اللجنة التنفيذية للصندوق المتعدد الأطراف

لتثبيت بروتوكول مونتريال

الاجتماع الثاني والستون

مونتريال، 29 نوفمبر/تشرين الثاني – 3 ديسمبر/كانون الأول 2010

تقرير عن تنفيذ المشروعات الموافق عليها بشروط تبليغ محددة
مقدمة

قدمت حكومات كندا وفرنسا وألمانيا واليابان، فضلاً عن برنامج الأمم المتحدة الإنمائي (اليونتديبي) ومنظمة الأمم المتحدة للتربية والثقافة والعلوم (اليونسكو) والبنك الدولي تقارير مركّلة عن تنفيذ المشروعات التالية، التي تشمل الاتفاقات الخاصة بها على شروط تبليغ محددة، كيما ننظر فيها اللجنة التنفيذية في اجتماعها الثاني والستين:

الصين: خطة إزالة المواد الكلوروفولوروكربونية في قطاع خدمة البريد: مراجعة التحقق لعام 2009 (اليونتديبي)

كوستاريكا: خطة الإزالة الوطنية لمواد المركّلة ألف (المجموعتان الأولى والثانية) (التقرير المراقبة للخطة 2009-2010) (اليونتديبي)

مشروع عالمي: فورمات المبتكّرة المستعمل كعمل في تصميم نظام البولوميتان. تقسيم من أجل التطبيق في مشروعات الصندوق المقدّرة الأطراف (اليونتديبي)

ستان: خطة إدارة الإزالة النهائية: تقرير المراجعة (اليونتديبي)

مشروعات أجهزة تبريد المباني

البرازيل: تقرير مركّلة عن المشروع التدريبي للاستيابارة المتكاملة للقطاع الفرعي لأجهزة تبريد المباني المركزية، مع التركيز على تطبيق تكنولوجيات خالية من المواد الكلوروفولوروكربونية وفعالية من حيث الطاقة تبديل أجهزة تبريد المباني القائمة على المواد الكلوروفولوروكربونية (اليونتديبي)

كوستاريكا: تقرير مركّلة عن المشروع التدريبي للاستيابارة المتكاملة للقطاع الفرعي لأجهزة تبريد المباني المركزية، مع التركيز على تطبيق تكنولوجيات خالية من المواد الكلوروفولوروكربونية وفعالية من حيث الطاقة تبديل أجهزة تبريد المباني القائمة على المواد الكلوروفولوروكربونية (اليونتديبي)

 كويا: تقرير مركّلة عن المشروع التدريبي للاستيابارة المتكاملة للقطاع الفرعي لأجهزة تبريد المباني المركزية، مع التركيز على تطبيق تكنولوجيات خالية من المواد الكلوروفولوروكربونية وفعالية من حيث الطاقة تبديل أجهزة تبريد المباني القائمة على المواد الكلوروفولوروكربونية (اليونتديبي)

الجمهورية العربية السورية: تقرير مركّلة عن المشروع التدريبي لتبديل أجهزة تبريد المباني المركزية القائمة على المواد الكلوروفولوروكربونية (اليونتديبي)
مشروع عالمي: تقرير مراحل عن المشروع العالمي لتبادل أجهزة تبريد المباني (الصين والمملكة المتحدة والمملكة المتحدة والمملكة المتحدة والهند والإنجليزية والمملكة المتحدة والمملكة المتحدة)

مشروع إقليمي - آسيا: تقرير مراحل عن مشروع تدريبي استراتيجي لتحويل المعالج لأجهزة تبريد المباني القائمة على المواد الكلوروفلووروكربونية في 6 بلدان آسيا (الكمبوديا ومصر وناميبيا ونيجيريا والسنغال والسودان) (الصين والمملكة المتحدة والمملكة المتحدة والمملكة المتحدة)

مشروع إقليمي - أوروبا: تقرير مراحل عن مشروع تدريبي لتبادل أجهزة تبريد المباني المركزية القائمة على المواد الكلوروفلووروكربونية (كرواتيا وجمهورية مقدونيا النوغوسلافية السابقة والجبل الأسود ورومانيا وصربيا) (الرومانيا)

مشروع إقليمي - أمريكا اللاتينية والبحر الكاريبي: مشروع تدريبي لـ"للإحراز المتكاملة للقطاع الفرعي لأجهزة تبريد المباني المركزية في البحر الكاريبي، مع التركيز على تطبيق تكنولوجيات خالية من المواد الكلوروفلووروكربونية وفعالية من حيث الطاقة لتبادل أجهزة تبريد المباني القائمة على المواد الكلوروفلووروكربونية (ليختنشتاين)

2- واستعرضت الأمانة التقارير الميدانية بشأن المشروعات المذكورة أعلاه في ضوء المقترحات الأصلية للمشروعات، وبيانات المواد المستفهرة للأوزون التي أبلغت عنها الحكومات المعنية بموجب المادة 7 من بروتوكول مونتريال، والمقررات ذات الصلة الصادرة عن اللجنة التنفيذية واجتماع الأطراف.

الصين: خطة إزالة المواد الكلوروفلووروكربونية في قطاع خدمة التبريد: مراجعة التطبيق لعام 2009 (الرومانيا)

3- بالنيابة عن حكومة الصين، قدمت اليونيدو، بوصفها الوكالة المنفذة الرئيسية لخطة إزالة المواد الكلوروفلووروكربونية في قطاع خدمة التبريد، إلى الاجتماع الثاني والستين للجنة التنفيذية تقرير تحقيق مستقل يتعلق باستهلاك الكليروفلووروكربون-12 في قطاع خدمة التبريد في الصين، يغطي عام 2009. وبموجب هذه الخطة القطاعية، فإن استهلاك الصين من الكليروفلووروكربون-12 هو أساسي في تنفيذه وسمح به لهذا القطاع.

الخلفية

4- ووفقًا على خطة إزالة المواد الكلوروفلووروكربونية في قطاع خدمة التبريد للصين في الاجتماع الرابع والأربعين للجنة التنفيذية، حيث تعمل اليونيدو بوصفها الوكالة الرئيسية واليابان بوصفها الوكالة الثانوية تنفيذية، ويتطلب إجمالي الأموال الموافق عليها من حيث المبدأ للخطة إلى 885 دولار أمريكي زائد تكاليف دعم الوكالة البالغة 836 دولارًا أمريكيًا. وعدل الاتفاق في الاجتماع الخامس والأربعين لإدراج اليونيدو أيضاً كوكالة متأصلة متعاونة. وتبني خطة إزالة المواد الكلوروفلووروكربونية في قطاع خدمة التبريد إلى دعم الصين في الوفاء بالتزاماتها، بموجب بروتوكول مونتريال، بما في ذلك الإزالة الكاملة للاستخدام المراقب للمواد
الكروفلوروكربونية قبل عام 2010. ووفق على الشريحة الأخيرة من هذه الخطة القطاعية في الاجتماع التاسع والخمسين للجنة التنفيذية.

التقرير المرحلى

5- يحدد الاتفاق بين الصين واللجنة التنفيذية الحد الأقصى المسموح به لاستهلاك الكروفلوروكربون-12 في قطاع خدمة التبريد. ويحدد هذا الاستهلاك عن طريق تحقيق من بيانات المادة 7، وخصوصا منها بيانات الاستهلاك المتوقع من مختلف الخطط القطاعية التي يزال فيها الكروفلوروكربون-12 بالتوالي. وقد وفرت الصين في السنوات السابقة مخزونات وطنية، لتوفير الكروفلوروكربون-12 لقطاعي خدمة التبريد وأجهزة الاستشراق المزودة بمقاس للجرعات لما بعد الإغلاق المعياري لقطاع الإنتاج في عام 2007.

6- ويتطلب الاتفاق بين الصين واللجنة التنفيذية التحقق بصورة مستقلة من بيانات المادة 7 بشأن استهلاك الكروفلوروكربون-12 في الصين، في حين يتم التأكيد من الاستهلاك في قطاع خدمة التبريد من خلال أنشطة الصناديق الذاتية للرصد والمراجعة. وكان التحقق من استهلاك عام 2009 من الكروفلوروكربون-12 في حد ذاته يستند في الماضي إلى عملية التحقق: نتائج تحقيق البنك الدولي من قطاع الإنتاج، ونتائج التحقق من المواد والتصديرات، فنحتل الثاني وبناء على إطار هذه الخطة القطاعية. ولم تتكن هناك أي واردات من المواد الكروفلوروكربونية إلى الصين في عام 2009. ووصل الإنتاج إلى 498.56 طن من قدرات استنفاد الأوزون والتصديرات إلى 100 طن من قدرات استنفاد الأوزون، وذلك فإن استهلاك الكروفلوروكربون-12 قدره 398.56 طن من قدرات استنفاد الأوزون، وقبل هذا الاستهلاك كمية قدرها 4.7 طن من قدرات استنفاد الأوزون عن الحد الأقصى البالغ 406.0 طن من قدرات استنفاد الأوزون المحدد في الاتفاق بين الصين واللجنة التنفيذية لعام 2009.

做什么的义务

7- أبلغت الأمانة اليونيدو بالمقرر المشروع في الاجتماع التاسع والخمسين للجنة التنفيذية بشأن مطالبة اليونيدو بأن تقدم سنويا، حسب السنة التقويمية، تقارير عن الأنشطة المضطلع بها حتى الاستخدام المالي لخطة الإزالة. وقدمت اليونيدو في وقت لاحق تقريرا عن التنفيذ إلى الاجتماع الثاني والستين، غير أن عملية إعداد الوثائق لهذا الاجتماع كانت قد انتهت بالفعل. وسيقدم التقرير السنوي المتعلق بالتنفيذ للنظر فيه في الاجتماع القادم للجنة التنفيذية.

توظيف الأمانة

8- توصي الأمانة اللجنة التنفيذية بأن:

تحيط علما بتقرير التحقق المتعلقة باستهلاك الكروفلوروكربونية في قطاع خدمة التبريد في الصين خلال عام 2009؛
(ب) تحيط عالمًا بأنه سيُنظر في تقرير التنفيذ السنوي للستينات 2009 و2010 في الاجتماع الثالث والستين للجنة التنفيذية.

