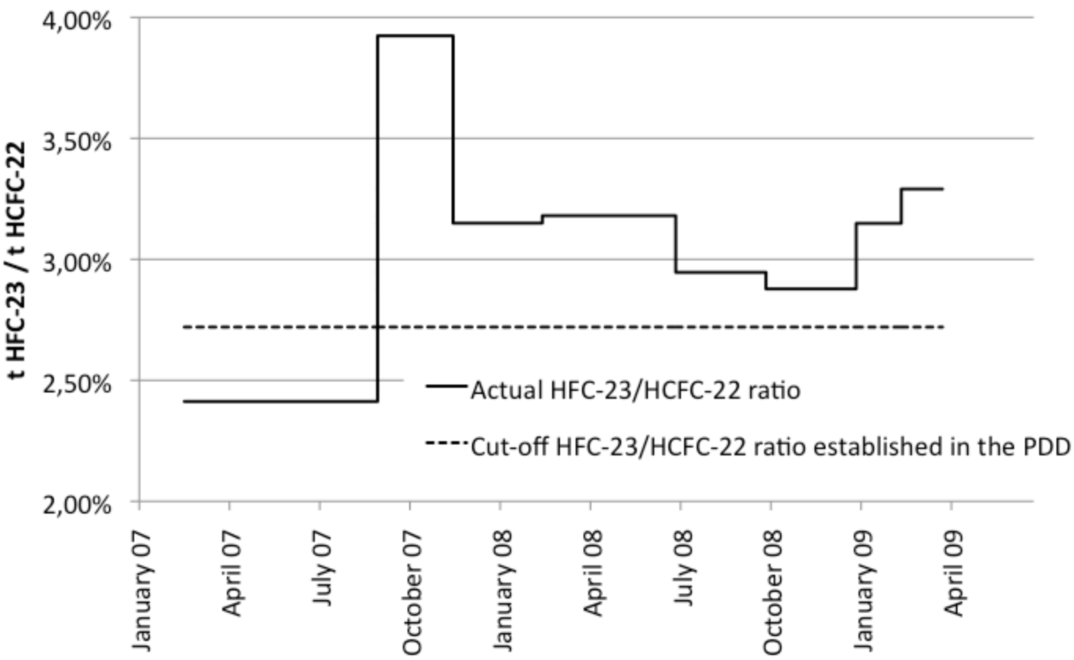


A HFC-23/HCFC-22 ratio that tends to just meet or slightly exceed the cut-off value established in the PDD can also be observed for projects 11, 193, 232, 306, 549, 550, 767, 807, 838, 868 and 1194. This raises the question whether the plants are intentionally operated in a manner that ensures that the cut-off value is always exceeded. Such behaviour would be economically rational, as the CDM provides very strong economic incentives not to lower the HFC-23/HCFC-22 ratio below the cut-off value. This suggests that most plant operators are aware of the strong economic incentives offered by the CDM to keep the HFC-23/HCFC-22 ratio above the maximum value established in the PDD. It would be very unlikely that all these plants operate at a HFC-23/HCFC-22 ratio just above the cut-off value simply by chance, given that the variation in the HFC-23/HCFC-22 rate over time was much larger for most plants in the period from 2000 to 2004.

At a few other plants the HFC-23/HCFC-22 ratio is more variable. For these plants the HFC-23/HCFC-22 ratio is sometimes above and sometimes below the cut-off value established in the PDD. This applies to projects 1, 3 and 115. A possible explanation is that these project participants are not aware of the economic incentives offered by the CDM to operate the plant at a higher HFC-23/HCFC-22 ratio or that they do not wish to intentionally increase their HFC-23 generation in order to maximise their CER revenues.

