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Implications of the Clean Development Mechanism under the Kyoto Protocol on other Conventions. The case of HFC-23 destruction

Lambert Schneider , Jakob Graichen and Nele Matz

Abstract

The destruction of HFC-23 waste streams in new HCFC-22 production facilities under the Clean Development Mechanism (CDM) is likely to have negative implications for both the mitigation of climate change and the protection of the ozone layer. These consequences were not foreseen when the Kyoto Protocol and its guidelines were drawn up. This paper describes the economic and environmental consequences of such CDM projects and looks for solutions which would make use of the cost-efficient abatement potential whilst avoiding negative environmental implications. Within the CDM, negative environmental effects could be avoided by introducing an adjustment factor depending on future market prices for certified emission reduction units and other parameters. Alternatively, the HFC-23 waste stream could be abated using financial support from multilateral funds which could possibly draw upon synergies with the financial mechanisms under the Montreal Protocol and the Stockholm Convention.

Key words:

Clean Development Mechanism, Kyoto Protocol, Montreal Protocol, International Public Law, Conflicts between Conventions, HFC-23, perverse incentives

1 Introduction

The Clean Development Mechanism (CDM) under the Kyoto Protocol aims at assisting developing countries in achieving sustainable development and industrialized countries in fulfilling their quantitative reduction targets under the Kyoto Protocol. Under the CDM, industrialized countries[1] may use Certified Emission Reduction Units (CERs) from greenhouse gas (GHG) emission reductions projects undertaken in developing countries[2] to fulfil their reduction commitments.

With the adoption of the Marrakech Accords at the seventh Conference of the Parties (COP) of the United Nations Framework Convention on Climate Change (UNFCCC) in 2001, the CDM was made operational with the adoption of the CDM modalities and procedures[3] and the election of the CDM Executive Board (EB). This prompt start of the CDM allowed project developers to start implementing CDM projects, even in advance of the Kyoto Protocol coming into force on 16 February 2005.

According to market information supplied by PointCarbon[4], by January 2005 about 1300 Joint Implementation (JI) and CDM projects had been proposed globally and about 270 projects were at a more advanced state of development (including the elaboration of a Project Design Document). Several governments have set up procurement tenders to purchase CERs. In 2004, the European Union adopted a linking directive, which allows companies in the European Emissions Trading Scheme (ETS) to use CERs in order to fulfil their commitments.[5] The overall market for CERs is estimated to consist of about 1,250 million tons of CO_2 equivalents ($MtCO_2e$) up to 2012 at a price of US$ 11 per tCO_2e in 2010.[6]

In the last three years the regulatory framework for the CDM has been further elaborated: by the end of 2004, the EB had approved 19 methodologies for calculating emission baselines and monitoring emission reductions. Four Designated Operational Entities (DOEs) – responsible for the independent validation of CDM projects and the certification of CERs – have been formally accredited and the first CDM project has been formally registered. 54 developing countries have appointed their Designated National Authorities (DNAs) to approve CDM projects.

At the tenth session of the COP, held in Buenos Aires in December 2004, Parties requested the Subsidiary Body for Scientific and Technological Advice (SBSTA), in collaboration with the EB, to develop a recommendation related to implications

[1] Parties included in Annex I of the United Nations Framework Convention on Climate Change (UNFCCC), in the following referred to as Convention, with a commitment inscribed in Annex B of the Kyoto Protocol.

[2] Parties not included in Annex I of the Convention

[3] Annex to decision 17/CP.7. Document: FCCC/CP/2001/13/Add.2, p. 26-49

[4] CDM & JI Monitor from 11 January 2005

[5] Directive 2004/101/EC of the European Parliament and of the Council of 27 October 2004 amending Directive 2003/87/EC establishing a scheme for GHG emission allowance trading within the Community, in respect of the Kyoto Protocol's project mechanisms, OJ L 338/18, 13.11.2004

[6] Haites, E. 2004: Estimating the Market Potential for the Clean Development Mechanisms. Review of Models and Lessons Learned. PCF, IEA, and IETA, PCFplus Report 19, Washington DC, USA

of CDM projects for the achievement of objectives of other environmental conventions and protocols, in particular with respect to new chlorodifluoromethane (HCFC-22) production plants and the Montreal Protocol. This request originates from a debate within the EB on the first two CDM projects[7] that requested registration in August 2004. These proposed CDM projects plan to destroy the GHG trifluoromethane (HFC-23), an unwanted by-product of HCFC-22 production.

HCFC-22 is an ozone depleting substance (ODS) as well as a GHG with a global warming potential (GWP)[8] of 1,700[9] and is controlled under the Montreal Protocol.[10] HCFC-22 is mainly used as refrigerant in air conditioning as well as commercial and industrial refrigeration systems. HCFCs have a lower ozone depleting potential than chlorofluorocarbons (CFCs) and are therefore used as intermediate replacements for CFCs.[11] In addition, HCFC-22 is used as feedstock for the production of polytetrafluoroethylene (PTFE). The use of HCFC-22 as feedstock is not controlled under the Montreal Protocol, since emissions from feedstock use are estimated to be insignificant.

HFC-23, the unwanted by-product of HCFC-22 production, is not an ODS but a GHG and controlled under the Kyoto Protocol. It has a very high GWP of 11,700 for the first commitment period from 2008 to 2012.[12]

If the HFC-23 waste stream is mitigated under the CDM, plant operators gain significant revenues from CERs, due to the high GWP of HFC-23. The revenues from CERs can be even larger than the production costs of HCFC-22 (see chapter 3 below). As a consequence, HCFC-22 production and consumption may be increased through the CDM. New HCFC-22 production plants might be constructed only due to the CDM. This could have negative implications for both the climate and the protection of the ozone layer, since HCFC-22 is an important ODS as well as a GHG. Consequently, the implementation of HFC-23 destruction projects under the CDM might have negative impacts on both the climate and the ozone layer.

From August 2004 to February 2005, the underlying baseline and monitoring methodology for HFC-23 destruction (AM0001)[13] was revised by the EB and limited to **existing** HCFC-22 production facilities. The limitation to existing facilities aimed at avoiding new HCFC-22 facilities being constructed due to the CDM.

