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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Sixty-second Meeting
Montreal, 29 November - 3 December 2010

REPORT ON IMPLEMENTATION OF APPROVED PROJECTS WITH SPECIFIC REPORTING REQUIREMENTS

Introduction

1. The Governments of Canada, France, Germany, and Japan as well as UNDP, UNIDO and the World Bank have submitted progress reports on the implementation of the following projects, where specific reporting requirements are contained in the agreements, for consideration by the Executive Committee at its 62nd Meeting:

(a) China: Refrigeration servicing sector CFC phase-out plan: 2009 verification audit (UNIDO)

(b) Colombia: National phase-out plan for Annex A (Group I and II) substances (2009-2010 progress report) (UNDP);

(c) Global: Methyl formate as blowing agent in the manufacture of polyurethane systems. An assessment for the application in MLF projects (UNDP)

(d) Oman: Terminal phase-out management plan: audit report (UNIDO)

Chillers Projects

(e) Brazil: progress report on the demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP)

(f) Colombia: progress report on the demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP)

(g) Cuba: progress report on the demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP and Canada)

(h) Syrian Arab Republic: Progress report on the demonstration project on the replacement of CFC centrifugal chillers (UNIDO)

(i) Global: progress report on the global chiller replacement project (China, India, Indonesia, Jordan, Malaysia, Philippines, and Tunisia) (World Bank)

(j) Region – Africa: progress report on strategic demonstration project for accelerated conversion of CFC chillers in 6 African countries (Cameroon, Egypt, Namibia, Nigeria, Senegal and Sudan) (UNIDO, France, Germany, and Japan)

(k) Region – Europe: progress report on demonstration project on the replacement of CFC centrifugal chillers (Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Romania, and Serbia) (UNIDO)

(l) Region – Latin America and the Caribbean: demonstration project for integrated management of the centrifugal chiller sub-sector in the Caribbean, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP)

2. The Secretariat reviewed the progress reports on the above listed projects in light of the original project proposals, ODS data reported by the Governments concerned under Article 7 of the Montreal Protocol, and relevant decisions taken by the Executive Committee and the Meeting of the Parties.

China: Refrigeration servicing sector CFC phase-out plan: 2009 verification audit (UNIDO)

3. On behalf of the Government of China UNIDO, as the lead implementing agency for the refrigeration servicing sector CFC phase-out plan, has submitted to the 62nd Meeting of the Executive Committee an independent verification report regarding the CFC-12 consumption in the refrigeration servicing sector in China, covering the year 2009. Under this sector plan, the CFC-12 consumption of China is the basis for the agreed maximum allowable consumption for the sector.

Background

4. The refrigeration servicing sector CFC phase-out plan for China was approved at the 44th Meeting of the Executive Committee, with UNIDO as lead agency and Japan as cooperating bilateral agency. The total funds approved in principle for the plan amounted to US $7,885,000 plus agency support costs of US $836,130. The agreement was amended at the 45th Meeting to also include UNEP as a cooperating implementing agency. The refrigeration servicing sector CFC phase-out plan is aimed at supporting China in meeting its Montreal Protocol obligations, including the complete phase-out of the controlled use of CFCs prior to 2010. The last tranche for this sector plan has been approved at the 59th Meeting of the Executive Committee.

Progress report

5. The agreement between China and the Executive Committee specifies a maximum allowable CFC-12 consumption for the refrigeration servicing sector. This consumption is determined by verifying the Article 7 data, deducting from it verified consumption data from various sector plans where CFC-12 is being phased out in parallel. China has in previous years established a national stockpile, meant to supply CFC-12 to the refrigeration serving and MDI sectors beyond the accelerated closure of the production sector in 2007.

6. The agreement between China and the Executive Committee requires that the Article 7 consumption of CFC-12 in China be independently verified, while consumption in the refrigeration servicing sector is to be confirmed through China's own monitoring and auditing activities. The verification of the 2009 consumption of CFC-12 was in itself historically based on two verifications: the results of the World Bank's production sector verification, and the results of the verification of imports and exports, both of which were carried out under this sector plan. The import of CFCs to China in 2009 was zero. With production of 498.56 ODP tonnes and export of 100 ODP tonnes, the consumption of CFC-12 was 398.56 ODP tonnes. This consumption is 7.4 ODP tonnes below the limit of 406.0 ODP tonnes specified in the agreement between China and the Executive Committee for the year 2009.

Secretariat's comments

7. The Secretariat has advised UNIDO regarding the decision taken at the 59th Meeting of the Executive Committee to request UNIDO to provide annually, by calendar year, reports on the activities undertaken until the financial closure of the phase-out plan. UNIDO subsequently submitted an implementation report to the 62nd Meeting; however, at that time the documentation for the meeting had already been completed. The annual implementation report will be provided for consideration at the next meeting of the Executive Committee.

Secretariat's recommendation

8. The Secretariat recommends that the Executive Committee:

(a) Takes note of the verification report regarding the CFC consumption in the refrigeration servicing sector in China during the year 2009; and

(b) Takes note that the annual implementation report for the years 2009 and 2010 will be considered at the 63rd Meeting of the Executive Committee.

Colombia: National phase-out plan for Annex A (Group I and II) substances (UNDP)

9. The national CFC phase-out plan (NPP) was approved by the Executive Committee at its 41st Meeting. Under the NPP, the Government of Colombia committed to phasing out all CFCs and halons by 1 January 2010. The Executive Committee approved in principle US $4.5 million for implementation of the NPP, and also the funding for two tranches at its 41st (US $2,146,820) and 47th (US $2,353,180) Meetings.

Progress report

10. A number of results have been achieved so far during the 2009-2010 work programme of the Colombia NPP, including: the certification of an additional 1,000 refrigeration servicing technicians, bringing the number of technicians certified since the beginning of the programme to over 4,500; the establishment of three refrigerant reclaiming centres; providing training equipment including ODS identifiers to 35 training centres; and organization of the annual seminar-workshop for the training institutes with the participation of 55 trainers. Nearly 10,000 records have been introduced into the Ozone Unit's servicing database. Technical assistance for the adequate disposal of halons has been provided to end-users in the telecommunications, banking, oil and energy sectors. Furthermore, several resolutions were drafted to amend the procedure established by the Minister of Environment to allow the import of refrigeration and air conditioning appliances; to establish environmental measures for the use of ODS; and to ban the use of hydrocarbon-based air conditioning systems in vehicles with more than 5 passengers.

11. The total approved funding of US $4,500,000 has been disbursed.

Independent verification

12. In 2010, an audit of the 2009 consumption verification report was undertaken by an independent auditor who concluded that "2009 data on imports of ODS reported by the OTU (Ozone Technical Unit) are totally reliable; and that Colombia is accomplishing its targets on internal consumption as agreed." The auditor also recommended that "the control system for imports and exports and the institutional strengthening is widely consolidated. The main recommendation is to persevere on this path."

2011 work programme

13. The Colombia NPP's work programme will focus on strengthening the refrigeration management plan by certifying 600 refrigeration technicians, strengthening the recovery/recycling network through the establishment of five refrigerant reclamation centres, and promoting the use of hydrocarbon-based refrigerants. It will also provide technical assistance and support to major ODS end-users in all sectors. Finally, the work programme will strengthen the national legal framework and the control of ODS trade, and strengthen the implementation and monitoring units.

Secretariat's comments

14. The Secretariat noted the comprehensive progress report on the implementation of the Colombia NPP, together with the supporting documents, including the verification report on national ODS consumption in Colombia. The 2009 CFC consumption of 110.6 ODP tonnes reported by the Government of Colombia under Article 7 of the Montreal Protocol is already 220.6 ODP tonnes below the allowable level of CFC consumption for that year of 331.2 ODP tonnes.

15. Upon a request for additional information on the status of implementation of the MDI Phase-out project, UNDP indicated that production of non-CFC MDIs is expected during the first quarter of 2011. The product development process, including registration, has been completed for salbutamol (production will commence once the manufacturing line is operational). The other four formulations are in different stages of development.

16. The Secretariat sought clarification from UNDP on whether the Government of Colombia will be able to achieve the complete phase-out of CFCs by the end of 2010 and sustain that level of consumption through the activities proposed in the final work programme. UNDP reported that, since 1 January 2010, CFC imports into Colombia were zero. Several actions are under implementation to reduce the use of CFC-11 in chillers and refrigeration equipment in operation. The established structure of national certification and training of technicians has allowed for mainstreaming and expansion of good servicing practices in refrigeration. At the regulatory level, the Government has established measures to ensure the sustainability of CFC phase out, including bans on imports of all CFCs and CFC-based equipment and on national manufacturing of products/equipment using CFCs.

Secretariat's recommendation

17. The Executive Committee may wish to take note of the progress report on the implementation of the national CFC phase-out plan (NPP) for Colombia, covering the 2009-2010 period, and approve the annual implementation programme for 2011.

Global: Methyl formate as blowing agent in the manufacture of polyurethane systems. An assessment for the application in MLF projects (UNDP)

Background

18. UNDP has submitted to the 62nd Meeting a technical report: "Methyl formate as blowing agent in the manufacture of polyurethane systems; an assessment for the application in MLF projects". The complete technical review is attached to this document.

19. At its 56th Meeting, the Executive Committee approved two pilot project for validation of methyl formate as a blowing agent in the manufacture of polyurethane foam in Brazil, and in microcellular polyurethane foam applications in Mexico. It noted that the projects were consistent with decision 55/43(e) and that they had been designed to disseminate the results from the validation of methyl formate technology in rigid, integral skin polyurethane foam, and microcellular polyurethane foam applications globally, and on the understanding that the projects would be the final validation projects for methyl formate in the manufacture of rigid, integral skin polyurethane foams, and microcellular polyurethane foams (decisions 56/50 and 56/51).

Executive summary

20. UNDP formulated a number of pilot projects to investigate the safe use of methyl formate (ecomate® or MF) to replace HCFC-141b in polyurethane (PU) foams application. The use of MF-based systems has been evaluated at Purcom Quimica (Brazil) and Quimiuretanos Zadro (Mexico) with the objective of assessing its performance compared to HCFC-141b-based systems, and establishing the feasibility of its use in Multilateral Fund projects.

21. The technology using MF in PU foam is owned and marketed by Foam Supplies, Inc., (FSI) in the United States of America. While MF use is still small compared to HCFC-141b, it has been growing substantially in the last few years, from 40 tonnes in 2005 to 910 tonnes in 2010 (January to August).

22. At the time the project was approved by the Committee, Purcom was the only Article 5 licensee of the technology; for that reason, it was selected to implement the pilot project. Since Purcom does not market shoesole systems, this application has been separately assessed through Zadro. To avoid the perception that the funding provided by the Multilateral Fund would cause any preferential treatment, it was agreed from the outset with FSI and relevant licensees that they would grant non-exclusive (sub-) licenses to any interested party that applies for Fund assistance to phase out HCFCs.

23. The project identified 17 PU foam applications. The action plan was based on a thorough evaluation of previous work by FSI and its licensees, for incorporation into the assessment and the elimination of applications requiring direct injection (mostly continuous operations). For the purpose of the pilot projects, acceptability was defined as determining the safe use of the technology based on health, safety and environmental data; determining the applicability of the technology based on its processability; determining the applicability of the technology by measuring relevant physical properties before and after replacing HCFC-141b; and collecting complementary information and views from enterprises that have tested MF formulations in their production. The outcome of the assessment is summarized in the table below.

Application	**Health, safety, environment**	**Processability**	**Physical properties**	**Assessment**
Flexible and integral skin				
Hyper-soft molded	+	+	+	+
Hyper-soft blocks	+	+	+	+
Viscoelastic molded	+	+	+	+
Viscoelastic blocks	+	+	+	+
Steering wheels	+	+*	+	+
Structural (rigid)	+	+*	+	+
Semi-flexible	+	+	+	+
Shoesoles	+	+*	+	+
Rigid foams				
Residential appliances	+	-	-	-
Other appliances	+	+	+	+/-
Panels, transportation, reefers	+	+	+	+
Spray	+	+	+	+
Blocks	+	+*	+	+
Pipe-in-pipe	+	+	+	+
Buoyancies	+	+	+	+

* Separate injection of MF recommended

\+ Acceptable, - unacceptable; +/- acceptable with conditions

24. Analysis of the outcome of the assessment led to the following conclusions:

(a) The use of MF as an alternative blowing agent to HCFC-141b in PU foam applications can be considered as an alternative in flexible/integral skin foam applications and in a number of rigid foam applications. For certain rigid foam applications mainly domestic appliances, the technology could not be recommended at this stage because the density required for this application cannot be reached by methyl formate at the current level of technology (i.e., further optimization of the technology is required), and for others the application of the technology should be analyzed on a case-by case-basis and could be subject to further optimization;

(b) To minimize safety risks for downstream users, such projects should preferably be implemented through their system suppliers as fully formulated systems;

(c) Project designers should ensure that: chemical compatibility is verified; minimum packed density is observed; health, safety and environmental recommendations are incorporated; and implications related to acidity are taken into account.

25. UNDP has developed generally applicable cost templates to calculate the incremental cost of conversion from HCFC-141b to MF-based foams. Capital costs and chemical costs can differ significantly from country to country and are also subject to economy of scale considerations.

Conclusion by the peer review

26. "The report and attachments are key parts of a comprehensive review of the suitability of MF for a range of applications as a replacement for HCFC-141b. The challenge is particularly severe as HCFC141b is used in a large number of A5 countries in almost all polyurethane foam applications. It must also be remembered that decision XIX/6 imposes tight and global deadlines that were rarely encountered by "emerging" blowing agents in the past. Many of the apparent shortfalls in MF's performance are very likely to be addressed by formulation optimisation but, in the present case, this optimisation process has not so far been led by the global polyurethane systems houses – as was the case with earlier blowing agents".

27. The peer review highlights the following areas that require further data/attention:

(a) Information on experience and MF usage per application (sub-sector);

(b) Combustibility safety during foam processing – need for concentration measurements and ventilation;

(c) Combustibility of the end product/foam in some cases;

(d) Data on spray foams and shoe soling elastomer applications;

(e) Further and longer-term dimensional stability test data, particularly for rigid insulating foams. As a temporary measure the density of foams which are normally near 32 kg/m^3 could be increased by 2-3 kg/m^3 to safeguard dimensional stability until more experience is gained; and

(f) Similarly, longer-term thermal conductivity testing using accelerated ageing methods such as the slicing method or ageing at 70°C

Secretariat's comments

28. The pilot projects for the validation of methyl formate approved by the Committee included workshops to disseminate the results of the projects. In this regard, a workshop was conducted in Brazil (23-24 March 2010) with the participation of 13 systems houses from six countries (Australia, Brazil, Chile, Colombia, Mexico, and the United States of America; 12 foam manufacturing enterprises from Brazil and Ecuador, representatives from six Article 5 countries (Argentina, Brazil, Chile, Mexico Paraguay and Venezuela (Bolivarian Republic of)) and representatives from UNDP, UNEP and UNIDO; two blowing agent wholesalers from Brazil and eight foam injection equipment manufacturers (Brazil and multinational). Dissemination of the results of the pilot projects has been conducted through the work being done as part of the preparation of HPMPs, including stakeholder meetings and visits to foams companies and systems houses. Dissemination through these channels has covered, among other countries: Argentina, Brazil, Chile, China, Dominican Republic, Egypt, Indonesia, Jamaica, Malaysia, Mexico, Nigeria, Trinidad & Tobago, and Uruguay. Interest and enquiries for further material have been received from companies in most of these countries. The Secretariat has also been informed that seven multinational systems houses have agreed to assess MF in their formulations.

29. The report on the assessment of MF has developed cost templates to calculate the capital cost of conversion from HCFC-141b to MF. However, consultations by the Secretariat with industry experts and some technology licensees that started in 2008 during preparation of the document on revised analysis of relevant cost considerations surrounding the financing of HCFC phase-out predominantly point to the fact that there is no retrofitting cost associated with the change to MF at enterprise level. On this issue, UNDP indicated that the template was based on discussions with the technology owner (FSI), and licensee companies (Australian Urethane Systems, Australia; Purcom, Brazil; Expanded, India; and Resichem, South Africa), that participated in the process optimization and evaluation of every single complaint that UNDP could identify. This process was required to avoid liability that could result from making superficial conclusions. UNDP had continued to collect market information that may assist fine-tuning the template, as well as other information in its assessment, to improve the quality of investment projects based on MF. Based on this information, UNDP concluded that acid-proofing needs to be part of an MF-based project.

Secretariat's recommendation

30. The Executive Committee may wish:

(a) To take note with appreciation of the report entitled "Methyl formate as blowing agent in the manufacture of polyurethane systems. An assessment for the application in MLF projects", submitted by UNDP;

(b) To request bilateral and implementing agencies to give full consideration of the assessment for the application of methyl formate when assisting Article 5 countries in preparing projects for the phase-out of HCFC-141b in polyurethane foam applications.

Oman: Terminal phase-out management plan: audit report (UNIDO)

Introduction

31. On behalf of the Government of Oman, UNIDO is submitting to the 62nd Meeting the verification report on the terminal phase-out management plan (TPMP) for CFCs. The TPMP was approved at the 52nd Meeting of the Executive Committee in July 2007 at the funding level of US $505,250 (including support costs). At the 57th Meeting, the Executive Committee provided funding to UNIDO in the context

of its Work Programme Amendments for the verification of the implementation of the TPMP in line with decision 45/54. This document is the result of this verification exercise.

Verification of the TPMP achievements

32. The verification was carried out from 12 July 2010 to 12 September 2010 by the Sultan Qaboos University in Oman, which collected and reviewed data on imports and consumption of CFCs, and reviewed the Government's policy in controlling the import and the consumption of ODS.

33. The Sultan Qaboos University conducted the survey based on the methodology described in the terms of reference. The verification focused on:

(a) Verifying/reviewing the country's policy in controlling the import and consumption of ODS and the division of responsibility between national institutions for enforcing the relevant policies;

(b) Reviewing the government's statistics on ODS imports against the data from the customs authority and the amount of quota issued against actual quota used in 2009;

(c) Reviewing the list of Oman's authorized importers against the record of customs authority;

(d) Reviewing, on a representative sampling basis if necessary, the records of importers against the customs authority records and the quota issued;

(e) Discussing conclusions on the achievement of the annual ODS reduction target as well as recommendations; and

(f) Reviewing the plan of action proposed by the Government of Oman to implement the recommendations from the auditors.

Conclusion and recommendation of the verification

34. The final recommendation of the verification exercise included the following:

(a) Further strengthen the cooperation between the National Ozone Unit (NOU) and Customs Authority to ensure closer monitoring of actual imports versus quotas issued to the importers to reduce discrepancies in reporting;

(b) Provide the customs authority with details of the TPMP activities plan to ensure support in meeting its objectives;

(c) Need to strengthen equipment and technical capacity of the customs authority to conduct efficient and effective monitoring of ODS imports; and

(d) The NOU to fully implement national regulations covering reporting of imported ODS and maintain an up to date data base so that imports can be easily verified.

Secretariat's comments

35. The Secretariat reviewed the verification report based on the methodology established. It appears that the verification process was conducted in conformity with the approved methodology. In the frame of the verification, the team contacted all CFC importers in Oman. Their distributors provided data that was

reviewed by the customs authority and the Ministry of Manpower. Oman does not produce CFCs and has not imported any since the beginning of the year 2010.

36. The review of the list of the government's authorized importers showed that 11 importers have been allocated quota for the import of CFCs from 2007 to 2009 out of which only 5 importers have used their quota. The quota allocated to importers and the quantities of CFC-12 imported are presented in the table below.

Quota issued and imports of CFCS from 2007 to 2009

Description	2007	2008	2009
Quota	16.889	9.195	4.093
Imports (as per NOU)	10.096	8.493	1.360
Balance	+6.793	+0.702	+2.733

37. The report highlighted the discrepancy between data from the NOU and customs authorities due to the methodology used by the customs authorities to record their data. According to the NOU, customs authorities' data may include other chemicals resulting in higher values compared to the NOU data. Thus, NOU data was considered more accurate than that from the customs authorities.

38. The analysis of data collected from the NOU and importers revealed that 2 importers did not use their permit to import CFC-12. Based on this finding, customs authorities committed themselves to develop a framework that will improve the management of allocated quota against imports. In this context, the NOU would systematically send licence permits to customs authorities. Moreover, any decision or action taken by both parties would be recorded in a common software to be provided once developed by the customs authorities.

39. The verification report refers to Article 19 of the regulations where each importer of controlled substances should provide the names, types, quantities and dates of imported substances together with information on end users during the previous year to the Ministry of Environment and Climate Affairs no later than the end of January of each year. It revealed that this has not been implemented by importers. In this regard, the verification team recommended that the NOU monitors closely the amount of ODS imported, distributed and consumed by recording relevant data in its own database.

40. The verification team also addressed the issue related to staffing at the customs authority level and identifiers provided to inspect refrigerants. The team considered that the staffing and the number of identifiers available were insufficient to inspect ODS imports at entry points. In this respect, it recommended that the NOU selects one entry point for inspection of all ODS and ODS-contained equipment.

41. The Secretariat noted that the conclusions and recommendations provided in the report (see paragraph 34 above) addressed all the issues found during the verification and that the verification exercise was successfully completed.

Secretariat's recommendation

42. The Executive Committee may wish to:

(a) Take note of the verification of the terminal phase-out management plan (TPMP) of CFCs in Oman in 2009 and the recommendations contained therein; and

(b) Encourage the Government of Oman to continue its efforts in controlling the use of CFCs, and to apply the conclusions and recommendations of this verification in the implementation of the HCFC phase-out management plan.

Chillers projects

Brazil: progress report on the demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP)

Colombia: progress report on the demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP)

Cuba: progress report on the demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP and Canada)

Syrian Arab Republic: Progress report on the demonstration project on the replacement of CFC centrifugal chillers (UNIDO)

Global: progress report on the global chiller replacement project (China, India, Indonesia, Jordan, Malaysia, Philippines, and Tunisia) (World Bank)

Region – Africa: progress report on strategic demonstration project for accelerated conversion of CFC chillers in 6 African countries (Cameroon, Egypt, Namibia, Nigeria, Senegal and Sudan) (UNIDO, France, Germany, and Japan)

Region – Europe: progress report on demonstration project on the replacement of CFC centrifugal chillers (Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Romania, and Serbia) (UNIDO)

Region – Latin America and the Caribbean: demonstration project for integrated management of the centrifugal chiller sub-sector in the Caribbean, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP)

Introduction

43. The Executive Committee had approved at its 47th and 48th Meetings eight demonstration projects for the replacement of CFC-using chillers for UNDP, UNIDO, the World Bank, Canada, France, Germany, and Japan comprising individual country projects, regional projects, and a global project. The approved project proposals suggested co-financing from a variety of sources, namely, the Global Environment Facility (GEF), Carbon Financing, Canadian International Development Agency (CIDA), the French Global Environment Facility, implementing agency funding and counterpart funding.

44. Through decision 55/5(d), the Executive Committee requested the Secretariat to "consult the Global Environment Facility and the implementing agencies on resolving co financing issues with respect to the approval of chiller projects, and when applicable, the related release of funding, and to report to the Executive Committee at its 56th Meeting on progress made in all chiller projects."

45. The Secretariat provided to the 56th Meeting information on the progress made in all chiller projects. The Executive Committee took decision 56/10 to note the report on progress made in all chiller projects and requested that the discussions held at the 56th Meeting be taken into account when preparing a revision of the desk study on the evaluation of chiller projects and when preparing a policy paper on "a facility for additional income from loans and other sources" in response to decision 55/2.

46. At the 59th Meeting, the Executive Committee decided through decision 59/8 to urge the agencies to accelerate implementation of the current chiller projects with co-funding modalities, to provide a progress report to the 62nd Meeting, and to encourage agencies to continue in their efforts to explore the applicability of carbon market instruments and other forms of co-financing, as appropriate, for the replacement also of HCFC equipment, particularly chiller equipment.