كولومبيا: خطة الإزالة الوطنية لمواد المرقق الألف (المجموعتان الأولى والثانية) (التقرير المركلي للفترة 2009-2010) (الإيوبونديي)

9- وافقت اللجنة التنفيذية على خطة الإزالة الوطنية لمواد الكلوروفلورووكربونية في اجتماعها الحادي والأربعين، وبموجب هذه الخطة، تتزعم حكومة كولومبيا إزالة جميع المواد الكلوروفلورووكربونية والهالونات بحلول 1 يناير 2010. وقد وافقت اللجنة التنفيذية من حيث المبدأ على مبلغ 4.5 مليون دولار لتنفيذ هذه الخطة، وأيضًا على تمويل الشريحتين الأوليتين في اجتماعها الحادي والأربعين (820 146 2 دولارًا أمريكيًا والسابع والأربعين (180 353 دولارًا أمريكيًا).

التقرير المركلي

10- تحقق عدد من النتائج حتى الآن في برنامج عمل خطة الإزالة الوطنية لكولومبيا للقرن 2009-2010، بما في ذلك: اعتماد 1000 تقني خدمة تبريد آخر، مما أدى إلى وصول عدد التقنيين المعتمدين منذ بداية البرنامج إلى ما يزيد عن 500 تقني؛ وإنشاء ثلاثة مراكز لاستعادة غازات التبريد؛ وتحرير معدات التبريد، بما في ذلك أجهزة الكشف عن المواد المستنفدة للأوزون إلى 35 مركزاً تكنولوجياً؛ وتنظيم حلقة العمل الدبلوماسية السنوية لمعاهد التدريب بمشاركة 55 مدرباً. ودخل ما يقرب من 1000 سجل في قاعدة بيانات الخدمة التابعة لوحدة الأوزون. وُفر إلى المستخدمين النهائيين في قطاعات الإتصالات السلكية واللاسلكية والشؤون المصرفية والبنك والطاقة مساعدة تقنية للتخلص بطريقة ملائمة من الهايالونات. وبالإضافة إلى ذلك، صيغت عدة قرارات لتعديل الإجراءات التي وضعها وزارة البيئة للسماح باستيراد أجهزة التبريد وتكيفها ووضع تدابير بيئية بشأن استعمال المواد المستنفدة للأوزون؛ وحظر استعمال نظم تكييف الهواء القائمة على المواد الهيدروكربونية في المركبات التي تزيد حمولتها عن 5 ركاب.

11- وتم صرف إجمالي التمويل المواقي على البالغ 500 000 دولار أمريكي.

التقرير المستقل

12- اضطلع مراجع مستقل، في عام 2010، بمراجعة تقرير التحقق من استهلاك عام 2009، واستنتج أن بيانات عام 2009 بشأن الورادات من المواد المستنفدة للأوزون والتي أبلغت عنها وحدة الأوزون التقنية مؤثرة تمامًا؛ وأن كولومبيا تحقق أهدافها بشأن الاستهلاك الداخلي حسب الاتفاق. كما أوصى المراجع بتطوير على نطاق واسع نظام المراقبة على الورادات والتصادرات والتعزيز المؤسسي. والتوثيق الرئيسية هي السر في هذا الطريق.
برنامج عمل عام 2011

13- سيركز برنامج عمل خطة الإزالة الوطنية للكومبيوتار على تعزيز خطة إدارة التبريد عن طريق اعتماد 600 تقني تبريد، والنهوض بشبكة الاسترداد/إعادة التدوير من خلال إنشاء خمسة مراكز لاستعادة غازات التبريد، وتشجيع استعمال غازات التبريد القائمة على المواد الهيدروكربونية. كما أنه سيوفر المساعدة التقنية والدعم لكي تستخدم المستخدمين النهائيين للمواد المستخدمة للأزونون في جميع القطاعات، وأخيرا، سيزيد برنامج العمل الإطار القانوني الوطني ومراعاة التجارة في المواد المستخدمة للأزونون، وسيتعزز التدقيق ووحدات الرصد.

تعليقات الأمانة

14- أحيطت الأمانة عالم بالتزوير المرحل الشامل بشأن تفعيل خط خطة الإزالة الوطنية للكومبيوتار، إضافة إلى الوثائق الداعمة، بما في ذلك تقرير التحقق بشأن الاستهلاك الوطني من المواد المستخدمة للأزونون في كومبيوتار. وقبل استهلاك المواد الكربونات الكربونية في عام 2009 البالغ 101.3 طن من قدرات استفاد الأوزون والذي أبلغته حكومة كومبيوتار بموجب المادة 2 من البروتوكول مونتريال بالفعل بكمية قدرها 220.6 طن من قدرات استفاد الأوزون عن أقصى مستوى مسموح به للاستهداف من المواد الكربونات الكربونية لـ233.1 طن من قدرات استفاد الأوزون.

15- ويبدو على طلاب للحصول على المزيد من المعلومات بشأن حالة تفعيل مشروع إزالة أجهزة الاستنشاق المزودة بمقياس للجرعات، أشار اليونيدب إلى أنه من المتوقع إنتاج أجهزة استنشاق مزودة بمقياس للجرعات خالية من المواد الكربونات الكربونية خلال الربع الأول من عام 2011. وأكملت عملية تطوير المنتج، بما في ذلك التسجيل، في حالة السليبوتامول (سبيدا الإنتاج قانون تشغيل خط التصنيع)، ولا تزال التصرفات الأربعة الأخرى في مراحل مختلفة.

16- وسعت الأمانة إلى الحصول على توضيح من اليونيدب بشأن ما إذا كانت حكومة كومبيوتار تستطيع تحقيق الإزالة الكاملة للمواد الكربونات الكربونية بحلول نهاية عام 2010 والمحافظة على هذا المستوى من الاستهلاك من خلال الأنشطة المقترحة في برنامج العمل النهائي. وأفاد اليونيدب بأنه لم تعد هناك أشخاص من المواد الكربونات الكربونية إلى كومبيوتار منذ 1 يناير/كانون الثاني 2010، وأضاف أن هناك عدة أنشطة نقية لخفض استعمال الكربونات الكربونية-11 في أجهزة تبريد المباش، ومعدات التبريد العامة، وسمح الهيكل الموضوع على الصعيد الوطني للاعتماد للتقنيين وتدريبهم بتعزيز ممارسات الخدمة الجيدة في مجال التبريد وتوزيع نتائجها، وعلى الصعيد التنظيمي، وضعت الحكومة تدابير للكفاءة استدامة إزالة المواد الكربونات الكربونية، بما في ذلك حظر الزيادة من جميع المواد الكربونات الكربونية والمعدات القائمة على هذه المواد وعلى منتجات/معدات التصنيع الوطنية التي تستعمل هذه المواد.
17- قام برنامج التدقيق في تصدع نظام البوليوريتن بالتوافق على برنامج التنفيذ السنوي لعام 2011.

مشروع عالمي: فورمات الميثيل المستعمل كعامل نفع في تصنيع نظام البوليوريتن. تقييم من أجل التطبيق في مشروعات الصندوق المتدف (اليوندبي)

الخليجية

18- قام اليووندبي إلى الاجتماع الثاني والستين تقريرا تقنيا: فورمات الميثيل كعامل نفع في تصنيع نظام البوليوريتن؛ تقييم من أجل التطبيق في مشروعات الصندوق المتدف (الكامل). ويرت الاستعراض التقني الكامل مرفقا بهذه الوثيقة.

وفي اجتماعها السادس والخمسين، وافقت اللجنة التنفيذية على مشروعين تجريبيين للتحقق من فورمات الميثيل كعامل نفع في تصنيع وفادات البوليوريتن في البرازيل وفي تطبيقات رغوي البوليوريتن الخلايا الدقيقة في المكسيك. ولاحظ أن المشروعين يتسقان مع المقرر 55/43(م) وأنهما صمما لتشمل نماذج عملية التحقق مئات التكنولوجيا فورمات الميثيل في تطبيقات رغوي البوليوريتن الجائزة ذات أدين مندمج ورغوي بوليوريتن الخلايا الدقيقة على الصعيد العالمي، وعلى أساس الفهم أن هذه المشروعات ستكون آخر مشروعات للتحقق من فورمات الميثيل في تصنيع رغوي البوليوريتن الجائزة ذات أدين مندمج ورغوي بوليوريتن الخلايا الدقيقة (المقرر).

الموجز التنفيذي

19- أعد اليوندبي عدا من المشروعات التجريبية لبحث الاستعمال المأمون لفورمات الميثيل أو فورمات الميثيل) لحل محل الهيدروفلوروكربون-141ب في تطبيقات رغواي البوليوريتن. وتم تقسيم Quimiuretanos Purcom Quimica (البرازيل) و Zadro المكسيك) بهدف تقسيم أداءها مقارنة بالنظام القائم على الهيدروفلوروكربون-141ب، وتحديد مدى جدوى استعمالها في مشروعات الصندوق المتدف (الكامل).

20- وعد اليوندبي عدد من المشروعات التجارية لبحث الاستعمال المأمون لفورمات الميثيل (®) في تطبيقات رغواي البوليوريتن. وتم تقسيم Quimiuretanos Purcom Quimica (البرازيل) و Zadro المكسيك) بهدف تقسيم أداها مقارنة بالنظام القائم على الهيدروفلوروكربون-141ب، وتحديد مدى جدوى استعمالها في مشروعات الصندوق المتدف (الكامل).

21- وتمتلك شركة Foam Supplies Inc. (FSI) في الولايات المتحدة التكنولوجيا التي تستعمل فورمات الميثيل في رغواي البوليوريتن وتقوم بتسويقها. وفي حين أن استعمال فورمات الميثيل لا يزال قليلا مقارنة بالهيدروفلوروكربون-141ب، إلا أن استعماله ازداد زيادة كبيرة في السنوات القليلة الأخيرة، من 40 طنا في عام 2005 إلى 910 أطنان في عام 2010 (يناير/كانون الثاني إلى أغسطس/آب).
في وقت موافقة اللجنة على المشروع، كانت شركة Purcom هي الشركة الوحيدة من بين شركاء المادتين 5 والمرخص لها باستعمال التكنولوجيا. ولهدى السبب، اهتمت لنفي المشروع التجاري. ومن ثم أن شركة Zadro لا توافق نظام نقل الأدلة، فقد خضع هذا التطبيق لتقييم مستقل من خلال شركة Purcom. ومن أجل تجنب أن يرى الفنون المقدمة من الصندوق المتعدد الأطراف على أنه يمنح معاملة تمييزية، فقد اتفق منذ البداية مع شركة FSI، والشركات المرخصة ذات الصلة على أنها ستمنح رخصة (فرعية) غير حصرية لأي طرف مهتم بالأمر يطلب الحصول على تمويل الصندوق لإزالة المواد الهيدروكربونفوكلوروكربونية.