One plant (project 449) operated at a lower HFC-23/HCFC-22 ratio than the cut-off value established in the PDD during its first monitoring period and increased its HFC-23/HCFC-22 ratio above the cut-off value established in the PDD during all subsequent monitoring periods. This is shown in Figure 3. This raises the question of whether these project participants initially achieved lower HFC-23/HCFC-22 ratios than the cut-off value established in the PDD but then became aware of the strong economic incentives offered by the CDM and intentionally increased their HFC-23/HCFC-22 ratio in subsequent monitoring periods.

Figure 3: HFC-23/HCFC-22 ratio during the crediting period for project 449



The most interesting result from the evaluation of data from registered projects is an assessment of the few monitoring periods where project participants could not claim CERs. In two out of the 163 monitoring reports no CERs were issued for the entire monitoring period because the maximum eligible amount of HCFC-22 production for that year had already been reached by the plant. Given that the project participants could not claim CERs during these periods – whatever the HFC-23/HCFC-22 ratio – the CDM did not provide any incentives to operate the plant in any particular manner.

Figures 4 and 5 show the HFC-23/HCFC-22 ratio over time for the two projects which faced this situation (projects 151 and 1105). The periods in which no CERs could be claimed are marked in grey. The figures show that in both cases the plants were operated during these periods at a significantly lower HFC-23/HCFC-22 ratio that was well below the cut-off value established in the PDD. Once CERs could be generated again, the HFC-23/HCFC-22 ratio increased again above the cut-off value.

Figure 4: HFC-23/HCFC-22 ratio during the crediting period for project 1105[2]

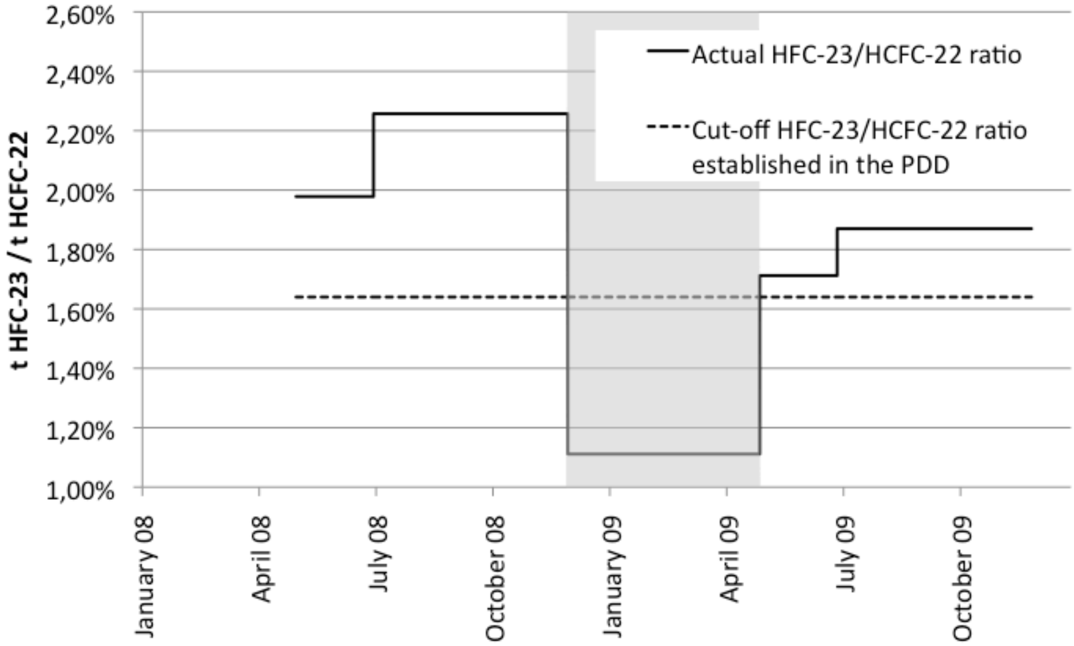
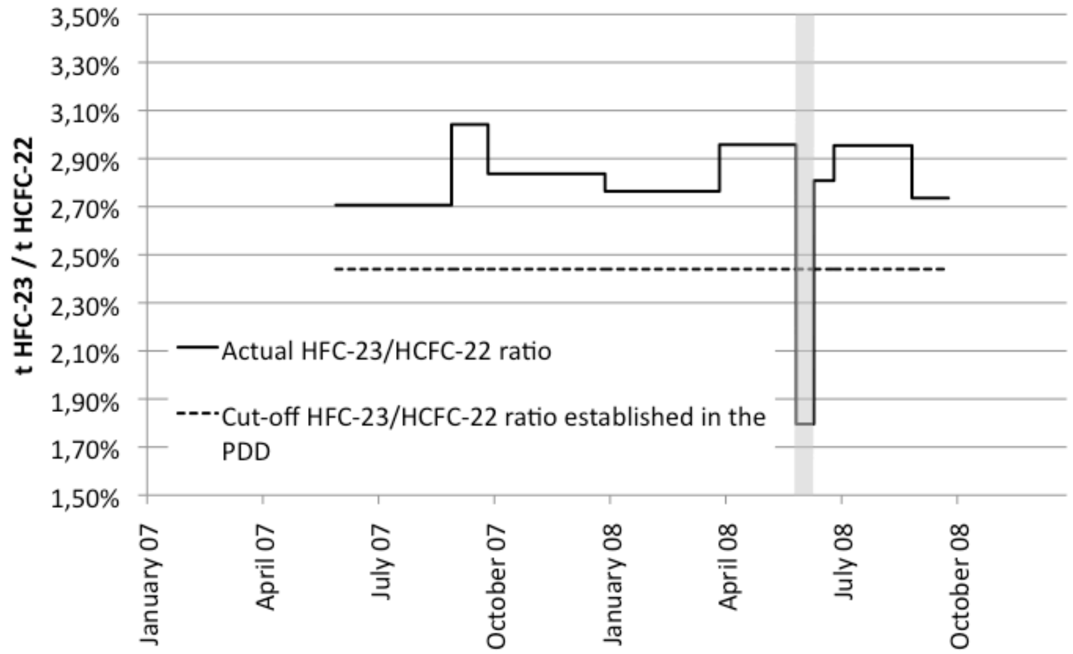