47. The progress report before the Executive Committee is in response to the above decisions, in particular decision 59/8.

Progress Report

48. In preparation for this progress report, the Secretariat distributed a three-part questionnaire to the three implementing agencies for chiller investment projects, namely UNDP, UNIDO and the World Bank. In the questionnaire, the agencies were requested to provide the following: a brief assessment of the experience to date and results achieved, a description of the co-financing mechanism used, and a summary of the activities undertaken. The questionnaire has been updated as compared to the previous version, to take into account additional information as well as the changing situation in which these projects are being implemented. This update is in line with decision 55/5 (d) of the Executive Committee, in which the Secretariat was requested to consult the implementing agencies on chiller projects. The questionnaires submitted by the agencies are provided as an attachment to this document.

49. For some countries, the implementation of the activities has showed significant progress during the last year. This is in particular true for Colombia, Jordan and the global chiller programme. A number of other projects showed no or almost no changes as compared to the report received last year.

50. Some programmes continue to face delays in implementation out of a variety of reasons. For example, some beneficiaries became insolvent before an activity could be implemented; in other cases, a similar problem occurred after the chillers were delivered, and new project beneficiaries had to be identified. In another example the beneficiaries are meant to provide the co-funding, but are financially not in the position to do so; in a particular case this situation has now continued for more than one year.

51. The majority of the chiller projects were approved by the Executive Committee five years ago with a number of expectations. An overview of the progress of the projects is shown in the table below. This table provides aggregated information regarding all projects, with the number of projects approved, the number of chillers that had to be phased out with the project funding and the expected co-funding, the revision that this number had undergone since the approval, and the actual status.

Original approval and current status of the chiller projects

	Number of projects	**Total of chillers to be replaced** (according to original MLF proposal)	**Revised number of chillers to be replaced** (according to latest planning)	**Number of chillers already replaced**
Projects approved	8	237	2,544	103

52. This table shows clearly that the implementation of the programme is much slower than anticipated. However, compared to the original objective, about 43 per cent of the chillers originally planned have in the meantime been converted. At the same time, the total number of chillers in the projects has increased more than ten-fold. Only one project, the chiller project for Latin America and the Caribbean showed almost no progress, and UNDP, as implementing agency, indicated that no additional chiller participants had been identified. UNDP suggests considering the project for cancellation at the 63rd Meeting. The replies from the agencies provided in the questionnaires allow some observations regarding the delays.

53. The difficult synchronization of the project cycles and requirements between the Global Environment Facility, GEF, the Clean Development Mechanism (CDM) and the Multilateral Fund is repeatedly mentioned. The agencies have to respect the procedures and schedules imposed by the funding institutions, which also have different policy frameworks, different deadlines. While the related issues were universal, the Resource Allocation Framework to beneficiary countries, adopted by the GEF Council in September 2005, has added previously unexpected complications; in particular the implementation of the new processes in the beneficiary countries caused significant delays. It was also noted that the CDM and the GEF request countries and agencies to follow strictly the established procedures, which are not co-ordinated between these institutions. Some agencies suggested that an improved coordination between funding bodies would reduce delays and facilitate the implementation of projects.

54. The agencies also had to face some unpredictable events during implementation such as the insolvency of project beneficiaries, or the withdrawal of financial intermediaries. With an increasing time lag between approval of the original project and implementation, these difficulties tended to increase. The unexpectedly long time required to organise the co-funding created an additional strain on the working relationships with chiller owners, and therefore on implementation. Finally, also the national project implementation modalities were cited as a potential cause for delays. In one country the mechanism chosen by the Government for co-funding did not create sufficient interest among possible beneficiaries, causing the need for project redesign.

55. As mentioned in the report to the 59th Meeting (UNEP/OzL.Pro/ExCom/59/10, para. 7), all agencies focussed not only on the replacement of chillers to reduce the demand for CFCs, but also on improving the energy efficiency of these systems. Some agencies advised that energy efficiency is not yet sufficiently promoted, and that the understanding of and interest in the benefits of energy efficiency improvements is not present for many stakeholders. However, in other cases and once the benefits were sufficiently transparent, the co-operation between the national governments and the agencies was very close and instrumental in moving the projects forward.

56. The questionnaires this year for the first time include questions regarding differences between the public and private sectors. It appears that agencies find it easier to work with private owners than with public ones. Public owners often have more difficulties to access additional resources needed, are faced with long and complex internal procedures, and might have priorities different from that of the private sector. Public sector owners seem, therefore, to have more difficulty in committing themselves and their resources to a replacement. One conclusion of one agency was that it appears meaningful to inform and take care of public owners upstream of the projects in order to avoid any subsequent complication or delay. On the other hand, private owners do not consider co-funding as a serious impediment as almost all of their commercial investments require several sources of funding.

57. Despite the obstacles and challenges reported, the agencies as a whole were quite satisfied with this co-funding experience. They even proposed replicating the experience in the future. UNIDO suggested a similar project be considered for the phase-out of HCFC-based chillers, and UNDP suggested that some elements of chiller co-financing could be explored for early domestic appliances retirement programmes. The World Bank believes also that similar approaches could be taken in the future, focusing on the institutional learning regarding the combination of funding from different sources with different

objectives. All the agencies agree that the lesson learnt from this co-funding experience will be useful for the setting up of future projects.

58. The Secretariat would like to take the opportunity to commend the work of the agencies regarding mobilisation of co-funding, and the flexibility and skill shown by all agencies in successfully overcoming difficulties related to expected financing sources that did not materialise, and in identifying other sources.

Secretariat's recommendation

59. The Executive Committee might wish to:

(a) Note the progress report on progress made in all chiller projects provided in document UNEP/OzL.Pro/ExCom/62/9; and

(b) Request the Secretariat to provide another report on progress achieved in chiller projects to the 65th Meeting.

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METHYL FORMATE AS BLOWING AGENT IN THE MANUFACTURE OF POLYURETHANE FOAM SYSTEMS

AN ASSESSMENT FOR THE APPLICATION IN MLF PROJECTS

OCTOBER 2010

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EXECUTIVE SUMMARY

The Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol, through Decision 55/43, acknowledged the need to assess HCFC free technologies for use in developing countries and invited its implementing agencies, as a matter of urgency, to prepare and submit specific project proposals for the assessment of chemical systems for use with non-HCFC blowing agents. In response to this mandate UNDP formulated a number of pilot projects to investigate newly introduced HCFC free alternative technologies. This report describes the outcome of an assessment on the safe use of methyl formate (ecomate® or MF) to replace HCFC-141b in PU foams.

The use of MF based systems in PU foams has been evaluated at Purcom Quimica Ltda in Barueri/SP, Brazil and Quimiuretanos Zadro SA de CV in San Francisco del Rincon/GTO, Mexico with the objective of assessing its performance compared with HCFC-141b based systems and establishing the feasibility of its use in MLF projects.

UNDP wishes to state herewith that:

The use of MF in PU foams constitutes proprietary technology;
UNDP has refrained from any investigation or disclosure that would infringe on said property rights but limited itself to evaluation and assessment;

While UNDP has made arrangements with the owner of the technology for technology disclosure and the offering of non-exclusive (sub-)licenses to prospective MLF project beneficiaries, the negotiation of such (sub-)licenses will be the responsibility of the beneficiaries;

Any findings and/or recommendations by UNDP are based on the assumption that beneficiaries will follow health and safety procedures as outlined by the Agency in this document and its attachment and/or recommended by the technology owner.

The technology using MF in PU foam is owned and marketed by Foam Supplies, Inc. (FSI) in the USA. While still small compared to HCFC-141b, its use has been growing substantially in the last few years as the following table shows:

Table 1

YEAR	AMOUNT (metric tons)		
	Methyl Formate	Polyol System	HCFC-141b Equivalent
2005	40	850	100
2006	75	1,500	180
2007	160	3,200	385
2008	360	7,200	864
2009	365	7,300	875
2010	910*	18,000	2,200

* Estimate based on January thru August

Source: Foam Supplies Inc. (FSI)

Purcom was at time of project initiation the only A5 licensee and, for that reason, was selected as the recipient for this project. Because Purcom does not market shoesole systems, this application has been separately assessed through Zadro. To avoid the perception that MLF funds would cause any preferential treatment, it was agreed from the onset with FSI and relevant licensees that they would grant non-exclusive (sub-) licenses to any interested party that applies for MLF-supported HCFC phase-out projects.

The project identified 17 PU applications. After project approval, November 2008, a slightly modified action program was prepared based on:

- A thorough evaluation and incorporation in the assessment of previous work by FSI and its licensees;
- Elimination of applications requiring direct injection (mostly continuous operations);

Acceptability, for the purpose of this project, was defined as follows:

- Determining the safe use of the technology based on health, safety and environmental (HSE) data;
- Determining the applicability of the technology based on its processability;
- Determining the applicability of the technology by measuring relevant physical properties before and after replacing HCFC-141b. ,
- Collecting complementary information, views from enterprises that have tested MF formulations in their production;

The summary outcome of the assessment is as follows:

Table 2

Foam Type	Application	Acceptability			
		Health, Safety and Environment (HSE)	Processability	Physical Properties	Assessment
Flexible and Integral Skin Foams	Hyper-soft molded	+	+	+	+
	Hyper-soft blocks	+	+	+	+
	Viscoelastic molded	+	+	+	+
	Viscoelastic blocks	+	+	+	+
	Steering wheels	+	+*	+	+
	Structural (rigid)	+	+*	+	+
	Semi-flexible	+	+	+	+
	Shoesoles	+	+*	+	+
Rigid Foams	Residential Appliances	+	-	-	-
	Other Appliances	+	+	+	+/-
	Panels, Transportation, Reefers	+	+	+	+
	Spray	+	+	+	+
	Blocks	+	+*	+	+
	Pipe-in-pipe	+	+	+	+
	Buoyancies	+	+	+	+

* = separate injection of MF recommended

+ Acceptable, - unacceptable; +/- acceptable with conditions

Analysis of the outcome of the assessment led to the following conclusions:

- The use of methyl formate as an alternative blowing agent to HCFC-141b in PU foam applications can be considered as an alternative in developing countries in flexible/integral skin foam applications and in a number of rigid foam applications. It is important to consider that for certain applications on rigid foam the technology could not be recommended at this stage and on others the application of the technology should be analyzed on a case by case basis and could be subject to further optimization.

- To minimize safety risks at downstream users, such projects should preferably be implemented through their system suppliers as fully formulated systems;

- Project designers should ensure that:

  - Chemical compatibility is verified;
  - Minimum packed density is observed;
  - Health, safety and environmental recommendations are incorporated;
  - Implications related to acidity are taken into account.

Costs

Conversion costs were to be determined in Phase-II of the MF assessment. A request for funding of this project at Purcom/Brazil, which would be treated as an investment project, was to be submitted jointly with this report. However, for the following reasons it is suggested to forego such a phase in Brazil:

- The price structure for PU chemicals in Brazil is not typical. The offering of locally produced polyols is limited and imported polyols are subject to significant import duties. HCFC-141b, on the other side, is lower in cost than in most other countries. The result is that MF systems currently are more than10% higher priced than HCFC-141b systems (in Mexico this is less than 5%).

In this context, UNDP has developed generally applicable cost templates to calculate the incremental cost of conversion from HCFC-141b to MF-based foams (4.5.1, 4.5.2). It should be pointed out that capital and chemical cost can differ significantly from country to country and are also subject to economy of scale considerations.

1. Introduction

The Executive Committee of the Multilateral Fund for the Implementation of the Montreal Protocol, through Decision 55/43 acknowledged the need to assess selected HCFC-free technologies for use in developing countries and invited implementing agencies as a matter of urgency to prepare and submit a limited number of time-specific project proposals for the development, optimization and validation of chemical systems for use with non-HCFC blowing agents. In response to this mandate, UNDP formulated a number of pilot projects to evaluate technology issues that it deemed unresolved. These issues ranged from determination of related global warming effects to validation of technologies that had been not, or only sporadic, been used in an Article-5 context. From these projects, six have been approved and one of these, the assessment of the use of methyl formate (MF) in non-continuous PU applications, has been technically completed. This particular pilot project has been designed around Purcom Quimica LTDA ("Purcom"), the largest independent system house in Brazil and specialized in tailor-made PU systems covering most PU applications. A notable exception is the application of PU foam in shoesoles, which has been validated through a pilot project executed by Quimiuretanos Zadro, a system house in Mexico that is specialized in PU shoesole systems.

MF as blowing agent in PU foams was first introduced by Foam Supplies, Inc. (FSI). The company filed December 18, 2001 for a US patent which was awarded June 22, 2004. By now, FSI has filed for, or has been awarded, patents in most major countries. The use of MF in PU foams has developed as follows (information from FSI):

Table 3

YEAR	AMOUNT (metric tons)		
	Methyl Formate	Polyol System	HCFC-141b Equivalent
2005	40	850	100
2006	75	1,500	180
2007	160	3,200	385
2008	360	7,200	864
2009	365	7,300	875
2010	910*	18,000	2,200

* Estimate based on January thru August

The development of ecomate® has taken a life of its own and market share has grown as shown in the table above. Marketed under the name ecomate®, MF is currently licensed to the following enterprises:

- Australian Urethane Systems — Asia Pacific
- British Oxygen Corporation — Selected European Countries
- Purcom Quimica — South America
- Expanded Incorporation — India
- Resichem — South Africa

FSI has agreed to non-exclusive (sub) licensing in the future to system houses that are beneficiaries of MLF-funded HCFC phase-out projects. While the Brazilian part of the assessment was concluded in February 2010, the shoesole part took until August 2010. A first draft—excluding shoesoles—was presented during a workshop March 23/24 held in Curitiba, Brazil, with the participation of system houses, government officers, end users, regional experts, National Ozone Officers from the region and

representatives from several implementing agencies as well as other providers of competing technologies. The completed assessment will be presented to interested parties at a workshop in Leon, Mexico (19th Oct 2010). The complete assessment addresses comments/suggestions from the first workshop participants, Foam Technical Options Committee (FTOC) individual experts consulted, as well as from a peer reviewer.

Technology is ever evolving and there could be future improvements in the use of MF as auxiliary blowing agent that may reduce or eliminate current performance limits. It is believed that the mandate of UNEP's Foams Technical Options Committee is to monitor and to report to the Montreal Protocol parties on such evolutions. UNDP believes that the current assessment is sufficient to draw conclusions on its potential use in MLF projects.

2. Project Design

Approved Design

The project in its approved version was designed to develop, optimize and assess the use of MF as replacement technology for HCFC-141b in 17 PU applications and would cover acquisition of the necessary testing/prototyping equipment; development of formulations for all pertinent applications; optimization and assessment of these formulations, as well as dissemination of the experience gained through workshops. It also included the determination of incremental changes and related costs (ICCs and IOCs) deemed necessary at both system houses and downstream users to use the technology safely.

Modified Design

- **Peer Review:** projects normally do include a peer review of the proposed design. However, in this case a peer as review was not required as part of the submission. UNDP felt it prudent to add such a review to the completion procedure of the project (**Attachment-I**).

- **Limitations**: it is emphasized that this assessment serves a very practical purpose which is ***to determine the extent to which MF can be satisfactorily used in MLF-funded HCFC phase-out projects and, in this way, avoid unexpected setbacks in project implementations***

  This does not include an exhaustive investigation into the way the technology works. It does include back-to-back testing with the technology it replaces but also review of existing data, specifically on health, safety and environment. The term *"**evaluation**"* **or** *"**assessment**"* therefore better describes the task at hand than the more formal/legal term *"**validation**"*.

- **Applications:** The applications for which the assessment was carried out are listed in the table under Section 3.
- **Optimization:** UNDP decided that optimization together with customers is more effective than prototyping at the system house only and would avoid some of the need for "phase-II" projects.
- **Collaborators:** While the project design remained centered around Purcom and Zadro, results have been shared and assistance was provided by other system houses using methyl formate, such as

Australian Urethane Systems:	Australia	Licensee
Resichem:	South Africa	Licensee
Foam Supplies, Inc.:	USA	Owner of the technology

  Together these system houses cover significant geographical areas. These companies have also shared their customer's views and information on their experience with MF (available upon request).

In recent HPMP related technical presentations the outcome of this assessment has been shared with PU system providers as well as downstream users. As a result, five system houses have already signed non-disclosure agreements and are testing MF systems in their own laboratories. Five others have contacted the technology owner of its licensees for the same purpose. Users in The Dominican Republic, Mexico, Nigeria and Uruguay have voiced their intention to convert to MF.

3. Project Implementation

The project was approved at the 56th ExCom meeting in November 2008. Funding was received in February 2009. The original list of applications was modified and reviewed on work already completed (to save time, Purcom started immediately after project conception). By late August 2009, formulation development was completed and by 8th October 2009 an action plan for the assessment was ready . By December 18, all optimization except shoesoles work was completed. In August, 2010 the optimization of shoesole formulations, which suffered initially from complications related to compatibility issues was finalized.

Following is a final list of applications that have been evaluated:

Table 4

Foam Type	Application	Milestones		
		Development	Optimization	Assessment
Flexible and Integral Skin Foams (FPF, ISF)	Hyper-soft molded	Completed	Completed	+
	Hyper-soft blocks	Completed	Completed	+
	Viscoelastic blocks	Completed	Completed	+
	Viscoelastic blocks	Completed	Completed	+
	Steering wheels	Completed	Completed	+
	Structural (rigid)	Completed	Completed	+
	Semi-flexible	Completed	Completed	+
	Shoesoles	Completed	Completed	+
Rigid Foams (RPF)	Domestic refrigeration	Completed	Discontinued*	-
	Other Appliances	Completed	Completed	+/-
	Transportation, Reefers	Completed	Completed	+
	Panels-discontinuous	Completed	Completed	+
	Spray	Completed	Completed	+
	Blocks	Completed	Completed	+
	Pipe-in-pipe	Completed	Completed	+

+ Acceptable, - unacceptable; +/- acceptable with conditions

***** The results did not justify continuation of trials

Notes: Methyl formate in continuous panels, boardstock and marine applications have been already proven in the USA, the UK and Australia on equipment and process conditions comparable to those in A5 countries. Other appliances include (apart from bottle coolers, display cabinets, etc) water heaters and thermoware which were previously separately listed but are very similar in formulations

4. Project Outcomes

Methyl-formate or methyl-methanoate is the methyl ester of formic acid. It belongs to the family of oxygenated hydrocarbons (hydrocarbons with one or more oxygenated functional groups). It has a relatively low molecular weight and is commonly used in the manufacture of formamides, formic acid, pharmaceuticals, insecticides and, more recently, as a blowing agent for foams. There has been also use as a refrigerant. A Material Safety Data Sheet (MSDS) prepared by the International Programme on Chemical Safety (IPCS) is attached (**Attachment-II**). There are also MSDSs from a number of suppliers and users.

Following data on physical properties have been taken from this MSDS and the 2006 FTOC report and compared with HCFC-141b, as it is targeted as an alternative to this substance:

Table 5

Property	Methyl Formate	HCFC-141b
Appearance	Clear liquid	Clear liquid
Boiling point	31.3°C	32°C
LEL/UEL	5-23%	7.6-17.7%
Vapor pressure	586 mm Hg @ 25°C	593 mm Hg @ 25°C
Lambda, gas	10.7 mW/mk @ 25°C	10.0 mW/mk @ 25°C
Auto ignition	>450°C	>200°C
Specific gravity	0.982	1.24
Molecular weight	60	117
GWP	Negligible	630
ODP	0	0.11

Sources: IPCS and FTOC

4.1 Health, Safety and Environment (HSE)

4.1.1 Health

Following data are taken from the Pesticide Action Network (PAN[1]) Registry:

Acute Hazard:	Not listed
Carcinogen:	Not listed
Endocrine Disruption:	Not listed
Reproductive and Development Toxicity:	Not listed

MF is transformed in the body very rapidly (with a half-life of several seconds) into formic acid and methanol. The MSDS mentions 'R20/22' (harmful by inhalation and if swallowed) and 'R36/37' (irritating to eyes and respiratory system). OSHA assigned the substance a 100 ppm TWA and 150 ppm STEL. In the USA, MF is recognized as "GRAS" (**G**enerally **R**ecognized **A**s **S**afe) and therefore exempt from premarket approval requirements of the Federal Food, Drug and Cosmetic Act. In the EU, it is pre-registered under REACH with no further action required u/t 2018.

[1] www.pan-international.org

Based on studies conducted on behalf of FSI by certified industrial hygienists (**Attachment-III**), process emissions from MF in an indoor sprayfoam application—a worst case emission scenario—were determined to be <10.00 ppm at operator samples and <23.00 ppm from area samples. These values are well under the OSHA PEL. For injection applications they were significantly lower.

Conclusion: *Based on the before mentioned evidence the use of MF as a blowing agent in PU foams appears not to create health concerns up and above those with HCFC-141b. It is highly recommended that applicable safe handling guidelines are followed.*

4.1.2 Safety

Methyl Formate's MSDS mentions that methyl formate is "*extremely flammable"* and "*vapor/air mixtures are explosive"*. Based on this, one of the main arguments voiced against the use of methyl formate as blowing agent in PU foams is its perceived explosiveness. The term explosiveness, however, should be used with care and properly defined. Explosion is defined as" the bursting, or rupture, of an enclosure or container due to the development of internal pressure from a deflagration or detonation as defined in NFPA 69". Essential elements required to trigger an explosion are fuel, air, an ignition source, and containment.

Please note that the fuel can be pure MF or an MF-based fully formulated systems. To bring the latter to explosion is virtually impossible. Apart from the problem to get the polyol mixture ignited, the heat of combustion is so low that the necessary pressure built-up in containment will just not be achieved.

Attachment IV deals with flammability issues in more detail. It concludes that:

- Methyl formate as a pure liquid is very flammable and requires proper safeguards. The risk of explosion is, however, remote because its low heat of combustion;
- A PU system base on methyl formate can be formulated as a low combustible liquid and will not reach the LFL even in the drum's head space; and
- There is no reason to treat methyl formate fully formulated systems differently from HCFC-141b fully formulated systems.

Flammability is therefore not an issue for downstream users that apply fully formulated systems. The situation is different for system houses that purchase "pure" (97.5%) methyl formate, blend this with polyol and other components and then package the fully formulated systems into drums for shipment. While measurements show that even then it is difficult to reach the lower flammable limit, it still exists and it is therefore advised to follow recommendations for handling flammable liquids, as below:

- Proper personal protective equipment;
- Closed blending containers, with a dry nitrogen blanket;
- Explosion proof equipment (pump, agitator, light, heating/cooling,);
- Electrically grounded equipment and drums (grounding clip);
- A stationary sensor with alarm function set on 20% LEL;
- Adequate ventilation
- Meter MF under the level of the liquid to which it is being added (to avoid static electricity)
- Use closed blenders to avoid human exposure to isocyanate vapors, in case methyl formate is blended in isocyanate

Conclusion: *There are fire safety risks associated with blending MF at system house level. They can be managed by following established standards and procedures. For preblended systems, no incremental fire risk exists.*

4.1.3 Environment

Methyl Formate is not registered as a hazardous air pollutant, groundwater contaminant or persistent organic pollutant (POP). Ecotoxicity data are not available. In the USA, methyl formate is not treated as a volatile organic compound (not a smog generator) and is SNAP approved. In Europe it is compliant with the RoHS and WEEE directives[2]. Its ODP is zero and its GWP insignificant (USEPA/Federal Register 69.190SNAP). In the EU it is preliminary permitted under REACH regulations.

Conclusion: *MF fully formulated systems do not pose an environmental hazard based on current regulations*

4.2 System Processability

4.2.1 Shipping & Storage

Shipment of MF can be carried out in carbon steel vessels or containers. No special material is required. Carbon steel is also acceptable for storage and piping. Under high moisture conditions (>80% RH) it is suggested to use stainless steel. Potential for moisture contamination can be avoided with a simple nitrogen blanket. MF has a very low viscosity (10% of that of water). This causes the need to recalibrate viscosity sensitive metering equipment (such as low-pressure pumps) but also allows for gravity or low pressure transfer (around 0.7 bar). Pump transfer is more suitable. Shipping, storage, and handling considerations are the same as for HCFC-141b. Transportation and storage labeling has to follow applicable regulations in the countries of use.