وحدد المشروع 17 تطبيقًا لرغاء البوليوريتان. واستنادت خطة العمل إلى تقييم شامل للعمل السابق الذي اضطلعته به FSI. والشركات الحاصلة على ترتيب منها، لإدراجها في التقييم وإزالة التطبيقات التي تتطلب حق المالوق. ولفترات المشروعات التجارية، حدد مدى القبول على أنه تحد الحد الاستخدام المตนئ للتكنولوجيا. استناداً إلى بيانات الصحة والسلامة والبيئة، وتحديد مدى قابلية تطبيق التكنولوجيا استناداً إلى مدى إمكانية تجهيزها. وتحديد مدى قابلية تطبيق التكنولوجيا عن طريق قياس الخواص المادية قبل وبعد تبديل الهيدروكربونفوكلوروكربون-1413، وجمع معلومات وأراء تكميلية من المؤسسات التي اختبرت تركيبات فورمات المميزة في إنتاجها. وترتدي نتيجة التقييم في الجدول أدناه.

<table>
<thead>
<tr>
<th>التطبيق</th>
<th>القيمة المادية</th>
<th>مدى إمكانية التجهيز</th>
<th>الصحة، السلامة، البيئة</th>
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<td>المشكلة شديدة الليونة</td>
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<tr>
<td>المشكلة ذات مزودة لزوجية</td>
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<td>قوالب ذات مزودة لزوجية</td>
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<td>عجلات القيادة</td>
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<td>الرغوي الجامدة</td>
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<td>أجهزة منزلية</td>
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<td>أجهزة أخرى</td>
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<td>أجهزة منزلية ذات خربات</td>
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<td>رجلاً</td>
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<tr>
<td>أدبيات داخل أدبيات</td>
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<tr>
<td>أدبيات تطفو على الماء</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

* يوصي ببعض مستقل لفورمات الميزة
+ مقبول، – غير مقبول، +/- مقبول بشروط
24- وآدى تحليل نتائج التقييم إلى الاستنتاجات التالية:

(أ) إن استخدام فورمات الميثيل كعامل نفخ بديل للهيدروكربون وفولفوريكربون-41-أب في تطبيقات الرغائوببولوريتان يمكن اعتباره كيبيك في تطبيقات الرغائوببولوريتان ذات أديم من/مندح وفي عدد من تطبيقات الرغائوببولوريتان. وفي حالة بعض تطبيقات الرغائوببولوريتان وأساساً الأجهزة المنزلية، لا يمكن التوصية باستخدام التكنولوجيا في هذه المرحلة لأن الكثافة المطلوبة لهذا التطبيق لا يمكن الوصول إليها باستخدام فورمات الميثيل على المستوى الحالي من التكنولوجيا.

(ب) هناك حاجة إلى مواصلة تطوير هذه التكنولوجيا وفي حالات أخرى، ينبغي تحليل التكنولوجيا على أساس حالة بحالة ويمكن أن تخفض للمزيد من التطور.

(ج) من أجل خفض مخاطر السلامة إلى الحد الأدنى للمستخدمين النهائيين للمعدات اللاحقة، ينبغي تنفيذ هذه المشروعات من خلال مورد نظامها بوصفها نظماً كاملة.

(ع) على مصممي المشروعات كنافذة التحقق من مدى توافق المادة الكيميائية، وحالة الحد الأدنى للكثافة المعبأة، وإدراج التوصيات المتعلقة بالصحة والسلامة والبيئة، والأخير في الحساب الأشتر المتصلة بالحموضة.

25- ويدعو البوتسدبي نماذج تكاليف تطبيق عموماً لحساب التكاليف الإضافية للتحويل من الهيدروكربون وفولفوريكربون-41-أب إلى الرغائوببولوريتان. ويمكن أن تختلف التكاليف الرأسمالية والكيميائية اختلافاً كبيراً من بلد إلى بلد وهي تخضع أيضاً لاعتبارات وفورات الحجم.

ب) استنتاج استعراض النظراء

26- يمثل التقرير والملحقات جزءاً رئيسي من استعراض شامل لمدى ملاءمة فورمات الميثيل لمجموعة من التطبيق. يحمل محلل الهيدروكربون وفولفوريكربون-41-أب. ويعتبر التحدي كيبيك نظراً لاستعمال الهيدروكربون وفولفوريكربون-41-أب في عدد كبير من بلدان الماد 5 في جميع تطبيقات الرغائوببولوريتان تقريبا. وينشأ التكاليف أيضاً من المقرر 19/6 يفرض مواعيد نهاية ضيقة وشملت نادراً ما كانت تواجهه عمولات النفاخ "الناشئة" في الماضي. ومن المرجح النغلب على العديد من العيوب الواضحة في أداء فورمات الميثيل عن طريق تطوير التركز، ولكن في هذه الحالة، لم تقد الشركات العالمية المعنية بنظام البوليوريتان عملية التطور هذه - مثلاً كان الحال مع عوامل النفاخ السابقة.

27- سلط استعراض النظراء الضوء على المجالات التالية التي تتطلب المزيد من البيانات/الاهتمام:

(أ) معلومات عن التجارب واستعمال فورمات الميثيل حسب التطبيق (قطاع فرعي).

(ب) سلامة الاحتراق خلال عملية تجيز الرغائوببولوريتان - الحاجة إلى قياسات التركز والتهوية.

(ج) قابلية الاحتراق المنتج النهائي/الرغائوببولوريتان في بعض الحالات.
بيانات عن رغامى الرش وتطبيقات الوحدات المرنّة (elastomer) لتعمل الأحذية;

بيانات أخرى وطويلة المدى عن اختبار الثبات البعدي، وخاصة للرغامى العازلة الجاسئة.

وكتب دير مؤقت يمكن زيادة كثافة الرغامى التي تكون في العادة بالقرب من 32 كغم/م² بكمية قدرها 2-3 كغم/م² لضمان الثبات البعدي حتى اكتساب المزيد من الخبرات;

بالمثل، اختبار قابلية التوصيل الحراري طويلة المدى، باستخدام طرق التقاعد المعجل مثل طريقة التقطيع في شكل شرائح أو التقاطع عند درجة حرارة 70 درجة مئوية.

**تعليقات الأمانة**

- 28- استلمت المشروعات التجريبية لتحقيق من فورمات الميثيل التي وافقت عليها اللجنة التنفيذية على حلقات عمل لنشاطات المشروعات. وفي هذا الصدد، نظمت حفلة عمل في البرازيل (23-24 مارس/آذار 2010) بمشاركة 13 شركة مصنعية بالعمل من ستة بلدان (أستراليا والبرازيل والسويد وكولومبيا والمكسيك والولايات المتحدة الأمريكية) و12 مؤسسة تصنيع رغامى في البرازيل وإيكوادور وستة من بلدان المادة 5 (الأرجنتين والبرازيل وتشيلي والمكسيك وباراغواي وفنزويلا (جمهورية - البوليفارية) وممثلون من اليونيدبي واليوونب واليونيوب وشركاء من شركات بيع عبوات النشر بالجملة من البرازيل وثمانية مصنعين لمعدات حقن الرغامى (البرازيل ومؤسسات عبر وطنية). ونشرت نتائج المشروعات التجريبية من خلال العمل المضطلع به كجزء من إعداد خطة إدارة إزالة المواد الهيدروكربوروكوبولينية، بما في ذلك اجتماعات أصحاب المصلحة وزيرات إلى شركات الرغامى والشركات المعنية بالنظم، وغطت عملية النشر من خلال هذه القنوات عادة بلدان من بينها الأرجنتين والبرازيل وتشيلي والصين وجمهورية الدومينيكان ومصر وإندونيسيا وجاميكا ومالزيا والمكسيك ونيجيريا وتشيلي وأوروغواي وأوروغواي. وأستلت تقارير تغطية بالاهتمام وطلبات بشأن المزيد من المواد من شركات في معظم هذه البلدان. كما أبلغت الأمانة بأن سبعة من الشركات المعنية بالنظم قد وافقت على تقييم فورمات الميثيل في تكاليفها.

- 29- وأعد التقرير السالف الذكر بتقديم فورمات الميثيل نماذج تكاليف لحساب التكاليف الرأسمالية للتحويل من الهيدروكربوروكوبولين-41 إلى فورمات الميثيل. غير أن المشاريع التي أجريتها الأمانة مع الخبراء من الصناعة وبعض الشركات المرخص لها باستعمال التكنولوجيا والتي بدأت في عام 2008 خلال إعداد الوثيقة المتعلقة بتحقيق تحليل اعتبارات التكاليف ذات الصلة المحيدة بتوفير إزالة المواد الهيدروكربوروكوبولينية تثير أساسا إلى أنه لا يوجد تكاليف إعادة تهيئة مربحة بالتحويل إلى فورمات الميثيل على مستوى المؤسسات. وأشار البوبتدبي، فيما يتعلق بهذه المسألة، إلى أن النموذج مستند إلى مناقشات مع منتجات التكنولوجيا (FSI) والشركات، Expanded Australian Urethane Systems، Purcom و Resichem، الحائزة على الترخيص، أستراليا، البرازيل، جنوب أفريقيا، التي شاركت في تطوير العملية وتقييم كل شكل فردية حددها البوبتدبي.

وكان هذه العملية مطلوبة لتغطي المسؤولية التي يمكن أن تنشأ عن التوصل إلى استنتاجات سطحية، وواصل.
اليونيدبي جمع المعلومات السوقية التي يمكن أن تساعد في تحسين النموذج، فضلا عن معلومات أخرى في تقييماته، لتحسين جودة المشروعات الاستثمارية القائمة على فورمات الميثيل. واستنادا إلى هذه المعلومات، استنتج اليونيدبي الحاجة إلى أن تكون عملية عدم الحموحة جزءًا من أي مشروع قائم على فورمات الميثيل.