Figure 5: HFC-23/HCFC-22 ratio during the crediting period for project 151



In conclusion, the available data suggests that it is likely that some plants would operate at a lower HFC-23/HCFC-22 ratio in the absence of the CDM and that the CDM provided incentives to operate plants at higher HFC-23/HCFC-22 ratios in order to maximise CER revenues. Hence, the current approach of a fixed cap on the HFC-23/HCFC-22 ratio based on historical data from 2000 to 2004 is problematic and likely resulted in the crediting of emission reductions that are not real. The key deficit of the current methodology is that it implicitly assumes that plants would continue to operate at or above a historically observed HFC-23/HCFC-22 ratio during all crediting periods (i.e. up to 2030). In contrast to more recently approved methodologies[4], this methodology assumes that no autonomous technological improvement or process optimisation would take place over time.

Adequacy of the cap on historical HCFC-22 production

The cap on historical HCFC-22 production that is eligible for crediting is documented in 17 out of the 19 registered projects. Two plants (projects 1 and 3) were registered based on a version of the methodology that did not yet contain a cap on HCFC-22 production eligible for crediting. Table 1 illustrates the actual HCFC-22 production during the first years of the crediting period in relation to the maximum eligible amount of HCFC-22 production for which HFC-23 destruction can be credited.

Table 1: Actual HCFC-22 production during the crediting period in relation to the maximum eligible amount of HCFC-22 production

Project	Year 1	Year 2	Year 3	Year 4	Year 5
11	109%	110%	106%		
115	72%	94%	96%	100%	101%
151	100%	101%	107%		
193	105%	102%	104%		
232	102%	101%	101%		
306	125%	120%			
499	101%	99%			
549	101%	113%	159%		
550	100%	109%	119%		
767	101%	101%			
807	69%	94%			
838	101%	103%			
868	105%	109%			
1105	148%				
1194	100%	101%			

Source: PDDs and monitoring reports published at the UNFCCC website (http://cdm.unfccc.int)

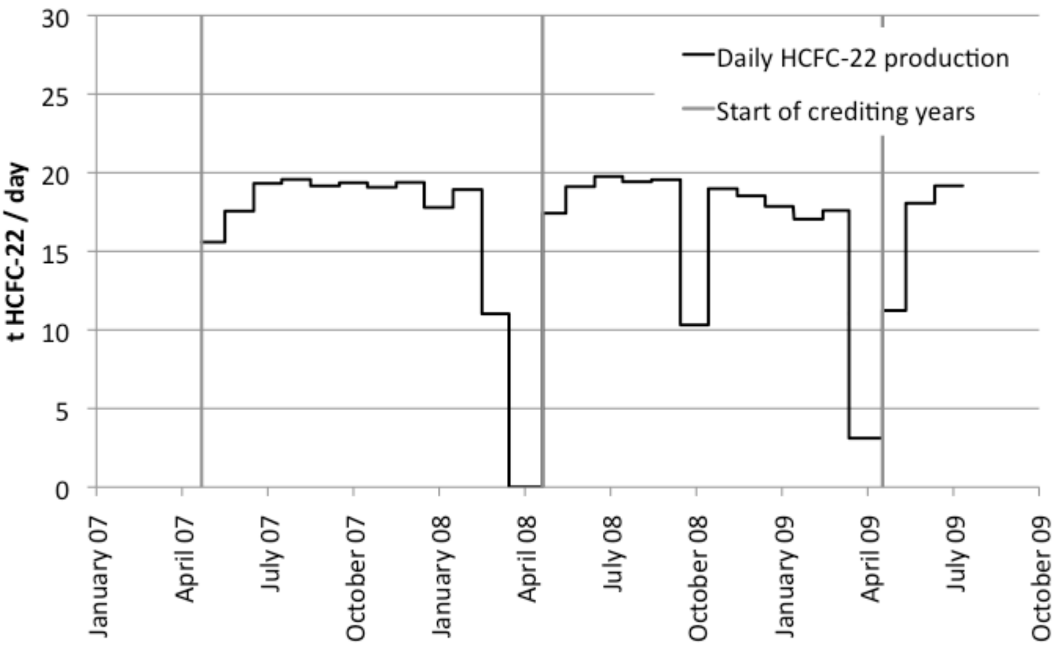
The data shows the following:

1. For several years two plants (projects 115 and 807) produced less HFCF-22 than the amount that is eligible for crediting. This means that the implicit assumption of the methodology that HCFC-22 production will always be above historical levels does not appear adequate. The plant operators could have increased their production, if technically feasible, to the eligible amount (100%) and could have even vented the HCFC-22 into the atmosphere, given that CER revenues are usually higher than HCFC-22 production costs. The cap in the methodology would not have prevented this. A possible explanation for why the project participants did not produce more HFCF-22 is again that these project participants may not have

wished to intentionally increase their HCFC-22 production in order to maximise their profit or that they may not have been aware of the strong economic incentives offered by the CDM to do so.

2. Several plants produced in each crediting year exactly the amount of HCFC-22 that is eligible for crediting or slightly exceeded this amount (the number is 100% or few percentage points above 100%). It is very unlikely that such behaviour occurred by chance. It appears that the amount of HCFC-22 produced in these cases is determined by the CDM rules and not by other factors, such as market demand.
3. Some plants heavily reduced or even stopped their HCFC-22 production once the amount of HCFC-22 that is eligible for crediting was reached and then resumed production when the new crediting year started. Figure 6 illustrates this for project 767. The plant had a relatively constant HCFC-22 production of about 15-20 tons per day until the HCFC-22 amount eligible for crediting was reached. From that point onwards, the production was reduced or the plant was even shut down (in April 2008). Production then resumed at the start of the next crediting year (1 May). Plant operators apparently had no incentives to produce HCFC-22 during times when no CERs could be gained from generating and destroying HFC-23. This poses the question of whether all of the HCFC-22 produced by the plant is produced for the market or whether a lower amount of HCFC-22 would have been produced in the absence of the CDM.