Conclusion: *No special considerations are required for shipment and storage of MF fully formulated systems*

4.2.2 Stability

Manufacturers typically offer shelf lives of 6 months for their systems after date of manufacturing if stored in original, unopened containers at temperatures typically between 10°C and 30°C. MF based rigid foam made from two year old samples did still match the reactivity of freshly blended product. Industrial trials showed that MF blended polyols for ISF applications are limited in stability and loose catalytic activity after about one month. Blending MF in isocyanate solved the problem.

Conclusion: *MF fully formulated polyol systems for all applications, except integral skin foams are sufficiently stable. MF blended isocyanate systems are stable*

[2] RoHS: Restriction of Hazardous Substances (EU directive), WEEE: Waste Electric and Electronic Equipment (EU directive)

4.2.3 Hydrolysis and Corrosion

With only small amounts of water in the polyol and none in isocyanates, hydrolysis is not expected to be a major issue. The measured pH (typically 6.25) indicates the same. The slight acidity raises, however, concern of potential corrosiveness. The manufacturers emphasize that, provided stabilized systems are used, no special considerations are needed for equipment. They claim that MF systems are used in all types of equipment, and that equipment used for processing HCFC-141b can be used with MF systems.

There are however two known cases where customers claimed corrosion issues. Investigation of the complaints showed that in one case the user was using un-stabilized systems while in the other case the age of the equipment (20+ years) may have played a role. The relationship of corrosion to the use of MF was not established in both cases. Nevertheless, caution is recommended.

Conclusion: *Equipment and components that come in contact with MF fully formulated systems should be preferably corrosion resistant*

4.2.4 Compatibility

Any auxiliary blowing agent requires compatible polyols and MF is not an exception. FSI states that it uses the same polyols, surfactants, catalysts and other additives as it did before (using HCFC-141b, HCFC-22 and HFC-134a). Purcom changed polyols in several cases, but this was part of an optimization process and would have been recommended for the same systems blown with HCFC-141b. For instance, Purcom's spray foam was not very successful in the market and needed stabilization by introducing additional polyols that are elsewhere common in spray foam applications. Their use improved Purcom's systems with both HCFC-141b and MF.

It should be emphasized that compatibility issues when changing blowing agents are normal. Cyclopentane-based systems required at their introduction sometimes significant polyol adjustments to overcome solubility issues and early HCFC-141b-based systems showed severe shrinkage and it took time to conclude that the potent solvent character of this substance limits it use in a system.

Conclusion: *There are no specific compatibility issues of MF with polyols and/or additives. However, it is recommended that in designing conversion projects, baseline polyols used need to be carefully checked and any required changes to polyols and related costs should be identified.*

4.3 Foam Properties

Determining the acceptability and applicability of an HCFC-141b replacement technology includes measuring of relevant physical properties before and after replacing HCFC-141b. The technology is deemed acceptable for a particular application if the physical properties are within a predetermined range (generally 10%) from the original properties using HCFC-141b. Testing has been conducted at following locations:

- Flexible and integral skin foams at Purcom;
- Shoesole foams at Zadro (Mexico) and CETEC (certified laboratory for shoe testing in Mexico);
- Rigid foams at FSI(USA);

- Steering wheels at Takata-Petri (Brazil). The company was not prepared to disclose testing details but confirmed compliance with relevant Volkswagen requirements and provided positive assessment. Domestic refrigerators at Mabe(Mexico).

Test protocols are on file. Test results have been categorized as follows:

- Flexible and Integral Skin Foams
  - Hypersoft Foams (molded, blocks)
  - Viscoelastic Foams (molded, blocks)
  - Semi flexible
  - Structural (rigid)
  - Steering Wheels
  - Shoesoles
- Rigid Foams
  - Domestic refrigeration
  - Other Appliances (including water heaters and thermoware)
  - Panels, Blocks and Transportation
  - Spray foams

4.3.1 Flexible and Integral Skin Foams

4.3.1.1 Hypersoft Foams

The tests were conducted at Purcom. Test results are as below:

Table 6

PROPERTY	TEST PROCEDURE		UNITS	HCFC-141b	MF
	NBR*	ASTM			
Density	8537	D-3574	Kg/m^3	19.4	19.2
ILD 25%	9176	D-3574	N	11	10
ILD 40%	9176	D-3574	N	13	13
ILD 65%	9176	D-3574	N	24	23
Comfort Factor	9176	D-3574	n/a	2.2	2.3
Resilience	8619	D-3574	%	42	40
Compression Set 90%	8797	D-3574	%	3	3
Tensile strength	8515	D-3574	kPa	80	88
Elongation	8515	D-3574	%	460	470
Tear Strength	8516	D-3574	N/m	456	460

*National Brazilian Standard

Conclusion: *The test results with MF are within an acceptable margin from the ones with HCFC-141b*

4.3.1.2 Viscoelastic Foams

The tests were conducted at Purcom. Test results are as below:

Table 7

PROPERTY	TEST PROCEDURE		UNITS	HCFC-141b	MF
	NBR	ASTM			
Density	8537	D-3574	Kg/m^3	34.2	34.8
ILD 25%	9176	D-3574	N	28	31
ILD 40%	9176	D-3574	N	36	39
ILD 65%	9176	D-3574	N	60	61
Comfort Factor	9176	D-3574	n/a	2.1	2
Resilience	8619	D-3574	%	6	5.5
Compression Set 90%	8797	D-3574	%	5	5
Tensile strength	8515	D-3574	kPa	60	65
Elongation	8515	D-3574	%	230	222
Tear Strength	8516	D-3574	N/m	270	301

Conclusion: *The test results with MF are within an acceptable margin from the ones with HCFC-141b or better*

4.3.1.3 (Semi) Flexible Integral Skin Foams

Tests were conducted at Purcom. Two different grades of hardness were tested:

Table 8
Black (softer)

PROPERTY	TEST PROCEDURE		UNITS	HCFC-141b	MF
	ASTM	DIN			
Product					
Molded Density	D-3574		kg/m3	288	285
Hardness	D-2240	53505	Shore A	35	35
Resilience	D-3574		%	45	45
Foam Core					
Internal Density	D-3574		Kg/m3	233	230
Tensile strength		53571	kPa	229	235
Elongation		53571	%	98	95
Tear Strength		53575	N/m	1,280	1,300
Compression set (50%)	D-3574		%	28	30
Skin Only					
Tensile strength		53504	kPa	1,000	1,000
Elongation		53504	%	96	95
Tear Strength		53515	N/m	4,380	4,375

Table 9
White (firmer)

PROPERTY	TEST PROCEDURE		UNITS	HCFC-141b	MF
	ASTM	DIN			
Product					
Molded Density	D-3574		kg/m3	300	298
Hardness	D-2240	53505	Shore A	44	44
Resilience	D-3574		%	45	45
Foam Core					
Internal Density	D-3574		Kg/m3	215	205
Tensile strength		53571	kPa	215	210
Elongation		53571	%	63	60
Tear Strength		53575	N/m	880	860
Compression set (50%)	D-3574		%	5	3
Skin Only					
Tensile strength		53504	kPa	1,720	1,700
Elongation		53504	%	79	77
Tear Strength		53515	N/m	4,700	4,680

Conclusion: *The test results with MF are within an acceptable margin from the ones with HCFC-141b*

4.3.1.4 Rigid Integral Skin Foams

There are no formal specifications for rigid integral skin foams in Brazil. The customer judges the surface, which needs to be free of pinholes. In very few exceptions, drop tests or bending tests are performed. The structural strength, however, is much larger than for comparable materials and generally no compliance tests are conducted. While most manufacturers use water-based systems, some insist on HCFC-141b because the skin is thicker (water-based products only provide densification towards the outside rather than a skin) and can be better polished. There is also a large use of rigid structural foam in shoesole applications (platform shoes). Test results on these are mentioned under "shoesoles" and in this case there are stringent requirements. In all rigid structural foam applications MF functioned as well as HCFC-141b.

Conclusion: *MF provides a comparable performance to HCFC-141b*

4.3.1.5 Steering Wheels

Takata-Petri in Brazil supplies steering wheels to almost all (international) car manufacturers in this country. They use exclusively MF systems which they blend in-house in the isocyanate site. This avoids system degradation of the polyol side which is observed when blending MF with ISF-specific catalysts and stabilizers. Takata-Petri confirms that the product meets the requirements of all their customers but declined to provide specifics claiming confidentiality. It was, however, willing to provide a written statement(available upon request) **(**Other, non-OEM suppliers of steering wheels use preblended ISF formulations with good results, however blended in the isocyanate side.

Conclusion: *MF provided a comparable performance to HCFC-141b as per the assessment of one company that supplies to international car manufacturers*

4.3.1.6 Shoesoles

Zadro's specifications are based on HCFC-141b-blown foams. It produces 8 main formulations that have been consolidated into four main ones—others being derivatives for special customers. All foam samples have been prepared in Zadro's laboratory using a low-pressure prototype dispenser. Densities have been determined by Zadro, other tests were performed by CIATEC, a federally owned and operated testing facility for the shoe industry. CIATEC is ISO-9001/2000 certified. The results are as follows:

Table 10

Property	**All types**	**R-095**	**R-096**	**R-099**	**QZCT15**	**Test Method**
Type		**SPORT**	**TRAVEL**	**RIGID**	**SEMI-RIGID**	
Blowing Agent	**141b**	**MF**	**MF**	**MF**	**MF**	
Density (kg/m^3)	<450	400	440	420	400	DIN 53420 ASTM D-792
Tear resistance (kgf/cm)	>6*	38.9	41.5	n/a	n/a	DIN 53507 ASTM D-624
Abrasion Resistance (mg, maximum)	<350	337.2	140.3	147.0	146.9	DIN 42516 ASTM D-1044
Flex Resistance (%, 30,000 cycles)	<200*	0	0	n/a	n/a	DIN 53543 ASTM D-1052

* Only applicable for flexible shoesoles

Tests protocols for all tests are on file.

Please note that formulation R-099 is rigid integral skin foam and the outcome support previous conclusions for this application. An important aspect of ISF foams in general is a smooth, pinhole-free surface. Methyl formate performed very well on this.

Conclusion: *MF perform equally or better compared to standards derived from HCFC-141b*

4.3.2 Rigid Insulation Foams

Test samples were prepared and tests were performed by FSI based on formulations prepared by, and chemicals from Purcom. This procedure was selected because Purcom did not have test facilities to perform full testing for these applications and no independent test facilities could be sourced in Brazil. On the other side, sending foam samples abroad compromised the samples so that local foaming was required. Test results were as follows:

4.3.2.1 Domestic Appliances

As part of an assessment of HCFC replacement technologies, Mabe, an international manufacturer of domestic refrigerators tested in its corporate technology center in Queretaro/Mexico a fully formulated, MF-based system from Purcom for domestic refrigeration insulation. A Lanzen panel ("Brett Mold") was used for these trials along with a Cannon high-pressure dispenser. Several samples were injected with minimal fills and over-packs of 10, 15 and 20%. A square mold was used in order to prepare test specimens for K-Factor, Compression and Dimensional Stability testing. Results were as follows:

Processing showed a slow reaction profile was compared with the current system. This would result in a dramatic cycle time extension on both cabinets and doors.

Free Density was recorded at 21 kg/m^3, which is a low density for Queretaro´s altitude, a 24 kg/m^3 is recommended.

Minimal Filling Density (MFD) was recorded at 33 kg/m^3 which is relatively high. Recommended MFD for domestic refrigeration is in the range of 27-28 kg/m^3. A low flow was observed, which predicts bad filling in narrow areas or complex geometries such as liners ribs, fridge mullion, etc.
Density Profile was calculated from an over-packed specimen which was 36 kg/m^3 at average but some sections shown densities as low as 28 kg/m^3. The average density/cut density ratio for this measurement must be in the range of 90-95%. In this case we found a ratio of 28/36x100 = **77%**.
When this parameter is below 90%, more PU is needed to achieve the minimal density which should be in the range of 30-31 kg/m^3. Purcom recommends a density of >35 kg/m^3 in order to get optimal results of this system, but this density could not be reached at this altitude because it would require over-pack exceeding 30%, which is too high and unsafe.

The K-Factor observed (0.18 BTU-in/ft^2.^{o}F.hr) was too high for time zero recording. Current values are around 0.135 BTU-in/ft^2.^{o}F.hr. This means a 33% difference and a potential increase in energy consumption of roughly 15%, which is detrimental for energy consumption standards.

Compression Set and Dimensional Stability were suitable and within specifications.

It was concluded that the system would need extensive optimization to meet the requirements of domestic appliance manufacturers in general and Mabe's relatively high altitude requirements specifically.
FSI as well as Purcom claim that through such optimization much better results can be obtained and, at a minimum, insulation and densities matching cyclopentane can be obtained. However, the aim of this assessment is comparison with HCFC-141b and the prevailing density for this application is 32 kg/m^3, which cannot be reached by MF at the current level of technology. It was decided therefore that continuing optimization of formulations for this sub-sector would serve no purpose for the MLF at this

point. FSI and Purcom may pursue this directly for their own benefit. Mabe's information is part of the testimonies.

Conclusion: *MF fully formulated systems in domestic appliances did not perform well. They showed higher densities and much lower insulation performance compared to HCFC-141b systems*

4.3.2.2 Other Appliances

The same system as used at Mabe was tested at Metalfrio/Celaya, Mexico and produced acceptable results for commercial refrigeration (bottle coolers) with densities around 36 kg/m^3 and improved k-factors. Metalfrio's baseline formulation, however, was water-based foam and therefore do not fit the assessment criteria.

Following tests were conducted on a generic fully formulated commercial refrigeration system and have significance for all other appliance foams:

Table 11

TESTS	UNITS	HCFC-141b UNDP-A*	HCFC-141b UNDP-B*	MF UNDP-C*	MF UNDP-D*
Closed Cell	%	98.20%	97.08%	98.76%	97.68%
Density,	pcf	1.72	1.67	1.69	2.10
Density, Cold Age, -80°F (-62.2°C)	pcf	1.72	2.08	1.88	2.00
Dimensional Stability 1-Day	Δ V, %	-21.99	-3.35	-0.62	-0.14
	Δ M, %	-2.08	0.27	0.52	0.94
Dimensional Stability 7-Day	Δ V, %	-22.60	-4.35	-1.12	-0.21
	Δ M, %	-2.56	-0.23	0.52	0.28
Density, Heat Age, 200°F (93.3°C)	pcf	1.69	2.03	1.91	1.99
Dimensional Stability 1-Day	Δ V, %	0.08	12.49	-6.43	-1.35
	Δ M, %	-1.03	-0.71	-1.51	-1.45
Dimensional Stability 7-Day	Δ V, %	2.86	2.62	-5.26	-1.20
	Δ M, %	-0.37	-0.04	-0.75	-0.98
Density, Humid Age, 158°F, 100% RH (70°C)	pcf	1.72	2.07	1.91	2.01
Dimensional Stability 1-Day	Δ V, %	7.50	5.75	-5.24	-2.73
	Δ M, %	0.99	0.94	-0.07	0.35
Dimensional Stability 7-Day	Δ V, %	8.18	6.23	-8.91	-2.61
	Δ M, %	4.10	1.45	3.55	7.09
Density, Compression, Parallel	pcf	1.71	2.10	1.95	2.02
	CS, psi	20.61	25.50	27.36	23.00
Density, Compression, Perpendicular	pcf	1.70	2.07	1.88	2.00
	CS, psi	12.12	18.29	13.81	20.30

TESTS	UNITS	HCFC-141b UNDP-A*	HCFC-141b UNDP-B*	MF UNDP-C*	MF UNDP-D*
Thermal Conductivity at 55°F midpoint Blowing Agent λ	mW/m-°K	10	10	10.7	10.7
k-factor	BTU-in/ft2-hr-°F	0.138	0.140	0.145	0.145
λ value	mW/m-°K	19.9	20.1	20.9	20.9

* refers to different foam sample batches

Test results are reported in the imperial system which is customary in the US. As the purpose of the tests is comparison, no conversion has been performed.

A more accurate thermal efficiency evaluation would be using products in side-by-side (reverse heat flow) testing). **Attachment–V** describes the outcome and conditions of such a test for a refrigerator and a freezer. With only 0.75 ^{0}C lower temperature increase compared with HCFC-141b, the results are better than expected from the difference in the λ factor of the blowing agents and appear to indicate that MF performs better in a laminated product than in a non-laminated sample.

Also important would be to assess long term performance of the foam. An evaluation of physical properties over an extended period of time is provided in **Attachment-VI**. The outcome shows that MF-based foams perform well over time with minimal degradation of foam properties.

4.3.2.2.1 Water heaters

While a sub-application for other appliance foams, the density of water heater foams are generally lower and over-pack is less.

Following results were measured with a Purcom system, foamed and tested at FSI:

Table 12

PHYSICAL PROPERTIES		TEST METHOD	UNITS	HCFC-141b SYSTEM	MF SYSTEM
Density	Core	D-1622	Pcf	2.07	2.12
Closed Cell Content		In-house	%	98.20	98.76
Perpendicular Compression	Density	D-1621	Pcf	2.23	2.35
	Strength	D-1621	Psi	29.40	29.57
Cold age	Density	D-1622	Pcf	2.23	2.32
	ΔV	D-6226	%	0.67	-0.57
	ΔM	D1622	%	-1.05	-0.79
Heat Age	Density	D-1622	Pcf	2.25	2.32
	ΔV	D-6226	%	1.35	-0.65
	ΔM	D1622	%	-1.10	-1.98
Humid Age	Density	D-1622	Pcf	2.20	2.29
	ΔV	D-6226	%	6.04	-8.84
	ΔM	D1622	%	1.69	-0.23

PHYSICAL PROPERTIES		TEST METHOD	UNITS	HCFC-141b SYSTEM	MF SYSTEM
Thermal Conductivity @ 55°F Midpoint	ʎ		mW/m-hr-°K	22.4	24.6
	K-factor	C-518	BTU-in/hr-ft²-F	0.155	0.171

4.3.2.2.2 Thermoware

This is also a sub-application of other appliance foams (FTOC classification) but with even lower densities than water heaters and less over-pack. Insulation values are also less critical and a more dimensional flexibility allows mitigation through design changes.

Following results were measured with a Purcom system, foamed and tested at FSI:

Table 13

PHYSICAL PROPERTIES		TEST METHOD	UNITS	HCFC-141b SYSTEM	MF SYSTEM
Density	Core	D-1622	Pcf	1.56	1.66
Closed Cell Content		In-house	%	97.08	97.68
Perpendicular Compression	Density	D-1621	Pcf	1.54	1.66
	Strength	D-1621	Psi	18.41	18.08
Cold age	Density	D-1622	Pcf	1.65	1,87
	ΔV	D-6226	%	1.34	-1.47
	ΔM	D1622	%	-0,50	-1.11
Heat Age	Density	D-1622	Pcf	1.67	1.95
	ΔV	D-6226	%	1.34	-1.47
	ΔM	D1622	%	-0,87	-2.04
Humid Age	Density	D-1622	Pcf	1.62	1.94
	ΔV	D-6226	%	5.32	-12.03
	ΔM	D1622	%	1.63	4.82
Thermal Conductivity @ 55°F Midpoint	ʎ		mW/m-hr-°K	20.8	24.0
	K-factor	C-518	BTU-in/hr-ft²-F	0.144	0.155

Conclusion: *The test results on essential properties with MF fully formulated systems in "Other Appliances" were within an acceptable margin from the ones with HCFC-141b*

4.3.2.3 Panels/Blocks/Transportation

Back to back commercial production of panels with HCFC-141b and with MF has been witnessed at Coldair in Curitiba/Brazil[3] with no difference in appearance and density except a significantly improved metal/foam adhesion. A visit of the company was included in the referenced workshop program in March 2010. Densities in these applications are typically 38-41 kg/m³—sometimes higher. Following are the results of comparative testing of a formulation from Purcom, foamed and tested at FSI for this kind of application:

[3] **ColdAir** Indústria e Comércio de Sistemas de Refrigeração Estrada da Graciosa, 5823, Curitiba - PR, 83412-460, Brazil. (0xx)41 3675-9545.The company can also be contacted through Purcom

Table 14

PHYSICAL PROPERTIES		TEST METHOD	UNITS	HCFC-141b SYSTEM	MF SYSTEM
Density	Core	D-1622	Pcf	1.88	1.96
Closed Cell Content		In-house	%	98.20	98.76
Perpendicular Compression	Density	D-1621	Pcf	1.78	2.03
	Strength	D-1621	Psi	20.54	26.72
Cold age	Density	D-1622	Pcf	1.82	2.08
	ΔV	D-6226	%	-2.44	0.37
	ΔM	D1622	%	-1.75	-1.08
Heat Age	Density	D-1622	Pcf	1.83	2.14
	ΔV	D-6226	%	1.40	0.10
	ΔM	D1622	%	-1.23	-1.02
Humid Age	Density	D-1622	Pcf	1.82	2.10
	ΔV	D-6226	%	6.15	3.96
	ΔM	D1622	%	0.12	0.11
Thermal Conductivity @ 55°F Midpoint	ʎ		mW/m-hr-°K	20.2	26.8
	K-factor	C-518	BTU-in/hr-ft-F	01.40	0.151

Conclusion: *The testified use of MF in current commercial production of rigid foam for panels/blocks/transportation applications indicates that there are no specific issues with MF as compared to HCFC-141b and product tests back this up.*

4.3.2.4 Spray foam

Purcom's HCFC-141b-based sprayfoam systems did not perform well in stability. The systems were based on locally produced Mannich (polyether) polyols only, while most sprayfoam systems include in addition a mix of aromatic amine and polyester polyols. The system was converted to MF, optimized with the mentioned different polyols and then shipped to the USA for foaming and testing**.** The results are as follows:

Table 15

PHYSICAL PROPERTIES		TEST METHOD	UNITS	HCFC-141b SYSTEM	MF SYSTEM
Density	Core	D-1622	Pcf	1.90	1.94
Closed Cell Content		In-house	%	97.08	97.68
Perpendicular Compression	Density	D-1621	Pcf	2.66	1.86
	Strength	D-1621	Psi	14.88	27.92
Cold age	Density	D-1622	Pcf	1.94	3.00
	ΔV	D-6226	%	-0.48	-0.90
	ΔM	D1622	%	0.00	0.37
Heat Age	Density	D-1622	Pcf	1.84	3.07
	ΔV	D-6226	%	-2.04	-7.84
	ΔM	D1622	%	-7.84	-0.61
Humid Age	Density	D-1622	Pcf	1.91	2.84
	ΔV	D-6226	%	-1.53	-2.89

PHYSICAL PROPERTIES		TEST METHOD	UNITS	HCFC-141b SYSTEM	MF SYSTEM
	ΔM	D1622	%	10.37	9.89
Thermal Conductivity @ 55°F Midpoint	ʎ		mW/m-hr-°K	19.9	24.5
	K-factor	C-518	BTU-in/hr-ft-F	0.138	0.170

All physical properties compare well except the thermal conductivity. It has to be kept in mind, however, that this is a completely new system for Purcom and some further optimization will be needed.
FSI sells MF sprayfoam systems in the US market along with HFC-134a-based sprayfoam systems. These compare as follows:

Table 16

PHYSICAL PROPERTIES		ASTM TEST METHOD	UNITS	ECOMATE SYSTEM	HFC-134a SYSTEM
Density	Free Rise		Pcf	1.9-2.1	1.9-2.1
	Core	D-1622	Pcf	2	2
Compressive Strength	Perpendicular	D-1621	Psi	24	20
Water Absorption	Weight	D-2127	lbs/ft²	0.01	0.02
	Volume	D-6226	%	>92	>92
Thermal Efficiency	Initial K factor	C-518	BTU-in/hr-ft-F	0.14-0.16	0.15-0.16
	BA ʎ		mW/m.k	10.7	14
Dimensial Stability	Wet	D-2126	% Vol change	<1	-1
	Dry		% Vol change	n/d	n/d
	Cold		% Vol change	0	0
Fire Resistance		UL94 HF1		Yes	Yes

Conclusion: *The mechanical properties of MF-based spray foams are equivalent to commercial HCFC-141b systems or better but the thermal efficiency needs further optimization*

4.4 Additional information from companies which are MF users

UNDP solicited and received views/information from companies where MF has been trialed. In addition, system houses that sell ecomate® systems were asked to collect the same from companies that currently use MF systems in their commercial operations.

