**Comment No. 1**

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**To:** bd-pm-pi@jcm.go.jp
**Subject:** Input on BOCM "Energy Saving by Introduction of High Efficiency Centrifugal Chiller"

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I have previously commented on the similar methodology in JCM Indonesia, ID_AM003

https://www.jcm.go.jp/id-jp/projects/2/public_comment_file

These comments on ID002, ID003 and ID_AM003, submitted in January 2015, are related to the Bangladesh methodology for chillers.

Following my comments January 2015, I received a confirmation from Mr. Tadashi Yoshida from JQA. Following up on this confirmation,

I submitted further comments to Dr. Yoshida on January 16, 2015. In October, ID_AM003 was changed and a Ver2.0 approved, however

the changes are only formal.

BD_PM001 is the same methodology as ID_AM002, both submitted by Nippon Koei Co. Furthermore, Nippon Koei Co. is also the

developer of ID004 and ID005 for chillers in textiles factories in Indonesia, the sole projects developed with ID_AM002.

There are three modifications in BD_PM001 compared to ID_AM002 and these modifications are good indicators of Nippon Koei's

judgment on the characteristics of its methodology:

a) eligibility criterion 5: is expanded by stating that the replaced chiller's refrigerant is being re-used and by requiring a prevention

plan (the re-use of the refrigerant) to be checked during project verification. This expansion of criterion 5 copies the criterion 4 in

myclimate Japan's methodologies ID_AM004 and ID_AM008.

b) CO2 emission factor for captive electricity generation: adding an option b for manufacturer specifications, and option c for monitored data for fuel consumption. These two added options are in line with the widely used Grid Emission Factor tool of the CDM.

c) the default COP for the reference chillers are different: in the Indonesian case there are five size classes while for Bangladesh there are three size classes, and the variation of the default COP in Bangladesh is lower (between 5.13 and 5.66) than in Indonesia (4.92 to 5.94).

These differences in the default COPs arise from the survey among chiller manufacturers that yields different results.

Nippon Koei's modification a) and b) indicate that Nippon Koei seeks to maintain a coherence of its methodology with terms included in related methodologies, both among JCM methodologies and regarding CDM tools such as the CDM Grid Emission Factor tool.

Nippon Koei's modification c) indicates that Nippon Koei seeks to reflect national circumstances in its methodology.

Below five improvements to BD_PM001 that seem to be in line with Nippon Koei's effort to assure coherence with other methodologies and improve its adequacy to Bangladesh. I hope to convince Nippon Koei to consider these improvements:

1. Distinguish three classes of refrigerants in the replaced chiller and specify GHG emissions from their re-use.
2. Incentivise the destruction of CFC refrigerant from replaced chillers
3. Add a threshold for the GWP of refrigerant in the new chiller to eligibility criterion 4
4. Include leakage of refrigerant in the project chiller
5. Instead of a default COP for the replaced chiller, use the design COP from its manufacturer

Each of these five improvements is an advance of the environmental integrity, while not reducing the simplicity and practicability of BD_PM001, and each of these five also improves the coherence with other methodologies.

I would also appeal to Nippon Koei to re-assess BD_PM001 in light of the Paris Agreement Article 6.2:

"Parties shall …… apply robust accounting to ensure, inter alia, the avoidance of double counting,

consistent with guidance adopted by the COP".

It might be a policy concern for JCM to assure that methodologies like BD_PM001 indeed yield an accounting robustness that will be required for cooperative approaches under the Paris Agreement.

1. Distinguish three classes of refrigerants (CFCs, HCFCs, HFCs) in the replaced chiller and specify emissions from their re-use.

Among all chiller replacements that can use BD_PM001 in Bangladesh, the replaced chillers' refrigerant is one of five substances:

CFC-11, CFC-12, HCFC-123, HCFC-22 and HFC-134a (from Carrier, Trane and York).

BD_PM001 demands that these gases are re-used and excludes the GHG impact of this re-use.

This exclusion jeopardizes the environmental integrity of BD_PM001.

