Information Note

Approaches for AM0001

I. Background

1. At its sixty-third meeting, the CDM Executive Board (the Board) requested the Methodologies Panel (the panel) to analyse the consequences of possible approaches where project participants may select one of the two following options (hybrid approach):

(a) Use of a HFC-23 waste generation rate (w-factor) of 1.0% applicable to HCFC-22 production lines that are eligible for CDM crediting; or

(b) Use of a higher w-factor (e.g. 1.2%) applicable to HCFC-22 production lines that are eligible for CDM crediting if HFC-23 emissions of non-CDM production lines are incinerated.

2. Further information on this request, including elements that should be considered by the panel when assessing this hybrid approach, is contained in annex 13 to the report of the sixty-third meeting of the Board. This note is prepared by the panel in response to this request by the Board and summarizes the results of its analysis. Section II below describes the proposed implementation of the hybrid approach, followed by an assessment of economic, technical and environmental effects in Section III.

II. Implementation of the hybrid approach

3. After a thorough analysis, taking into account the assessment in Section III, the panel recommends that the proposed hybrid approach should consist of the following elements:

(a) The w-factor is set at 1.0%. However, the w-factor can be increased from 1.0% to 1.2% if the emission reductions achieved from the voluntary decomposition of HFC-23 from non-eligible HCFC-22 production lines in the production facility equal or exceed the additional CERs issued due to the increase in the w-factor. This ensures that the overall impact of increasing the w-factor is neutral or positive, because the emission reductions achieved from the voluntary decomposition of HFC-23 would at least match the additional CERs issued due to the higher w-factor.

Example: Under a CDM project, the eligible production lines generate 1000 t of HCFC-22 during a monitored period. Using a w-factor of 1.0% would result in baseline emissions of 10 t HFC-23, whereas a cap of 1.2% would result in baseline emissions of 12 t HFC-23. The increase in the waste generation rate would result in the additional issuance of 23,400 CERs (corresponding to 2 t HFC-23). These CERs could only be issued if the project participants voluntarily abate at least 2 t HFC-23 from HCFC-22 production lines that are not eligible for crediting under the CDM;

(b) The project participants can decide during the crediting period, on an *ex post* basis, whether they wish to opt for the voluntary accounting of HFC-23 decomposition from non-eligible production lines. The decision is made separately for each reporting period. The project participants can choose the length of the reporting period from one day to one year. The emission

reductions are calculated separately for each reporting period, but several reporting periods can be included in one verification report. These arrangements provide the project participants flexibility when they wish to account for the voluntary decomposition of HFC-23. It also provides flexibility on the duration of the verification period (maximum one year);

(c) During those reporting periods for which the project participants decide *ex post* to account for the voluntary decomposition of HFC-23 from non-eligible HCFC-22 production lines, any HFC-23 emissions from the non-eligible HCFC-22 production lines are accounted as leakage emissions. This encourages that a large amount of the HFC-23 is abated (in practice most CDM plants abate more than 99.99% of the HFC-23 generated) and also avoids any perverse economic incentives to shift HCFC-22 production from eligible production lines to non-eligible production lines as result of the CDM incentive (see Section III.2 below). The possibility to decide for each reporting period whether or not the voluntary decomposition of HFC-23 from non-eligible HCFC-22 production lines should be accounted for, enables the project participants to exclude any periods when they may face problems in the operation of the HFC-23 decomposition facility which may result in HFC-23 emissions.

III. Assessment of the proposed approach

4. The approach described above is assessed with regard to the issues given below:

(a) Economic incentives for decomposition of HFC-23;

(b) Avoiding incentives to increase HCFC-22 production or HFC-23 generation;

(c) Environmental benefits in terms of overall GHG emission reductions;

(d) Shifting between the two options during the crediting period;

(e) Implications on monitoring requirements for non-eligible HCFC-22 production lines.

III.1 Economic incentives for decomposition of HFC-23

5. The panel analyzed to what extent the proposed hybrid approach provides incentives to opt for the voluntary decomposition of HFC-23 from non-eligible production lines. In doing so, it is assumed that the project participants behave in a manner that is economically rationale and strive to maximize their profits.