The first Conference under the Kyoto Protocol, to be held in December 2005 in Canada, will need to take a decision on how to proceed with CDM projects in **new** HCFC-22 facilities, and might also take a general decision on how to address the negative implications of the CDM for the objectives of other Conventions.

Against this background, we will describe in this paper the technical (chapter 2) and economic (chapter 3) aspects of HFC-23 destruction under the CDM, show the implications of HFC-23 CDM projects in new HCFC-22 production plants for the mitigation of climate change and the protection of the ozone layer (chapter 4), analyze legal aspects (chapter 5), discuss possible ways forward (chapter 6) and provide conclusions and recommendations (chapter 7) for how this issue could be addressed.

2 Abatement of HFC-23 emissions

HCFC-22 is produced from chloroform ($CHCl_3$) and hydrogen fluoride (HF) with antimony pentachloride ($SbCl_5$) as catalyst in a reactor under steady state conditions. The product stream leaving the reactor contains, in addition to HFCC-22, several by-products (including HFC-23) which are removed in subsequent processing steps. HFC-23 is typically separated as vapour from the condensed HCFC-22 and vented to the atmosphere. Approximately 98 to 99 percent of HFC-23 emissions occur at the condenser vent, while other emission sources – such as leakages from valves, compressors and flanges – are estimated to have much lower emissions.[14]

7 "Project for GHG emission reduction by thermal oxidation of HFC 23 in Gujarat, India" and "HFC Decomposition Project in Ulsan" (see http://cdm.unfccc.int)

8 The global warming potential (GWP) describes the global warming effect of a GHG over a time horizon of 100 years in mass relation to carbon dioxide

9 IPCC 2001: Climate Change 2001: The Scientific Basis. Contribution of Working Group 1 to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Cambridge, United Kingdom and New York, NY, USA

10 Under the Montreal Protocol, consumption of HCFCs for other purposes than feedstock-use is gradually phased out. Industrialized countries (non-Article 5.1 Parties) are committed to gradually reduce their consumption of HCFCs (e.g. by 90% until 2015, 99.5% until 2020 and 100% until 2030 - compared to the base level in 1989). Developing countries (Article 5.1 Parties) are committed to stabilize production and consumptions levels from 2016 to the 2015 level. Consumption and production of HCFCs for other purposes than feedstock-use is phased out by 2040.

11 Under the Montreal Protocol, HCFC-22 has an ozone depleting potential of 0.055 compared to the ozone depleting potential of CFC-11.

12 Article 5.3 of the Kyoto Protocol and decision 2/CP.3 establish that during the first commitment period the global warming potentials for a time horizon of 100 years from the Second Assessment Report by the IPCC should be used.

13 AM0001 (see http://cdm.unfccc.int/methodologies/-PAmethodologies/approved.html)

14 Rand, S., Ottinger, D.,Branscome, M. 1999: Opportunities for the reduction of HFC-23 emissions from the production of HCFC-22. Proceedings from the joint IPCC-TEAP expert meeting 1999. http://arch.rivm.nl/env/int/ipcc/docs/IPCC-TEAP99/files/m99a7-1.pdf

HFC-23 emissions can be abated by various means. Process optimization and thermal oxidation of the waste stream are considered the most important measures.

Process optimization can help to reduce the HFC-23/HCFC-22 ratio in the stream leaving the reactor. In the Revised 1996 IPCC Guidelines[15] a default value of 4% is suggested for the HFC-23/HCFC-22 ratio, based on the US GHG inventory from 1990 to 1993.

However, several other sources suggest that the ratio can be much smaller if the process is optimized. According to Rand et al. (1999), some US plants have reduced the HFC-23/HCFC-22 ratio from 3 to 4 percent to approximately 1.5 to 2 percent.[16] The company DuPont explained in a letter to the CDM Executive Board that it achieved at the Louisville plant a ratio of 1.37 percent and that this ratio is an economically attractive course of action. However, optimal economic operation conditions are not necessarily the same as conditions that minimize HFC-23 generation. In addition, process optimization may be more complex in the case of swing plants that can switch between production of CFC-11, CFC-12 and HCFC-22.

Harnisch and Höhne (2002) analyzed atmospheric measurements and reported emissions of HFC-23 as well as HCFC-22 production data. Based on the comparison they came to the conclusion that "*a 4% by-production factor around 1990 does not seem to be supported by atmospheric measurements, while 2% in 1990 and less thereafter seems possible*".[17] This indicates that on a global scale, most plants apparently already have a significantly lower ratio than 4%.

Taking this more recent information into account, the EB17 decided in December 2004 to assume a maximum value of 3%, and a more conservative default value of 1.5% in cases where estimates for the HFC-23/HCFC-22 ratio are unavailable, in the revised methodology AM0001 for the baseline scenario.[18]

Thermal oxidation is a demonstrated technology that can reduce HFC-23 emissions by about 99 percent. Thermal oxidation is therefore in most cases the preferred option to mitigate HFC-23 emissions from HCFC-22 production. GHG abatement costs of this option are relatively low. The Third Assessment Report by the IPCC mentions abatement costs of about EUR 1.90 per tCO_2e in the EU, based on a report from 1998.[19] The US EPA (2001) estimates typical abatement costs with 0.73 US$ per tCO_2e.[20] According to information from a workshop held in Sanya Citiy (China)[21], HFC-23 destruction costs amount to about 4 to 6 US$ per kg HFC-23, including amortization of the required investments. This corresponds to GHG abatement costs of about 0.34 to 0.51 US$/$tCO_2e$. The special report on the ozone and climate by IPCC and TEAP estimates abatement costs to be below 0.2 US$/$tCO_2e$.[22]

3 Economic implications of HFC-23 abatement under the CDM

The abatement of HFC-23 emissions under the CDM reduces the cost of HCFC-22 production, since the revenues from CERs may be considerable. The extent of this effect depends on the quantity of emission reductions, the share of CERs allocated to the plant operator (which is assumed to be the investor), GHG abatement costs, the market price for CERs, and the HCFC-22 market price. In the following, we will calculate the economic effect of HFC-23 destruction under the CDM in three different scenarios which reflect the possible range of impacts.