CFC:

CFC-11 and CFC-12 are not produced or sold in any country of the world (banned since 2010) and therefore the total volume of CFC in Bangladesh is physically limited. Re-using CFC-11 or CFC-12 therefore prolongs the life-time of other chillers that would be replaced sooner as these other chillers would faster run out of CFC refrigerant to refill them. This is a significant increase of GHG emissions outside of the project boundary while caused by the project.

HCFC:

Whereas HCFC-123 and HCFC-22 are still produced and Bangladesh imported 84 tonnes HCFC-22 and 5 tonnes HCFC-123 in 2010 for use in industrial chillers (see Table 3 in www.multilateralfund.org/65/English/1/6524.pdf). Most of the 89 tonnes was used to re-fill refrigerants that leaked during normal operations of the chillers.

Bangladesh is implementing an HCFC Phaseout Management Plan (HPMP) under the Montreal Protocol and is therefore obliged to achieve a 35% reduction by 2020, 67% by 2025 and total phase-out by 2030. Stage 2 of the Bangladesh HPMP will include Montreal funding for chiller replacements (stage 1 focused HCFC-141b) and therefore the GHG impact of the re-use of HCFC-22 and HCFC-123 from replaced chillers can be influenced by this Stage 2 of the HPMP. Since the Montreal Protocol funds only the incremental costs, the availability of re-used HCFC-123 and re-used HCFC-22 can affect the replacement decisions.

HFC: HFC-134a is still unregulated and the future inclusion of HFC-134a in the Montreal Protocol is uncertain.

In conclusion, BD_PM001 should distinguish three classes of refrigerants CFCs, HCFCs and HFCs and define for each of the three what the GHG impact of refrigerant re-use is and what should enter the baseline. At least, a separate baseline is required for CFC because the increase in GHG emissions from the prolongation of the operation of other old and inefficient chillers can be higher than the GHG reduction from the replacement of the chiller included in BD_PM001.

2. Incentivise the destruction of CFC refrigerant from replaced chillers

The majority of chillers to replace in Bangladesh contain CFC-11. Since CFC-11 and CFC-12 are not produced any more in any country in the world, destroying CFC-11 effectively reduces the CFC emitted to the atmosphere. Eventually all CFC in all chillers in Bangladesh will reach the atmosphere unless what is recovered from old chillers is burnt. CFC destruction is credited with voluntary emission reductions in the VCS standard, VM0016, and in the Californian Compliance Offset Protocol when destroyed in the US.

In the past, CFC from Nepal, India and Mexico has been transported to the US for destruction and Californian credits have been issued.

JCM should be cognisant of the Californian and the VCS standard and assess whether it would be in JCM's policy to credit CFC destruction.

Because of the high GWP of CFCs, the reduction credits from BD_PM001 would increase substantially and thereby support a broader application.

The results obtained from ID_AM002 with only two projects in Indonesia show that the applicability is otherwise quite low.

CFCs have been a prominent field of global environmental cooperation and it seems relevant for Nippon Koei's efforts to render

BD_PM001 coherent with other carbon accounting, to also deal with CFC as it relates to other emissions trading, again in light of the

Paris Agreement Art 6.2.

The Montreal Protocol's Multilateral Fund has in the past funded a few CFC destruction pilots but failed to proceed (UNEP/OzL.Pro/ExCom/70/54).

Complementing the Montreal Protocol and reduce GHG gases where Montreal failed could be a relevant aspect for bilateral crediting.

3. adding a threshold for the GWP of refrigerant in the new chiller to criterion 4

JCM methodologies ID_AM003 and ID_AM008 include eligibility criteria for new refrigerant to be CO2 or NH3 "Natural refrigerants"

and GWP 1, thereby excluding all HCFCs and HFCs in the project case. This is a contradiction with respect to BD_PM001 and its

criterion 4. Aside of this JCM internal incoherence, a GWP threshold would account for more national circumstances of climate

policies and emissions trading.

Without a GWP limit for new chiller refrigerant, BD_PM001 leads to more chillers with HFCs in Bangladesh, and in consequence

increases the burden on Bangladesh to comply with the Montreal Protocol in the future.

If a HCFC-123 chiller with a GWP of 79, is replaced with a chiller with HFC-407c that has GWP 1700, the GHG impact from the

refrigerant increases 21-fold when the leakage during operation is the same volume (in most cases this is so since perfect maintenance

is not realistic). In HPMPs in many countries in Asia a very significant substitution of HCFC chillers with HFC chillers is occurring

(see Montreal Protocol decision XIX/6).