6. The economic incentives to voluntarily abate HFC-23 from non-eligible production lines depend on: (i) a number of project specific parameters, such as the amount of HCFC-22 production in eligible and non-eligible production lines, and the HFC-23 decomposition costs, as well as on: (ii) market parameters, such as prices for CERs. In other words, the incentives vary between different projects and can vary over time due to changes in market conditions. Not all of these parameters are under the control of the project participants.

7. For this reason, the incentives to abate HFC-23 were assessed for different scenarios, reflecting a plausible range for key parameters. The economic incentives were assessed in comparison with the option of using a value of 1.0% and not voluntarily abating HFC-23 emissions from non-eligible production lines. In order to limit the number of scenarios, only the most important parameters affecting the result were varied in the scenarios. Details on the

underlying assumptions and the data used in the calculations are provided in the appendix to this note.

8. The most important parameters that affect the results and that may vary from project to project are the following:

(a) **HFC-23** decomposition **costs.** The HFC-23 decomposition costs greatly depend on whether the existing HFC-23 decomposition facility has sufficient capacity to also incinerate the HFC-23 from non-eligible production lines or whether a new HFC-23 decomposition facility needs to be installed. In the scenarios, both situations: (i) the use of an existing HFC-23 decomposition facility; and (ii) the installation of a new HFC-23 decomposition facility were considered;

(b) **Revenues from CER sale.** The additional revenues due to a higher w-factor depend considerably on the price agreed for CER delivery and on additional fees or taxes on CER revenues. Two different scenarios were considered to reflect a plausible range of revenues: (i) a price of 7 US$ which corresponds closely to the current market price for primary CERs from HFC-23 projects; and (ii) a significantly lower price of 2.5 US$, taking into account that the actual revenues for the operators of the plant may be significantly lower in some situations. Further information on the sources of data for these scenarios is provided in the appendix to this note;

(c) **Size of the eligible and non-eligible HCFC-22 production lines.** The incentives from the CDM depend considerably on the amount of HCFC-22 production in eligible lines (as this determines the amount of additional CERs being issued) and the amount of HFC-23 that is decomposed (which depends, on the amount of HFC-23 generated and thus the amount of HCFC-22 produced in non-eligible production lines). In other words large eligible production lines will generate more CERs and small non-eligible production lines involve lower costs to abate the HFC-23 from these lines.

9. These three key parameters are varied and combined in different ways, resulting in 16 different scenarios. A summary of the results is illustrated in the two tables for existing incinerators and new incinerators below. It is assumed that 99% of the HFC-23 generated will be decomposed (current CDM plants achieve an even higher rate).

10. The first table below shows that in cases where the existing incinerator can be used, it is for all scenarios economically attractive to voluntarily abate the HFC-23 emissions and opt for the higher w-factor. This can be explained by the very low marginal costs for decomposition of HFC-23.

Scenario	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
HFC-23 incinerator	Existing	Existing	Existing	Existing	Existing	Existing	Existing	Existing
CER prices	Current price	Current price	Current price	Current price	Low price	Low price	Low price	Low price
HCFC-22 production in eligible lines	Large	Large	Small	Small	Large	Large	Small	Small
HCFC-22 production in non-eligible lines	Large	Small	Large	Small	Large	Small	Large	Small
Economically attractive to opt for voluntary abatement?	yes	yes	yes	yes	yes	yes	yes	yes
Net environmental benefits (MtCO2e)	8.1	0.8	1.3	1.3	8.1	0.8	1.3	1.3

11. The result is different for situations where a new HFC-23 decomposition facility needs to be installed to abate the HFC-23 from non-eligible production lines. In this case, the voluntarily HFC-23 decomposition is only attractive in some of the scenarios. In cases where the eligible HCFC-22 production lines are small, the additional revenues from a higher w-factor are too little to recover the investment costs for the new incinerator. In these cases, the project participants would not opt for the voluntary decomposition of HFC-23.

Scenario	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**
CER prices	Current price	Current price	Current price	Current price	Low price	Low price	Low price	Low price
HCFC-22 production in eligible lines	Large	Large	Small	Small	Large	Large	Small	Small
HCFC-22 production in non-eligible lines	Large	Small	Large	Small	Large	Small	Large	Small
Economically attractive to opt for voluntary abatement?	yes	yes	no	no	no	yes	no	no
Net environmental benefits (MtCO2e)	8.1	0.8	0.0	0.0	0.0	0.8	0.0	0.0

12. In summary, it can be said that opting for the voluntary decomposition of HFC-23 is generally economically attractive where an existing incinerator can be used. It is also economically attractive where the HCFC-22 production lines that are eligible for crediting are relatively large. Precise information on the location and capacity of non-eligible HCFC-22 production lines is not available.