Taking into account the information on abatement costs above, we assume that HFC-23 abatement costs in developing countries vary from 0.20 to 1 US$ per tCO_2e. The quantity of emission reductions is determined by the baseline assumption for the HFC-23/HCFC-22 ratio, since about 99 percent of HFC-23 can be destroyed by thermal oxidation. According to the revised baseline and monitoring methodology for HFC-23 destruction projects, the HCFC-23/HCFC-22 ratio may vary between 1.5 and 3 percent in the baseline scenario. Haites (2004) estimates the market price for CERs to be 11 US$ by 2010 with a range of ±50 percent. This level corresponds to current market prices for EU allowances (EUAs) in the European Emissions Trading Scheme, which allows companies to use CERs for

15 IPCC (1996): Revised 1996 IPCC Guidelines for National Greenhouse Gas Inventories. Volume 3. Reference Manual, page 2.42

16 C.f. Rand et al. 1999, supra note 14

17 Harnisch, J., Höhne, N. 2002: Comparison of Emissions Estimates Derived from Atmospheric Measurements with National Estimates of HFCs, PFCs and SF6. ESPR 9 (5), pp. 315-320

18 Meeting report of EB17, page 3 (http://cdm.unfccc.int/EB/Meetings/017/eb17rep.pdf)

19 C.f. IPCC 2001, supra note 9

20 US EPA 2001: U.S. High GWP Gas Emissions 1990-2010: Inventories, Projections and Opportunities for Reduction. http://www.epa.gov/highgwp/projections.html

21 Personal information provided from a participant from the International Workshop on HFC-23 Clean Development Mechanisms (CDM) Project Cooperation in China. 4-6 February 2004. Sanya City, Hainan Province, China

22 IPCC/TEAP 2005: Special Report on Safeguarding the Ozone Layer and the Global Climate System: Issues related to Hydrofluorocarbons and Perfluorocarbons.

fulfilling their reduction commitments. According to market information supplied by Point Carbon, EUA prices varied between 7 and 13 EUR between mid 2003 and February 2005. In our economic analysis, we use a price range from 5 to 15 US$/CER. Furthermore, we assume that 50-98% of the CERs are allocated to the plant operator. Current market prices for HCFC-22 range from 1.1 to 2.4 US$ per kg.[23]The assumptions and results for three scenarios are presented in Table 1 (p. 50).

- In a **Low Impact Scenario** we calculate the lower end of the potential economic impact of the CDM. In this scenario, we assume a low HFC-23/HCFC-22 ratio, relatively high abatement costs, low CER prices, a low share of CERs allocated to the plant operator and high HCFC-22 prices.
- In a **Reference Scenario** we reflect current CER prices in the largest market – the ETS – and assume other parameters to be at a medium level.
- In a **High Impact Scenario** we calculate the higher end of the potential economic impact of the CDM. In this scenario, we assume a high HFC-23/HCFC-22 ratio, relatively low abatement costs, high CER prices, a high share of CERs allocated to the plant operator and low HCFC-22 prices.

Table 1 shows that the economic implications of the CDM are considerable. The revenues from CERs may be considerably higher than the market price for HCFC-22 and thus also higher than production costs. In this calculation, CER prices are the most sensitive parameter. In the reference scenario, with CER prices at 10 US$, CER revenues from the destruction of HFC-23 exceed HCFC-22 production costs. In the optimistic low impact scenario, the effect is comparatively small but still notable. In the scenario with high impact, CER revenues are more than four times higher than HCFC-22 production costs.

Such price effects are well-known in the context of the CDM and are referred to as rebound effects. However, they are normally of much smaller magnitude and do not influence the costs of the product to such an extent.

In the following, we will analyze the consequences of these price effects.

[23] Meeting report of the thirteenth meeting of the Methodological Panel under the CDM Executive Board, page 4 (http://cdm.unfccc.int/Panels/meth/Meth13_rep.pdf)

4 Environmental implications of HFC-23 CDM projects

As illustrated above, revenues from HFC-23 destruction under the CDM significantly decrease or even outweigh HCFC-22 production costs. This may impact HCFC-22 production and consumption patterns in developing countries.

Under the Montreal Protocol, developing countries are committed to limiting their direct use of HCFC-22. While its use as a feedstock is not restricted by the Montreal Protocol, the consumption and production of HCFCs for other purposes than feedstock use is in developing countries is limited from 2016 to 2040 to the production and consumption levels of 2015. The use of HCFC-22 is gradually being phased out in industrialized countries (i.e. 99.5% reduction by 2020 compared to the base level in 1989).

HCFC-22 production is growing rapidly in developing countries, especially in China and India. Overall production capacity is expected to expand and shift from developed to developing countries. In their special report on climate and the ozone, IPCC and TEAP estimate that despite the phase out in developed countries, global HCFC-22 production for both feedstock and non-feedstock use will grow by 44% from 491 kt in 2000 to about 707 kt in 2015, about 40% of which would be used as feedstock.[24] This growth is mainly attributed to an increasing demand in developing countries.

HCFC-22 is widely used in commercial and industrial refrigeration systems and stationary air conditioning. Depending on the application, it can be replaced by the non-ozone depleting HFCs, hydrocarbons, ammonia and carbon dioxide. In developing countries, HCFC-22 is still the most common refrigerant, but other alternatives are being introduced.[25]

If HCFC-22 production costs become negative or decrease substantially due to CER revenues from HFC-23 destruction, this could reduce market prices for HCFC-22, potentially involving an increase in HCFC-22 production, since the use of HCFC-22 would become economically more attractive compared to other refrigerants. To estimate the consequences of the CDM, a key question is to what extent lower or negative HCFC-22 production costs result in lower HCFC-22 market prices and to what extent such lower market prices result in an increased use of HCFC-22 instead of other substances.

[24] C.f. IPCC/TEAP (2005), supra note 22

[25] C.f. IPCC/TEAP (2005), supra note 22

As the CER revenues lead to considerable competitive advantages and as there are globally less than 20 existing HCFC-22 production plants in developing countries, we expect that practically all existing production plants will use the CDM to abate HFC23.[26] However, in markets with a growing demand – as in the case of HCFC-22 in developing countries – the market price is determined by the full costs of **new** production facilities. If next to existing plants also new production facilities can use the CDM and produce HCFC-22 at low or negative costs, it is likely that the market price for HCFC-22 will be considerably reduced. Thus, enabling **new** HCFC-22 production facilities to use the CDM to reduce HFC-23 emissions would likely lead to a significant reduction of the HCFC-22 market price.