Following table shows the answers received (actual letters are on file):

Table 17

Foam Type	Application	Company	Country	Acceptability Assessment
Flexible and Integral Skin Foams	Hyper-soft molded	Kumar	Brazil	+
	Hyper-soft blocks	Aumar	Brazil	+
	Viscoelastic molded	Aumar	Brazil	+
	Viscoelastic blocks	Tropical	Brazil	+
	Steering wheels	Takata Petri	Brazil	+
	Structural (rigid)	Injefox Poliuretane	Brazil Brazil	+ +
	Semi-flexible	Injefox Rallyspeed	Brazil Australia	+ +
Rigid Foams	Domestic refrigeration	Mabe	Mexico	-
	Commercial refrigeration	Gelopar Zero Chill Flow Fabristeel Perlick H&K Dallas Cooke	Brazil South Africa Australia China USA USA New Zealand	+ + + + + + +
	Water heaters	Prosol	Brazil	+
	Transportation, Reefers	Termosul	Brazil	+
	Panels continuous	Paneltech	Australia	+
	Panels-discontinuous	Danica	Brazil	+
	Spray	Somma Isar Global Polyair	Brazil Brazil Australia Australia	+ + + +
	Blocks	Coldair	Brazil	+
	Thermoware	Plastitalia Evakool	Brazil Australia	+ +
	Pipe-in-pipe	Somma	Brazil	+
	Buoyancies	Sealite	Australia	+

+ Acceptable, - unacceptable; +/- acceptable with conditions

Some of the customers purchase MF-based systems already 3-5 years.

4.5 Conversion Costs

UNDP has developed a generally applicable cost template to calculate incremental cost of conversion from HCFC-141b to MF-based foams. It should be pointed out that capital and chemical cost can differ significantly from country to country and are also subject to economy of scale considerations.

4.5.1 Incremental Capital Costs

Table 18

ENTITY	ACTION	CALCULATION	COSTS (US$)
System House	Explosion proofing of blending tanks	AA x 30,000	
System House	Nitrogen dispenser	BB x 8,000	
System House	Spray/PIP retrofit package	CC x 5,000	
System House	LPD retrofit package	DD x 10,000	
System House	Pycnometer (closed cell tester)	1 x 5,000	
System House	Portable K-factor tester	1 x 10,000	
System House	Refractometer (test chemical purity)	1 x 10,000	
System House	Small rent-out dispenser	EE x 10,000	
System House	Project Management	FF customers @ 1,000	
System House	Monitoring & technology transfer		
System House	Contingencies	10% capital costs	
System house	**Sub-Total**		
Customers	Spray/PIP retrofit packages	GG x 5,000	
Customers	LPD/HPD retrofit package	HH x 10,000	
Customers	New Dispensers	II x 20,000	
Customers	Trials, testing, training,	KK customers @ 3,000	
Customers	Contingencies	10% of 202,000	
Customers	**Sub-Total**		
		GRAND TOTAL	
		C/E (US$/kg/ODS)	

4.5.2 Incremental Operating Costs

Following is an example of an incremental cost template for IOCs. Prices are for illustration only. Four system houses/experts were asked to convert a given HCFC-based formulation to MF. The results are quite similar. The last two formulations leave the chemical ration the same, which is required for sprayfoams.

Table 19

CHEMICAL	PRICE (US$/kg)	BASELINE		Company A		Company B		Company C		Company D	
		%	Cost	%	Cost	%	Cost	%	Cost	%	Cost
Polyol	3.20	38	1.22	40	1.28	40.6	1.30	42.5	1.36	44	1.41
Isocyanate	3,00	50	1.50	53	1.59	53.4	1.60	50	1.50	50	1.50
HCFC-141b	2.40	12	0.29	--	--	--	--	--	--	--	--
MF	4.00	--	--	7	0.28	6	0.24	7.5	0.30	6	0.24
Cost			3.01		3.15		3.14		3.16		3.15
Difference			**Base**		**0.14**		**0.13**		**0.15**		**0.14**

4.6 System Details

With proprietary technology involved, formulation disclosure is a complex issue. While UNDP has been involved with and has financially supported adjustments of MF-containing formulations for applications that were not already commercial and/or optimizing such formulations in an A5 context, it has not ventured into the underlying technology partly due to intellectual property issues.

Following general rules apply when changing from HCFC-141b to MF as auxiliary blowing agent (ABA):

- Equimolar replacement would require 1 kg HCFC-141b to be replaced by 0.51 kg MF;
- Because of the strong solvent effect of MF, this ration can change at lower MF loads;
- However, the objective to keep the system non flammable, limits the maximum amount of MF to 8 php; equivalent to 16 php HCFC-141b. Increased water levels make up for additional blowing;
- In practice, 1 kg HCFC-141b can be replaced by anywhere from 0.35 kg (spray foam) to 1kg (high-density ISF);
- An MF system has to be stabilized to work well, with minimal hydrolysis and related corrosion and potential silicon/catalyst attack. This stabilization is proprietary technology.

To support MLF recipients, UNDP has arranged with FSI and its licensees that any interested (potential) MLF recipient will be offered, on request:

- Product Information Sheets (PIS) for specific applications;
- Samples and use instructions subject to signature of a non-disclosure/non-analysis agreement;
- A non-exclusive use (sub-) license.

5. Conclusions

Based on the information presented in this Report it is concluded that:

5.1 Health, Safety, Environment

- The use of MF does not create health concerns up and above those with HCFC-141b. Both substances have flammable limits but in fully formulated systems will not reach these even remotely under process conditions;
- Flammability of MF is an inherent safety risk. However, this risk is sharply mitigated—even virtually eliminated—at downstream user level when using fully formulated systems;
- MF-based systems do not pose an environmental hazard based on current knowledge/regulations;
- MF-based systems are approved by the US EPA for use in **all** foam applications (SNAP approval).

5.2 System Processability

- Special considerations are required for the shipment and storage of pure MF.
- No special considerations are required for fully formulated systems with less than 6% MF (polyols) or less than 2% MF (MDI) following USDOT regulations. Local regulations have to be consulted.
- MF-blended polyol systems for all applications except for integral skin foams are stable. MF-blended isocyanate systems are always stable. UNDP does not support blending in isocyanate and proposes instead separate injection through a third stream as developed by Zadro for shoesoles;
- Although there is no conclusive evidence of corrosive effects, it is recommended that components that come in contact with MF or MF blends should be corrosion resistant;
- There are no identified compatibility issues of MF with polyols and/or additives. However, it is recommended that when designing conversion projects, the compatibility of baseline polyols will be carefully checked and any required changes to polyols and related costs should be identified.

5.3 Foam Properties

- MF based hypersoft foams match HCFC-141b foams;
- MF based viscoelastic foams match HCFC-141b foams;
- MF based flexible/semi-/rigid/rigid ISF foams match HCFC-141b within an acceptable range;
- MF-based shoesole systems match or exceed HCFC-141b foams;
- MF based rigid foams for other appliances match HCFC-141b foams within an acceptable range;
- MF based spray foams match HCFC-141b systems within an acceptable range and outperform HCFC-134a and HCFC-22-based systems;
- MF based rigid foams for discontinuous panels and transportation match HCFC-141b foams within an acceptable range;
- Product and long-term performance (reversed heat flow and 5 year performance) is acceptable.

It is concluded from customer testing that:

- MF based foams for steering wheels match HCFC-141b foams within an acceptable range;
- MF based foams for domestic refrigerators and freezers do not sufficiently match HCFC-141b foams based on density and insulation.

Information provided by companies that are MF users indicates that:

Integral Skin:

- One company that supplies products to international car manufacturers informed that MF based rigid integral skin foams match HCFC-141b foams within an acceptable range. Other companies that manufacture steering wheels use standard ISF systems
  MF based foams for buoyancies match HCFC-141b foams within an acceptable range
- One company that produces continuous panels informed that it uses MF without any problem and that MF based foams match HCFC-141b foams within an acceptable range

5.4 Conversion Costs

UNDP has developed a cost template to calculate the incremental cost of conversion from HCFC-141b- to MF-based foams. It should be pointed out, however, that capital and operating (chemical) costs can differ significantly from country to country and that these are also subject to economy of scale operations and location of the supplier.

5.5 Overall Assessment

Following is a consolidated overview of the findings of this report:

Table 20

Foam Type	Application	Assessment			
		HSE	Processability	Physical Properties	Results
Flexible and Integral Skin Foams	Hyper-soft molded	+	+	+	+
	Hyper-soft blocks	+	+	+	+
	Viscoelastic molded	+	+	+	+
	Viscoelastic blocks	+	+	+	+
	Steering wheels	+	+*	+	+
	Structural (rigid)	+	+*	+	+
	Semi-flexible	+	+	+	+
	Shoesoles	+	+*	+	+
Rigid Foams	Residential Appliances	+	-	-	-
	Other Appliances	+	+	+/-	+/-
	Panels, Transportation, Reefers	+	+	+	+
	Spray	+	+	+	+
	Blocks	+	+*	+	+
	Pipe-in-pipe	+	+	+	+
	Buoyancies	+	+	+	+

* = separate injection of MF recommended

+ Acceptable, - unacceptable; +/- acceptable with conditions

Based on this assessment, UNDP believes that the use of Methyl Formate as an alternative blowing agent to replace HCFC-141b in PU foam applications in MLF projects would have to be subject to the following conditions:

1. Projects should preferably be implemented through local system houses to minimize safety risks at downstream users ;
2. Project designers should ensure that:
    a. Chemical compatibility is verified,
    b Minimum density is observed,
    c. Health, safety and environmental recommendations are incorporated,
    d. Implications related to the flammable and corrosive character of the substance are addressed,
    e. A compliance monitoring proposal is included.
    f. Local availability and costs of polyols and other elements should be considered to determine operational costs.

Attachments

1. ATTACHMENT Ia: METHYL FORMATE ASSESSMENT: RESPONSE TO PEER REVIEW
2. ATTACHMENT Ib: PEER REVIEW ON THE ASSESSMENT OF METHYL FORMATE AS A POLYURETHANE FOAM BLOWING AGENT WITH COMMENTS
3. ATTACHMENT II: METHYL FORMATE - MATERIAL SAFETY DATA SHEET
4. ATTACHMENT III: METHYL FORMATE EMISSIONS
5. ATTACHMENT IV: COMBUSTIBILITY OF METHYL FORMATE
6. ATTACHMENT V: REVERSE HEAT FLOW STUDY
7. ATTACHMENT VI: LONG TERM PERFORMANCE

ATTACHMENT Ia: METHYL FORMATE ASSESSMENT: RESPONSE TO PEER REVIEW

Decision 55/43 requires Agencies to inform the ExCom on pilot projects through *"a progress report after each of the two implementation phases…".* UNDP suggested **in addition,** the following alternative supervision arrangements:

1. By the Secretariat through an independent, qualified foam expert.
2. ExCom to consider requesting Parties to have the supervision of the validation through the UNEP Foams Technical Options Committee (FTOC).

UNDP felt that such a peer review, which could be extended to a preview of intended individual validation programs and preview/endorsement before transferring to Phase-II sub-projects, would increase project quality and general acceptability. However, the FTOC felt that its participation in such a review process would fall outside its mandate and declared itself unable to provide a formal opinion on the report. UNDP then resorted to the usual peer review process for proposed ODS phaseout projects and requested a review by Dr. Mike Jeffs, formerly employed by Huntsman, former Secretary General of ISOPA and standing member of the FTOC. The full review is shown below, with comments provided on UNDP's request by Mr. Bert Veenendaal, UNDP Senior Expert Foams (in "review' mode).

A first draft of this assessment was completed and presented to the FTOC May 18 as part of the FTOC's general technology review process. Comments and suggestions from individual FTOC members were taken into account in a new draft dated June 1, 2010 which was forwarded to the peer reviewer June 3. Present version of the report addresses the comments provided by the independent technical report (Attachment Ib). Below is a summary of UNDP answers to some of the points in the review. The reviewer mentions following required characteristics for a foam blowing agent with the following characteristics:

1. *An established use base, preferably over some years, such that its use can be stated as "well proven" in all the target applications*
2. *Very low GWP and hence no environmental pressures to curtail its use; also the toxicology should not require any special measures to protect personnel in the manufacturing areas*
3. *Economical to use in terms of both the costs per kg of foam made and the safety (flammability) engineering requirements*
4. *Safe to use without the precautions required for pentane and safe to use in the application of spray foams*
5. *Suitable for a broad range of applications in terms of the various aspects of processability*

UNDP does not necessarily disagree with these required characteristics but would like to point out that in the case of methyl formate there was in 2007 no established use base in A2 countries and exactly for that reason it was deemed necessary to prepare an assessment for a substance that, at least from available literature, promised to fit all other requirements mentioned by the reviewer. UNDP does remark in its report on the—rather dramatic—increase of the use of methyl formate after that date, but just to indicate a trend that started after the decision for an assessment was made. For the same reason, testimonies for each application have been collected from companies that use MF in their commercial operations. If there would have been an established use base in A2 countries at the time of project preparation, no assessment would have been needed.

All other requirements have been addressed albeit in another format, i.c.:

- Health, Safety, Environment (HSE)
- System Processability
- Physical Properties
- Conversion Costs

Health, Safety, Environment – while health and environment related data are accepted by the reviewer, a desire for more emission testing is voiced. In response, UNDP has commissioned two additional industrial hygiene

studies (one in Brazil and one in South Africa) that will be submitted separately to the ExCom. However, UNDP does not really see the need, as the studies incorporated in the assessment show consistently a very large safety margin in operator exposure as well compared to the flammability potential under operation conditions (<0.2% of the LFL. It can indeed be stated that it has been impossible in trials to create conditions in which the lower flammable limit could even be approached. In view of flammability risk MF gases are comparable with HCFC-141b. UNDP is, however, not adverse to the idea of a post-implementation HSE review by a qualified person and has already sourced affordable equipment for that purpose (~ US$ 2,000 per monitor). There are also monitoring badges available from at least two suppliers and these may also be considered.

System Processability – reviewer correctly voices exposure concerns when remarking on the stability of polyol blends for integral skin foams and the proposed solution (by Purcom) to blend MF in the isocyanate. UNDP mentions in its report (section 5.5: Overall Validation) that *"based on the need to blend MF with the isocyanate this is not recommended from an HSE point of view"*. However, in the mean time, as part of the evaluation of MF in shoesole applications, an alternative procedure has been developed that avoids the need of blending in isocyanate.

Physical Properties – The reviewer states his preference to test from machine samples rather than from laboratory ones. This opinion is generally shared but for integral skin, which features commonly metal inserts and relatively small, complicated shaped parts, this is not always possible and praxis has shown good correlation between hand-mix and machine samples in physical properties. Apart from ISF/FMF applications, all samples originate from machine-made foams which is essential of insulation and shoesole applications. The mentioned lack of information on rigid ISF foams is recognized and remediated in the final assessment. The observation that insufficient testing on rigid foams is conducted is related to the fact that the reviewer based his report on an outdated version of the assessment. The newer version UNDP sent well before the peer review report includes complete test results for all applications.

Conversion Costs – This section is misunderstood. MF containing systems can be handled without specific safety precautions related to flammability or explosion risk. This is not the case for system houses but one system house supplies at average 30 customers. In other words, safety related costs are reduced to 1/30 of those of hydrocarbon projects. The cost threshold in Mexican projects pending approval (less than US$ 5.00/kg ODS) shows this impressively. Actual operating costs differ greatly per country. To facilitate fair comparison, UNDP has developed a cost template that offers standardization in costing approaches. The template is included in the final report.

Editorial Comments – UNDP agrees with the suggestions but wants to point out that most of these were already implemented in the June version of the assessment.

Conclusions – the reviewer observes that global polyurethane system houses have not taken a lead in optimizing MF technology. This is indeed the case and is the very reason that the MLF needed to take the lead on this or forgo a technology that shows potential in cost containment as well in foam properties. Recently though, changes in attitude are becoming apparent and two of these global players have now signed evaluation agreements for MF. Also, the explosive growth in the use of MF—albeit still a minor technology compared with HCFCs or HCFs—shows growing acceptance.

In all this, the limited scope of this assessment should be emphasized. The MLF does not want project failures and wants to make sure that recipients know the pros and cons of a technology that is as of yet not, or not well, known in most A5 countries. The aim is not to conduct or fund research and development. UNDP feels that this assessment provides a clear picture of the potential of methyl; formate to replace HCFC-141b and will avoid adverse surprises during project implementation—as has been, for instance, the case with LCD technology.

ATTACHMENT Ib: PEER REVIEW ON THE ASSESSMENT OF METHYL FORMATE AS A POLYURETHANE FOAM BLOWING AGENT WITH COMMENTS

Dr Mike Jeffs
14/07/2010

1. INTRODUCTORY COMMENTS

Several novel blowing agent technologies have been introduced since the beginning of the MLF process and most have played significant roles in ODS replacement in both A2 and A5 countries. In general, most of these technologies were developed by the major polyurethane formulation suppliers, who operate in both A2 and A5 countries. In many cases they worked with fluorocarbon or hydrocarbon suppliers. This approach has been very successful and a full palette of technologies has been successfully delivered. Additional technological refinements have often been developed by smaller system houses for niche applications in both A2 and A5 countries. A key-blowing agent has been HCFC-141b, which is well proven, and in large-scale use for polyurethane insulation foams plus integral skin foams for shoe soles and automotive/furniture applications.

However, the acceleration of the phase-down of HCFC-141b availability under Decision XIX/6 has emphasized the critical role that this blowing agent has carried out. It has been economical to use, flammability precautions are minor and inexpensive and the physical properties of foams based on it, particularly insulation values, closely match those of CFC-11, which it replaced. It should be remembered that, when first introduced in the early 1990s, HCFC-141b-based foams had major dimensional instability problems leading to large insurance payouts (for shrunken roofs).

Hydrocarbon (pentane)-based foam technologies were introduced at the same time as HCFC-141b and have been very successful but are only economical to apply at medium to large blowing agent-consuming enterprises and, so far, have been considered to be unsafe to use for the important spray foam application.

The later HFCs, such as HFC-245fa and HFC-365mfc, have been successfully introduced in several applications but their in-use costs (operating costs) are much (30 to 100%) higher than for HCFC-141b. Additionally, because of their comparatively high GWPs, their use may be controlled by legislation in both A2 and A5 countries.

Thus, Decision XIX/6 forces on the foam industry the very urgent requirement for a blowing agent with the following characteristics:

6. An established use base, preferably over some years, such that its use can be stated as “well proven” in all the target applications
7. Very low GWP and hence no environmental pressures to curtail its use; also the toxicology should not require any special measures to protect personnel in the manufacturing areas
8. Economical to use in terms of both the costs per kg of foam made and the safety (flammability) engineering requirements
9. Safe to use without the precautions required for pentane and safe to use in the application of spray foams
10. Suitable for a broad range of applications in terms of the various aspects of processability
11. Suitable for a broad range of applications in terms of foam physical properties including dimensional stability and insulation values (for insulating foams)

This report has been commissioned by the UNDP and funded by the MLF to ascertain whether or not technology based on Methyl Formate (MF) meets these criteria. The technology owner is Foam Supplies, Inc (FSI) which sells and licenses MF technology as ecomate®

2. KEY COMMENTS

The report reviewed is dated 25/05/2010 and includes an Attachment (Appendix) on a study of Reverse Heat-Flow. Additional information from FSI on 5-year ageing of foam articles and on "Safe Handling Recommendations for ecomate® spray foam systems" has also been taken into consideration by the reviewer ***(see comment under Editorial Comments).***

In addressing the six criteria listed at the end of Section 1 the following can be stated:

1. The total usage of MF for foam blowing has built up over 5 years and 365 tons were used in 2009. In considering that up to 16 separate applications targeted this usage of MF in 2009 the usage is just less than 23 tons per application. ***There may be some applications where there has been above average usage, which could bring use experience in that application up to the cusp of the "well proven" status. If this is the case there is no relevant information in the report for such a judgment to be made.***

   Another consideration is with regard to the experience cited by various enterprises in their testimonies (Section 4.4). A total of 30 enterprises have submitted these testimonies and their average usage of MF must have been only about 12 tons per user. ***This cannot be interpreted as sufficient use to be characterised as "well proven".*** It is also noted that the evaluation in shoe soling application will be evaluated in an additional programme to take place in Mexico.

   In determining the relevance of the reported use of MF it would be illuminating to identify those applications where usage per enterprise exceeded, for example 50 tons in 2009. It would also be very useful to cite the use per sub-sector.

2. It is clear that the GWP of MF is very low and there should not be any environmental/climate issue with this. In addition, there is no evidence of any other environmental issue.

   The toxicology data do not raise significant concerns but it should be noted that all training activities are opportunities to remind staff that there should be no exposure to diisocyanates (MDI or TDI). It is the reviewer's understanding that MF will be registered for the European Union's REACH Regulation by BASF (due by 11/2010) and that this registration will include the application of foam blowing. The data in this registration submission should be incorporated in revisions of the MSDS. The rather limited industrial hygiene data (only two applications) show emissions are below OSHA limits.

3. The costs per kg of foam made are understood to be broadly similar to those for HCFC-141b. However, most usage of MF-based technologies is expected to be by small to medium-sized foam manufacturers who buy pre-blended formulations from system houses. It is clear that the equipment and procedures required for the safe preparation of formulations are similar to those for pentane. The capital costs associated with the storage and pre-blending operations for pentane are about 50% of the overall costs for a complete foaming plant. Presumably, the MLF will meet these very significant capital costs.

4. In considering the question of safety in foaming operations there are several factors to consider – see table for the main combustibility parameters for MF.

   The data indicate that MF's combustibility performance is in-between those of HCFC-141b and pentane. Whilst this is not a precise scientific statement it indicates that concern is considerably higher than for HCFC-141b. The report contains data on airborne concentrations of MF in two processing/applications. ***As an intermediate measure it is advisable to measure concentrations of MF for each foaming operation to ascertain proximity or otherwise to the LEL.***

	Methyl Formate	HCFC-141b	Cyclopentane
Flash Point C	-19°C	None	-49°C
Flame Limits (v%)			
Lower (LEL)	4	7.6	1.5
Upper (UEL)	23	17.7	7.8
Auto Ignition Temperature	449	550	260
DOT Shipping Classification	Class III Flammable	Not regulated	Class III Flammable

The reviewer has more concern with respect to spray foam operations, particularly in confined situations. The FSI document "Safe Handling Recommendations for ecomate® spray foam systems" referred to above gives guidance and a clear set of recommendations should be developed for each (processing) application and, especially, for spray foaming. These recommendations should include a requirement, until a further review, for MLF projects to include the measurement of concentrations and the provision for detectors and enhanced ventilation.

See also comments on the combustibility of foams in section VI below.

5. The report contains information on shipping and storage, stability, hydrolysis/ corrosion and compatibility with polyols. One issue raised is the stability in integral skin formulations and the apparent solution of blending in the diisocyanate (typically MDI) stream rather than in the polyol. This should be approached with care because of the hazards of handling diisocyanates. It is also mentioned that this stability issue may be associated with the limited range of polyols available to Purcom.

   In the discussion on hydrolysis and corrosion it is noted that equipment and components should be preferably corrosion resistant. This conservative approach is supported.