III.2 Avoiding incentives to increase HCFC-22 production or HFC-23 generation

13. In allowing the project participants to use a higher w-factor it is important to ensure that any such provision does not create incentives to increase HCFC-22 production or the waste generation rate as a result of the economic incentives. In the following different potential incentives are discussed.

Potential incentives to install new HCFC-22 production lines

14. The additional revenues associated with the increase of the w-factor from 1.0% to 1.2% could in specific situations create incentives to install a new HCFC-22 production line which would not be installed in the absence of the CDM. This situation could occur in a production facility where the existing eligible production lines are relatively large and where non-eligible production lines are absent, or the production in non-eligible production lines is significantly smaller than in the eligible production lines. In this case, the construction of a new HCFC-22 production and voluntary decomposition of HFC-23 from this production line could result in additional CER revenues, because the project participants would then become eligible to use the higher w-factor for the existing HCFC-22 production lines.

To avoid such a situation, the proposed draft revision of the methodology requires that at least one non-eligible HCFC-22 production line already exists at the project site in order to be eligible to opt for the higher w-factor of 1.2%

Potential incentives to increase the HFC-23 waste generation in <u>non-eligible</u> HCFC-22 production lines

15. The additional revenues associated with the increase of the w-factor from 1.0% to 1.2% could in some cases create incentives to increase HFC-23 generation in <u>non-eligible</u> production lines beyond levels that would occur in the absence of the CDM.

16. Similar to the incentive to construct new lines, this situation could occur if the production in non-eligible production lines is significantly smaller than in eligible production lines. In such cases, the project participants could face a situation where the CO_2 equivalent of the HFC-23 generated in the non-eligible production lines could be lower than the additional CERs issued as a result of the higher w-factor. However, if the HFC-23 generation is lower than the additional CERs issued, the project participants would not be eligible to opt for higher w-factor of 1.2%, as no net environmental benefits in terms of GHG decomposition would be achieved.

Example: A plant produces 30,000 t HCFC-22 per year in production lines that are eligible under the CDM. Assuming a voluntary decomposition of 100% of the HFC-23 from non-eligible HCFC-22 production lines, an increase in the w-factor from 1.0% to 1.2% would result in the additional issuance of 702,000 CERs per year. The facility has a small production line which is not eligible under the CDM. This production lines produces 2,000 t HCFC-22 per year and operates at a waste generation rate of 2.0%, generating HFC-23 emissions equivalent to 468,000 tCO_2e. In this case, the amount of additional mitigation (468,000 tCO_2e if all HFC-23 is incinerated) is smaller than the amount of additional CERs issued (702,000). The project participants would therefore not be eligible to voluntarily opt for the higher w-factor.

17. In this situation, the project participants would have an economic incentive to increase the HFC-23 generation beyond levels that would occur without the CDM, in order to become eligible to opt for the higher w-factor. Such an increase in HFC-23 generation from non-eligible production lines could be achieved by:

(a) Expanding HCFC-22 production, either by shifting HCFC-22 production from eligible to non-eligible production lines (this is economically attractive if the HCFC-22 production in eligible production lines exceeds the maximum amount of HCFC-22 production that is eligible for crediting) or by expanding production which involves a shift from other production lines in the market; and/or

(b) Increasing the HFC-23 waste generation rate (in the example above, an increase in the waste generation rate from 2.0% to 2.5% would increase the HFC-23 generation and subsequent decomposition from 468,000 to 702,000 tCO_2e and allow the project participants to opt for the higher w-factor).

18. An increase in the HFC-23 generation from non-eligible production lines and subsequent decomposition of the generated HFC-23 would not result in real emission reductions, as CERs would be issued for GHG emissions that were only generated as a result of the CDM or that would be abated in the absence of the CDM.