The CDM methodology AM060 for chillers, does not permit a chiller replacement with a new one containing HFC-407c.

The most straightforward source of such a threshold could be the new HFC law in Japan revised in April 2015, containing GWP thresholds 1500, 750 and 100. There is also the industrial voluntary action plan for F-gases by 14 industry associations in Japan.

Another source could be American Carbon Registry's "Emission Reduction Measurement and Monitoring Methodology for Use of Reclaimed HFC Refrigerants and Advanced Refrigeration Systems" (addresses in particular HFC-407c in chillers), the US-EPA's SNAP rules and the EU's F-gas regulations. A threshold would assure that Bangladesh does not import chillers that are not permitted anymore in Japan, EU or USA, especially during a rapidly evolving technological transformation.

4. Include leakage of refrigerant in the project chiller

Criterion 5 requires a plan for not releasing refrigerants but omits normal leakage during operations.

In the literature, leakage rates between 1 and 5% are typically estimated for centrifugal chillers in industrial refrigeration.

Leakage rates can be much higher than 5% when the maintenance is not of good quality. The annual imports of HCFC-123 around 5 tonnes are a good indicator that the average leakage of the HCFC-123 chillers in Bangladesh is close to 5%.

During the development of AM060 by the CDM secretariat, expert studies on emission scenarios considered for CFC chillers in India an average leakage of 23.6%. (http://unfccc.int/resource/webcast/cdm/eb36 /downl/3b_EB36_ppp.pdf)

Since refrigerants are a significant cost, the quantities refilled are documented and the emissions can be added to G. Calculation of project emissions.

Criterion 5 requires a plan while not referring to the actual achievement of the planned effort. If it is appropriate to assume plan realisation in good faith, then it could be similarly appropriate to assume that the purchase of refrigerant and measurement of the re-filling is executed in good faith, so the information to calculate leakage is always available.

Finally, there is a trade-of between improving criterion 4 (adding a GWP threshold for new chillers) and improving criterion 5, the accounting for leakage. At least one of these two improvements is needed. When leakage is accounted for, the GWP threshold is a lesser concern, and when the GWP threshold required is low, the accounting of leakage is less imperative.

Chiller manufacturers might provide good and simple parameters to approximate leaked refrigerant volumes, for example, based on number of maintenance routines, lengths and pressure levels. Since BD_PM001 uses defaults astutely, a default for the inevitable leakage during maintenance seems the appropriate solution.

5. Instead of a default COP for the replaced chiller, use the design COP from its manufacturer

The manufacturer's documentation always includes the design COP. Therefore this value is always available at no cost or particular effort and can be used to calculate the baseline emissions more accurately than a default COP.

An attractive solution is to leave a choice of default or design COP to the project developer. This is also similar to the approach chosen in BD_PM001 for the electricity emission factor for captive power. The higher conservativism of a reference default COP does not increase BD_PM001's practicability. The incentive for the chiller replacement from the emission reduction credits can reflect the particular operational circumstances.

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Improvements 1. and 2. concern the project boundary and the current changes in the industrial refrigeration sector.

It is certainly a matter of judgement to what extend general changes in a sector should influence the project boundary.
Supply and demand for refrigerants affect the sector as a whole in particular during periods of technological changes.
Defining project boundaries for refrigerants that are extensively regulated by international agreements should not be
done in isolation, esp. for CFC - related impacts.
Improvements 3. and 4. are less a matter of judgement rather than a matter of physics and accuracy. The project chiller's
refrigerant has properties regarding the ozone layer and regarding the Greenhouse effect. There is ample evidence and
practice in the Montreal and the Kyoto Protocols that one cannot ignore the other. Perhaps increasing the double phase-outs
in the Montreal Protocol (more HFCs) is seen as unavoidable, although contrary to Montreal ExCom work, however,
using a refrigerant with a higher GWP than the replaced one increases GHG emissions. Similar carbon accounting
methodologies address both.

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As for ID_AM003, I would be pleased to provide further input if you regard this as relevant.

Thank you for your kind attention,
Thomas Grammig