   As stated in the report, questions of polyol compatibility arise whenever a chemical component is changed in formulations. Purcom has been active in this area, including on spray foam systems in collaboration with UNDP. Unfortunately, circumstances prevented the evaluation of the foams resulting from this process. The recommendation that potential users optimise their formulations around MF is, of course, fully supported.

6. Foam property information is provided for 10 applications using either flexible or rigid products. The latter include several insulation foam applications. The test sample preparation methods are given in Attachment-VI. It is noted that flexible and integral skin samples were prepared by hand mixing. ***It would be preferable and more representative of production techniques to have machine-made samples.*** Samples for rigid foams (pour and spray foams) were prepared using dispensing machines. Comments per application are as follows:

- **Hyper Soft Foams:** Purcom carried out a range of tests (ASTM and National Brazilian Standard) and results are essentially the same as for the HCFC-141b-based control.

- **Viscoelastic Foams:** Purcom carried out a range of tests (ASTM and National Brazilian Standard) and results are essentially the same as for the HCFC-141b-based control.

- **Flexible Integral Skin Foams (Including Steering Wheels):** Purcom carried out a range of tests (ASTM and DIN) on two hardness grades (ca. 35 and 44 hardness by Shore A) and results are similar to those obtained for the HCFC-141b-based control. There is no data for Steering Wheels as the testing was carried out by

the enterprise Takata-Petri who has not shared their data except to state that the MF-based material met VW requirements (Specification #?). ***The reviewer recommends that data be obtained by additional testing to verify the suitability of MF in this application.*** (Note that shoe-soling testing will be carried out at a later date (in Mexico).

- Rigid Integral Skin Foams: There is no information on who performed the evaluation (Purcom?) and no data. One criterion is that the surface is free of pinholes. ***It is claimed that foams based on MF give a comparable performance to those based on HCFC-141b but further information would be helpful.***

- Rigid Insulation Foams: It is clear that the evaluation of the properties of rigid insulating foams based on MF is incomplete. This is due to limited testing facilities being available at Purcom plus the nature of test data required to verify insulating foams, which should include medium-long terms ageing tests on thermal conductivity and dimensional stability. The latter are partially covered by the additional paper on "Ecomate After Five Years" and by the Reverse Heat Leakage Tests (Attachment 4). The former has several illustrations of parts stored for 5 years. Changes in dimensions are stated to be less than 3.5% in all cases.

  1. **Domestic Appliances:** Mabe carried out the testing with formulations developed by Purcom. The foam system required higher densities than those that are normal in this application, poor flow and cure time plus thermal conductivities much higher than for HCFC-141b-based foams. It is accepted that the foam system was not optimised around MF and improved results are likely as a result. Given the position achieved by cyclopentane and pentane blends it was decided not to pursue optimisation in this sub-sector.

  2. **Other Appliances:** The formulations used in the previous section were tested by another enterprise (Matalfrio/Celaya) and compared to HCFC-141b-based controls. Based on the results displayed, the MF-based foams showed more shrinkage, on average, in the dimensional stability testing up to 7 days. No longer-term data is displayed. . There was also a small increase (4.5%) in initial thermal conductivity. It is noted that reverse heat leakage tests by FSI on unspecified formulations showed slightly less heat leakage for MF compared to HCFC-141b-based foamed cabinets. The data in the "Ecomate After Five years" for a drinks dispenser a slightly higher loss in insulation efficiency after 5 years compared to a HFC-134a-based control. Tests on display cabinets showed losses in insulation efficiency that were less than for the HFC-134a-based controls.

  3. **Water Heaters:** A Purcom system was foamed and tested by FSI in comparison to a HCFC-141b-based control. The cold, hot and humid ageing data do not show the ageing period involved and so no comments are possible beyond the point that there is little difference in properties compared to the control. The initial thermal conductivity is about 10% higher for MF compared to HCFC-141b-based foams.

  4. **Thermoware:** Again, a Purcom system was foamed and tested by FSI in comparison to an HCFC-141b-based control. The densities in this application are lower than in the previous appliance applications. However, it is noted that shrinkage is higher than for the controls, particularly under hot and humid conditions. Again, the test time is not specified. The initial thermal conductivity is over 7% higher for MF compared to HCFC-141b-based foams.

  5. **Panels/Blocks/Transportation:** Again, a Purcom system was foamed and tested by FSI in comparison to an HCFC-141b-based control. At the higher densities in these applications here is no significant difference in dimensional stability test data shown. Again, the test time is not specified. The initial thermal conductivity is about 8% higher for MF compared to HCFC-141b-based foams. The data in the "Ecomate After Five years" for an insulated shipping container showed a small loss in insulation efficiency after 5 years. ***An additional point is the combustibility of the finished articles, particularly if they are subject to building codes/regulations in the end use such as part of a building – this is the case in many A5 countries. This information should be obtained where applicable.***

6. **Spray Foams:** It would appear that only data from FSI is included and then in comparison with a control based on HFC-134a that is generally not used in A5 countries. The data show, not altogether surprisingly, better properties for MF than for the control. ***Further testing is necessary and will be carried out with an optimised formulation to be developed by Purcom and foamed and tested by FSI. It is necessary to include controls based on HCFC-141b in this extension of the testing programme. An additional point is the combustibility of the foam in use. Spray foams are normally subject to building codes/regulations in the end use such as part of a building – this is the case in many A5 countries. This information should be obtained where applicable.***

3. EDITORIAL COMMENTS

There are a small number of editorial comments to be made. These include:

- All pages to be numbered and correlated with the Contents (page 2)
- Consideration to be given to inclusion of the additional papers from FSI on 5-year ageing of foam articles and on "Safe Handling Recommendations for ecomate® spray foam systems" into the report (as attachments?)
- There are additional style/language/grammar points which should be clear after a Word spell check.

4. CONCLUSIONS

The report and attachments are key parts of a comprehensive review of the suitability of MF for a range of applications as a replacement for HCFC-141b. The challenge is particularly sever as HCFC141b is used in a large number of A5 countries in almost all polyurethane foam applications. It must also be remembered that Decision XIX/6 imposes tight and global deadlines that were rarely encountered by "emerging" blowing agents in the past. Many of the apparent shortfalls in MF's performance are very likely to be addressed by formulation optimisation but, in the present case, this optimisation process has not, so far, been led by the global polyurethanes systems houses – as was the case with earlier blowing agents.

However, this review highlights several points that require further data/attention. These are included in the text of this review in ***blue italic font***. They are in the following areas:

- Information on experience and MF usage per application (sub-sector)
- Combustibility safety during foam processing – need for concentration measurements and ventilation
- Combustibility of the end product/foam in some cases
- Data on spray foams and shoe soling elastomer applications
- Further and longer-term dimensional stability test data, particularly for rigid insulating foams. As a temporary measure the density of foams which are normally near 32 kg/m^3 could be increased by 2-3 kg/m^3 to safeguard dimensional stability until more experience is gained
- Similarly, longer term thermal conductivity testing using accelerated ageing methods such as the slicing method or ageing at 70°C

ATTACHMENT II: METHYL FORMATE - MATERIAL SAFETY DATA SHEET

METHYL FORMATE 0664 April 1997			
CAS No: 107-31-3 RTECS No: LQ8925000 UN No: 1243 EC No: 607-014-00-1 Formic acid methyl ester Methyl methanoate C2H4O2 / HCOOCH3 Molecular mass: 60.1			
TYPES OF HAZARD/ EXPOSURE	**ACUTE HAZARDS/SYMPTOMS**	**PREVENTION**	**FIRST AID/FIRE FIGHTING**
FIRE	Extremely flammable.	NO open flames, NO sparks, and NO smoking.	Powder, alcohol-resistant foam, water spray, carbon dioxide.
EXPLOSION	Vapor/air mixtures are explosive.	Closed system, ventilation, explosion-proof electrical equipment and lighting. Prevent build-up of electrostatic charges (e.g., by grounding). Do NOT use compressed air for filling, discharging, or handling.	In case of fire: keep drums, etc., cool by spraying with water.
EXPOSURE			
Inhalation	Cough. Dizziness. Dullness. Headache. Labored breathing. Shortness of breath. Unconsciousness.	Ventilation, local exhaust, or breathing protection.	Fresh air, rest. Artificial respiration may be needed. Refer for medical attention.
Skin	Redness.	Protective gloves.	Remove contaminated clothes. Rinse skin with plenty of water or shower. Refer for medical attention.
Eyes	Redness.	Safety goggles.	First rinse with plenty of water for several minutes (remove contact lenses if easily possible), then take to a doctor.
Ingestion	(Further see Inhalation).	Do not eat, drink, or smoke during work.	Rinse mouth. Give a slurry of activated charcoal in water to drink. Induce vomiting (ONLY IN CONSCIOUS PERSONS!). Rest. Refer for medical attention.
SPILLAGE DISPOSAL		**PACKAGING & LABELLING**	
Evacuate danger area! Collect leaking liquid in sealable containers. Absorb remaining liquid in sand or inert absorbent and remove to safe place. Do NOT wash away into sewer. Personal protection: self-contained breathing apparatus.		F+ Symbol Xn Symbol R: 12-20/22-36/37 S: (2-)9-16-24-26-33 UN Hazard Class: 3 UN Pack Group: I	
EMERGENCY RESPONSE		**SAFE STORAGE**	
Transport Emergency Card: TEC (R)-30S1243 NFPA Code: H 2; F 4; R 0		Fireproof. Separated from strong oxidants. Cool.	
Prepared in the context of cooperation between the International Programme on Chemical Safety and the European Commission © IPCS 2005 **SEE IMPORTANT INFORMATION ON THE BACK. IPCS** International Programme on Chemical Safety			

0664 METHYL FORMATE	
IMPORTANT DATA	
Physical State; Appearance COLOURLESS LIQUID, WITH CHARACTERISTIC ODOUR. **Physical dangers** The vapor is heavier than air and may travel along the ground; distant ignition possible. The vapor mixes well with air, explosive mixtures are easily formed. **Chemical dangers** Reacts vigorously with oxidants. **Occupational exposure limits** TLV: 100 ppm as TWA, 150 ppm as STEL; (ACGIH 2004). MAK: 50 ppm, 120 mg/m3; Peak limitation category: II(4); skin absorption (H); Pregnancy risk group: C; (DFG 2004).	**Routes of exposure** The substance can be absorbed into the body by inhalation of its vapor and by ingestion. **Inhalation risk** A harmful contamination of the air can be reached very quickly on evaporation of this substance at 20/C. **Effects of short-term exposure** The substance is irritating to the eyes and the skin. The vapor is irritating to the eyes and the respiratory tract. The substance may cause effects on the central nervous system. Medical observation is indicated.
PHYSICAL PROPERTIES	
Boiling point: 32/C Melting point: -100/C Relative density (water = 1): 0.98 Solubility in water, g/100 ml at 20/C: 30 Vapor pressure, kPa at 20/C: 64 Relative vapor density (air = 1): 2.07 Relative density of the vapor/air-mixture at 20/C (air = 1): 1.7 Flash point: -19/C Auto-ignition temperature: 449/C Explosive limits, vol% in air: 5-23 Octanol/water partition coefficient as log Pow: -0.21	
ENVIRONMENTAL DATA	
NOTES	
The odor warning when the exposure limit value is exceeded is insufficient. Card has been partly updated in October 2004 and 2005. See sections Occupational Exposure Limits, EU classification, Emergency Response.	
ADDITIONAL INFORMATION	
LEGAL NOTICE	Neither the EC nor the IPCS nor any person acting on behalf of the EC or the IPCS is responsible for the use which might be made of this information

ATTACHMENT III: METHYL FORMATE EMISSIONS

1. Occupational Exposure

Methyl formate has been assessed by OSHA (the US Occupational Safety and Health Administration), resulting in an Occupational Guideline September 1978, which is still valid. This information has been incorporated in all available MSDSs. OSHA and the American Conference of governmental Industrial Hygienists (ACGIH) have both instituted applicable exposure limits as follows:

OSHA PEL (ppm)	ACGIH TLV (ppm)	ACGIH STEL (ppm)
100	100	150

PEL = permissible emission limit (8 hr average)
TLV = threshold value limit (8 hr average)
STEL = short term exposure limit (15 min average)

FSI commissioned three industrial hygienic (IH) surveys, two by "Safe Day Consulting" (Missouri) and one by ICU (Texas). These surveys covered sprayfoam (1) and refrigerated vending machines applications (2-this survey was repeated to determine the effect on emissions of a low and high production rate). Both contractors are certified, used AIHA accredited laboratories and maintained chain of custody logs. Full individual results cannot be published because of pertinent US laws that regulate such disclosure to safeguard medical records (HIPAA and AAEMR). UNDP has confidentially reviewed the chains of custody and has de-personalized detailed records of the outcome on file. The outcomes were as follows:

Application	Survey Date	Concentration Range	Average Concentration
Sprayfoam	02-18-2004	1.3 – 23 ppm	8.2 ppm
Vending Machines	03-13-2003	0.0 – 4.5 ppm	2.2 ppm
Vending Machines	02-18 2004	0.5 – 23 ppm	0.9 ppm

Under no circumstance the permissible emission level was even approached and, so even less the lower flammability level (50,000 ppm).

2. Other Exposure

The ICU survey also including sampling around drums with polyol blend with the following results

- 6" above open container 0 ppm
- Immediately above open container: 0 ppm
- 2" above liquid: < 500 ppm (<1% LFL)
- 6" above liquid: 0 ppm
- Immediately above fresh foam: 0 ppm
- Immediately above 1hour old foam: 0 ppm

These tests were done with an electronic monitor programmed in % LFL and therefore not able to make precise differentiation at very low LFLs.

Conclusion: no specific exposure control limits are needed for methyl formate system operations

ATTACHMENT IV: COMBUSTIBILITY OF METHYL FORMATE

One of the arguments voiced against the use of methyl formate as blowing agent in PU foams is its perceived explosiveness. This has been initially the case with HCFC-141b as well—first projects included explosion proofing—but praxis showed this concern was not justified. It may be useful to look into the phenomenon of combustibility.

1. BACKGROUND

Properties commonly used to define flammable substances are [4]:

- **flash point**: the lowest temperature at which vapors above the liquid will "flash" when exposed to a flame in a standard test apparatus
- **auto-ignition temperature**: the temperature at which a flammable substance will burn spontaneously (without an external ignition source)
- **flammable limits**: concentrations range where a flame will propagate away from an ignition source
- **maximum explosion pressure**: highest buildup of pressure after ignition in a closed vessel
- **maximum rate of pressure rise**: maximum slope of the plot of pressure versus time, after ignition, up to maximum pressure
- **minimum ignition energy**: smallest amount of energy in an electric spark which will ignite a flammable mixture
- **heat of combustion**: the energy released as heat when a compound undergoes complete combustion with oxygen under standard conditions

2. APPLICATION TO EXPANSION AGENTS

Combustibility - a blowing agent is commonly stored and processed as a liquid but then turns due to an exothermic reaction between water and isocyanate (and to a lesser extent polyol and isocyanate) into a gas, expanding the still liquid reaction mixture and filling the generated foam cells. Addressing the combustibility of a blowing agent as a liquid is therefore equally important as of MF as a gas. For instance, HCFC-141b is not flammable as a liquid but its vapors may still burn. As it easily generates vapors at ambient conditions it should therefore also be tested for gaseous flammable properties. HCFC-141b is therefore often listed as "moderately" flammable or simply "yes"[5]. Methyl formate, on the other side, is, even as a liquid flammable—which does not necessarily imply explosive. I t has a burning profile very much like alcohol, i.e. it burns with a low energy, blue flame and its energy of combustion is very low—much more like HCFC-141b than like pentanes. Following data show this:

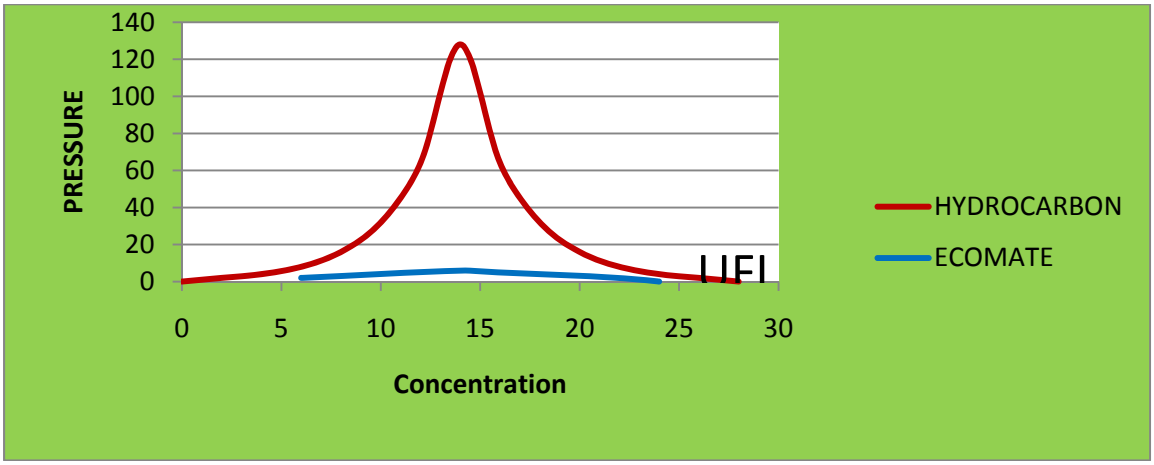
Substance	Heat of Combustion (kcal/g)	Comments
HCFC-141b	1.88	
Methyl Formate	3.88	
Pentane (commercial mix)	11.5	Cyclopentane estimated ~10% lower

The low heat of combustion is also the reason that neither HCFC-141b nor MF adds to the fire load of foams the way HCs do. HCFC-containing polyol systems generally are non flammable and the same is the case for MF—**within certain limits.**

Finally, a low heat of combustion decreases the **explosion pressure** and the **maximum rate of pressure rise** as the following picture shows (courtesy FSI):

[4] Panov, G.E. and Polozkov, V. T.. "Flammable Substances", Encyclopedia of Occupational Health and Safety, 3rd Edition, International Labor Office Geneva, pp. 881-883 (1983)

[5] Lavelle, J. P., "Flammability Characteristics of HCFC 141b and HCFC-142b", Journal of Fire Sciences 1989 7; pp 426-439



Flash Point is commonly the primary property to describe the fire hazard of a **liquid**. Pure MF, with its flashpoint of -32^0 C certainly needs proper safeguarding but this changes after blending with a product of no or low combustibility. Tests have shown such systems to be meeting non-flammability labeling criteria by the US-DOT—non-sustained burning at 120^0 F (ASTM D4206-96)—at MF concentrations <6% for polyols and <2% for isocyanates. Such concentrations suffice to reformulate almost all HCFC-based systems. FSI has this certified through sustained burning tests in September 2005 by the St. Louis testing Laboratories.

Flammable, Flammability, or **Explosive** limits are the primary property describing the fire hazard of **gases**. They indicate the proportion of combustible gases in a mixture, between which limits this mixture is flammable. The lower flammable limit (LFL) describes the leanest mixture that is still flammable, i.e. the mixture with the smallest fraction of combustible gas, while the upper flammable limit (UFL) identifies the richest flammable mixture. A **deflagration** is a propagation of a combustion zone at a speed less than the speed of sound in the un-reacted medium. A **detonation** is a propagation of a combustion zone at a velocity greater than the speed of sound in the un-reacted medium. An **explosion** is the bursting, or rupture, of an enclosure or container due to the development of internal pressure from a deflagration or detonation as defined in NFPA 69.

The three essential items for burning a material are fuel, air (or another oxidizing agent), and an ignition source. If there is not enough fuel, the mixture is considered below the lower flammability limit and it will not burn. Once the fuel-air mixture is within the flammable range, there still must be an ignition source present for it to burn (assuming the temperature is less than the auto-ignition temperature). Given a substance has a flammability range, there are several potential scenarios:

Scenario	Mitigating Action
The LFL will not be approached	No action required
The LFL can be approached or exceeded	Exhaust will keep the space under LFL
The LFL will be exceeded	Spark arrestors will keep the space free of ignition sources

The mitigation actions for the latter two scenarios are frequently combined and completed with an early warning system (sensors with alarm function).

3. APPLICATION TO METHYL FORMATE

For neither HCFC-141b nor methyl formate the LFL will be even remotely be approached under standard process conditions (ambient temperatures 15-40 ^{0}C; substance emissions under legal exposure limits) as the following calculations show:

Methyl Formate

- LEL = 5% in air by volume = 125 g/m^3 = 50,000 ppm
- Maximum concentration allowed by OSHA.NIOSH/ACGIH:
  - TWA = 100 ppm = 250 mg/m^3 = **0.20% of LFL**
  - STEL = 150 ppm = 375 mg/m^3 = **0.30% of LFL**

HCFC-141b

- LEL = 7.4% in air by volume = 925 g/m^3 = 193,000 ppm
- Maximum concentration allowed (WEEL):
  - TWA = 500 ppm = 2,4 g/m^3 = **0.26% of LFL**
  - STEL = 3,000 ppm = 14.4 g/m^3 = **1.56% of LFL**

4. CONCLUSIONS

- Methyl formate as a pure liquid is very flammable and requires proper safeguards. The risk of explosion is, however, remote because its low heat of combustion;
- A PU system base on methyl formate can be formulated as a low combustible liquid and will not reach the LFL even in the drum's head space; and
- There is no reason to treat methyl formate differently from HCFC-141b.

ATTACHMENT V: REVERSE HEAT FLOW TESTS (SUMMARY, DETAILED VERSION IN SEPARATED FILE)

INTRODUCTION

Reverse heat flow testing can be used to determine the heat flowing through the product which must be removed by the cooling system. This testing provides a measurement of the comparative efficiency of a cooling system in which insulation foam is one of the components. By keeping all other parameters the same, the comparative insulation performance of one insulation component can be measured. In this case this is applied to comparing different foam types.

Foam Supplies, Inc. (FSI commissioned this test in March 2008 as part of a program to support customers in achieving Energy Star performance for their appliance products. The test, however, also provides a comparison between the insulation performance of HCFC-141b and methyl formate.

TEST METHOD

Two identical freezer chest were used, one with methyl formate blown foam and one with HCFC141b foam. Each chest was heated by one light bulb of 40W at an ambient temperature of 4.40^0 C. The chests were fed from one energy source (= same voltage) for 24 hours. The temperature at that point was

89.890 F for the HCFC-141b foam
88.6640 F for the methyl formate foam

Difference 1.25^0 F or 0.7^0 C

The test was repeated with a 100W lamp at an ambient temperature of -17.8^0 C. Tis time the temperatures were

86.01^0 F for the HCFC-141b foam
84.73^0 F for the methyl formate foam

Difference 1.27^0 F or 0.7^0 C

The differences are deemed by the industry as negligible

CONCLUSION

HCFC-141b and methyl formate blown foams perform virtually identical in energy loss.

Details of the tests are on file.

ATTACHMENT VI: LONG TERM PERFORMANCE (SUMMARY, DETAILED VERSION IN SEPARATED FILE)

INTRODUCTION

The purpose of this study is to evaluate the long-term performance of MF-blown foams. A number of parts of various types from a variety of industries were stored in a warehouse at ambient conditions for a minimum of 5 years. Similar parts were foamed and tested when initially trialed and the results of those tests were used as the baseline for this study.