Figure 6: Daily HCFC-22 production during the crediting period for project 767



The development of the price for HCFC-22 in China, the most important market for HCFC-22, is another indicator that the production of HCFC-22 could be driven by CDM rules. According to the CHEAA appliance magazine (2009), the price dropped in 2008 from 15,000 RMB/ton to 8000 RMB/ton, the lowest price in history. Apparently, this price drop can only partly be explained by normal market effects, such as seasonal variations. The magazine reports that the prices for raw materials such as chloroform and hydrogen fluoride increased, resulting in higher production costs. According to the magazine, two factories stated that production was not profitable at such low HCFC-22 prices. Although market prices are driven by many factors, this information suggests that the CDM may have influenced the prices for HCFC-22. If the CDM lowers the price for HCFC-22, this could have substitution effects in the market and result in less use of other refrigerants (such as HFCs or hydrocarbons) that do not harm the ozone layer and in part have lower global warming potentials.

In conclusion, the evaluation of data from registered projects suggests that the production pattern of HCFC-22 plants is strongly driven by the possibility to gain CERs and that the current cap is not effective in preventing perverse incentives that can result from the CDM.

Implications of the new agreement under the Montreal Protocol

In September 2007 Parties to the Montreal Protocol on Substances that Deplete the Ozone Layer agreed to accelerate the phase-out of HCFCs in both developed and developing countries. The new phase-out schedule for developing countries is illustrated in Table 2 below. For developing countries, the base year is now the average of 2009 and 2010, whereas previously the base year was 2015. A freeze is already envisaged by 2013 and a 10% decrease below the base year level is required by 2015. By 2025, the production for emissive uses will have been reduced by about two thirds below 2009 / 2010 levels.

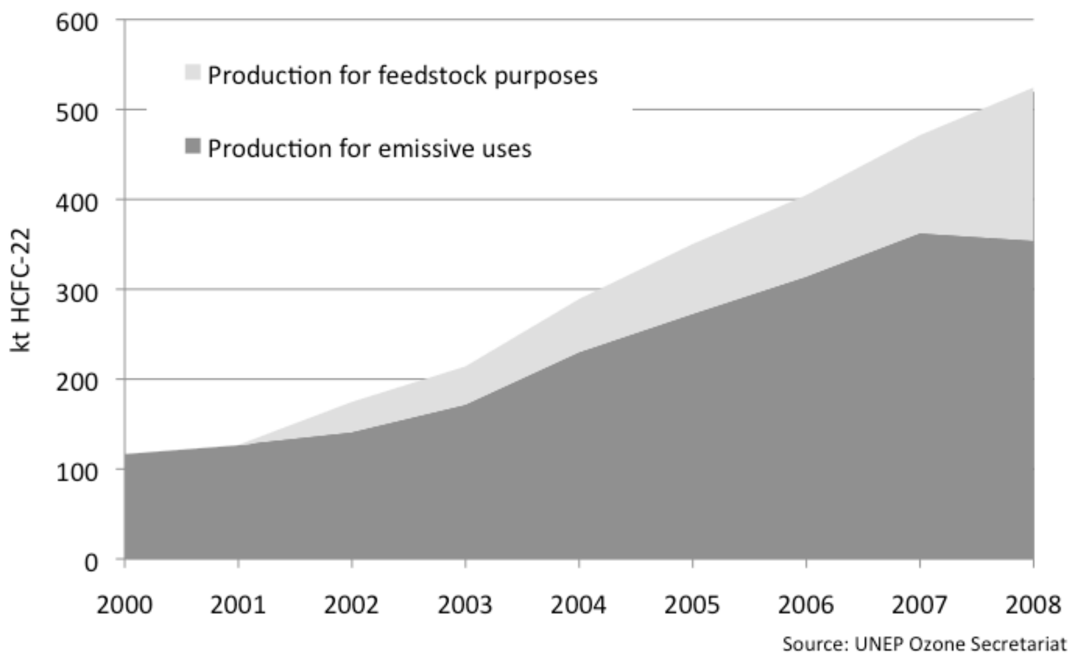
Table 2: Time schedule for phasing out HCFCs in developing countries under the Montreal Protocol