Lowered (or negative) HCFC-22 market prices could change the demand patterns of refrigerants, thereby changing both the emissions of ozone depleting substances and GHGs. The potential substitution effects due to the CDM are difficult to determine, since there are different alternative refrigerants to HCFC-22, the future use of which depends also on other factors than refrigerant prices, including equipment costs, technical innovations (e.g. regarding energy efficiency), the regulatory framework, safety and reliability concerns, etc. The demand for HCFC-22 as feedstock is likely to remain relatively unaffected, since there are no reasonable alternatives to HCFC-22. In Table 2 (p. 50) we provide a qualitative assessment of potential substitution effects.

Chlorfluorocarbons (CFCs) have high ozone depleting and global warming potentials. Developing countries have to phase out production of CFCs by 2010 and receive financial support from the Multilateral Fund to substitute CFCs. In refrigeration and air conditioning, HCFC-22 is a substitute for CFCs. Lower HCFC-22 production costs could accelerate the substitution of CFCs. However, we estimate this effect to be very small, because developing countries already receive financing to substitute CFCs and because China, as the largest producer, will halt CFC production by as early as July 2007.[27]

While HCFC-22 is an important substitute for CFCs, there are other non-ozone depleting refrigerants that can be used instead of HCFC-22. These include hydrofluorocarbons (HFCs), which are GHGs, and also hydrocarbons, ammonia and carbon dioxide, which are neither ozone depleting substances nor potent GHGs. Decreased HCFC-22 prices could delay the substitution of HCFC-22 by non-ozone depleting substances, as developing countries have to phase out HCFC-22 production for refrigeration only by 2040. Reduced HCFC-22 production costs could also exacerbate efforts to switch directly from CFCs to non-ozone depleting substances.

As the allowed consumption and production level of HCFCs from 2016 to 2040 will be limited to the 2015 level, an increased HCFC-22 production due to the CDM until 2015 would affect the allowed level for the subsequent 25 years until 2040. Thus, the impacts would last well beyond the crediting period of any CDM project activity.

The increased use or the delayed substitution of HCFC-22 by non-ozone depleting substances has obvious negative implications for the protection of the ozone layer. Regarding the mitigation of climate change, the substitution effects are more complex, depending on the GWPs of the substitutes and other factors, such as the efficiency and charge of the appliance, the carbon intensity of the electricity system and whether end-of-life recovery takes place. Systems with hydrocarbons, ammonia or carbon dioxide are clearly superior to systems with HCFCs and HFCs. In the case of systems with HFCs, lifetime GHG emissions may vary considerably and may be lower or higher compared to HCFC-22 systems. Total effects of an increased use of HCFC-22 on GHG emissions are difficult to estimate. However, they are likely to be negative in the mid- and long-term since systems based on hydrocarbons, ammonia and carbon dioxide are expected to gain in importance.

Next to these substitution effects, reduced HCFC-22 production costs could have further negative implications for the mitigation of climate change:

- **Increased emissions of HFC-23.** If HCFC-22 production increases due to the CDM, an increased level of emissions from the by-product HFC-23 would also occur. Consequently, in new facilities, HFC-23 destruction projects under the CDM would partly reduce emissions that have been caused by the CDM. Such a CDM project activity would not result in emission reductions compared to a situation without the CDM.
- **Production shifts from Annex I to non-Annex I countries**. As a result of the CDM, the HCFC-22 production is likely to move from industrialized to developing countries, as production becomes economically more attractive in developing countries under the CDM. Such production shifts are unlikely to occur directly – dismantling a plant in an industrialized country

[26] For example, China – by far the largest HCFC-22 producer in the world – is considering a sectoral country-wide program to abate HFC-23 emission in all plants in China.

[27] Information released by the Multilateral Fund http://www.multilateralfund.org/news/1103293986850.htm

but are more likely to occur indirectly in the long term, with plants in industrialized countries closing down and new plants in developing countries being constructed.

and reconstructing it in a developing country –

- These production shifts do not result in any real emission reductions but (a) industrialized countries would account the reduction of emissions in their GHG inventories, and in addition, and (b) CERs would be generated by the new plants in developing countries. Consequently, due to such double counting, global GHG emissions would increase by about twice the amount of CERs generated.
- **Market distortions.** Due to the high economic revenue from CERs, plants already applying advanced technologies to reduce or destroy HFC-23 have a severe economic disadvantage compared to plants with out of date technology which implement these standards through a CDM project. As a consequence, environmentally advanced production plants may be shut down due to their higher production costs. If they are replaced by new HFCF-22 production plants built under the CDM, the CERs would not correspond to real emission reductions either and would increase global GHG emissions if used for compliance purposes in industrialized countries.
- **Construction of new HCFC-22 plants without any production purpose.** With current market prices for CERs, it would be economically feasible to build a HCFC-22 production plant with the sole purpose of destroying the HFC-23 waste stream without selling the actual product (HCFC-22) to the market. As a consequence, the production of HCFC-22 (together with the HFC-23 waste stream) may only be initiated because of the CDM. CERs generated by such activities would not correspond to any real emission reductions and would increase global GHG emissions if used for compliance purposes in industrialized countries.

In summary, due to the high revenue of CERs, the destruction of HFC-23 under the CDMis particularly sensitive in new HCFC-22 production facilities and is likely to negatively affect both the protection of the ozone layer and the mitigation of climate change. In the following we will analyze legal aspects of these implications.

5 Legal aspects

5.1 Precendents in international law

The proliferation of international agreements dealing with environmental issues has led to significant potential for overlap and contradiction between different legal instruments. The question of how conflicts between international conventions could be resolved, although not a new problem for international law, has been discussed in several studies in the last few years.[28] Likewise, the assessment of contradictions specifically between different environmental agreements as well as possible approaches to solve such overlaps has only relatively recently emerged as a research issue in international law.[29]

Although conflicts between environmental agreements are rarely reflections of incompatible obligations imposed upon the contracting parties, contradictions in the programmatic approaches or tensions that result from different means of implementation may diminish the effectiveness of the relevant regimes. This becomes apparent in our example of HFC-23 destruction projects under the Kyoto Protocol, where the mitigation of a GHG (HFC-23) indirectly involves an increase of an ozone depleting substance (HCFC-22) controlled under the Montreal Protocol.