INSULATION VALUE

An insulated shipping container manufactured on July 12, 2002 was after 5 years retested in accordance with the original test method. A block of dry ice was placed into the container and the lid closed and sealed with shipping tape. Ambient temperature was 70·F. The temperature inside the box was measured with a thermocouple and allowed to stabilize for 1 hour before reaching stasis. This initial temperature was measured and the test began from there. The interior temperature was then measured and recorded every 24 hours. The results are as follows:

Inside Temperature	Initial Testing July 13-15, 2002	Retesting November 10-12, 2008
24 hours	No change	1^0 F increase
48 hours	4^0 F increase	6^0 F increase
72 hours	6^0 F increase	8^0 F increase

In another test, Individual samples were taken from three commercial refrigerators to compare insulation values from when they were originally foamed and five years later. The refrigerators were stored under ambient conditions in a warehouse. Samples were tested at different temperatures relating to their particular end-use but all follow-up testing was run at the same temperatures as the original test. Sample were tested In following ASTM-C 518: "Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus". The results are as follows:

Application	Test temperature (^{0}F)	Δ k Factor
Cold Vending Machine	75	+1.2%
Cold Vending Machine	77	+2.4%
Glass front reach-in Cabinet	55	+12.5%

THERMAL STABILITY

Soft drink dispensers with exposed foam skins were tested using the “Ice Melt” method according to industry standards. One gallon plastic jugs were filled with equal amounts of tap water and then frozen. Lids for the units were constructed from identical pieces of e>.1:ruded polystyrene to make the test consistent between units. A jug of ice was placed into each unit and the lid placed on top. At 24 hour intervals the water was poured off each jug and the jug was then reweighed to calculate the melt. All units were tested at 75 'F ambient to simulate a convenience store atmosphere. Test -Identical units were constructed and tested using foam systems blown with different blowing agents. The test units were foamed with an ecomate system and the control units were foamed with the manufacturer's current HFC-134a system. The test was designed to measure both the difference in insulation value when it is made and after multiple years in the field. The results were that after more than five years storage, the unit foamed with MF showed 0.5% more loss in insulation value over time than the HFC-134a control. Neither unit exhibited a change in physical dimensions greater than 1%.

DIMENSIONAL STABILITY

More than 20 foam parts were stored under ambient conditions in a warehouse for 5 years. The parts included exposed skin soft drink dispensers, ice bins, rotomolded food service carriers, doors and walk-in cooler panels. All parts remained stable after 5 years. The worst part exhibited less than 3.5% change in any direction.

QUESTIONNAIRES ON CHILLER PROJECTS

Brazil: progress report on the demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP)

Colombia: progress report on the demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP)

Cuba: progress report on the demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP and Canada)

Syrian Arab Republic: Progress report on the demonstration project on the replacement of CFC centrifugal chillers (UNIDO)

Global: progress report on the global chiller replacement project (China, India, Indonesia, Jordan, Malaysia, Philippines, and Tunisia) (World Bank)

Region – Africa: progress report on strategic demonstration project for accelerated conversion of CFC chillers in 6 African countries (Cameroon, Egypt, Namibia, Nigeria, Senegal and Sudan) (UNIDO, France, Germany, and Japan)

Region – Europe: progress report on demonstration project on the replacement of CFC centrifugal chillers (Croatia, the former Yugoslav Republic of Macedonia, Montenegro, Romania, and Serbia) (UNIDO)

Region – Latin America and the Caribbean: demonstration project for integrated management of the centrifugal chiller sub-sector in the Caribbean, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers (UNDP)

Project data			
Title	Demonstration project for integrated management of the centrifugal chiller sub-sector, focusing on application of energy - efficient CFC-free technologies for replacement of CFC-based chillers		
Approved at [ExCom Meeting]	47th		
Country/countries/region covered	Brazil		
MLF funding approved	1,000,000		
Minimum co-funding requirement	252,000		
Source(s) of co-funding as envisaged in project proposal (amount envisioned	GEF: US$ 1 Million		
Number of chillers to be replaced	12		
Lead agency	UNDP		
MLF funding associated			1,000,000
Other agencies/bilaterals	Agency 1	Agency 2	Agency …
Name	-	-	-
Responsibility	-	-	-
MLF funding associated	-	-	-

Results / assessment (provide some brief text, please; bullet points also possible)	
General experience	Ensuring cofinancing and starting the project took more than two years. Being one of the first experiences to combine different sources of funding for climate change mitigation and ozone protection, it has been difficult to achieve a timely combination of the two sources due to different policy frameworks and project cycles managed. However, valuable experience has been gained on this issue for future comparable initiatives under GEF 5. As reported in previous years GEF requested to include a finance institution as the administrator of the performance/risk guarantee financial instrument/business model. UNDP does the capacity strengthening, technical and financial assistance to public buildings and the financial institution administer the private sector portion. The project received CEO endorsement in July 29, 2009 and the project document for the GEF was signed and first meetings under the framework of the two projects took place. Current situation of the MLF component is being analysed as the delay in obtaining the cofinancing may have generated changes in the original situation.
Greatest challenges	As reported in previous years the main challenge was related to the obtention of the cofinancing that took several years.
Lessons learned	See above
Did you work with both public and private owners, and if yes: was there a different policy/approach needed for the two?	The project, which is in initiation phase, covers work with both private and public owners. According to information collected during project preparation it appears that working with private owners may be easier as the system to receive the savings from the energy gains is simpler, the owner invests in the conversion and the owner saves in the energy bill. Budgets are less simple in the public sector, for instance, in some cases the process required to obtain approval for the investment is long, or in other occasions the monetary savings from the energy gains are not necessarily received by the same department that decides to undertake the investment on the chiller, and this could make the process more complex.
Remarks on interest by chiller owners / did you experience good co-operation / did the quality of interaction change with time?	Chiller owners are interested and in expectation that the project removes the main barriers for them to undertake the investment. Interaction was limited during the period taken to obtain the cofinancing required to start the project; however, now that this is resolved, the project is starting and closer interaction with the chiller owners is expected to be restablished.
Remarks on interest by chiller owners	
Expected results beyond chillers funded: (e.g.: Will the demonstration lead to more chillers being replaced, if yes how concrete is that understanding? If no why is that assumed? ...)	It is expected that the demonstration will provide the elements to other chiller owners to invest in their chillers conversion. The GEF project cofinancing this demonstration will establish the conditions to replicate the conversions done through the MLF project by any chiller owner interested.
Reasons for delays	Move from GEF 3 to GEF 4 and need to get RAF allocation approved by the Government, a decision out of the control of the National Ozone Unit. Introduction of the financial institution required redrafting of the proposal, and due diligence process by financial institution took longer than expected. Process of signature of project document for the combined initiative (GEF and MLF) could only start once the two approvals cycles were completed. Project document is now signed and several meetings among the stakeholders have taken place.
Experience with funding organisations	See above
How do you see the potential of replication of this approach for other sectors?	Some elements of the present approach such as the combining of funding could be explored for early appliances retirement programmes. Chillers projects and early domestic appliances retirement approaches are two of the identified sources of CFC for destruction in Brazil and other countries.
Would you say that this co-funding experience was positive?	It had positive and negative elements. It was positive because was successfully materialized, the negative part was the delay of several years to obtain the minimum cofinancing to start the project.
Should a similar approach be taken in the future again, what are your suggestions for improvements a) related to the MLF; b) related to other donors (where relevant); c) related to implementation and co-operation with stakeholders and the country; d) related to other issues.	a) and b) Better coordination with other funding bodies would ensure timely cofinancing and avoid delays. c) Coordination with the Ministry of Energy is necessary to undertake projects that involve energy efficiency, a strong commitment from this Ministry is very important to support project implementation. During the project implementation new areas of improvement will be identified.
Impact on the chiller market in the relevant country/countries; market transformation observed	N.A.
Other remarks and/or explanations	

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding		Refers to all co-financing that materialised
Co-funding institution	GEF	IDB	Private Sector	Government	GEF cofinancing
Name, purpose of programme					
Amount approved in total (currency)	13,750,000	15,000,000	50,000,000	165,000	
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?	Yes	No	Yes	No	yes/no
If yes: Did the amount change (please provide from … to)	from 350,000 to 13,750,000		It was expected during project preparation but there was no estimation		
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly		GEF requested the need for a financial institution. UNDP had to contact as per instruction of the GEF		During GEF project preparation	Explain briefly: 2, 3 sentences (separate below) or some bullet points
How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)	3.5				
Date of approval	14-Jun-07	14-Jun-07	14-Jun-07	14-Jun-07	
Major conditions associated	CEO Endorsement received in July 29, 2009. Project document signed.	To be used in the Partial Performance Guarantee Mechanism			e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)	GEF project covers Energy Efficiency for buildings	GEF project covers Energy Efficiency for buildings			
Funds agreed by the MFSto be released based on that approval	Based on project's Excom condition. 100% of the MLF approval can be released now as the minimum cofinancing was ensured.				
Date of related release of Funds by the MFS	MLF project disbursements have not started yet.				

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding		Explanations
Co-funding institution	Not Applicable				
Name, purpose of programme					
Amount sought in total					
How much of that constitutes project costs in the MLF definition					
Expected approval					
Reasons for the delay					
Major conditions associated					
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)					

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding		Explanations
Co-funding institution	Not Applicable				
Name, purpose of programme					
Amount sought in total					
How much of that constitutes project costs in the MLF definition					
When was the quest for co-funding from this institution/programme abandoned?					
Reasons for the decision					

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding		Explanations
Co-funding institution	Not applicable				
Name, purpose of programme					
Amount sought in total					
How much of that constitutes project costs in the MLF definition					
When was the quest for co-funding from this institution/programme abandoned?					
Reasons for the decision					

General information		Explanations
How many chiller users have been identified in the country	1250	
How many chillers remain?	TBD	The original estimation will be reconfirmed or updated as part of the project implementation.
How many belong to the public sector? How many to the private sector?	TBD	The original estimation will be reconfirmed or updated as part of the project implementation.
What share of the country's chiller users have been identified (estimated)	90%	
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	Yes	The Interamerican Development Bank will participate in the project and will administer the Partial Performance Guarantee Risk Mechanism.

Per (main) activity	Activity 1	Activity 2	Activity 3	Activity …	Explanations
Type of activity	Enhancing EE investments through capacity building in private and public sector buildings	Access to EE services and commercial financing for public sector buildings enhanced with a public building initiative	Interest enhanced in the replacement of energy inefficient CFC-using chillers	Partial Performance Guarantee Mechanism (PPGM) made available to stimulate EE investment through ESCOs	e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Brazil	Brazil	Brazil	Brazil	
Status	GEF CEO endorsement received. Project document signed. Inception Workshop completed. Project manager appointed. Project Steering Committee planning meetings took place.	GEF CEO endorsement received. Project document signed. Inception Workshop completed. Project manager appointed. Project Steering Committee planning meetings took place.	GEF CEO endorsement received. Project document signed. Inception Workshop completed. Project manager appointed. Project Steering Committee planning meetings took place.	GEF CEO endorsement received. Project document signed. Inception Workshop completed. Project manager appointed. Project Steering Committee planning meetings took place.	Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements					
Owner, use					e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded					
(Expected) Status of completion					
Actual cost with a break down by					
equipment					
installation					
construction					
Information on energy efficiency					
Original technology					
Age of chiller being replaced					
Original capacity					
Replacement technology					(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity					[please provide unit = kW or tons]
Assumed / measured change in energy efficiency					(from/unit to /unit)
Assumed annual saving in energy					(in kWh)

Project data			
Title	Demonstration Project for integrated management of the centrifugal chiller sub-sector, focusing on applications of energy-efficient CFC-free		
Approved at [ExCom Meeting]	47th		
Country/countries/region covered	Colombia		
MLF funding approved	1,000,000		
Minimum co-funding requirement	705,000		
Source(s) of co-funding as envisaged in project proposal (amount envisioned	GEF: US$ 1 Million		
Number of chillers to be replaced	13		
Lead agency	UNDP		
MLF funding associated	1,000,000		
Other agencies/bilaterals	Agency 1	Agency 2	Agency …
Name	-	-	-
Responsibility	-	-	-
MLF funding associated	-	-	-

Results / assessment (provide some brief text, please; bullet points also possible)	
General experience	As of Today the main experience gained has been the capacity to combine funding from different sources to tackle the climate change and the ozone challenges. Being one of the first experiences to combine these sources of funding it has been difficult to achieve a timely combination of the two sources due to different policy frameworks and project cycles managed. Valuable experience has been gained on this issue for future comparable initiatives under GEF 5. With regards to the status of the GEF cofinancing, MSP was approved and cofinancing was therefore officially obtained.
Greatest challenges	Obtaining Cofinancing
Lessons learned	See above
Did you work with both public and private owners, and if yes: was there a different policy/approach needed for the two?	The project, which is in initiation phase, covers work with both private and public owners. According to information collected during project preparation it appears that working with private owners may be easier as the system to receive the savings from the energy gains is simpler, the owner invests in the conversion and the owner saves in the energy bill. Budgets are less simple in the public sector, for instance, in some cases the process required to obtain approval for the investment is long, or in other occasions the monetary savings from the energy gains are not necessarily received by the same department that decides to undertake the investment on the chiller, and this could make the process more complex.
Remarks on interest by chiller owners / did you experience good co-operation / did the quality of interaction change with time?	Chiller owners are interested and in expectation that the project removes the main barriers for them to undertake the investment. The quality of the interaction decreased due to the long time required to obtain the cofinancing required to start the project; however, now that this is resolved and the project is starting, the NOU will focus on improve the interaction with the chiller owners again.
Expected results beyond chillers funded: (e.g.: Will the demonstration lead to more chillers being replaced, if yes how concrete is that understanding? If no why is that assumed? ...)	1. While removing the barriers for conversion to non-CFC energy efficient chillers, it is expected that other additional chillers will be benefited from the project as the owners will be able to benefit from the favourable regulatory and financial conditions package set by the project (business model for market transformation). 2. In addition, through the cofinancing the promotion of energy efficiency will extend to create a comprehensive program for energy efficiency In buildings with the following main outcomes: development of regulations to promote energy efficiency In buildings, stimulation of the demand and supply for energy efficiency and creation of awareness and capacity to take advantages of the market opportunities presented by building energy efficiency.
Reasons for delays	Cofinancing procurement took longer than expected due to the change of operational procedures in the GEF (improvements on the project cycle, introduction of the PIF and PPG instead of PDF A and PDF B, etc) and creation and inclusion of the project in the Resource Allocation Framework established for the country. As the Resource Allocation Framework consists on a limited allocation of funds for projects in Climate Change the final decision on what projects are submitted is out of the National Ozone Unit control. Several changes were done to the cofinancing proposal to have a comprehensive energy efficient buildings project, this generated additional delays.
Experience with funding organisations	For future initiatives where MLF and GEF funding could be combined, coordination among the two funds will be an added value as it will allow synchronizing project cycles.
Impact on the chiller market in the relevant country/countries; market transformation observed	N.A.
How do you see the potential of replication of this approach for other sectors?	Some elements of the present approach such as the combining of funding could be explored for early appliances retirement programmes. Chillers projects and early domestic appliances retirement approaches are two of the identified sources of CFC for destruction in Colombia and other countries.
Would you say that this co-funding experience was positive?	It had positive and negative elements. It was positive because was successfully materialized, the negative part was the delay of several years to obtain the minimum cofinancing to start the project.
Should a similar approach be taken in the future again, what are your suggestions for improvements a) related to the MLF; b) related to other donors (where relevant); c) related to implementation and co-operation with stakeholders and the country; d) related to other issues.	a) and b) Better coordination with other funding bodies would ensure timely cofinancing and avoid delays. c) Coordination with the Ministry of Energy is necessary to undertake projects that involve energy efficiency, a strong commitment from this Ministry is very important to support project implementation. During the project implementation new areas of improvement will be identified.
Other remarks and/or explanations	

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding	Refers to all co-financing that materialised
Co-funding institution	GEF	Government of Colombia		
Name, purpose of programme	Cofinancing obtained through a Medium Size Project submitted to GEF under the Climate Change Focal Area: 'CO-EFFICIENCY', Improving Energy Efficiency in Buildings in Colombia through Synergies between Environmental Conventions.	Sales Taxes Exemption		
Amount approved in total (currency)	1,000,000	Reduction of the Sales taxes (16%) for the materials procured by chiller owners during chillers conversion. Final value will be known at the end of the project when all the conversions take place.		
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?	Yes	Yes		yes/no
If yes: Did the amount change (please provide from … to)	Minimum cofinancing as per Excom approval was 705,000.	No		
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly				Explain briefly: 2, 3 sentences (separate below) or some bullet points
How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)	975,000 will be used in the activities related to the project, 25,000 were used in the preparation of the GEF Medium Size Project.	It covers only activities directly related to the chillers replacement.		
Date of approval	October 7 2009	Available to chiller onwners when purchasing elements for the conversion.		
Major conditions associated	Signature of document in Oct 2009 (accomplished), closing date of the project July 2012 and Final Report 6 months after.			e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)	Strengthening of government institutions in charge of promoting EE. Establish policies to promote EE in buildings. Enhance stakeholders technical knowledge.			

Funds agreed by the MFS to be released based on that approval	100%. The cofinancing level obtained from the GEF MSP is above the minimum required as per the Excom condition associated to the project.			
Date of related release of Funds by the MFS				

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution			Chiller owners	
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Expected approval				
Reasons for the delay				
Major conditions associated				
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)				

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

General information		Explanations
How many chiller users have been identified in the country?	50	
How many chillers remain?	TBD	The original estimation will be reconfirmed or updated based on the study being completed as part of the project implementation.
How many belong to the public sector? How many to the private sector?	TBD	The original estimation will be reconfirmed or updated based on the study being completed as part of the project implementation.
What share of the country's chiller users have been identified (estimated)	13	This is the number of chillers expected to be included in the demonstration. The project will create the conditions for the remaining chillers to be converted.
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	Yes	The project will identify the bank-partner that will manage the fund. The project will work with the bank to detail the loan structure for the program including interest rate and loan term.

Per (main) activity	Activity 1	Activity 2	Activity 3	Activity …	Explanations
Type of activity	Identification and mitigations of risks	Validating business model	Assess success of demo projects	Put in place conditions for implementation	e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Colombia				
Status	Cofinancing obtained. Project documents for GEF and MLF projects signed by the parties. Local expert to undertake updated inventory of chillers including characterization of each one of the units in service and diagnosis of the required investment for conversion being contracted. In parallel, discussions with international expert and private companies are taking place to analyse the possibility to migrate to alternative technologies with low GWP additional to the ones considered in the design of the project.	Local consultant is being contracted to undertake analysis of the financial instruments available and select the most suitable to combine in the business model to facilitate initial investment by chiller owners.	Application of the business model in the 13 chillers will take place once these studies in Activity 1 and Activity 2 are completed.	This activity will take place after activity 3 is completed. Results from the demonstrative conversions will be disseminated through a workshop and will also be published.	Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements					
Owner, use					e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded					
(Expected) Status of completion					
Actual cost with a break down by					
equipment					
installation					
construction					
Information on energy efficiency					
Original technology					
Age of chiller being replaced					
Original capacity					
Replacement technology					(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity					[please provide unit = kW or tons]
Assumed / measured change in energy efficiency					(from/unit to /unit)
Assumed annual saving in energy					(in kWh)

Project data			
Title	Demonstration project for integrated management of the centrifugal chiller sub-sector in Cuba, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers		
Approved at [ExCom Meeting]	47th		
Country/countries/region covered	Cuba		
MLF funding approved	984,353 US$ plus support cost		
Minimum co-funding requirement	410,125 US$		
Source(s) of co-funding as envisaged in project proposal (amount envisioned and currency in brackets)	Canada (public and private), UNDP Thematic Trust Fund on Energy, and Cuban Government		
Number of chillers to be replaced	Replace 7 chillers and convert 5 chillers (this target was revised with the Secretariat before ExCom 53 in 2007)		
Lead agency	UNDP		
MLF funding associated	All funds are now with UNDP. Funds initially approved to Environment Canada has been transferred to UNDP at ExCom 51.		
Other agencies/bilaterals	Agency 1	Agency 2	Agency …
Name			
Responsibility			
MLF funding associated			

Results / assessment (provide some brief text, please; bullet points also possible)	
General experience	The implementation of the chillers project in Cuba is now well on track, though it has faced several lengthily delays in the process. 4 Chillers have now been replaced and they are currently being tested before they go into full operation. Several technical issues have been detected and are in the process of being fixed. 5 additional Chiller sites are currently being prepared for the installation of the remaining 5 chillers. All the equipment is in Cuba, and we expect the process to finish before the end of the year. All co-finance has been secured. There is a high commitment from the government of Cuba, and Environment Canada has played an instrumental role in assuring the co-finance from Private and Public Sector in Canada, as well as with the coordination of all the stakeholders.
Greatest challenges	There have been different challenges in different stages of the project. Initially it was complicated to get the co-finance assured. The company that was interested in doing chiller retrofits left the project at a late stage, and thereby leaving the project in a complicated state. This situation was discussed with the Secretariat, and the agreement was to increment the number of chillers replacements as well as removal of additional chillers (where one new chiller replaces two old ones). Later on there have been some technical challenges that needed to be resolved. In 2008 Hurricane Ike caused tremendous damage to Cuba and to several of the buildings where we are in the process of replacing chillers. One chiller compressor got damaged during the hurricane, and we will have to replace one of the compressors. This is the first time this kind of chillers will be installed in an article 5 country in LAC, and it has also generated some challenges for the chiller manufacturer. Most of the problems have been solved, and we expect to finish the installation of the remaining chillers soon.
Lessons learned	The need to raise additional co-finance in a MLF project substantially delays the implementation process.
Remarks on interest by chiller owners	The government of Cuba has so far been very satisfied with the project.
Expected results beyond chillers funded: (e.g.: Will the demonstration lead to more chillers being replaced, if yes how concrete is that understanding? If no why is that assumed? ...)	It is expected that the current project will promote chillers replacement in Cuba. There are still many old CFC based chillers left in Cuba. This project will show that new and advanced technology works in Cuba and generates large energy savings.
Reasons for delays	See above - Co-finance issues, bureaucratic challenges, technical challenges, hurricane Ike.
Experience with funding organizations	Very positive experience with the Canada (Private and Public sector co-finance)
Impact on the chiller market in the relevant country/countries; market transformation observed	All chillers are owned by the government of Cuba. No market transformation will take place. The purpose of this project is to test a new technology in an article 5 context.
Other remarks and/or explanations	Prices of raw materials and thereby chillers have increased since the development and approval of the project.

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding	Refers to all co-financing that materialized
Co-funding institution	Government of Canada	Private Sector Canada	UNDP	
Name, purpose of programme	Technology Early Action Measures (TEAM) by the Government of Canada	Chiller producer	Thematic Trust Fund for Energy	
Amount approved in total (currency)	655.000 CAD	335.000 CAD	40.000 US$	
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?	Co-finance from Canada was foreseen though not negotiated at that stage.	not explicitly. Co-finance from public and private sector in Canada was mentioned.	yes	yes/no
If yes: Did the amount change (please provide from … to)	amount was not specified in original document. The negotiated amount is higher than the external resources required by ExCom 47.		no	
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly		Environment Canada identified the possibility of requesting funds from TEAM and with private sector participation.		Explain briefly: 2, 3 sentences (separate below) or some bullet points
How much of the co financing constitutes project costs in the MLF definition (see letter from MFS)	All of it	Most of it.	Most of it	
Date of approval	2007	2007	2006	
Major conditions associated	Must demonstrate Canadian technology, and must generate climate benefits.	Is dependent of approval of TEAM funds (which already happened)	Support the implementation of the Chillers project in Cuba.	e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)	no	yes, training of Cuban technicians in Canada, translation of technical manuals, site visits in Cuba, etc.	Regional workshop to disseminate results from project.	
Funds agreed by the MFS to be released based on that approval	984.353 US$	984.353 US$	984.353 US$	
Date of related release of Funds by the MFS	Oct-07			

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Expected approval				
Reasons for the delay				
Major conditions associated				
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)				

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

General information		Explanations
How many chiller users have been identified in the country	According to the original documents there are about 200 chillers in Cuba.	
What share of the country's chiller users have been identified (estimated)	9 new chillers will be installed.	
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	Environment Canada is playing a key role in project implementation and in securing co-finance.	