	Current agreement	Previous agreement
Base year	2009 / 2010	2015
Freeze	2013	2016
10% reduction	2015	-
35% reduction	2020	-
67.5% reduction	2025	-
97.5% reduction	2030	-
100% reduction	2040	2040

Over the past decade, the production of HCFC-22 has increased rapidly in developing countries due to various factors, including a high economic growth rate in China and production shifts from industrialised to developing countries. With the new agreement under the Montreal Protocol, these growth rates are expected to slow down and reverse. Parties to the Montreal Protocol may start to implement policies and measures early to facilitate the implementation of the earlier phase-out, and significant funding will be provided for this purpose under the Multilateral Fund.

Figure 7 shows HCFC-22 production for emissive uses and feedstock applications in developing countries from 2000 to 2008. The figure shows a strong increase in production from 2000 to 2007. Production for emissive uses peaked in 2007 and decreased from 2007 to 2008, although the new agreement only requires stabilisation by 2013. The strong increase is mainly driven by the replacement of CFCs by HCFCs and economic growth. The reduction after 2007 can be explained by two reasons. First, some countries, such as China, had already phased out a large portion of CFCs in 2007 (UNEP 2007). Second, several manufacturers already started to switch from HFCFs to other refrigerants. This development was partly driven by the ban on imports of HCFC-22 refrigeration appliances into the US from 1 January 2010.

Figure 7: HCFC-22 production in developing countries



In contrast to production for emissive uses, production for feedstock purposes is not regulated under the Montreal Protocol and thus not limited. The figure shows that production has grown significantly, with extraordinary growth from 2007 to 2008 that compensated for the reduction in production for emissive uses.

The development of future HCFC-22 production in developing countries is uncertain. Several aspects have to be taken into account:

- The recent ban on the import of HCFC-22 appliances into the US will impact the production of HCFC-22 in China in the years 2009 and 2010 – the base years for the accelerated phase-out under the Montreal Protocol. It is possible that the production for emissive uses will further decrease in 2009 and 2010.
- Similarly, the financial crisis could have significant implications for HCFC-22 production in 2009 and 2010 and thus impact the future phase-out path.
- In the past, agreed phase-out schedules under the Montreal Protocol were often implemented earlier than required. For example, several developing countries phased out CFCs earlier than required under the Montreal Protocol. It is possible that the phase-out of HCFC-22 production could occur faster than required under the Protocol – if CDM incentives do not prevent this development.
- HCFC-22 demand for feedstock applications is generally expected to grow. However, expected growth rates have typically been lower than actual growth rates. McCulloch and Lindley (2007) report that HCFC-22 demand for feedstock purposes in China was 20.3 kt in 2001. They further state that a linear growth rate of 4.1 kt was observed over six years and that “there is every reason to expect that

this demand will continue to grow and there is no evidence to predict a change in the growth rate". The enormous growth observed from 2007 to 2008 is difficult to explain. It occurs during the period when most CDM projects started to receive CERs. This raises the (admittedly speculative) question of whether some of this production would not have occurred without the CDM, given the evidence provided above that the cap on HCFC-22 may not be effective and that HCFC-22 production is in practice strongly determined by CDM rules rather than by other factors.