Three approaches for dealing with conflicts between international treaties can be identified: the regulation by the law of treatises, the adoption of so-called “conflict clauses” or “saving clauses” by the treaties themselves, and mitigation by an institutional approach, namely co-operation involving the plenary organs of the treaties in question. The law of treaties – either as codified rules in the Vienna Convention on the Law of Treaties (VCLT), e.g. article 30 VCLT, or as rules of customary law e.g. concerning rules like the *lex-specialis*-rule[30] or the *lex-posterior*-rule,[31] – does not offer viable means of preventing or solving conflicts.

Article 30 VCLT which is based upon *lex posterior* only relates to treaties dealing with the same subject matter. Although it is unclear and subject to interpretation under what circumstance two treaties can be said to be dealing with the same subject matter, it is clear that the objective of the Montreal-Protocol is the protection of the ozone layer and not the mitigation of climate change – despite most ozone depleting substances being GHGs – and that the objective of UNFCCC und Kyoto-Protocol is the mitigation of climate change.

The establishment of a general rule of *lex posterior* faces the following difficulty: it cannot be assumed

[28] See Sadat-Akhavi, A. 2003: Methods of Resolving Conflicts Between Treaties; Pauwelyn, J. 2003: Conflict of Norms in Public International Law; Matz, N. 2005, Wege zur Koordinierung völkerrechtlicher Verträge.

[29] See Wolfrum, R., Matz, N. 2003: Conflicts in International Environmental Law.

[30] The more specific legal rule prevails.

[31] The rule concluded later overrides the earlier one.

that states generally express the will to abrogate an earlier treaty on one environmental question when acceding to a later one on a different aspect of environmental protection. This is particularly true if conflicts or contradictions are not obvious and only emerge in the subsequent process of implementation. In principle, the same is valid for a general rule of *lex specialis*. Furthermore, in the case of international conventions it is particularly difficult to establish which of the two treatises is the more specific.

In principle, conflict clauses, although they cannot provide general rules on conflict mitigation, are viable tools for clarifying the relationship between two or more international treaties on a case-by-case basis. However, in case of the Kyoto Protocol and the Montreal Protocol, there are no conflict clauses which could settle the potential conflict resulting from HFC23 destruction projects. By referring only to GHGs that are not controlled by the Montreal Protocol in Article 4 of the UNFCCC and inter alia Article 7 of the Kyoto Protocol, an attempt was made to separate conflicts at the implementation level (see chapter 5.2 below). However, in the case of unforeseen conflicts at the implementation level, a solution cannot be reached by the use of conflict clauses, unless the agreements would be modified or amended which is in itself, generally, a lengthy and cumbersome process.

In such cases where international legal mechanisms fail to properly address the issue, the only viable means of approaching the conflict is by means of a political process based upon cooperation between the relevant institutions. In the light of the particularly widespread participation in, and the attempted universality of, environmental legal regimes, approaches as to how to resolve contradictions should be developed at an institutional level, i.e. involving the plenary organs of the agreements, for the regimes as such. Either a solution is found by decisions or resolutions of the institutions concerned, preferably the relevant COPs, or policies are fixed by a memorandum of understanding between the organs of the treaties involved.

6.2 Consideration of Montreal gases under the CDM

In chapter 4 above, we showed that the destruction of HFC-23 under the CDM in new HCFC-22 production facilities is likely to lead to an increase of emissions of HCFC-22, an ODS controlled under the Montreal Protocol that is also a GHG. An important legal question is whether substances that are controlled by the Montreal Protocol should be taken into account in the determination of emission reductions under the CDM, in particular if such emissions are increased due to the CDM.

Generally, the Montreal Protocol addresses the reduction of ODS, while the UNFCCC and the Kyoto Protocol address the reduction of GHGs. Substances that are both an ODS and a GHG are controlled under the Montreal Protocol, while under the UNFCCC and the Kyoto Protocol gases controlled under the Montreal are explicitly excluded in order to avoid overlap by two regimes addressing the same emissions: Article 4 of the UNFCCC and Article 3 of the Kyoto Protocol, which refer to the list of GHGs in Annex A of the Kyoto Protocol, are limited to gases not controlled under the Montreal Protocol. However, the objective of the UNFCCC in Article 2 is more general, since it aims to stabilize GHG concentrations, including all GHGs – also ODS – according to the definition of GHGs in Article 1.

Article 12 of the Kyoto Protocol refers to “emission reductions” and does not specify whether emission reductions are limited to Annex A gases. This omission has been addressed in the CDM modalities and procedures, paragraph 44 of which reads: “*The baseline for a CDM project activity is the scenario that reasonably represents the anthropogenic emissions by sources of greenhouse gases that would occur in the absence of the proposed project activity. A baseline shall cover emissions from all gases, sectors and source categories listed in Annex A within the project boundary. (…)*”

Paragraph 44 clearly defines that Annex A gases shall be considered in baselines. However, there is some ambiguity as to whether the determination of baseline emissions is limited to Annex A gases or whether the baseline may also include other GHGs. Furthermore, it is interesting to note that Annex A gases are not mentioned in the context of adjustments for leakage (paragraphs 50 and 51 of the CDM modalities and procedures). Under this provision, project participants shall adjust emission reductions for leakage which is defined as net changes of GHG emissions outside the project boundary. Therefore, it could be argued that the determination of baseline emissions may (or may not) be limited to Annex A gases but that a limitation to Annex A gases does not appear to be envisaged in the context of adjustments for leakage. Following this line of argument, project participants would need to take changes of GHGs controlled under the Montreal Protocol into account if they are measurable and attributable to the project activity.

According to information from participants involved in the negotiations of the CDM modalities and procedures, differentiation between baseline emissions and adjustments for leakage in the coverage of gases was never discussed in negotiations of the contact group and was not intentionally introduced in the modalities and procedures. However, negotiators were probably also not aware of the possibility that CDM projects may lead to increases of GHGs controlled by the Montreal Protocol.