توصية الأمانة

30- قد ترغب اللجنة التنفيذية في أن:

(أ) تحفيز علماء بالتقدير بالتقدير المعنون فورمات الميثيل كعمل نفخ في تصميم نظام البوليمرات، تقييم من أجل تطبيق في مشروعات الصندوق المتعدد الأطراف، المقدم من اليونيدبي?

(ب) تطلب إلى الوكالات الثنائية والمنفذة إيلاء الاعتبار الكامل للتقنية لتطبيق فورمات الميثيل عند مساعدة بلدان المادة 5 في إعداد مشروعات إزالة الهيدروكلوروروكربون-141 في تطبيقات رعاية البوليمرات.

غمان: خطة إدارة الإزالة النهائية: تقرير المراجعة (اليونيدب)

مقدمة

31- بالنسبة عن حكومة غمان، تقوم اليونيدب بالتعاون الثاني والستين تقرير تحقيق المتعلق بخطة إدارة الإزالة النهائية للمواد الكلوروروكربونية. ووفقًا على خطة إدارة الإزالة النهائية في الاجتماع الثاني والخمسين للجنة التنفيذية في يوليو/تموز 2007 بمستوى تمويل قدره 250 505 دولارًا أمريكيًا (ما هي ذلك تكلف الدعم). وفي الاجتماع السابع والخمسين، وقررت اللجنة التنفيذية تمويل اليونيدب في سياق تعديلات برنامج عملها للتحقيق من تنفيذ خطة إدارة الإزالة النهائية بما يتماشى مع القرار 45/54. وهذه الوثيقة هي نتيجة عملية التحقق المشار إليها.

التحقيق من إنجازات خطة إدارة الإزالة النهائية

32- أجري التحقق من 12 يوليو/تموز إلى 12 سبتمبر/أيلول 2010 من قبل جامعة السلطان قابوس في غمان، التي جمعت واستعراضت معلومات عن الورادات والاستهلاك من المواد الكلوروروكربونية، واستعراضت أيضا السياسة العامة الحكومية لبرامج الورادات والاستهلاك من المواد المستنفدة للأوزون.

33- وأجرت جامعة السلطان قابوس المسح استنادًا إلى المنهجية الموصوفة في الاختصاصات. وركز التحقق على:

(أ) التحقق من/استعراض السياسة العامة للبلد لبرامج الورادات والاستهلاك من المواد المستنفدة للأوزون وتوسيع المسؤوليات بين المؤسسات الوطنية لتنفيذ السياسات العامة ذات الصلة;
استعراض الإحصاءات الحكومية بشأن الواردات من المواد المستنفدة للأوزون مقارنة بالبيانات الواردة من هيئة الجمارك ومقياسحصص الصادرة مقارنة بالحصص الفعلية المستعملة في عام 2009؛

(ب) استعراض قائمة المستوردين المعتمدين في عمان مقارنة بسجل هيئة الجمارك.

(ج) استعراض، على أساس عينة تمثيلية إذا تطلب الأمر، سجلات المستوردين مقارنة بسجلات هيئة الجمارك والحصص الصادرة.

(د) مناقشة الاستنتاجات المتعلقة بإنجاز هدف التخفيف السنوي للمواهد المستنفدة للأوزون فضلا عن التوصيات.

(ه) استعراض خطة العمل التي اقترحتها حكومة عمان لتنفيذ توصيات المراجعين.

(و) استنتاج التحقق ووصيته:

- اشتملت التوصية النهائية لعملية التحقق على ما يلي:

  (أ) مواصلة تعزيز التعاون بين وحدة الأوزون الوطنية وهيئة الجمارك لضمان مراقبة أوقاف الواردات الفعلية مقارنة بالحصص الصادرة للمستوردين لخفض التباني في الإبلاغ.

  (ب) تزويد هيئة الجمارك ببيانات عن أنشطة خطة إدارة الإزالة النهائية لضمان الدعم في تحقيق أهدافها.

  (ج) الحاجة إلى التهوض بالمعدات والقدرة التنفيذية لجهة الجمارك لإجراء رصد فعال وكفاءة الواردات من المواد المستنفدة للأوزون.

  (د) تنفيذ وحدة الأوزون الوطنية للوائح الوطنية التي تغطي الإبلاغ عن المواد المستنفدة للأوزون المستوردة تفاصيل كاملا وتحافظ على قاعدة بيانات مستكملة بحيث يمكن التحقق من الواردات بسهولة.

- تعلقات الأمانة:

- استعرضت الأمانة تقرير التحقق استنادا إلى المنهجية الموضوعة. وبدو أن عملية التحقق أجريت بما يتناسب مع المنهجية المعتمدة. وفي إطار التحقق، استلزم الفريق بجميع مستوردي المواد الكلوروفلوروكربونية في عمان. وقدم موزع المواد بيانات استعراضها هيئة الجمارك ووزارة القوة العاملة. ولا تنتج عن المواد الكلوروفلوروكربونية ولم تصدر أي كمية منها منذ بداية عام 2010.

وبرد في الجدول أدناه الحصص المخصصة للمستوردين وكميات الكولورسفروكربون-12 المستوردة.

<table>
<thead>
<tr>
<th>الواردات (فقًا لوحدة الأوزون الوطنية)</th>
<th>2007</th>
<th>2008</th>
<th>2009</th>
</tr>
</thead>
<tbody>
<tr>
<td>النصف</td>
<td>16.889</td>
<td>9.195</td>
<td>4.093</td>
</tr>
<tr>
<td>الورق</td>
<td>10.096</td>
<td>8.493</td>
<td>1.360</td>
</tr>
<tr>
<td>الرصيد</td>
<td>6.793</td>
<td>0.702</td>
<td>2.733</td>
</tr>
</tbody>
</table>

37- وأبرز التقرير التباين بين البيانات الواردة من وحدة الأوزون الوطنية والإدارات الجمركية نتيجة المنهجية التي تستعملها الإدارات الجمركية لتسجيل بياناتها. ووفقًا لوحدة الأوزون الوطنية، فإن بيانات الإدارات الجمركية يمكن أن تشمل على مواد كيميائية أخرى مما يؤدي إلى قيم أعلى مقارنة ببيانات وحدة الأوزون الوطنية، ولذا تعتبر بيانات وحدة الأوزون الوطنية أكثر دقة عن البيانات الواردة من الإدارات الجمركية.

38- وأوضح تحليل البيانات المجمعة من وحدة الأوزون الوطنية والمستوردين أن هناك إثنتين من المستوردين لم يستعملوا ترخيصهما لاستيراد الكولورسفروكربون-12. واستنادًا إلى هذه النتيجة، التزمت الإدارات الجمركية بإعداد إطار من شأنه أن يحسن إدارة الحصص المخصصة مقارنة بالواردات. وفي هذا السياق، ترسل وحدة الأوزون الوطنية بشكل منتظم ترخيص الترخيص إلى الإدارات الجمركية. وبالإضافة إلى ذلك، يسجل أي قرار أو إجراء يتخذ من الطرفين في برنامج على الحاسبة، فور توفيره فور انتهاء الإدارات الجمركية من إعداده.

39- ويشير تقرير التحقق إلى المادة 19 من اللوائح التي تتطلب من كل مستورد للمواد المركبة تقديم أسماء وأنواع ومكبات المواد المستوردة وتواريخ الاستيراد مع معلومات عن المستخدمين النهائيين خلال السنة السابقة إلى وزارة البيئة والشؤون المناخية في موعد لا يتجاوز نهاية يناير/كانون الثاني من كل سنة. وأوضح التقرير أن المستوردين لم يلتزموا بذلك. وفي هذا الصدد، أوصى فريق التحقق بأن ترصد وحدة الأوزون الوطنية عن قرب الكميات المستوردة والموزعة والمستهلكة من المواد المستنفدة للأوزون عن طريق تسجيل البيانات ذات الصلة في قاعدة بياناتها.

40- كما تناول فريق التحقق مسألة الموظفين في هيئة الجمارك والأجهزة التي وفرت للكشف عن غازات التبريد. ويرى الفريق أن عدد الموظفين والأجهزة المتأثرة غير كاف لفحص جميع الواردات من المواد المستنفدة للأوزون عند نقاط الدخول. وفي هذا الصدد، يوصي الفريق بأن تختار وحدة الأوزون الوطنية نقطة دخول واحدة لفحص جميع المواد المستنفدة للأوزون والمعدات التي تحتوي على هذه المواد.

41- ولاحتظ الآمانة أن الاستنتاجات والتوصيات الواردة في التقرير (انظر الفقرة 34 أعلاه) تتناول جميع المسائل الناشئة خلال عملية التحقق وأن عملية التحقق أكملت بنجاح.
توصية الأمانة

42 - قد ترغب اللجنة التنفيذية في أن:

(أ) تحبّط علماً بقرير التحقق المتعلق بخطة إدارة الإزالة النهائية للمواد الكلوروفلوروكربونية في

لمعان في عام 2009 والتوصيات الواردة فيه؛

(ب) تشجّع حكومة معان على مواصلة جهودها لمراقبة استعمال المواد الكلوروفلوروكربونية،

وبتطبيق استنتاجات وتوصيات هذا التحقق في تنفيذ خطة إدارة إزالة المواد

الهيدروكلوروفلوروكربونية.

مشروعات أجهزة تبريد المباني

البرازيل: تقرير مركّلي عن المشروع التدليلي للإدارة المتكاملة للقطاع الفرعي لأجهزة تبريد المباني المركّبة، مع التركيز على تطبيق تكنولوجيات خالصة من المواد الكلوروفلوروكربونية وفعالة من حيث الطاقة لتبدّل أجهزة تبريد المباني القائمة على المواد الكلوروفلوروكربونية (اليونيدو).