Per (main) activity	Activity 1	Activity 2	Activity 3	Activity …	Explanations
Type of activity	Inspection of chillers sites	Preparation of sites	Replacement of 4 chillers	Replacement of 5 chillers	e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Cuba	Cuba	Cuba	Cuba	
Status	Completed. All Chiller sites have been inspected.	Completed. All Chiller sites have been prepared.	Completed. First four chillers were commissioned in 2009 and after a period of troubleshooting, they are now functioning fine.	5 additional chillers were replaced in 2010, and all chillers have now been replaced in the project. The 5 chillers are in the process of being tested, and they should enter in full operation soon.	Smardt made a mission to Cuba in 2010 where they monitored the operation of the 4 chillers that were installed in 2009, and at the same time started up the operation / test phase of the final 5 chillers. We are in the process of identifying better ways to continuously monitor the operation of the chillers and delegate more responsibility to the Cuban technicians in order to be less dependant on Smardt in the daily operation of the Chillers. Additional training to Cuban technicians will probably be needed.
In case of chiller replacements					
Owner, use		Government, 1 scientific institute, one Theater, 2 hospitals.	Government, 5 hospitals.		e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded	All sites are owned by the government of Cuba				
(Expected) Status of completion					
Actual cost with a break down by					
equipment			No data	No data	
installation			No data	No data	
construction			No data	No data	
Information on energy efficiency					
Original technology			Centrifugal Chillers	Centrifugal Chillers	
Age of chiller being replaced					
Original capacity			Must be verified. In several cases two old chillers will be replaced with one new.		
Replacement technology			Direct drive variable-speed oil-free centrifugal chiller, incorporating magnetic bearing technology		(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity			1 x 250 TR, 3 x 150 TR	5 x 150 TR	[please provide unit = kW or tons]
Assumed / measured change in energy efficiency			No data	No data	(from/unit to /unit)
Assumed annual saving in energy			No data	No data	(in kWh)

Project data			
Title	Demonstration project on the replacement of CFC centrifugal chillers		
Approved at [ExCom Meeting]	47		
Country/countries/region covered	Syria / West Asia		
MLF funding approved	585,961		
Minimum co-funding requirement	27,195		
Source(s) of co-funding as envisaged in project proposal (amount envisioned and currency in brackets)	Counterpart co-financing (US$ 179,000)		
Number of chillers to be replaced	3 to be replaced and 4 to be retrofitted		
Lead agency	UNIDO		
MLF funding associated	585,961		
Other agencies/bilaterals	Agency 1	Agency 2	Agency …
Name	N/A	N/A	N/A
Responsibility	N/A	N/A	N/A
MLF funding associated	N/A	N/A	N/A

Results / assessment (provide some brief text, please; bullet points also possible)	
General experience	The overall assessment for the implementation of this project is good because of the interest of the chiller owners, the willingness of the chiller suppliers to engage in the project, the coordination by the NOU and the support of procurement services unit in negotiating and finding solutions to facilitate the project implementation.
Greatest challenges	2 major difficulties faced UNIDO in implementing this project. 1) huge fluctuations in the exchange rate from EUR to US$, 2) difficulty of shipping the compressors of the chillers to be retrofitted to the USA to perform the retrofit at Trane USA due to the embargo on Syria, 3) the results of the retrofitting are not so efficient nor guaranteed as the chiller are old!
Lessons learned	Due to the mentality of chiller owners and the fact that most chillers are publicly owned, having local commercial banks engaged in financing chiller replacements was found inappropriate.
Remarks on interest by chiller owners / did you experience good co-operation / did the quality of interaction change with time?	The chiller owners were interested and cooperative however it is difficult for the hospital to mobilize resources sufficient for the replacement of the chillers as the budget normally covers other medical related expenses.
Remarks on interest by chiller owners	The Ministry of Health and the Ministry of Tourism showed high interest in participating in the project and committed funding beyond that foreseen in the project to complete the project.
Expected results beyond chillers funded: (e.g.: Will the demonstration lead to more chillers being replaced, if yes how concrete is that understanding? If no why is that assumed? ...)	It is expected that after the completion of the regional seminar and the dissemination of the demonstration results, more chillers would be replaced.
Reasons for delays	N/A
Experience with funding organisations	N/A
Impact on the chiller market in the relevant country/countries; market transformation observed	The chiller suppliers were involved since the onset of the project, they are engaging in more intense marketing activities and show a lot of competitiveness.
How do you see the potential of replication of this approach for other sectors?	Yes a project for an early replacement programme of chiller or other equipment would be useful to deal with the HCFC service sector.
Would you say that this co-funding experience was positive?	Yes however there is no replication impact.
Should a similar approach be taken in the future again, what are your suggestions for improvements a) related to the MLF; b) related to other donors (where relevant); c) related to implementation and co-operation with stakeholders and the country; d) related to other issues.	A similar project may be applied to the phase out of HCFC based chillers on a revolving fund basis with some grant subsidy to be given as an incentive. However this needs to be early on in planning the HCFC phase out to allow for sufficient time for the revolving fund to be replenished.
Other remarks and/or explanations	

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding	Refers to all co-financing that materialised
Co-funding institution	Le Meridien Latakia (Ministry of Tourism)	El-Basel Hospital (Ministry of Health)		
Name, purpose of programme	Counterpart co-financing	Counterpart co-financing		
Amount approved in total (currency)	US$ 120,000	US$ 150,000		
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?	yes	yes		yes/no
If yes: Did the amount change (please provide from … to)	the amount foreseen remained the same	from 52,900 to 150,000		
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly	N/A	N/A		Explain briefly: 2, 3 sentences (separate below) or some bullet points
How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)	74,000	100,000		
Date of approval	Nov - 06 Funds disbursed in July 2007	Jan-08		
Major conditions associated	None	None		e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)	None	Replacement of cooling towers, pipes and water pumps.		
Funds agreed by the MFS to be released based on that approval	585,961			
Date of related release of Funds by the MFS	Dec-06			

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Expected approval				
Reasons for the delay				
Major conditions associated				
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)				

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

General information					Explanations
How many chiller users have been identified in the country	32 CFC-based centrifugal chillers (including those considered under the project)				
How many chillers remain?					
How many belong to the public sector? How many to the private sector?					
What share of the country's chiller users have been identified (estimated)	All				
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	No				

Per (main) activity	Activity 1	Activity 2	Activity 3	Activity …	Explanations
Type of activity	Chiller Replacement	Chiller retrofit	Supplier Seminar		e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Syria	Syria	Austria		
Status	Completed	The retrofit of the chillers operating at Al-Basel Hospital is impractical and inefficient as the chillers are old and not well maintained. The implementation has been pending and retrofitting seems not to be possible. A request to consider replacement of the chillers instead of the retrofit was addressed to the Executive Committee through the progress report.	Completed		Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements					
Owner, use	Hotel Le Meridien, Cooling of hotel rooms, offices and public areas	Al-Basel Hospital, Latakia "Hospital Cooling"			e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded	Nov-06	Nov-08			
(Expected) Status of completion	Dec-08	Jun-11			
Actual cost with a break down by					
equipment	435,000	180,000			
installation	28,000 including a 3 year maintenance contract.	0			
construction	Counterpart responsibility locally!	Counterpart responsibility			
Information on energy efficiency					
Original technology	CFC-12, centrifugal				
Age of chiller being replaced	30 years (1978)				
Original capacity	320 tons				
Replacement technology	HFC134a, screw chiller				(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity	1120 kW				[please provide unit = kW or tons]
Assumed / measured change in energy efficiency	from COP = 2.5 to COP=4.5				(from/unit to /unit)
Assumed annual saving in energy	1750 kWh				(in kWh)

Project data			
Title	Global: Global chiller replacement project (China, India, Indonesia, Malaysia and Philippines)		
Approved at [ExCom Meeting]	The 47th ExCom Meeting		
Country/countries/region covered	China, India, Indonesia, Jordan, Malaysia, Philippines and Tunisia		
MLF funding approved			$6,884,612
Minimum co-funding requirement			$13,769,224
Source(s) of co-funding as envisaged in project proposal (amount envisioned	GEF, CDM ($70 million and $82 million respectively as per original project proposal, based on a total $683 million cost)*		
Number of chillers to be replaced			150
Lead agency			The World Bank
MLF funding associated			$516,346
Other agencies/bilaterals	Agency 1	Agency 2	Agency …
Name	N/A	N/A	
Responsibility			
MLF funding associated			

Results / assessment (provide some brief text, please; bullet points also possible)	
General experience	There has been overall a positive response by chiller owners, financial institutions and other partners (GEF, suppliers, US EPA, etc) on the potential of the project. The fact that all stakeholders are willing to move forward however does not eliminate the lead-time required to set up the institutional framework and finalize financing, project management and disbursement requirements. This is particularly so give the complexity of the initiative which combines financing from several sources as well as separate environmental objectives.
Greatest challenges	The greatest challenges were/are developing an overall implementation framework at the country level where stakeholder interests are balanced with the needs of the overall project, overcoming misunderstanding about the ExCom decision on the chiller replacement project (in terms of eligibility and co-financing) and obtaining agreement by national governments to allocate GEF financing to chiller replacement under the climate change window. More recently, there have been challenges with securing carbon financing because of perceived risk that an insufficient number of CERs would be generated before the first compliance period ends in 2012 which was a requirement of the originally envisioned purchaser.
Lessons learned	Developing a comprehensive program with multiple funding sources and several environmental goals requires a significant amount of time upfront. However, once a good and workable model is developed, time can be saved when replicating the program for other countries.
Did you work with both public and private owners, and if yes: was there a different policy/approach needed for the two?	To date we have worked on a very limited basis with both private and public owners. Because the subsidy amount awarded was the same for both (in the case of Jordan), public sector owners of course have had more difficulty in committing to replacement and convincing their management for the need to replace chillers. There has been one or two cases where payment to the supplier has been slow. If the public sector is involved, very early awareness raising and engagement is necessary to give it sufficient time to make the business case for replacement, budget the required resources and follow internal procurement procedures.
Remarks on interest by chiller owners / did you experience good co-operation / did the quality of interaction change with time?	Chiller owners are extremely interested in the program given that energy prices continue to increase and the convincing figures in energy savings that are shown utilizing the model. This interest has been observed in all countries where chiller discussions have taken place. For the Philippines and Jordan in particular, there was positive response from chiller owners - they have been extremely proactive and have followed up with the NOU/project coordinator in hopes of accelerating the process. As was the case in Thailand years back, the awareness brought on by the many consultations with building owners and the demonstrated results shown from those that have replaced chillers have served to catalyze replacements outside the project in the entire sector.
Expected results beyond chillers funded: (e.g.: Will the demonstration lead to more chillers being replaced, if yes how concrete is that understanding? If no why is that assumed? ...)	It is expected that the entire chiller sector in a country will be transformed with first the seed funds from the MLF and GEF but eventually through revenue generated by the CDM. Moreover, it is hoped that chiller replacement will cause chiller owners to seek other energy efficiency measures in their buildings, either alone or in partnership with other EE programs in the country.
Reasons for delays	The reason for delay in starting project implementation was time needed by countries to decide on and request an allocation under the GEF for chiller replacement (climate change). Other time consuming, but necessary steps were development and approval of the chiller energy efficiency methodology under the CDM, developing a project framework at the country level (in coordination with executing agency candidates, suppliers, the Government, etc) and review and clearance of the first component of the global chiller project by GEF (for India). In addition, the first component of the project for India coincided with restructuring of the GEF project cycle. The most recent form of delay was for Indonesia. The project was delayed because the requirements for co-financing could not be met, particularly through the mechanism chosen by the Government of Indonesia – concessional lending. A modality satisfactory and feasible to the Government was accepted allowing this project to move forward.
Experience with funding organisations	The experience has been positive in terms of GEF, once it could be clearly demonstrated the environmental benefits attributed to each funding entity under the project (as well as the chillers replaced). There has been some uncertainty with the originally planned purchaser of emission reductions in both the India and Philippines component because of perceived risk. However, a KfW has agreed to be a buyer in both cases. In the case of Indonesia, it was difficult to use the environment fund for concessional lending as this would have limited the chiller owners to one commercial bank with which they may not have a business relationship/collateral. This created a roadblock for project development.
Impact on the chiller market in the relevant country/countries; market transformation observed	Chiller replacement under the project has only taken place in Jordan and the Philippines to date.
How do you see the potential of replication of this approach for other sectors?	The potential for replication in other sectors is extremely high. Under the Global Chiller Replacement Project, several modalities were/are being piloted. These approaches address specific barriers or constraints that may be present in other sectors and countries. The idea however of using synergies to generate environmental co-benefits and hence different sources of funds has now been realized and will give the confidence to other stakeholders that this model is feasible. Moreover the different external and internal approaches and procedures required can now be easily followed - the source of delay from the first project - India was due to having to forge new ground in almost all aspects (methodology, lining up pro
Would you say that this co-funding experience was positive?	The co-funding experience was generally positive. Private owners do not see co-funding in itself as a major difficulty as normally all of their commercial investments require several sources of funding. It is also the nature of the lenders to distribute their commercial risk. However, there is room for improvement. Given that funding is from several sources with several requirements, more preparation work needs to be done simultaneously on all fronts so that the project start is not held back from processes attributed to one source of funds.
Should a similar approach be taken in the future again, what are your suggestions for improvements a) related to the MLF; b) related to other donors (where relevant); c) related to implementation and co-operation with stakeholders and the country; d) related to other issues.	As implied above, we believe the approach should and will have to be taken in the future, given likely constraints in financing for different sectors, technologies and applications. In regards to the MLF, the Executive Committee provided clear guidance and parameters of how to approach the project (for instance 1:3 cofinancing requirement and obligation to use the model the determine the level of subsidy) and the funding followed without much difficulty. In regards to the other donors, focal points for other financial mechanisms (i.e. GEF country focal points) need to be included in the process early on to ensure full understanding of the project objectives, modality and outputs/benefits. Energy efficiency in particular is a difficult sell and therefore a lot upfront education and explanation is needed (potential energy efficiency gains substantiated by analytical work is key) for all stakeholders, including the managers of the relevant funds. In terms of carbon finance, an area of financing in which the MP community was not so familiar prior to these projects, special attention is required on the speed of preparation. Delays led to a number of chillers being excluded from the project and carbon finance because the methodology has strict requirements on the age window of eligible chillers. The total amount of carbon finance expected is lower than originally planned - simply because of project delays. Thus in terms of carbon finance time is of the essence.
Other remarks and/or explanations	Jordan's approach is different than for India and the Philippines because of its small CFC-based chiller sector. No objection was expressed by the Secretariat at the 56th ExCom Meeting to proceed with the approach. Malaysia will not participate in the project as all its chillers are HCFC based. China and Tunisia will most likely not participate in the project. Indonesia will proceed but also with a slightly different approach where GEF co-financing will be used to fund bank guarantees.

*Funding sources are the same as originally planned, however the amounts have been reduced to correspond with the chillers to be replaced and based on applying the model on a country basis.

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding	Refers to all co-financing that materialised
Co-funding institution	GEF	CDM		
Name, purpose of programme	Chiller Energy Efficiency Project			
Amount approved in total (currency)	US$6,300,000	US$5,850,000		
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?	yes	yes		
If yes: Did the amount change (please provide from … to)	yes, from 10.4 to 6.3 million.	yes from $12.8 to $15 to 5.85 million.		The ratio of carbon revenue expected has gone down since preparation of the initial project document because of the decrease in size of the fleet eligible for carbon finance under the methodology.
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly	n/a	n/a		Explain briefly: 2, 3 sentences (separate below) or some bullet points
How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)	US$5,700,000	US$5,850,000		
Date of approval	Apr-08			
Major conditions associated	None	n/a		e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; ...
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)	TA; Monitoring and Verification			
Funds agreed by the MFS to be released based on that approval	US$1,000,000	n/a		
Date of related release of Funds by the MFS	26-Aug-09			The funding was made available to IDBI upon signing of the grant agreement. However, funds will be disbursed based on withdrawal applications. US$230,000 has been disbursed to the special account to date.

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Expected approval				
Reasons for the delay				
Major conditions associated				
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)				

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution	US EPA			
Name, purpose of programme	TA			
Amount sought in total	In-kind ($150,000)			
How much of that constitutes project costs in the MLF definition	0			

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding	Refers to all co-financing that materialised
Co-funding institution	GEF	CDM (KfW)		
Name, purpose of programme	Chiller Energy Efficiency Project			
Amount approved in total (currency)	US$2,600,000	$6,000,000		The amt of carbon financing expected was $7.77 million. Actual purchaser, Kfw, has agreed to $6 million.
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?	yes	yes		
If yes: Did the amount change (please provide from … to)	yes, from 3.655 to 2.6 millio	yes from $3.623 to $7.77 to $6 million.		The ratio of carbon revenue expected has gone down slightly since preparation of the initial project document because of the decrease in size of the chiller fleet eligible for carbon finance under the methodology.
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly	n/a	n/a		Explain briefly: 2, 3 sentences (separate below) or some bullet points
How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)	US$2,600,000	US$6,000,000		
Date of approval	Nov. 2008			The Bank Board approved the Philippines Energy Efficiency Project in June 2010.
Major conditions associated	None	n/a		e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)	TA; Monitoring and Verification			
Funds agreed by the MFS to be released based on that approval	US$1,000,000	n/a		
Date of related release of Funds by the MFS	not yet released			Five grant agreement effectiveness conditions are in place which have not yet been met. Therefore no MLF funding has been released to the country to date.

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Expected approval				
Reasons for the delay				
Major conditions associated				
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)				

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution	US EPA			
Name, purpose of programme	Technical Assistance			
Amount sought in total	$150,000 (in kind)			
How much of that constitutes project costs in the MLF definition	100%			

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding	Refers to all co-financing that materialised
Co-funding institution	GEF	Concessional Loan		
Name, purpose of programme	Chiller Energy Efficiency Project			
Amount approved in total (currency)	US$3,300,000	$20,000,000		
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?	no	no		
If yes: Did the amount change (please provide from … to)				
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly	In June 2009. See explanation.	In late 2009.		In 2006 and 2007, some efforts were made to see how GEF support could be linked to the soft loan program of the Government and KfW with limited success. It was not until June 2009, that the GEF National Focal Point agreed to support the submission of chiller project to be funded under GEF 4 with the utilization of a novel approach (GEF funding will be used to fund bank guarantees).
How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)	US$3,300,000	US$20,000,000		
Date of approval	Mar. 2010			
Major conditions associated	None	n/a		e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)	TA; Monitoring and Verification			
Funds agreed by the MFS to be released based on that approval	US$1,000,000	n/a		
Date of related release of Funds by the MFS	not yet released			

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Expected approval				
Reasons for the delay				
Major conditions associated				
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)				

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				

General information		Explanations
How many chiller users have been identified in the country	1100	440 chillers have been targeted for replacement through GEF, MLF and CDM assistance (at 14-20%) under the Chiller Replacement Project. As of Sep. 2010, the pipeline includes about 62 CFC-based eligible (per the CDM methodology) chillers.
How many chillers remain?	It is estimated that the same baseline number exists - no chillers have been replaced under the project to date.	
How many belong to the public sector? How many to the private sector?	There are 440 chillers targeted by the project, however, we have not received the break down between private and public sectors.	
What share of the country's chiller users have been identified (estimated)	100%	Number was estimated through a data collection process. The data collection was conducted using two approaches: chiller manufacturer's survey; and chiller owners' survey. Chiller manufacturers' survey was the basis for the development of a database. It was created through the development and administration of a survey questionnaire and included a web-based data collection system. It included direct administration of the survey questionnaire in separate meetings will all of the major chiller manufacturers. Chiller owners' survey was conducted through the indirect administration of a survey questionnaire via mailings and a web site developed for this purpose. It was supported by advertisement and announcements in association newsletter.
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	Yes	IDBI selected as the executing agency and will be responsible for fund management and project implementation.

Per (main) activity	Activity 1	Activity 2	Activity 3	Activity 4	Explanations
Type of activity	Chiller Replacement	Technical Assistance	Monitoring and Verif	Project Management	e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	India	India	India	India	
Status	Project was approved by the Bank Board and the Grant Agreement was signed between the Bank with Ministry of Finance and with IDBI in Aug 09. Since project commencement in Sep. 09, all Memorandum of Agreements have been signed with all the chiller manufacturers and suppliers active in the country. PMU set up in IDBI, the coordinating entity. Intensive marketing strategy was launched and a number of workshops were held to inform potential beneficiaries about the project. There was a change in the carbon buyer and an ERPA was signed with KfW in early 2010. Legal Emissions Transfer Agreements have been signed with 5 chiller owners. A Monitoring and Verification Agency has been contracted and the baseline for 5 chillers has been completed. The POA has been identified and PDD is about to be finalized and expected to be submitted to the CDM-EB by Dec. 10.				Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements					No chillers replaced as of Sep. 10.
Owner, use					e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded					
(Expected) Status of completion					
Actual cost with a break down by					
equipment					
installation					
construction					
Information on energy efficiency					
Original technology					
Age of chiller being replaced					
Original capacity					
Replacement technology					(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity					[please provide unit = kW or tons]
Assumed / measured change in energy efficiency					(from/unit to /unit)
Assumed annual saving in energy					(in kWh)

General information		Explanations
How many chiller users have been identified in the country	250	195 chillers have been targeted initially (first phase) for replacement through GEF, MLF and KfW assistance under the Chiller Replacement Project.
What share of the country's chiller users have been identified (estimated)	100%	The inventory of CFC centrifugal chillers was developed on the basis of information provided by chiller suppliers.
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	Yes.	A Project Management Contractor has been selected (competitively) to support DENR in its role as Coordination Entity to manage the project. KfW and DENR are working together to secure a DOE for validation.