In summary, due to the accelerated phase-out under the Montreal Protocol, HCFC-22 production for emissive uses will be phased-out until 2030. The speed of the phase-out will depend on the production level in the base years 2009 and 2010 and on how quickly the agreement is implemented by the host countries. The development of feedstock production is more uncertain; however, it is unlikely to fully compensate for the decrease in production for emissive uses. In addition, a report under the Multilateral Fund concludes that it is unlikely that Chinese HCFC-22 production for refrigeration will be converted for feedstock production (UNEP 2008). In this regard, overall production in developing countries is likely to decline over time. Moreover, some countries do not have any production for feedstock purposes, and in many cases HCFC-22 production for feedstock purposes is integrated with plants that use the HCFC-22.

If the demand for HCFC-22 declines in the future, the cap established in AM0001 may no longer fulfil its purpose. In establishing the cap, a key implicit assumption was that HCFC-22 demand will continue to grow. Clearly, this assumption becomes invalid with the accelerated phase-out under the Montreal Protocol.

In conclusion, the HCFC-22 demand in developing countries may drop below the cap established in AM0001 at some point in the future, mainly as a result of the new agreement under the Montreal Protocol. From that point on, the CDM would provide perverse incentives to continue producing HCFC-22 in a setting where it would otherwise decline. The current approach needs to be revised to avoid undermining efforts to phase out ozone-depleting substances.

Options to address perverse incentives

Very high CER revenues versus low GHG abatement costs are the reason for the perverse incentives in this project type. Hence, perverse incentives could effectively be avoided by reducing the high profits that plant operators currently make. This could be achieved using various approaches as discussed by Wartmann et al. (2006) in the context of crediting new HCFC-22 production facilities. Potential options include:

- issuing CERs only for a proportion of the HFC-23 emission reduction;
- Transferring revenues that exceed project costs to a fund that supports sustainability purposes
- Having an independent intermediary institution finance these projects
- Having a multilateral institution (such as the Global Environment Facility or the Multilateral Fund under the Montreal Protocol) fund HFC-23 destruction.

All these options pursue the same generic approach: they take the large profits from CER revenues away from plant operators. The first two options provide a solution within the CDM while the latter options would provide a solution outside the CDM. The following discusses the first option in more detail, mainly because it could be relatively easily implemented by means of a simple revision of the applicable baseline and monitoring methodology.

Partial crediting could be achieved by using a default emissions benchmark for determining baseline emissions. Emission benchmarks are already used in a number of CDM methodologies. In the case of HCFC-22 production this could be a baseline emission rate for HFC-23 emissions per HCFC-22 production. If set at an adequate level, such an emissions benchmark could ensure that the profits from CER revenues are significantly lower than the production costs for HCFC-22. This would avoid perverse incentives to produce more HCFC-22, to generate more HFC-23 or to continue producing HCFC-22 when the demand for HCFC-22 drops due to the accelerated phase-out of HCFCs under the Montreal Protocol. Even if some weaker perverse incentives effects persist, an ambitious baseline emission benchmark would compensate for such effects, as the actual GHG abatement would in this case be significantly larger than the amount of CERs issued.

Choosing the level of the benchmark will be an important and challenging issue. The benchmark must ensure both that CER revenues do not significantly impact HCFC-22 production costs and that still sufficient incentives are provided to pursue CDM project activities. The most sensitive parameter is the future CER price, which is uncertain and may vary considerably over time. Moreover, the benchmark should clearly not exceed 1%, given that one plant operated at a HFC-23/HCFC-22 ratio of 1.1% during a period when CERs could not be claimed. Within these constraints, there is a range at which the baseline emission benchmark could be set. The final choice is clearly a policy decision.

The author proposes to set the emission benchmark at 0.2%. The implications of such a benchmark are illustrated in Table 3. The table shows that such a benchmark would strongly limit the impact of CER revenues on the HCFC-22 production costs. For a range of CER prices from US$ 10 to US$ 30 the proposed benchmark would limit the impact of CER revenues by up to one third of HCFC-22 production costs, while still keeping HFC-23 abatement economically attractive at the lower end of this CER price range.