كولومبيا: تقرير مركّلي عن المشروع التدليلي للإدارة المتكاملة للقطاع الفرعي لأجهزة تبريد المباني المركّبة، مع التركيز على تطبيق تكنولوجيات خالصة من المواد الكلوروفلوروكربونية وفعالة من حيث الطاقة لتبدّل أجهزة تبريد المباني القائمة على المواد الكلوروفلوروكربونية (اليونيدو).

كوريا: تقرير مركّلي عن المشروع التدليلي للإدارة المتكاملة للقطاع الفرعي لأجهزة تبريد المباني المركّبة، مع التركيز على تطبيق تكنولوجيات خالصة من المواد الكلوروفلوروكربونية وفعالة من حيث الطاقة لتبدّل أجهزة تبريد المباني القائمة على المواد الكلوروفلوروكربونية (اليونيدو وكندا).

الجمهورية العربية السورية: تقرير مركّلي عن المشروع التدليلي لتبدّل أجهزة تبريد المباني المركّبة القائمة على المواد الكلوروفلوروكربونية (اليونيدو).

مشروع عالمي: تقرير مركّلي عن المشروع العالمي لتبدّل أجهزة تبريد المباني (الصين والهند وإندونيسيا والأردن وماليزيا والفلبين وتونس) (البنك الدولي).

مشروع أفريقي - أفريقية: تقرير مركّلي عن مشروع تدليلي استراتيجي للتمويل المعجل لأجهزة تبريد المباني القائمة على المواد الكلوروفلوروكربونية في 6 بلدان أفريقية (الكاميرون ومصر وناميبيا ونيجيريا والسنغال والسودان) (اليونيدو وفرنسا وألمانيا واليابان).

مشروع أفريقي - أوروبا: تقرير مركّلي عن مشروع تدليلي لتبدّل أجهزة تبريد المباني المركّبة القائمة على المواد الكلوروفلوروكربونية (كرواتيا وجمهورية مقدونيا اليوغوسلافية السابقة والجبل الأسود ورومانيا وصربيا) (اليونيدو).
مشروع قلبي - أمريكا اللاتينية والبحر الكاريبي: مشروع تدليلي لإدارة المتكاملة للقطاع الفرعي لأجهزة تبريد المبانى المركزي في البحر الكاريبي، مع التركيز على تطبيق تكنولوجيات خالية من المواد الكليوروفوروكربونية
وفعالية من حيث الطاقة لتبديل أجهزة تبريد المباني القائمة على المواد الكليوروفوروكربونية (البيوتنيدبي)

مقدمة

43- وافق اللجنة التنفيذية في اجتماعها السابع والأربعين والثامن والأربعين على تنظيم مشاريع تنفيذية لتبديل أجهزة تبريد المباني التي تستعمل المواد الكليوروفوروكربونية لليوتنيدبي، اليوبنيدو، والبنك الدولي، وكندا وفرنسا وألمانيا وليبيا تشمل مشاريعًا على الصعيد قطري ومشاريع إقليمية وموضوعية عالميا. وتشير مقترحات المشاريع المستقلة عليها إلى تمويل مشترك من عدة مصادر، وهي مرفق البيئة العالمية، وتمويل الكربون، ووكالة القدنية للتنمية الدولية، وשרות البيئة العالمية، وتمويل الوكالات التنفيذية والجهات التنظير.

44- ومن خلال القرار 55/55، طلبت اللجنة التنفيذية إلى الأمانة أن تتعاون مع مرفق البيئة العالمية والوكالات التنفيذية حول حل مسائل التمويل المشترك بخصوص المقترحات على مشروعات أجهزة تبريد المباني، وصرف التمويل حيث يكون ذلك ممكنًا، وأن تبلغ اللجنة التنفيذية في اجتماعها السادس والخمسين بالتقدم المحرز في جميع مشروعات أجهزة تبريد المباني.

45- وقامت الأمانة إلى الاجتماع السادس والخمسين بتنفيذ معلومات بشأن النتائج المحرز في جميع مشروعات أجهزة تبريد المباني، وأصدرت اللجنة التنفيذية القرار 56/10 للاجتهام عالمًا بالقرار المتصل بالتقدم المحرز في جميع المشروعات السابقة الخاصة بأجهزة تبريد المباني وطلبت مراعاة المناقشات التي جرت خلال الاجتماع السادس والخمسين عند إعداد تقني للدراسة النظري بشأن توجيه مشروعات أجهزة تبريد المباني وعند إعداد ورفع سياسة عامة بشأن "مرفق للتدخل الإضافي من النقر والخصم الأخرى" استجابة للقرار 55/2.

46- وفي الاجتماع السابع والخمسين، قررت اللجنة التنفيذية من خلال القرار 8/5 أن تحت الوكالات على التعجيل بتنفيذ المشروعات الحالية المتعلقة بأجهزة تبريد المباني الممولة بتقديم مشاريع وأن تقدم تقارير مرحليا إلى الاجتماع الثاني والستين، وأن تشجع الوكالات على وضعية جهودها لاستكشاف مدى قابلية تطبيق أدوات سوق الكربون وغيرها من أشكال التمويل، حسب الأهداف، لتبديل المعدات القائمة على المواد الهيدروكلوروفوروكربونية، وخاصة أجهزة تبريد المباني.

47- وأعد التقرير المعرض أمام اللجنة التنفيذية استجابة للمقررات المشار إليها أعلاه، وخاصة المقرر 8/59.

التقرير المرحلى

48- تقدمت لهذه التقرير المرحلة، ووضعت الأمانة استبيانًا من ثلاث أجزاء على الوكالات الثلاث المنفذة للمشروعات الإستراتيجية المتعلقة بأجهزة تبريد المباني، وهي اليوبنيدبي، واليوتنيدو، والبنك الدولي. وطلبت في
الاستبان إلى الوكالات تتوفر ما يلي: تقييم موجز عن الخبرات حتى اليوم والنتائج التي تحققت، ووصف لأدبية التمويل المشترك المستعملة، وموجز عن الأنشطة المصطلح بها. وتم تحديث الاستبان مقارنة بالنسخة السابقة لمراعاة المعلومات الإضافية فضلاً عن تغير الأوضاع التي نفتت فيها هذه المشروعات. ويتباين التقرير المحدث مع القرار 55/5 (د) للجنة التنفيذية، الذي طلب فيه إلى الأمانة أن تشارح مع الوكالات المنفذة بشأن مشروعات أجهزة تبريد المباني. وترد الاستبانات التي قدمتها الوكالات كمرفق بهذه الوثيقة.

وفي حالة بعض البلدان، تحقق تقدم كبير في تنفيذ الأنشطة خلال السنة الماضية. ويدل هذا على خصائص كولومبيا والأردن والمشروع العالمي لأجهزة تبريد المباني. ولم تحقق عدد من المشروعات الأخرى أي تغير أو تغير طفيف مقارنة بالتقدير المستلم السنة الماضية.

ولا تزال بعض البرامج تواجه تحديات في التنفيذ لعدة أسباب. وعلى سبيل المثال، أصبح بعض المستقبدين معенным قبل تنفيذ النشاط؛ وفي حالات أخرى، حدثت مشكلة مماثلة بعد تسلم أجهزة تبريد المباني وتعيين مستقبلدين جديد للمشروع. وفي حالة أخرى، كان يتعين أن يقدم المستقبدين تمويلا مشتركاً، ولكن لم يسمح وضعهم بالمالي بذلك؛ وفي إحدى الحالات الخاصة استمر هذا الوضع لما يزيد عن سنة.

ووافق اللجنة التنفيذية على معظم مشروعات أجهزة تبريد المباني منذ خمس سنوات إلا في عدد من الحالات. ويرد في الجدول أدناه استعراض عام للتقدم في هذه المشروعات. ويبيّن هذا الجدول معلومات مجمعة فيما يتعلق بجميع المشروعات، مع عدد المشروعات الموافقة عليها، وزود أجهزة تبريد المباني التي تبين إتالها بتمويل المشروع والتمويل المشترك المتوقع، والنتائج التي أجري على هذا الرقم منذ الموافقة عليها والحالة الفعلية.

<table>
<thead>
<tr>
<th>عدد المشروعات الموافقة عليها</th>
<th>عدد المشروعات</th>
<th>مجموع أجهزة تبريد المباني التي يعين تدبيها (وفقاً للدكتور الأسترال)</th>
<th>العدد المنفق لأجهزة تبريد المباني التي يعين تدبيها (وفقاً لعملية تطبيقات الدفعت).</th>
<th>عدد أجهزة تبريد المباني التي تم تدبيها بالفعل</th>
</tr>
</thead>
<tbody>
<tr>
<td>8</td>
<td>237</td>
<td>2,544</td>
<td>103</td>
<td>3200</td>
</tr>
</tbody>
</table>

و وبين هذا الجدول بوضوح أن تنفيذ البرنامج أبطأ بكثير مما كان متوقعاً. غير أنه مقارنة بالهدف الأصلي، تم تحويل 43 في المائة من أجهزة تبريد المباني المزمع تنفيذها في الأصل خلال هذه الفترة. وفي الوقت نفسه، زاد مجموع عدد الأجهزة في المشروعات بأكثر من عشرة أضعاف. وفي مشروع واحد فقط، لم يتحقق أي تقدم قريباً وهو مشروع أجهزة تبريد المباني لأمريكا اللاتينية والبحر الكاريبي، وإشارة اليونسيف، يوصف الوكالة المنفذة، إلى أنه لم يتم تحديد مشاركي أخر من أصحاب أجهزة تبريد المباني. ويتم التحقيق اليونسيف النظر في إلغاء المشروع في الاجتماع الثالث والستين. وتوفر الردود الباردة من الوكالات على الاستبان بعض الملاحظات المتعلقة بالتأتي الناتج.
53- وأظهر في مرات متكررة إلى صعوبة تحقيق التزام بين دورات المشروعات والمتطلبات الخاصة بمرفق البيئة العالمية والأنظمة التنموية التنظيمية والصناديق الممولة الأطراف، وعلى الوكالات أن تحتزم الإجراءات والجدول الزمني للبرنامج من قبل مؤسسات التمويل، التي لديها أيضا أطر مختلفة للسياسة العامة، ومواعيد نهائية مختلفة. وفي حين كانت المساواة ذات الصلة عالمية صعبة، فإن إطالة تخصيص الموارد للبلدان المستفيدة، المعتمد من قبل مجلس مبرق البيئة العالمية في سبتمبر/أيلول 2005، قد أضاف تردديات غير متوقعة في الماضي.