The definition of the purpose of the CDM in Article 12, paragraph 2, also indicates that a simple non-consideration of GHGs not included in Annex A may not be appropriate: "*The purpose of the CDM shall be to assist Parties not included in Annex I (…) in contributing to the ultimate objective of the Convention*". As explained above, the ultimate objective of the Convention, as defined in Article 2 of the Convention, is to stabilize all GHG emissions, defined as all gases that absorb and re-emit infrared radiation. Following this line of argument, CDM projects which reduce Annex A gases but which involve a net increase in **overall** GHGs would not fulfil the purpose of the CDM and would consequently not be eligible under the CDM.

Also the COP, in its request to SBSTA to consider the implications of CDM projects for other Conventions, specifically referred to the broad definition of GHGs in Article 1 of the Convention.

Although there are is a strong legal argument that the CDM should not result in an increase of GHG emissions, the consideration of Montreal gases under the CDM would cause some difficulties: A certain overlap between the Montreal Protocol and the Kyoto Protocol would be introduced. In addition, the consideration of Montreal gases in adjustments for leakage but not in the calculation of baseline emissions would introduce an inconsistency. Finally, the quantities of CERs issued would not be linked anymore to the emissions according to GHG inventories. We therefore believe that the consideration of Montreal gases under the CDM is not the best option to address this issue.

6 A way forward

Above we showed that the destruction of HFC-23 in **new** HCFC-22 production facilities under the CDM is likely to be counterproductive to both the climate and the ozone layer. This raises the question whether and how the CDM or other mechanisms are best suited to make use of this significant, low-cost mitigation potential. Generally, there could be two different ways to prevent negative effects:

- the development of a new baseline methodology for new HCFC-22 facilities, or
- the exclusion of new HCFC-22 installations from the CDM, providing different means for abating the waste stream.

6.1 Development of a new baseline methodology

In practice, the development of an adequate baseline methodology for new HCFC-22 facilities would be methodologically very difficult, since indirect production shifts or substitutions effects are very difficult to quantify with a reasonable degree of confidence. Even if leakage effects could be quantified, a new methodology would need to make sure that negative implications for the protection of the ozone layer are avoided. This appears only possible if the market price for HCFC-22 is not lowered considerably due to the CDM. As the market price will be largely determined by the production costs in new facilities, a new methodology would need to ensure that HCFC-22 production costs in new facilities are not lowered considerably due to CER revenues. Such an approach would also avoid other potential leakage effects, such as productions shifts from industrialized to developed countries, and would thus also avoid the difficult quantification of potential leakage effects.

In order to reduce the effect of CER revenues on production costs, the quantity of CERs issued could be capped or adjusted in different ways. For example, an adjustment factor could be introduced discounting emission reductions in a way that HCFC-22 production costs are only reduced by a certain extent (e.g. less than 20%). Similarly, the HFC-23/HCFC-22 ratio may be reduced respectively. This approach would, however, limit the issuance of CERs considerably.

Table 3 (p. 50) shows the implications for the reference scenario if HCFC-22 productions costs should not be lowered by more than 20%. The proposed approach would lead to a very significant discount of emission reductions, with only about 25% of actual emission reductions issued as CERs in the reference scenario. Nevertheless, under both scenarios, project developers would still have significant economic incentives to invest in the mitigation of the HFC-23 waste stream, since revenues from CERs are more than twice as large as mitigation costs.

The main disadvantage of this approach is that the choice of the appropriate level of an adjustment factor or the HFC-23/HCFC-22 is relatively arbitrary. Firstly, a choice would need to be made which reduction in production costs is acceptable and likely not to result in significant leakage effects or negative impacts on emissions of Montreal gases. Secondly, the appropriate adjustment level would depend on the market price for CERs – which, however, may change during the crediting period of the project. Thus, the adequate level of adjustment is rather difficult and arbitrary to determine *ex-ante* in the baseline scenario, particularly taking into account the price fluctuations for CERs observed recently. This problem might partly be addressed by an *ex-post* calculation of the adjustment factor, based on actual market prices during the monitored period. Lower CER market prices would respectively result in a lower adjustment of emission reductions and vice versa.

Although emission reductions are highly discounted, the proposed approach has a number of merits: Firstly, the approach avoids the methodologically difficult quantification of leakage effects. Secondly, it still provides strong economic incentives for project developers to implement HFC-23 destruction technologies. Finally, it allows using a market mechanism, such as the CDM, for the destruction of HFC-23 in new facilities, which may be more efficient than the provision of other means outside the CDM.

6.2 Provision of financial resources outside the CDM

An entirely different approach would be to exclude new HCFC-22 installations from the CDM and to provide different means for abating the waste stream. While there is theoretically the possibility of creating a new mechanism or a new fund especially for such a case, mechanisms or funds from existing multilateral institutions should be preferred. In chapter 5 it was argued that the only viable mean of resolving conflicts between different conventions is a political process based on cooperation between the relevant institutions. In the following we will show potential links to two other conventions, which could be used for addressing the HFC-23 destruction in new facilities.

The Stockholm Convention, which came into force in May 2004, aims at reducing persistent organic pollutants (POPs) like DDT or dioxin. Apart from banning the use of 12 POPs, the treaty focuses on the disposal of obsolete stockpiles of these chemicals existing for instance in electrical appliances and waste dumps. Thermal oxidation, which is used to destroy HFC-23 waste streams, is also used to destroy POPs; it would be possible to build combined HFC-23/POPs destruction facilities at HCFC-22 production sites. A similar link exists to the Montreal Protocol and the disposal of ODS. Developing countries are starting to build up used and non-recyclable stocks of ODS which could be destroyed along with HFC-23 in combined installations.

Programmes of the Global Environment Facility (GEF), the designated interim financial mechanism of the Stockholm Convention, or the Multilateral Fund (MLF), financing the phase-out of ODS, could be extended to fund joint projects between UNFCCC and one or both of the other conventions. For developing countries this would lead to similar investments and technology transfer as under the CDM. Plant operators would have an incentive to participate in such programmes since they could charge fees for the destruction of POPs and/or ODSs for third parties. For industrialized countries, a combined approach would be an economically attractive way of addressing several different environmental issues at the same time.