Table 3: Implications of the proposed cap on the HFC-23/HCFC-22 ratio

Scenario		Low CER price	Reference	High CER price
Assumptions				
Actual HFC-23 / HCFC-22 ratio		2,5%	2,5%	2,5%
Cap on HFC-23 / HCFC-22 ratio	-	0,2%	0,2%	0,2%
HFC-23 abatement costs	US$/$CO_2$e	0,5	0,5	0,5
Market price for CERs	US$/CER	10	20	30
Market price for HCFC-22	US$/kg HCFC22	1,7	1,7	1,7
Economic effects of CER revenues				
CER revenues	US$ / kg HCFC22	0,23	0,47	0,70
Abatement costs	US$/kg HCFC22	0,15	0,15	0,15
Net revenues from CDM	US$/kg HCFC22	0,09	0,32	0,56
Reduction of HCFC-22 production costs due to the CDM	**-**	**5%**	**19%**	**33%**

Source: Own estimates, UNFCCC (2005), Schneider et al. (2005)

In practice the HFC-23 abatement costs are lower, since a revision of the methodology usually only applies to projects at the renewal of the crediting period. For these projects the investment costs for the HFC-23 facility were fully recovered during the first crediting period. A variation on this approach has been discussed by Schneider et al. (2005). In that case the benchmark is determined ex-post based on the actual observed market price for CERs. However, such an approach has not been applied to the CDM thus far and could be controversial.

An ambitious emissions benchmark would also help to address other objectives pursued by the COP/MOP:

- The introduction of an ambitious emissions benchmark would provide considerable net atmospheric benefits as the amount of CERs issued would be significantly lower than the achieved emission reductions. Ambitious benchmarks and discounting of emission reductions have generally been proposed under the CDM in order to enhance its environmental benefits (see, for example, Bakker et al. 2009, Butzengeiger et al. 2010, Chung 2007, Schneider 2009, UNFCCC 2009).

- The sustainable development benefits of the CDM could be increased considerably. The destruction of HFC-23 is generally regarded to have very low sustainable development benefits (see, for example, Sutter and Parreño 2005). An ambitious emissions benchmark would reduce the amount of CERs from this project type and thus provide incentives to develop other projects with potentially higher sustainable development benefits.

- The geographical distribution of CDM projects would improve. HCFC-22 production plants are mostly located in China and other more advanced developing countries. No plant is located in a Least Developing Country or in Africa – countries which have been prioritised by the COP/MOP. The lower supply of CERs from HFC-23 destruction projects would indirectly increase the CDM market share of these countries.

Conclusions

The evaluation of data from registered projects shows that the current provisions in the CDM methodology for HFC-23 destruction do not appear sufficient to avoid perverse incentives for generating more HFC-23 and/or HCFC-22 as a result of the CDM. This situation may worsen with the accelerated phase-out of HCFCs under the Montreal Protocol and may undermine efforts to phase out ozone-depleting substances. A revision of the current crediting approach is thus urgently needed to address these issues. An ambitious emission benchmark for crediting HFC-23 destruction under the CDM would address perverse incentives that can currently be observed for registered projects and would at the same time contribute to achieving key objectives pursued under the CDM. A request for revision of the crediting methodology for HFC-23 projects that includes such a benchmark was recently submitted for consideration to the CDM Executive Board by a non-governmental organisation (CDM Watch 2010).

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Endnotes

1 See http://cdm.unfccc.int

2 The last monitoring report has been uploaded at the UNFCCC website but CERs have not yet been issued.

3 The methodology AM0001 for HFC-23 destruction was the first methodology that was approved under the CDM. Many of the more recently approved methodologies account for autonomous technological improvements, e.g. by lowering the baseline emissions over time.