19. To address this situation, two provisions were included in the draft revised methodology:

(a) The non-eligible HCFC-22 production should have a certain minimum size to safely assume that the HFC-23 generation in non-eligible production lines significantly exceeds the amount of additional CERs issued; and

(b) The remaining HFC-23 emissions from the non-eligible production lines are accounted as leakage emissions.

III.3 Environmental benefits in terms of overall GHG emission reductions

20. The voluntary decomposition of HFC-23 from non-eligible production lines could have considerable environmental benefits, as the project participants have strong economic incentives to abate a large amount of HFC-23, as any unabated HFC-23 emissions from non-eligible production lines are accounted as leakage emissions.

21. Accurate information on how much HCFC-22 is produced in non-eligible production lines is not available. However, the *maximum* potential benefits in terms of GHG decomposition are estimated in the following. For this purpose, it is assumed that all non-eligible HCFC-22 production would occur in production lines located at existing facilities and that 99% of the HFC-23 emissions from these production lines would be voluntarily abated. The total HCFC-22 in developing countries amounted to about 558 kt in 2009[1], of which about 270 kt HCFC-22 were produced in production lines that are eligible under the CDM. Thus, about 288 kt HCFC-22 were produced in production lines that are not eligible under the CDM. Assuming further a HFC-23 waste generation rate of 3.0% as the upper end of the plausible range, these production lines could potentially emit about 100 $MtCO_2e$ per year. In contrast, the maximum additional amount of CERs that could be issued due to the increase of the w-factor corresponds to about 4.4 million CERs.[2] Hence, the environmental benefits of this approach could range from zero (in the worst case) to up to a about 95 $MtCO_2e$ per year.

22. Based on the opinion of experts consulted by the secretariat, it is likely that there exist at least five plants with eligible HCFC-22 production lines, which have at least one non-eligible HCFC-22 production line, located at the same industrial facility. In addition, it needs to be taken into account that some plants have chosen a ten year crediting period in which case the revised methodology would not apply to their projects. Furthermore, some plants may not opt for the voluntary decomposition from non-eligible production lines. The actual environmental benefits are therefore likely to be lower but could still be considerable.

III.4 Shifting between the two options during the crediting period

23. The possibility of shifting between the two options (a w-factor of 1.0% OR a w-factor on 1.2% in combination with voluntary HFC-23 decomposition from non-eligible production lines) within the crediting period provides project participants more flexibility. This possibility ensures that the hybrid approach is in practice a *no-lose* option for the project participants. They would not face significant risks if they do not manage to abate the HFC-23 from non-eligible production lines during a certain period (e.g. due to technical problems with the HFC-23 decomposition facility).

24. The panel could not identify any issues with regard to environmental integrity of this approach and therefore recommends that this flexibility be provided. It is recommended that project participants can determine *ex post* for each reporting period *p* whether they opt for the voluntary decomposition of HFC-23 or choose a w-factor of 1.0%. Given that the revised methodology determines the overall emission reductions for each reporting period *p*, shifting

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[1] FCCC/TP/2011/2, page 6.

[2] This value is an estimate, as accurate information on the maximum amount of HCFC-22 production that is eligible for crediting is not available from all PDDs. Some projects use a version of the methodology where this information does not need to be provided. Other projects can not renew their crediting period, as they chose a single crediting period of 10 years. Based on information available from PDDs, it is estimated that the amount of HCFC-22 that is eligible for crediting in all projects that qualify under the methodology corresponds to up to 190 kt HCFC-22 per year.

between the two options in an *ex post* approach can be easily implemented. For practical reasons, such as the accounting for stored HFC-23, it is recommended that the shortest permissible interval for the reporting period *p* is 24 hours.

III.5 Implications on monitoring requirements for non-eligible HCFC-22 production lines

25. To implement the proposed approach, at least the HFC-23 incinerated and the amount of HFC-23 generated from non-eligible production lines would need to be monitored. However, the panel recommends to also monitor the HCFC-22 production as well as other HFC-23 streams (e.g. to the storage tank). Determining these parameters enables to conduct a plausibility check of the amount of HFC-23 incinerated. It would also allow to assess whether the other production lines were operated in a reasonable range of the HFC-23 waste generation rate, to appropriately account for storage of HFC-23 from other production lines, and to prevent a situation where HFC-23 may be transported from other sites to the project for the purpose of decomposition (which is not allowed under the methodology) or that HFC-23 generated as a waste production from other processes is accounted.