وبصفة خاصة، أدى تنفيذ الأعمال الجديدة في البلدان المستفيدة إلى تأخيرات كبيرة، ولاحظ أيضا أن آلية التنفيذ النظيفة ومرفق البيئة العالمية يطلبان إلى البلدان والوكالات اتباع الإجراءات الموضوعة بصورة رسمية، وهي غير منسقة بين هاتين الوكالتين. وأشارت بعض الوكالات إلى أن تحسين التنسيق بين هيئة التمويل يمكن أن يؤدي إلى خفض التأخيرات وتسريع تنفيذ المشروعات.

54- كما اضطرت الوكالات إلى معواجهة بعض الأحداث التي لا يمكن التنبؤ بها خلال التنفيذ مثل إعصار المستفيدين من المشروعات، أو انسحاب الوسطاء الماليين. ومع زيادة الوقت المنقضي بين الموافقة على المشروع الأصلي والتنفيذ، مالت هذه الصعوبات إلى زيادة. وأدى تطبيق البرامج الزمنية و/tcp لتنظيم التمويل المشترك إلى ضعف إضافي في علاقات العمل مع ملاك أجهزة تبريد المباني، وبالتالي على التنفيذ. وأخيرا، أثير إلى طرق التدقيق الوطني للمشروعات كسبب محتمل للتأخير. وفي إحدى البلدان، لم تؤد الآلية التي اخترتها الحكومة للتمويل المشترك إلى خلق الاهتمام الكافي بين المستفيدين المحتملين، مما تطلب الحاجة إلى إعادة تصميم المشروع.

55- وبسببها ذلك، في التقرير المقدم إلى الاجتماع التاسع والخمسين (القرية 7 من UNEP/OzL.Pro/ExCom/59/10)، لم تركز جميع الوكالات على تبديل أجهزة تبريد المباني لخفض الطلب على المواد الكلوترونوكوبورية فحسب، بل أيضا لتحسين فعالية هذه النظم من حيث الطاقة. وأشارت عدة وكالات إلى أن فعالية الطاقة لم تتشبع بعد بما فيه الكفاية، وأنهم منافكون فعالية الطاقة والاهتمام بها غير موجودة لدى العديد من أصحاب المصلحة. غير أنه في حالات أخرى، وبد أن أصبحت منافع شفافة بما فيه الكفاية، كان التعاون بين الحكومات الوطنية والوكالات وثيق جدا ومهم في المشاريع.

56- وتشمل استبيانات هذه السنة أول مرة على أسئلة تتعلق بالاختلافات بين القطاعين العام والخاص. ويبدو أن الوكالات تجد أنه من الأيسر العمل مع الملاك من القطاع الخاص، على سبيل المثال من القطاع العام في كثير من الأحيان صعوبة أكبر في الحصول على الموارد الإضافية المطلوبة، ويواجهون إجراءات داخلية طويلة ومعقدة. وقد يكون لديهم أولويات مختلفة عن أولويات القطاع الخاص. ولذلك، يبدو أن الملاك من القطاع العام يواجهون صعوبات أكبر في التزامهم وتوفر مواردهم للتنفيذ. وكان أحد استنتاجات إحدى الوكالات هو أنه يبدو من المفيد إبلاغ ملاك المعدات السابقة من القطاع العام بالمشاريع من أجل تجنب أي تكاليف احتق أو تأخير. ومن الناحية الأخرى، لا يرى ملاك القطاع الخاص التمويل المشترك كعائق خطير نظرًا لأن جميع استثماراتهم التجارية تقريبًا تطلب مصادر متعددة من التمويل.
وعلى الرغم من العوائق والتحديات المبلغ عنها، كانت الوكالات ككل راضية إلى حد ما عن تجربة التمويل المشترك هذه. حتى أنها اقترحت تكرار هذه التجربة في المستقبل. وافترضت اليونيدو النظر في مشروع مماثل لإزالة أجهزة تبريد المباني القائمة على المواد الهيدروكلوروفورموكربونية، وافترج اليونيدو أنه يمكن استكشاف بعض عناصر التمويل المشترك لأجهزة تبريد المباني لبرامج تدريب المباني لبرامج تدريب المباني للآجهزة المنزلية. ويعتقد البنك الدولي أنه يمكن اتباع نهج مماثلة في المستقبل، مع التركيز على التعلم المؤسسي فيما يتعلق بجمع التمويل من مصادر مختلفة ذات أهداف مختلفة. وتشتقت جميع الوكالات على أن التدريب المستقبلي من تجربة التمويل المشترك هذه سيكون مفيدا في إعداد المشاريع في المستقبل.

وتود الأمانة أن تنتهي الفرصة لتثبيت على عمل الوكالات فيما يتعلق بتعبئة التمويل المشترك وموئلها وماهيتها في نجاح التغلب على الصعوبات المتعلقة ببعض التمويل المتوقعة التي لم تتحقق، وفي تحقيق مصادر تمويل أخرى.

توصية الأمانة

قد ترغب اللجنة التنفيذية في أن:

تحيي علما بالقرارات المرحلية المتعلقة بالتقدم المحرز في جميع مشروعات أجهزة تبريد المباني الوارد في الوثيقة 9/9;

تطلب إلى الأمانة توفير تقرير مرحلى آخر بشأن التقدم المحرز في مشروعات أجهزة تبريد المباني للاجتماع الخامس والستين.
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

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

* 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>
<thead>
<tr>
<th>Foam Type</th>
<th>Application</th>
<th>Acceptability</th>
<th>Acceptability</th>
<th>Acceptability</th>
<th>Acceptability</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Health, Safety</td>
<td>Processability</td>
<td>Physical</td>
<td>Assessment</td>
</tr>
<tr>
<td></td>
<td></td>
<td>and Environment (HSE)</td>
<td></td>
<td>Properties</td>
<td></td>
</tr>
<tr>
<td>Flexible and Integral Skin Foams</td>
<td>Hyper-soft molded</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Hyper-soft blocks</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Viscoelastic molded</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Viscoelastic blocks</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Steering wheels</td>
<td>+</td>
<td>+*</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Structural (rigid)</td>
<td>+</td>
<td>+*</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Semi-flexible shoesoles</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Rigid Foams</td>
<td>Residential Appliances</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Other Appliances</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+/-</td>
</tr>
<tr>
<td></td>
<td>Panels, Transportation, Refers</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Spray</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Blocks</td>
<td>+</td>
<td>+*</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Pipe-in-pipe</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Buoyancies</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

* = 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 than 10% 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**

<table>
<thead>
<tr>
<th>YEAR</th>
<th>AMOUNT (metric tons)</th>
<th>Methyl Formate</th>
<th>Polyol System</th>
<th>HCFC-141b Equivalent</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td></td>
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<td>850</td>
<td>100</td>
</tr>
<tr>
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<td></td>
<td>75</td>
<td>1,500</td>
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<td>2007</td>
<td></td>
<td>160</td>
<td>3,200</td>
<td>385</td>
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<td>864</td>
</tr>
<tr>
<td>2009</td>
<td></td>
<td>365</td>
<td>7,300</td>
<td>875</td>
</tr>
<tr>
<td>2010</td>
<td></td>
<td>910*</td>
<td>18,000</td>
<td>2,200</td>
</tr>
</tbody>
</table>

* 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>
<thead>
<tr>
<th>Foam Type</th>
<th>Application</th>
<th>Milestones</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Development</td>
</tr>
<tr>
<td>Flexible and Integral Skin Foams (FPF, ISF)</td>
<td>Hyper-soft molded</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Hyper-soft blocks</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Viscoelastic blocks</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Viscoelastic blocks</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Steering wheels</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Structural (rigid)</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Semi-flexible</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Shoesoles</td>
<td>Completed</td>
</tr>
<tr>
<td>Rigid Foams (RPF)</td>
<td>Domestic refrigeration</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Other Appliances</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Transportation, Reefers</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Panels-discontinuous</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Spray</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Blocks</td>
<td>Completed</td>
</tr>
<tr>
<td></td>
<td>Pipe-in-pipe</td>
<td>Completed</td>
</tr>
</tbody>
</table>

+ 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

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

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” (Generally Recognized As Safe) 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.

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\(^1\) 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

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\(^2\) 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>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST PROCEDURE</th>
<th>UNITS</th>
<th>HCFC-141b</th>
<th>MF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>8537 D-3574</td>
<td>Kg/m³</td>
<td>19.4</td>
<td>19.2</td>
</tr>
<tr>
<td>ILD 25%</td>
<td>9176 D-3574</td>
<td>N</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>ILD 40%</td>
<td>9176 D-3574</td>
<td>N</td>
<td>13</td>
<td>13</td>
</tr>
<tr>
<td>ILD 65%</td>
<td>9176 D-3574</td>
<td>N</td>
<td>24</td>
<td>23</td>
</tr>
<tr>
<td>Comfort Factor</td>
<td>9176 D-3574</td>
<td>n/a</td>
<td>2.2</td>
<td>2.3</td>
</tr>
<tr>
<td>Resilience</td>
<td>8619 D-3574</td>
<td>%</td>
<td>42</td>
<td>40</td>
</tr>
<tr>
<td>Compression Set 90%</td>
<td>8797 D-3574</td>
<td>%</td>
<td>3</td>
<td>3</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>8515 D-3574</td>
<td>kPa</td>
<td>80</td>
<td>88</td>
</tr>
<tr>
<td>Elongation</td>
<td>8515 D-3574</td>
<td>%</td>
<td>460</td>
<td>470</td>
</tr>
<tr>
<td>Tear Strength</td>
<td>8516 D-3574</td>
<td>N/m</td>
<td>456</td>
<td>460</td>
</tr>
</tbody>
</table>