The main advantage of this approach is that there would not be any perverse incentives to increase the production of GHG or ODS as a result of the CDM. The costs for the global abatement of HFC-23 from new HCFC-22 production facilities would be rather low and the abatement of HFC-23 would be additional to commitments under the Kyoto Protocol. Multilateral financial resources to deal with the abatement of HFC-23 would also allow for a significant amount of additional CDM investment in other sectors, in which the contribution to national sustainable development objectives of developing countries might be higher. A disadvantage of this approach is that not all new HCFC-22 production plants may use the financial resources and implement HFC-23 destruction equipment. In addition, the disbursement of financial resources through a multilateral institution could be a less efficient process than the use of the flexible mechanisms.

7 Conclusions and recommendations

In our analysis we showed that the destruction of HFC-23 in new HCFC-22 facilities under the CDM would likely lead to increased emissions of GHGs as well as ozone depleting substances because production costs of HCFC-22 are expected to be negative when revenues from generated CERs are taken into account. While there is no direct clause on how to handle negative effects on the objectives of other conventions under the Kyoto Protocol or the UNFCCC, there should be great interest in minimising the negative consequences of the CDM for the objective of the Montreal Protocol as well as for climate mitigation, since most Parties are signatories to both treaties.

We identified two options to avoid negative implications for the protection of stratospheric ozone and climate mitigation from new HCFC-22 production plants: the development of a new baseline methodology with a relatively high adjustment of emission reductions or the provisions of financial resources through bilateral or multilateral institutions. The advantages and disadvantages of these options are illustrated in Table 4 (p. 50).

We believe that both options, a new baseline methodology and the provision of financial resources, could be reasonable approaches to address this issue. A new baseline methodology would need to ensure that the market price of HCFC-22 is not considerably lowered due to the CDM in order to avoid negative implications on stratospheric ozone. At the same time leakage effects would need to be quantified – which is methodologically difficult – or avoided. A rigorous discounting of emission reductions could ensure that both prerequisites are met. Nevertheless, project developers would still have strong economic incentives to implement HFC-23 abatement under the CDM.

If financial mechanisms are explored to make use of the significant and cost-efficient HFC-23 abatement potential in new HCFC-22 production plants, synergies with activities under the Stockholm Convention and the Montreal Protocol could be used. By using these synergies, transaction costs could be minimized and resources used in an efficient manner.

Appendix: Tables

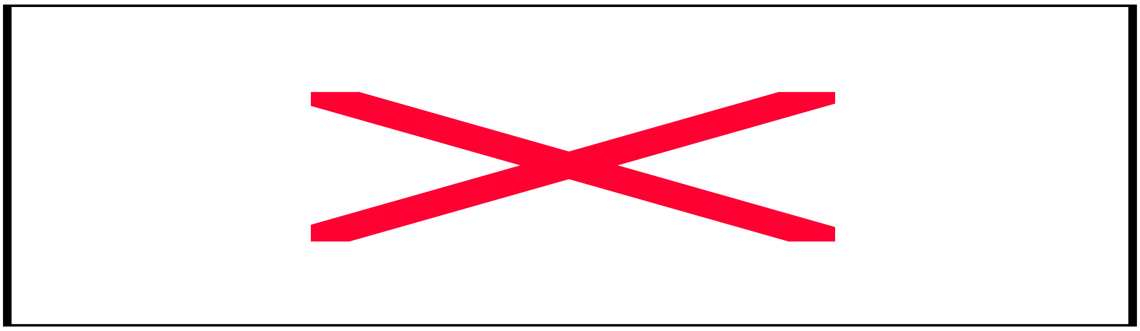

Table 1:Economic implications of HFC-23 destruction under the CDM

HCFC-22 is used instead of…	**Impact on climate mitigation**	**Impact on stratospheric ozone**	**Estimated importance**
CFCs	positive	positive	small
HFCs	depends on substance	negative	large
Hydrocarbons, ammonia, carbon dioxide, water, etc	negative	negative	large

Table 2: Substitution effects of increased HCFC-22 consumption

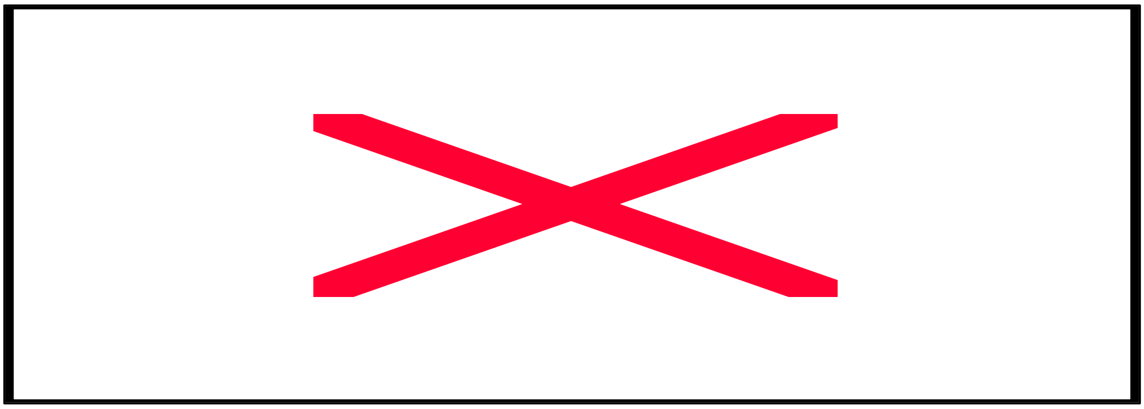

Table 3: Limitation of effects of CER revenues on HCFC-22 production costs in the reference scenario.

	Option A New baseline methodology	Option B Provision of financial resources outside the CDM
Advantages	A market mechanisms (the CDM) can be used to abate HFC-23 in a timely and efficient manner	Negative implications for the protection of the ozone layer due to the CDM are completely avoided Additional benefits for the environment, as HFC-23 is abated in addition (and not instead) of other CDM projects
Disadvantages	Large and arbitrary leakage adjustments are required to avoid negative implications on the ozone layer and leakage effects; the appropriate level of adjustment depends on future CER prices that are uncertain	Multilateral resources on an incremental cost basis do not provide strong economic incentives to implement HFC-23 abatement measures The provision of multilateral resources takes time and may be less efficient than a market mechanisms The complete exclusion of HFC-23 projects from the CDM could send a negative signal to the CDM market

Table 4: Advantages and disadvantages of approaches to mitigate HFC-23 emissions from new

The Öko-Institut (Institut für angewandte Ökologie - Institute for Applied Ecology, a registered non-profit-association) was founded in 1977. Its founding was closely connected to the conflict over the building of the nuclear power plant in Wyhl (on the Rhine near the city of Freiburg, the seat of the Institute). The objective of the Institute was and is environmental research independent of government and industry, for the benefit of society. The results of our research are made available of the public.