26. Information on HCFC-22 production is generally readily available and does not require the installation of additional measurement equipment because the production is usually logged and can easily be crosschecked with profit and loss reports. Measurement of HFC-23 streams involves cost which amounts to about US$ 20,000 per measurement device. In the case of installation of a second decomposition device due to the voluntary decomposition of HFC-23, additional measurement equipment would be required to meter the HFC-23 flow to the incinerator and any HFC-23 in the waste stream. Similarly, in the case of storage of HFC-23 from other production lines, additional meters may be required to measure the amount of HFC-23 stored. In total, the additional costs associated with measuring HFC-23 streams are moderate compared to the potential benefits from increasing the w-factor.

Appendix

Information on calculations performed

The tables contained in Section III.1 of this note illustrates the calculation performed for each scenario. The following assumptions and sources were used in calculating the economic incentives for different scenarios:

HFC-23 decomposition costs for new incinerators

The installation of a new HFC-23 decomposition facility can involve investment costs of several million US$. An investment of US$ 8 million was assumed, based on data from a CDM plant in China where an investment of US$ 7.6 million was made.[3] The fixed operational and maintenance costs were estimated with US$ 200,000 per year. This data is based on a large HCFC-22 production plant. For small HCFC-22 production plants, the costs were assumed to be 30% lower.

A lifetime of 10 years was assumed and a rate of 10% was used for the average weighted cost of capital. The variable operational and maintenance costs for electricity and steam consumption were calculated as about 0.004 US$/t CO_2e, based on information provided in a PDD on electricity and steam consumption. As a conservative approach, 0.01 US$/t CO_2e were assumed for the variable operational maintenance costs. This conforms with information on marginal HFC-23 decomposition costs referencing the International Energy Agency (IEA).[4]

HFC-23 decomposition costs for existing incinerators

In the case where existing incinerators can be used to abate additional HFC-23, only the increase in operation and maintenance costs for the incinerator and a small investment to connect other HCFC-22 production lines to the incinerator need to be considered. The investment for connecting other HCFC-22 production lines was estimated with US$ 100,000. For the variable operation and maintenance costs, the same data as for new incinerators was used.

Revenues from CERs

For the price scenario reflecting current prices for CERs from HFC-23 projects, two data sources were used, which both confirmed the same price range. Prices from emission reduction purchase agreements (EPRAs) are referred to in a number of letters of approval for projects from the host country government. These prices range from US$ 6.5 to US$ 11. By October 2011, the prices for primary CER prices from HFC-23 projects, as inquired from traders, were in the range of about US$ 5.50. Based on this range a price of US$ 7 was used as the market price. For the lower price, the tax on CER revenues implemented in one host country was reflected which would result in significantly lower net revenues from CERs of about US$ 2.5.

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[3] Environmental Assessment Report. HFC-23 Emissions Reduction at Changshu 3F Zhonghao New Chemical Materials Company. November 18, 2005, page 23. Last retrieved on 25 October from <http://www-wds.worldbank.org/>.

[4] European Wind Energy Association (EWEA). EWEA position on restrictions to the use of international credits in the EU emission trading system from Clean Development Mechanism (CDM) projects reducing industrial gases. Last retrieved on 25 October from <http://www.ewea.org/>.

Monitoring and transaction costs

As highlighted above, the additional costs for monitoring are moderate. The project participants may also face slightly increased costs for verification, as additional parameters need to be verified, although it can be assumed that any such costs would be quite low. As a conservative approach, an annual increased cost for monitoring and verification of US$ 100,000 was assumed. In addition, fees for issuance of CERs and the share of proceeds for the adaptation fund were considered in the calculation.

Waste generation rate

A waste generation rate of 2.5% was assumed for new production lines.

Fraction of HFC-23 that can technically be abated

CDM plants generally abate practically all HFC-23 (more than 99.999%). Given that project participants have the possibility to opt out from the option to voluntarily abate HFC-23 from non-eligible production lines at any time during the crediting period, such as during maintenance or malfunction of the incinerator (see Section III.4), it is assumed that during the times where the project participants opt for voluntary decomposition, a similarly high decomposition rate will be achieved. As a conservative approach, a slightly lower value of 99.0% was used.

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