*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

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST PROCEDURE</th>
<th>UNITS</th>
<th>HCFC-141b</th>
<th>MF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>8537</td>
<td>D-3574</td>
<td>34.2</td>
<td>34.8</td>
</tr>
<tr>
<td>ILD 25%</td>
<td>9176</td>
<td>D-3574</td>
<td>28</td>
<td>31</td>
</tr>
<tr>
<td>ILD 40%</td>
<td>9176</td>
<td>D-3574</td>
<td>36</td>
<td>39</td>
</tr>
<tr>
<td>ILD 65%</td>
<td>9176</td>
<td>D-3574</td>
<td>60</td>
<td>61</td>
</tr>
<tr>
<td>Comfort Factor</td>
<td>9176</td>
<td>D-3574</td>
<td>2.1</td>
<td>2</td>
</tr>
<tr>
<td>Resilience</td>
<td>8619</td>
<td>D-3574</td>
<td>6</td>
<td>5.5</td>
</tr>
<tr>
<td>Compression Set 90%</td>
<td>8797</td>
<td>D-3574</td>
<td>5</td>
<td>5</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>8515</td>
<td>D-3574</td>
<td>60</td>
<td>65</td>
</tr>
<tr>
<td>Elongation</td>
<td>8515</td>
<td>D-3574</td>
<td>230</td>
<td>222</td>
</tr>
<tr>
<td>Tear Strength</td>
<td>8516</td>
<td>D-3574</td>
<td>270</td>
<td>301</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST PROCEDURE</th>
<th>UNITS</th>
<th>HCFC-141b</th>
<th>MF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Molded Density</td>
<td>D-3574</td>
<td>kg/m3</td>
<td>288</td>
<td>285</td>
</tr>
<tr>
<td>Hardness</td>
<td>D-2240</td>
<td>Shore A</td>
<td>35</td>
<td>35</td>
</tr>
<tr>
<td>Resilience</td>
<td>D-3574</td>
<td>%</td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Internal Density</td>
<td>D-3574</td>
<td>Kg/m3</td>
<td>233</td>
<td>230</td>
</tr>
<tr>
<td>Tensile strength</td>
<td>53571</td>
<td>kPa</td>
<td>229</td>
<td>235</td>
</tr>
<tr>
<td>Elongation</td>
<td>53571</td>
<td>%</td>
<td>98</td>
<td>95</td>
</tr>
<tr>
<td>Tear Strength</td>
<td>53575</td>
<td>N/m</td>
<td>1,280</td>
<td>1,300</td>
</tr>
<tr>
<td>Compression set (50%)</td>
<td>D-3574</td>
<td>%</td>
<td>28</td>
<td>30</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST PROCEDURE</th>
<th>UNITS</th>
<th>HCFC-141b</th>
<th>MF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tensile strength</td>
<td>53504</td>
<td>kPa</td>
<td>1,000</td>
<td>1,000</td>
</tr>
<tr>
<td>Elongation</td>
<td>53504</td>
<td>%</td>
<td>96</td>
<td>95</td>
</tr>
<tr>
<td>Tear Strength</td>
<td>53515</td>
<td>N/m</td>
<td>4,380</td>
<td>4,375</td>
</tr>
</tbody>
</table>
Table 9

<table>
<thead>
<tr>
<th>PROPERTY</th>
<th>TEST PROCEDURE</th>
<th>UNITS</th>
<th>HCFC-141b</th>
<th>MF</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>ASTM</td>
<td>DIN</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Product</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Molded Density</td>
<td>D-3574</td>
<td></td>
<td>300</td>
<td>298</td>
</tr>
<tr>
<td>Hardness</td>
<td>D-2240</td>
<td>53505</td>
<td>Shore A</td>
<td>44</td>
</tr>
<tr>
<td>Resilience</td>
<td>D-3574</td>
<td></td>
<td>45</td>
<td>45</td>
</tr>
<tr>
<td>Foam Core</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Internal Density</td>
<td>D-3574</td>
<td></td>
<td>215</td>
<td>205</td>
</tr>
<tr>
<td>Tensile strength</td>
<td></td>
<td>53571</td>
<td>kPa</td>
<td>215</td>
</tr>
<tr>
<td>Elongation</td>
<td></td>
<td>53571</td>
<td>%</td>
<td>63</td>
</tr>
<tr>
<td>Tear Strength</td>
<td></td>
<td>53575</td>
<td>N/m</td>
<td>880</td>
</tr>
<tr>
<td>Compression set (50%)</td>
<td></td>
<td>D-3574</td>
<td>%</td>
<td>5</td>
</tr>
<tr>
<td>Skin Only</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tensile strength</td>
<td></td>
<td>53504</td>
<td>kPa</td>
<td>1,720</td>
</tr>
<tr>
<td>Elongation</td>
<td></td>
<td>53504</td>
<td>%</td>
<td>79</td>
</tr>
<tr>
<td>Tear Strength</td>
<td></td>
<td>53515</td>
<td>N/m</td>
<td>4,700</td>
</tr>
</tbody>
</table>

**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**

<table>
<thead>
<tr>
<th>Property</th>
<th>All types</th>
<th>R-095</th>
<th>R-096</th>
<th>R-099</th>
<th>QZCT15</th>
<th>Test Method</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
<td></td>
<td>SPORT</td>
<td>TRAVEL</td>
<td>RIGID</td>
<td>SEMI-RIGID</td>
<td></td>
</tr>
<tr>
<td><strong>Blowing Agent</strong></td>
<td></td>
<td>141b</td>
<td>MF</td>
<td>MF</td>
<td>MF</td>
<td></td>
</tr>
<tr>
<td>Density (kg/m³)</td>
<td></td>
<td>&lt;450</td>
<td>400</td>
<td>440</td>
<td>420</td>
<td>400</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DIN 53420</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ASTM D-792</td>
</tr>
<tr>
<td>Tear resistance (kgf/cm)</td>
<td></td>
<td>&gt;6*</td>
<td>38.9</td>
<td>41.5</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>DIN 53507</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ASTM D-624</td>
</tr>
<tr>
<td>Abrasion Resistance (mg, maximum)</td>
<td>&lt;350</td>
<td>337.2</td>
<td>140.3</td>
<td>147.0</td>
<td>146.9</td>
<td>DIN 42516</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ASTM D-1044</td>
</tr>
<tr>
<td>Flex Resistance (% 30,000 cycles)</td>
<td>&lt;200*</td>
<td>0</td>
<td>0</td>
<td>n/a</td>
<td>n/a</td>
<td>DIN 53543</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>ASTM D-1052</td>
</tr>
</tbody>
</table>

* 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/m³, which is a low density for Queretaro’s altitude, a 24 kg/m³ is recommended.

Minimal Filling Density (MFD) was recorded at 33 kg/m³ which is relatively high. Recommended MFD for domestic refrigeration is in the range of 27-28 kg/m³. 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/m³ at average but some sections shown densities as low as 28 kg/m³. 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 28/36 x 100 = 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/m³. Purcom recommends a density of >35 kg/m³ 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/ft².ºF.hr) was too high for time zero recording. Current values are around 0.135 BTU-in/ft².ºF.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/m³, 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
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/m³ 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

<table>
<thead>
<tr>
<th>TESTS</th>
<th>UNITS</th>
<th>HCFC-141b UNDP-A*</th>
<th>HCFC-141b UNDP-B*</th>
<th>MF UNDP-C*</th>
<th>MF UNDP-D*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Closed Cell</td>
<td>%</td>
<td>98.20%</td>
<td>97.08%</td>
<td>98.76%</td>
<td>97.68%</td>
</tr>
<tr>
<td>Density,</td>
<td>pcf</td>
<td>1.72</td>
<td>1.67</td>
<td>1.69</td>
<td>2.10</td>
</tr>
<tr>
<td>Density, Cold Age, -80°F (-62.2°C)</td>
<td>pcf</td>
<td>1.72</td>
<td>2.08</td>
<td>1.88</td>
<td>2.00</td>
</tr>
<tr>
<td>Dimensional Stability 1-Day</td>
<td>Δ V, %</td>
<td>-21.99</td>
<td>-3.35</td>
<td>-0.62</td>
<td>-0.14</td>
</tr>
<tr>
<td>Δ M, %</td>
<td>-2.08</td>
<td>0.27</td>
<td>0.52</td>
<td>0.94</td>
<td></td>
</tr>
<tr>
<td>Dimensional Stability 7-Day</td>
<td>Δ V, %</td>
<td>-22.60</td>
<td>-4.35</td>
<td>-1.12</td>
<td>-0.21</td>
</tr>
<tr>
<td>Δ M, %</td>
<td>-2.56</td>
<td>-0.23</td>
<td>0.52</td>
<td>0.28</td>
<td></td>
</tr>
<tr>
<td>Density, Heat Age, 200°F (93.3°C)</td>
<td>pcf</td>
<td>1.69</td>
<td>2.03</td>
<td>1.91</td>
<td>1.99</td>
</tr>
<tr>
<td>Dimensional Stability 1-Day</td>
<td>Δ V, %</td>
<td>0.08</td>
<td>12.49</td>
<td>-6.43</td>
<td>-1.35</td>
</tr>
<tr>
<td>Δ M, %</td>
<td>-1.03</td>
<td>-0.71</td>
<td>-1.51</td>
<td>-1.45</td>
<td></td>
</tr>
<tr>
<td>Dimensional Stability 7-Day</td>
<td>Δ V, %</td>
<td>2.86</td>
<td>2.62</td>
<td>-5.26</td>
<td>-1.20</td>
</tr>
<tr>
<td>Δ M, %</td>
<td>-0.37</td>
<td>-0.04</td>
<td>-0.75</td>
<td>-0.98</td>
<td></td>
</tr>
<tr>
<td>Density, Humid Age, 158°F, 100% RH (70°C)</td>
<td>pcf</td>
<td>1.72</td>
<td>2.07</td>
<td>1.91</td>
<td>2.01</td>
</tr>
<tr>
<td>Dimensional Stability 1-Day</td>
<td>Δ V, %</td>
<td>7.50</td>
<td>5.75</td>
<td>-5.24</td>
<td>-2.73</td>
</tr>
<tr>
<td>Δ M, %</td>
<td>0.99</td>
<td>0.94</td>
<td>-0.07</td>
<td>0.35</td>
<td></td>
</tr>
<tr>
<td>Dimensional Stability 7-Day</td>
<td>Δ V, %</td>
<td>8.18</td>
<td>6.23</td>
<td>-8.91</td>
<td>-2.61</td>
</tr>
<tr>
<td>Δ M, %</td>
<td>4.10</td>
<td>1.45</td>
<td>3.55</td>
<td>7.09</td>
<td></td>
</tr>
<tr>
<td>Density, Compression, Parallel</td>
<td>pcf</td>
<td>1.71</td>
<td>2.10</td>
<td>1.95</td>
<td>2.02</td>
</tr>
<tr>
<td>CS, psi</td>
<td>20.61</td>
<td>25.50</td>
<td>27.36</td>
<td>23.00</td>
<td></td>
</tr>
<tr>
<td>Density, Compression, Perpendicular</td>
<td>pcf</td>
<td>1.70</td>
<td>2.07</td>
<td>1.88</td>
<td>2.00</td>
</tr>
<tr>
<td>CS, psi</td>
<td>12.12</td>
<td>18.29</td>
<td>13.81</td>
<td>20.30</td>
<td></td>
</tr>
</tbody>
</table>
Thermal Conductivity at 55°F midpoint Blowing Agent $\chi$