Per (main) activity	Activity 1	Activity 2	Activity 3	Activity 4	Explanations
Type of activity	Chiller Replacement	Technical Assistance	Monitoring and Verif	Project Managemen	e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Philippines	Philippines	Philippines	Philippines	
Status	Kfw will be the project carbon buyer for the CDM component of the project and agreed to purchase $6 million in CERs. The WB Board approval of the project occurred in June 2010. Several chiller candidates have been selected to validate for monitoring plan which would be submitted to the CDM EB and already 7 chillers have been replaced. Validation of the methodology/project must be carried out by a DOE to ensure that emission reductions to be obtained from the project can be converted to CERs. Selection of a DOE is underway.				Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements					TOTAL No. replaced as of Sep 2010 = 7
Owner, use					e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded					
(Expected) Status of completion					
Actual cost with a break down by					
equipment					
installation					
construction					
Information on energy efficiency					
Original technology					
Age of chiller being replaced					
Original capacity					
Replacement technology					(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity					[please provide unit = kW or tons]
Assumed / measured change in energy efficiency					(from/unit to /unit)
Assumed annual saving in energy					(in kWh)

General information		Explanations
How many chiller users have been identified in the country	20	CFC-based chillers only. However, six of these chillers have been removed from the list of chillers targeted for MLF assistance (30% incentive) because they were already replaced with new chillers and required criteria for eligibility have not been fulfilled.
How many chillers remain?	Four CFC-based chillers remain.	
How many belong to the public sector? How many to the private sector?	They belong to the Airport International Group which was once public but has been privatized. Of the chillers already replaced, two belonged to a public entity, the rest to the private sector.	
What share of the country's chiller users have been identified (estimated)	100%	
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	No	

Per (main) activity	Activity 1	Activity 2	Activity 3	Explanations
Type of activity	Chiller Replacement	Technical Assistance	Project Management	e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Jordan	Jordan	Jordan	
Status	First subgrant agreement for a chiller replacement subproject was signed in late 2009. Chiller was replaced by January 2010. As of Sep. 10, 16 CFC-based chillers have been replaced (however, not all will receive MLF funding). Draft proposals submitted by 2 owners are expected to be cleared by end Oct. 10. Building owners have or are in the process or preparing their project documents, including technical specifications and details of planned new chillers.	NOU has hired technical consultant to assist in project implementation, in particular to provide technical backstopping to chiller owners and the NOU. A firm has been hired to manage CFC disposal and safe storage for the replaced chillers in Oct. 2010. A technical workshop was held for chiller owners and another is planned in late 2010.	Signing of subgrant agreements started in late 2009. PMU is responsible for following up with chiller owners and ensuring complete documentation for clearance by the WB. The PMU also organizes training events and consults with chiller owners.	Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements	N/A	N/A	N/A	TOTAL No. replaced as of Sep 2010 = 16
Owner, use				e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded				
(Expected) Status of completion				
Actual cost with a break down by				
equipment				
installation				
construction				
Information on energy efficiency				
Original technology				
Age of chiller being replaced				
Original capacity				
Replacement technology				(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity				[please provide unit = kW or tons]
Assumed / measured change in energy efficiency				(from/unit to /unit)
Assumed annual saving in energy				(in kWh)

General information		Explanations
How many chiller users have been identified in the country	160	
What share of the country's chiller users have been identified (estimated)	100%	
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	No	

Per (main) activity	Activity 1	Activity 2	Activity 3	Explanations
Type of activity	Chiller Replacement	Technical Assistance	Project Management	e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Indonesia	Indonesia	Indonesia	
Status				Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements	N/A	N/A	N/A	
Owner, use				e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded				
(Expected) Status of completion				
Actual cost with a break down by				
equipment				
installation				
construction				
Information on energy efficiency				
Original technology				
Age of chiller being replaced				
Original capacity				
Replacement technology				(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity				[please provide unit = kW or tons]
Assumed / measured change in energy efficiency				(from/unit to /unit)
Assumed annual saving in energy				(in kWh)

Project data			
Title	Strategic Demonstration Project for Accelerated Conversion of CFC Chillers in 5 African Countries (Cameroon, Egypt, Namibia, Nigeria and Sudan)		
Approved at [ExCom Meeting]	48		
Country/countries/region covered	Cameroon, Egypt, Namibia, Nigeria and Sudan		
MLF funding approved	US$ 2000000		
Minimum co-funding requirement	US$ 477876		
Source(s) of co-funding as envisaged in project proposal (amount envisioned and currency in brackets)	French Global Environment Facility		
Number of chillers to be replaced	20		
Lead agency	UNIDO		
MLF funding associated	747,500		
Other agencies/bilaterals	Agency 1	Agency 2	Agency …
Name	France	Germany	Japan
Responsibility	implementation assigned to UNIDO	capacity building activities	implementation assigned to UNIDO
MLF funding associated	360,000	192,500	700,000

Results / assessment (provide some brief text, please; bullet points also possible)	
General experience	The project implementation is not yet fully operationalized therefore the general experience so far relates to the mobilization of additional resources. In this context, working with the bilateral agencies to mobilize the support of the French Global Fac.
Greatest challenges	1) Introducing to the FGEF the concept of linking the Kyoto Protocol and Montreal Protocol through replacing CFC based chillers with energy efficient non-CFC based chillers, 2) Synchronizing the project cycles of FGEF and MLF and 3) Introducing a new concept to the national ozone units
Lessons learned	
Remarks on interest by chiller owners / did you experience good co-operation / did the quality of interaction change with time?	Not yet started
Remarks on interest by chiller owners	N/A
Expected results beyond chillers funded: (e.g.: Will the demonstration lead to more chillers being replaced, if yes how concrete is that understanding? If no why is that assumed? ...)	One component under the projects deals with the elaboration of a chiller replacement policy and replication of the demonstration results
Reasons for delays	N/A
Experience with funding organisations	The FGEF and the French Ministry of Environment was very supportive and enthusiastic about the project concept. This facilitated the quick approval of the co-funding requirement.
Impact on the chiller market in the relevant country/countries; market transformation observed	The chiller suppliers were involved since the onset of the project, they are engaging in more intense marketing activities and show a lot of competitiveness.
How do you see the potential of replication of this approach for other sectors?	N/A
Would you say that this co-funding experience was positive?	N/A
Should a similar approach be taken in the future again, what are your suggestions for improvements a) related to the MLF; b) related to other donors (where relevant); c) related to implementation and co-operation with stakeholders and the country; d) related to other issues.	N/A
Other remarks and/or explanations	In accordance with the approval conditions, Senegal was added to the list of countries covered by the project.

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding	Refers to all co-financing that materialised
Co-funding institution	French Global Environment Facility (FGEF)			
Name, purpose of programme	Energy efficiency and climate change			
Amount approved in total (currency)	EUR 750,000			
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?	yes			yes/no
If yes: Did the amount change (please provide from … to)	The funding approved increased from US$ 500,000 to EUR 750,000			
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly	N/A			Explain briefly: 2, 3 sentences (separate below) or some bullet points
How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)	EUR 750,000			
Date of approval	Jul-07			
Major conditions associated	None			e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)	None			
Funds agreed by the MFS to be released based on that approval	2,000,000			
Date of related release of Funds by the MFS	Sep-07			

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Expected approval				
Reasons for the delay				
Major conditions associated				
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)				

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Reasons for the decision				

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

General information								Explanations
How many chiller users have been identified in the country	340 CFC-based centrifugal chillers, which are still operating in Cameroon (16), Egypt (230), Namibia (6), Nigeria (64), Senegal (7) and Sudan (13) (including those considered under the project)							
How many chillers remain?	0	N/A	200	7	13	16	50	
How many belong to the public sector? How many to the private sector?	60% of the chillers are privately owned							
What share of the country's chiller users have been identified (estimated)	All							
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	No							

Per (main) activity	Activity 1	Activity 2	Activity 3	Activity 4	Activity 5	Activity 6	Activity …	Explanations
Type of activity	Chiller Replacement	Regional Workshop	Setup of a financial mechanism				Setup of a financial mechanism	e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Namibia	Egypt	Egypt	Senegal	Sudan	Cameroon	Nigeria	
Status	Completed	The workshop was held in September 2006 and the results were published by GTZ (copy attached)	1)Project steering committee operational, 2) Agreement with the national bank of Egypt will be signed by end October 2010 3) Chiller replacements will start in December 2010.	1) Project beneficiaries were selected however the beneficiary does not have sufficient funds to co-finance the replacement.	1) 3 beneficiaries were selected, 2) Procurement of the chillers will be initiated at the end of November 2010, 3) Establishment of a financial mechanism not feasible therefore counterparts will provide direct co-financing.	The NOU wishes that all the owners benefit from the fund therefore local banks are being contacted to check options for establishment of a revolving fund to cover all remaining beneficiaries.	1) Steering Committee Established, 2) selection of the project beneficiaries is ongoing 3) Agreement with the Nigerian Industry Bank will be signed in December 2010	Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements								
Owner, use	Katatura Hospital, hospital cooling			Hotel (Government owned)	Textile Industries			e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded	Jan-08							
(Expected) Status of completion	Dec-08							
Actual cost with a break down by								
equipment								
installation								
construction								
Information on energy efficiency								
Original technology								
Age of chiller being replaced								
Original capacity								
Replacement technology								(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity								[please provide unit = kW or tons]
Assumed / measured change in energy efficiency								(from/unit to /unit)
Assumed annual saving in energy								(in kWh)

Project data			
Title	Demonstration project on the replacement of CFC centrifugal chillers (Croatia, Macedonia, Romania and Serbia and Montenegro)		
Approved at [ExCom Meeting]	47		
Country/countries/region covered	Croatia, Macedonia, Romania and Serbia and Montenegro / Eastern Europe and Central Asia		
MLF funding approved	US$ 1,069,074		
Minimum co-funding requirement	US$ 416,175		
Source(s) of co-funding as envisaged in project proposal (amount envisioned and currency in brackets)	Counterpart co-financing (US$ 750,000)		
Number of chillers to be replaced	12 chillers		
Lead agency	UNIDO		
MLF funding associated	US$ 1,069,074		
Other agencies/bilaterals	Agency 1	Agency 2	Agency …
Name	N/A	N/A	N/A
Responsibility	N/A	N/A	N/A
MLF funding associated	N/A	N/A	N/A

Results / assessment (provide some brief text, please; bullet points also possible)	
General experience	The overall assessment for the implementation of this project is good because of the interest of the chiller owners, the willingness of the chiller suppliers to engage in the project and the support of the procurement services unit at UNIDO in negotiating prices.
Greatest challenges	1) Solvency of companies in the region. Some end-users who were pre-selected went bankrupt before the implementation of the project therefore other beneficiaries were selected however in some other cases, the beneficiaries went bankrupt after the chillers were commissioned. With a lot of support from the NOUs, the chillers were reallocated to other beneficiaries.
Lessons learned	1)Low operating hours due to the weather conditions in the region make the energy savings not so attractive, saving on maintenance costs of the old chillers and compliance with EU regulations become the major drivers for the replacement in the Eastern European Region! Energy Service Companies would only be interested in such projects if it integrates other measures relating to green buildings! 2) Replacement of the chillers alone do not yield the expected energy savings. To obtain optimal energy savings, other components in the chilling plant including the cooling towers, piping and pumps should be replaced. This is usually very costly and acts as a disincentive for the replacement.
Did you work with both public and private owners, and if yes: was there a different policy/approach needed for the two?	Yes both public and private sector beneficiaries were considered. Since the counterpart co-financing was used, no major difference in the approach was needed.
Remarks on interest by chiller owners / did you experience good co-operation / did the quality of interaction change with time?	The chiller owners were interested and cooperative. Often the incentive given to replace one chiller triggered the counterparts to replace the other chillers if more than one were operated!
Expected results beyond chillers funded: (e.g.: Will the demonstration lead to more chillers being replaced, if yes how concrete is that understanding? If no why is that assumed? ...)	Given the accession of many participating countries into EU and their wish to comply with EU regulations on CFCs, the chiller owners are aware of the urgent need to replace their chillers! No replication impact is expected.
Reasons for delays	N/A
Experience with funding organisations	N/A
Impact on the chiller market in the relevant country/countries; market transformation observed	The chiller suppliers were involved since the onset of the project, they are engaging in more intense marketing activities and show a lot of competitiveness.
How do you see the potential of replication of this approach for other sectors?	Yes a project for an early replacement programme of chiller or other equipment would be useful to deal with the HCFC service sector.
Would you say that this co-funding experience was positive?	Yes however there is no replication impact.
Should a similar approach be taken in the future again, what are your suggestions for improvements a) related to the MLF; b) related to other donors (where relevant); c) related to implementation and co-operation with stakeholders and the country; d) related to other issues.	A similar project may be applied to the phase out of HCFC based chillers on a revolving fund basis with some grant subsidy to be given as an incentive. However this needs to be early on in planning the HCFC phase out to allow for sufficient time for the revolving fund to be replenished.
Other remarks and/or explanations	

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding	Refers to all co-financing that materialised
Co-funding institution	5 Counterparts	5 counterparts		
Name, purpose of programme	Counterpart co-financing	counterpart co-financing		
Amount approved in total (currency)	US$ 230,000	US$ 240,000		
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?	yes	yes		yes/no
If yes: Did the amount change (please provide from … to)	the amount foreseen is equivalent to that approved	the amount foreseen is equivalent to that approved		
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly	N/A	N/A		Explain briefly: 2, 3 sentences (separate below) or some bullet points
How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)	US$ 183,000	US$ 195,000		
Date of approval	Nov - 06	Nov - 06		
Major conditions associated	None	None		e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)	None	None		
Funds agreed by the MFS to be released based on that approval	471,679			
Date of related release of Funds by the MFS	May-07			

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Expected approval				
Reasons for the delay				
Major conditions associated				
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)				

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

General information						Explanations
How many chiller users have been identified in the country	Romania: 7 CFC-based centrifugal chillers (including those considered under the project) Croatia: 22 CFC-based centrifugal chillers (including those considered under the project) Macedonia FYR: 23 CFC-based centrifugal chillers (including those considered under the project) Serbia and Montenegro: 34 CFC-based centrifugal chillers (including those considered under the project)					
How many chillers remain?						
How many belong to the public sector? How many to the private sector?						
What share of the country's chiller users have been identified (estimated)	Almost all 95%					During project implementation some new sites were detected in Serbia, which were not part of the original inventory
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	No					

Per (main) activity	Activity 1	Activity 2	Activity 3	Activity …	Explanations
Type of activity	Chiller Replacement	Chiller Replacement in concrete pipeline phase	Supplier Seminar		e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Romania (1), Macedonia (2), Serbia (1), Montenegro (1)	Croatia (4), Serbia (2)	Austria	Serbia (1)	
Status	Completed	Completed except the one in Viskoza Kord, Serbia. The company was bankrupt during 2010. UNIDO with the assistance of the NOU are trying to recover the chiller and to reutilize it for a new beneficiary. Additional costs to bring the chiller into operation might be needed.	Completed	Awaiting advise of the Secretariat regarding reimbursement of the hospital for the costs incurred to replace the chiller at VMA.	Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements					
Owner, use	1) Radio House, cooling of technical rooms and studios 2) National Bank, cooling, 3) OHIS chemical factory, cooling of mechanical equipment, 4) Airport Belgrade, cooling 5) Television Montenegro, cooling of technical rooms and studios	1) Zagrebcanka Business Tower, Cooling, 2) SRDJ Galeria, Cooling, 3) Clinic Osijek, hospital cooling, 4) Ministry of Economy, cooling, 5) Vizkoza Kord, cooling, 6) Radio Television Serbia (RTS), cooling of technical rooms and studios		VMA	e.g. "city of x", "hospital cooling"
When was the agreement with the owner concluded	Sep-06	Apr-08			
(Expected) Status of completion	Dec-08	Dec-09			
Actual cost with a break down by					
equipment	585,000	680,000			
installation (startup only)	20,000	30,000			
construction	Counterpart responsibility locally!	Counterpart responsibility locally!			
Information on energy efficiency					
Original technology	All five are CFC-11, centrifugal	1) CFC-11, centrifugal 2) CFC-11, centrifugal 3) CFC-12, centrifugal 4) CFC-11, centrifugal 5) CFC-114, centrifugal 6) CFC-11, centrifugal			

	Age of chiller being replaced	1) 30 years (1978) 2) 32 years (1976) 3) 34 years (1974) 4) 30 years (1978) 5) 29 years (1979)	1) 33 years (1975) 2) 36 years (1972) 3) 27 years (1981) 4) 25 years (1983) 5) 42 years (1956) 6) 30 years (1979)			
	Original capacity	1) 580 kW 2) 900 kW 3) 605 kW 4) 800 kW 5) 930 kW	1) 974 kW 2) 1080 kW 3) 700 kW 4) 1,046 kW 5) 1,512 kW 6) 930 kW			
	Replacement technology	All five are HFC-134a, screw	1) HFC-134a, screw 2) HFC-134a, screw 3) HFC-134a, screw 4) HFC-134a, centrifugal 5) HFC-134a, screw 6) HFC134a, screw			(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
	Replacement capacity	1) 580 kW 2) 1100 kW 3) 600 kW 4) 956 kW 5) 950 kW	1) 1204 kW 2) 644 kW 3) 1248 kW 4) 999 kW 5) 900.1 kW 6) 604.8 kW			[please provide unit = kW or tons]
	Assumed / measured change in energy efficiency	1) from COP = 3.2 to COP = 6.1 2) from COP = 2.8 to COP = 6.35 3) from COP = 3.5 to COP= 6.24 4) from COP = 3.4 to COP = 5.11 5) from COP = 3.72 to COP=5.04	1) from COP = 3.45 to COP = 4.8 2) from COP =3.40 to COP = 5 3) from COP =3.43 to COP = 5.91 4) from COP= 4.3 to COP = 6.05 5) from COP=3.69 to COP = 5.52 6) from COP= 3.72 to COP=5.48			(from/unit to /unit)
	Assumed annual saving in energy					(in kWh)

Project data			
Title	Regional demonstration project for integrated management of the centrifugal chiller sub-sector in the Caribbean, focusing on application of energy-efficient CFC-free technologies for replacement of CFC-based chillers		
Approved at [ExCom Meeting]	47th		
Country/countries/region covered	Jamaica, Barbados, Trinidad and Tobago and the Dominican Republic		
MLF funding approved	1,000,000		
Minimum co-funding requirement	690.000 US$		
Source(s) of co-funding as envisaged in project proposal (amount envisioned	Regional GEF MSP of 1.000.000 US$ + 160.000 US$ UNDP Trust Fund		
Number of chillers to be replaced	14		
Lead agency	UNDP		
MLF funding associated			
Other agencies/bilaterals	Agency 1	Agency 2	Agency …
Name			
Responsibility			
MLF funding associated			

Results / assessment (provide some brief text, please; bullet points also possible)		
	General experience	The Chillers project in the Caribbean has faced several challenges. The project was originally developed with the idea that a regional MSP on energy efficiency would serve as co-finance for the project. However, the RAF discussions and many other similar problems meant that the idea was abandoned a long time ago. We have been looking for other co-financing sources. The most promising one was developed by our finance analyst on business models, where he established the criteria for a financial mechanism for the public sector in Jamaica, and this had in principle been approved by a financial institution. However, simultaneously to that exercise we were trying to make a list of the remaining chillers in Jamaica (one of the four countries). The result of the assessment was that there were only 9 CFC based chillers left in Jamaica, and 7 of them were replaced after the chillers project was approved leaving only two CFC based chillers in the country. This is of course not enough to establish a financial mechanism. We have not been able to locate additional chillers. We are therefore in a situation where it is difficult to comply with the original project objective – to develop a financial mechanism for chillers replacement. It is also not possible to develop the model under the GEF so we will not seek financial assistance from the GEF. We never managed to identify any CFC based chillers in Barbados and Trinidad and Tobago. We had a list of some chillers in the Dominican Republic. Last time we went there we tried to visit the buildings, but there were no CFC chillers left. The maintenance workers told us that they had been replaced a long time ago. They are now, HCFC or HFC based Chillers. The countries in the region have through the replacements that already took place lived up to the co-finance requirements of the agreement, and it is suggested that the project will focus on co-financing replacement of remaining CFC based chillers, and provide additional technical support and training in the countries to support chillers replacements.
	Greatest challenges	To locate CFC based centriful chillers in the countries
	Lessons learned	
	Remarks on interest by chiller owners	Public Sector in Jamaica very interested in the project. Jamaica has been the most pro-active player in the project.
	Expected results beyond chillers funded: (e.g.: Will the demonstration lead to more chillers being replaced, if yes how concrete is that understanding? If no why is that assumed? ...)	
	Reasons for delays	The implementation of the RAF in the GEF made it very difficult for UNDP to prepare the regional MSP and submit it to the GEF SEC. An alternative finance strategy was developed by our finance analyst. However, most of the chillers had already been replaced when the strategy was developed
	Experience with funding organisations	The GEF SEC has a different project cycle than the MLF, and it is not always easy combine the two funding sources - this is especially the case in multi country projects. This is further complicated for countries that does not have an individual RAF.
	Impact on the chiller market in the relevant country/countries; market transformation observed	Most of the market transformation already took place. Public sector, especially in Jamaica, seems to be the sector with the most difficulties.
	Other remarks and/or explanations	

Co-funding information

Per approved co-funding	1st co-funding	2nd co-funding	… co-funding	Refers to all co-financing that materialised
Co-funding institution		UNDP Energy TTF	Jamaica	
Name, purpose of programme		Regional Caribbean demonstration project on application of CFC-free energy efficient technologies for replacement of CFC-based centrifugal chillers.	Replacement of chillers in Public and Private Sector	
Amount approved in total (currency)		160,000	not quantified	
Was this co-funding foreseen in the original submission to the 47th/48th Meeting?		yes	no	yes/no
If yes: Did the amount change (please provide from … to)		No		
If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly		This was foreseen in the original proposal	High energy prices promoted the process	Explain briefly: 2, 3 sentences (separate below) or some bullet points
How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)		Most of it	All of it.	
Date of approval		2006	2006 - 2008	
Major conditions associated		To support the implementation of the chillers programme. It is complimentary to another project funded by the UNDP TTF on Energy Efficiency in Public Buildings in Jamaica that was approved before 2006.	no specific conditions	e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)		see above		
Funds agreed by the MFS to be released based on that approval		0	0	
Date of related release of Funds by the MFS				

Per co-funding presently sought	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
Expected approval				
Reasons for the delay				
Major conditions associated				
Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)				

Co-funding sources previously pursued but subsequently abandoned	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution	GEF			
Name, purpose of programme	Regional Energy Efficiency Programme			
Amount sought in total	1000000			
How much of that constitutes project costs in the MLF definition	Most of it.			
When was the quest for co-funding from this institution/programme abandoned?	The idea of presenting a proposal to the GEF was abandoned when the RAF was implemented.			
Reasons for the decision	To coordinate a four country regional MSP country with RAF is quite complicated			

Additional external resources acquired for the chiller phase-out	1st co-funding	2nd co-funding	… co-funding	Explanations
Co-funding institution				
Name, purpose of programme				
Amount sought in total				
How much of that constitutes project costs in the MLF definition				
When was the quest for co-funding from this institution/programme abandoned?				
Reasons for the decision				

General information		Explanations
How many chiller users have been identified in the country	Dominican Republic : No CFC based Centrifugal Chillers have been identified. We have visited the locations identified during project preparation, but all had been replaced. Trinidad and Tobago: No CFC based centrifugal chillers have been identified. Jamaica: We have located 9 CFC based centrifugal chillers of which 7 were replaced in 2006 and 2007.	We have only found CFC based chillers in Jamaica (9) and 7 had been substituted at the time we did the survey. Jamaica has not imported CFCs since 2006 and we doubt that additional chillers can be found there. In neither of the four countries we have found CFC based chillers when we
What share of the country's chiller users have been identified (estimated)	There might be chillers in the private sector in both Jamaica and the Dominican Republic, but it has not been possible to locate them so far.	We believe that only a very limited number of CFC based chillers would still be in the countries. We have not been able to locate additional chillers.
Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly	UNDP developed with funds from the Thematic Trust Fund on Energy the principles of a finance scheme for Chillers replacement. The scheme was discussed with stakeholders and 3 potential banks (all showed interest in the scheme). However, the low quantity of chillers to be replaced made if impossible to reach a critical mass, and it would therefore not be cost efficient to implement the scheme in Jamaica.	

Per (main) activity	Activity 1	Activity 2	Activity 3	Activity …	Explanations
Type of activity	Development of financial Scheme	Identification of CFC based chillers	Replacement of 7 chillers	Potential replacement of 2 chillers	e.g.: Chiller replacement / Chiller retrofit / Workshop / …
Country	Jamaica				
Status	Principles for financial scheme developed and shared with main stakeholders. Low quantity of chillers made it impossible to implement the scheme.	9 chillers in 7 locations identified in Jamaica. Seven have been replaced. No CFC based chillers found in Dominican Republic and Trinidad and Tobago.	Seven chillers replaced in Jamaica		Completed, new chiller fully functional/largely completed, new chiller delivered and in the process of installation and trial/partially completed, new chiller delivery expected … / Tendering complete and contract issued / Tender process ongoing / Preparation of tender process // Workshop planned / Workshop held (when?) / Results published (when? Please provide copy)
In case of chiller replacements					
Owner, use			The seven Chillers were located in the following locations: Sangster International Airport, Starfish Hotel, Bank of Jamaica, Airport Authority of Jamaica, and Jamaica Pegasus Hotel.		The Ministry of Health main building in Kingston, Jamaica has two CFC based chillers. We have no additional information on these chillers.
When was the agreement with the owner concluded					
(Expected) Status of completion			Completed		
Actual cost with a break down by					
equipment			Funded by company		
installation			Funded by company		
construction			Funded by company		
Information on energy efficiency					
Original technology			N/A		
Age of chiller being replaced			N/A		
Original capacity			N/A		
Replacement technology			All chillers replaced with 134 a chillers from Carrier, York and Trane.		(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)
Replacement capacity					[please provide unit = kW or tons]
Assumed / measured change in energy efficiency					(from/unit to /unit)
Assumed annual saving in energy					(in kWh)