The institute's mission is to analyse and evaluate current and future environmental problems, to point out risks, and to develop and implement problem-solving strategies and measures. In doing so, the Öko-Institut follows the guiding principle of sustainable development.

The institute's activities are organized in Divisions - Chemistry, Energy & Climate Protection, Genetic Engineering, Sustainable Products & Material Flows, Nuclear Engineering & Plant Safety, and Environmental Law.

The Environmental Law Division of the Öko-Institut:

The Environmental Law Division covers a broad spectrum of environmental law elaborating scientific studies for public and private clients, consulting governments and public authorities, participating in law drafting processes and mediating stakeholder dialogues. Lawyers of the Division work on international, EU and national environmental law, concentrating on waste management, emission control, energy and climate protection, nuclear, aviation and planning law.

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The University of Applied Sciences in Bingen was founded in 1897. It is a practiceorientated academic institution and runs courses in electrical engineering, computer science for engineering, mechanical engineering, business management for engineering, process engineering, biotechnology, agriculture, international agricultural trade and in environmental engineering.

The *Institute for Environmental Studies and Applied Research* (I.E.S.A.R.) was founded in 2003 as an integrated institution of the University of Applied Sciences of Bingen. I.E.S.A.R carries out applied research projects and advisory services mainly in the areas of environmental law and economy, environmental management and international cooperation for development at the University of Applied Sciences and presents itself as an interdisciplinary institution.

The Institute fulfils its assignments particularly by:

- Undertaking projects in developing countries
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- **Companies and environment**
  - Environmental management
  - Risk management

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The Society for Institutional Analysis was established in 1998. It is located at the University of Applied Sciences in Darmstadt and the University of Göttingen, both Germany.

The sofia research group aims to support regulatory choice at every level of public legislative bodies (EC, national or regional). It also analyses and improves the strategy of public and private organizations.

The sofia team is multidisciplinary: Lawyers and economists are collaborating with engineers as well as social and natural scientists. The theoretical basis is the interdisciplinary behaviour model of *homo oeconomicus institutionalis*, considering the formal (e.g. laws and contracts) and informal (e.g. rules of fairness) institutional context of individual behaviour.

The areas of research cover

- Product policy/REACh
- Land use strategies
- Role of standardization bodies
- Biodiversity and nature conversation
- Water and energy management
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- Economic opportunities deriving from environmental legislation
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elni

In many countries lawyers are working on aspects of environmental law often with environmental initiatives and organisations or as legislators, but have limited contact with other lawyers abroad, although such contact and communication is vital for the successful and effective implementation of environmental law.

In 1990 a group of lawyers from various countries therefore decided to initiate the Environmental Law Network International (elni) to promote international communication and cooperation worldwide. Since then elni has grown to a network of about 350 individuals and organisations from throughout the world.

Since 2005 elni is a registered non-profit association under German Law.

elni coordinates a number of different activities:

Coordinating Bureau

The Coordinating Bureau was originally set up at and financed by the Öko-Institut in Darmstadt, Germany, a non-governmental, non-profit making research institute. The Bureau is currently hosted by the University of Applied Sciences in Bingen. The Bureau acts as an information centre where members can obtain information about others working in certain areas thus promoting the development of international projects and cooperation.

elni Review

The elni Coordinating Bureau produces and sends to each member the elni Review twice a year containing members' reports on projects, legal cases and developments in environmental law. elni therefore encourages its members to submit such articles to be published in the Review in order to allow the exchange and sharing of experiences with other members.

elni Conferences and Fora

elni conferences and Fora are a core element of the network. They provide scientific input and the possibility for discussion on a relevant subject of environmental law and policy for international experts. The aim is to bring together scientists, policy makers and young researches, giving the opportunity to exchange views and information as well as developing new perspectives.

Publication Series

The elni publications series contains 12 volumes on different topics of environmental law.

- Environmental Law and Policy at the Turn to the 21st Century, Liber amicorum, Betty Gebers, Ormond/Führ/Barth (eds.) Lexxion 2006.
- Access to Justice in Environmental Matters and the Role of NGOs, de Sadeleer/Roller/Dross, Europa Law Publishing 2005.
- Environmental Law Principles in Practice, Sheridan/Lavrysen (eds.), Bruylant 2002.
- Voluntary Agreements - The Role of Environmental Agreements, elni (ed.), Cameron May Ltd., London 1998.
- Environmental Impact Assessment - European and Comparative; Law and Practical Experience, elni (ed.), Cameron May Ltd. London 1997.
- Environmental Rights: Law, Litigation and Access to Justice, Deimann / Dyssli (eds.), Cameron May Ltd. London 1995.
- Environmental Control of Products and Substances: Legal Concepts in Europe and the United States, Gebers/Jendroska (eds.), Peter Lang, 1994.
- Dynamic International Regimes: Institutions of International Environmental Governance, Thomas Gehring; Peter Lang, 1994.
- Environmentally Sound Waste Management? Current Legal Situation and Practical Experience in Europe, Sander/ Küppers (eds.), P. Lang, 1993
- Licensing Procedures for Industria Plants and the Influence of EC Directives, Gebers/Robensin (eds.), P. Lang, 1993.
- Civil Liability for Waste, v. Wilmowsky/Roller, P. Lang 1992.
- Participation and Litigation Rights of Environmental Associations in Europe, Führ/ Roller (eds.), P. Lang, 1991.

elni Website: elni.org

The elni website at *http://www.elni.org* contains news about the network and an index of elni articles, gives an overview of elni activities, and informs about elni publications. Internships for young lawyers/law students at the Öko-Instituts environmental law division are also offered on the web.

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