<table>
<thead>
<tr>
<th>Tests</th>
<th>UNITS</th>
<th>HCFC-141b UNDP-A*</th>
<th>HCFC-141b UNDP-B*</th>
<th>MF UNDP-C*</th>
<th>MF UNDP-D*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Conductivity</td>
<td>mW/m·°K</td>
<td>10</td>
<td>10</td>
<td>10.7</td>
<td>10.7</td>
</tr>
<tr>
<td>k-factor</td>
<td>BTU-in/ft²-hr·°F</td>
<td>0.138</td>
<td>0.140</td>
<td>0.145</td>
<td>0.145</td>
</tr>
<tr>
<td>$\chi$ value</td>
<td>mW/m·°K</td>
<td>19.9</td>
<td>20.1</td>
<td>20.9</td>
<td>20.9</td>
</tr>
</tbody>
</table>

* 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 °C lower temperature increase compared with HCFC-141b, the results are better than expected from the difference in the $\chi$ 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

<table>
<thead>
<tr>
<th>Physical Properties</th>
<th>Test Method</th>
<th>UNITS</th>
<th>HCFC-141b SYSTEM</th>
<th>MF SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Core</td>
<td>Pcf</td>
<td>2.07</td>
<td>2.12</td>
</tr>
<tr>
<td>Closed Cell Content</td>
<td>In-house</td>
<td>%</td>
<td>98.20</td>
<td>98.76</td>
</tr>
<tr>
<td>Perpendicular</td>
<td>Density</td>
<td>Pcf</td>
<td>2.23</td>
<td>2.35</td>
</tr>
<tr>
<td>Compression</td>
<td>Strength</td>
<td>%</td>
<td>98.20</td>
<td>98.76</td>
</tr>
<tr>
<td>Cold age</td>
<td>Density</td>
<td>Pcf</td>
<td>2.23</td>
<td>2.32</td>
</tr>
<tr>
<td></td>
<td>$\Delta V$</td>
<td>%</td>
<td>0.67</td>
<td>-0.57</td>
</tr>
<tr>
<td></td>
<td>$\Delta M$</td>
<td></td>
<td>-1.05</td>
<td>-0.79</td>
</tr>
<tr>
<td>Heat Age</td>
<td>Density</td>
<td>Pcf</td>
<td>2.25</td>
<td>2.32</td>
</tr>
<tr>
<td></td>
<td>$\Delta V$</td>
<td>%</td>
<td>1.35</td>
<td>-0.65</td>
</tr>
<tr>
<td></td>
<td>$\Delta M$</td>
<td></td>
<td>-1.10</td>
<td>-1.98</td>
</tr>
<tr>
<td>Humid Age</td>
<td>Density</td>
<td>Pcf</td>
<td>2.20</td>
<td>2.29</td>
</tr>
<tr>
<td></td>
<td>$\Delta V$</td>
<td>%</td>
<td>6.04</td>
<td>-8.84</td>
</tr>
<tr>
<td></td>
<td>$\Delta M$</td>
<td></td>
<td>1.69</td>
<td>-0.23</td>
</tr>
</tbody>
</table>
Physical properties test method UNITS HCFC-141b system MF system

<table>
<thead>
<tr>
<th>PHYSICAL PROPERTIES</th>
<th>TEST METHOD</th>
<th>UNITS</th>
<th>HCFC-141b SYSTEM</th>
<th>MF SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Thermal Conductivity @ 55°F Midpoint</td>
<td>K-factor</td>
<td>C-518</td>
<td>0.155</td>
<td>0.171</td>
</tr>
<tr>
<td></td>
<td>mW/m-hr-oK</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>PHYSICAL PROPERTIES</th>
<th>TEST METHOD</th>
<th>UNITS</th>
<th>HCFC-141b SYSTEM</th>
<th>MF SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Core</td>
<td>D-1622</td>
<td>1.56</td>
<td>1.66</td>
</tr>
<tr>
<td>Closed Cell Content</td>
<td>In-house</td>
<td>%</td>
<td>97.08</td>
<td>97.68</td>
</tr>
<tr>
<td>Perpendicular Compression Density</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.54</td>
<td>1.66</td>
</tr>
<tr>
<td>Perpendicular Compression Strength</td>
<td>D-1621</td>
<td>Pcf</td>
<td>18.41</td>
<td>18.08</td>
</tr>
<tr>
<td>Cold age</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.63</td>
<td>1.87</td>
</tr>
<tr>
<td>Cold age</td>
<td>D-6226</td>
<td>%</td>
<td>1.34</td>
<td>-1.47</td>
</tr>
<tr>
<td>Cold age</td>
<td>D1622</td>
<td>%</td>
<td>-0.50</td>
<td>-1.11</td>
</tr>
<tr>
<td>Heat Age</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.67</td>
<td>1.95</td>
</tr>
<tr>
<td>Heat Age</td>
<td>D-6226</td>
<td>%</td>
<td>1.34</td>
<td>-1.47</td>
</tr>
<tr>
<td>Heat Age</td>
<td>D1622</td>
<td>%</td>
<td>-0.87</td>
<td>-2.04</td>
</tr>
<tr>
<td>Humid Age</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.62</td>
<td>1.94</td>
</tr>
<tr>
<td>Humid Age</td>
<td>D-6226</td>
<td>%</td>
<td>5.32</td>
<td>-12.03</td>
</tr>
<tr>
<td>Humid Age</td>
<td>D1622</td>
<td>%</td>
<td>1.63</td>
<td>4.82</td>
</tr>
<tr>
<td>Thermal Conductivity @ 55°F Midpoint</td>
<td>K-factor</td>
<td>C-518</td>
<td>0.144</td>
<td>0.155</td>
</tr>
<tr>
<td></td>
<td>mW/m-hr-oK</td>
<td></td>
<td>20.8</td>
<td>24.0</td>
</tr>
</tbody>
</table>

**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 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

<table>
<thead>
<tr>
<th>PHYSICAL PROPERTIES</th>
<th>TEST METHOD</th>
<th>UNITS</th>
<th>HCFC-141b SYSTEM</th>
<th>MF SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Core</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.88</td>
</tr>
<tr>
<td>Closed Cell Content</td>
<td>In-house</td>
<td>%</td>
<td>98.20</td>
<td>98.76</td>
</tr>
<tr>
<td>Perpendicular</td>
<td>Density</td>
<td>D-1621</td>
<td>Pcf</td>
<td>1.78</td>
</tr>
<tr>
<td>Compression</td>
<td>Strength</td>
<td>D-1621</td>
<td>Psi</td>
<td>20.54</td>
</tr>
<tr>
<td>Cold age</td>
<td>Density</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.82</td>
</tr>
<tr>
<td></td>
<td>ΔV</td>
<td>D-6226</td>
<td>%</td>
<td>-2.44</td>
</tr>
<tr>
<td></td>
<td>ΔM</td>
<td>D1622</td>
<td>%</td>
<td>-1.75</td>
</tr>
<tr>
<td>Heat Age</td>
<td>Density</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.83</td>
</tr>
<tr>
<td></td>
<td>ΔV</td>
<td>D-6226</td>
<td>%</td>
<td>1.40</td>
</tr>
<tr>
<td></td>
<td>ΔM</td>
<td>D1622</td>
<td>%</td>
<td>-1.23</td>
</tr>
<tr>
<td>Humid Age</td>
<td>Density</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.82</td>
</tr>
<tr>
<td></td>
<td>ΔV</td>
<td>D-6226</td>
<td>%</td>
<td>6.15</td>
</tr>
<tr>
<td></td>
<td>ΔM</td>
<td>D1622</td>
<td>%</td>
<td>0.12</td>
</tr>
<tr>
<td>Thermal Conductivity</td>
<td>$\lambda$</td>
<td>C-518</td>
<td>mW/m-hr-K</td>
<td>20.2</td>
</tr>
<tr>
<td>@ 55°F Midpoint</td>
<td>K-factor</td>
<td></td>
<td>BTU-in/hr-ft°F</td>
<td>01.40</td>
</tr>
</tbody>
</table>

**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

<table>
<thead>
<tr>
<th>PHYSICAL PROPERTIES</th>
<th>TEST METHOD</th>
<th>UNITS</th>
<th>HCFC-141b SYSTEM</th>
<th>MF SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Core</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.90</td>
</tr>
<tr>
<td>Closed Cell Content</td>
<td>In-house</td>
<td>%</td>
<td>97.08</td>
<td>97.68</td>
</tr>
<tr>
<td>Perpendicular</td>
<td>Density</td>
<td>D-1621</td>
<td>Pcf</td>
<td>2.66</td>
</tr>
<tr>
<td>Compression</td>
<td>Strength</td>
<td>D-1621</td>
<td>Psi</td>
<td>14.88</td>
</tr>
<tr>
<td>Cold age</td>
<td>Density</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.94</td>
</tr>
<tr>
<td></td>
<td>ΔV</td>
<td>D-6226</td>
<td>%</td>
<td>-0.48</td>
</tr>
<tr>
<td></td>
<td>ΔM</td>
<td>D1622</td>
<td>%</td>
<td>0.00</td>
</tr>
<tr>
<td>Heat Age</td>
<td>Density</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.84</td>
</tr>
<tr>
<td></td>
<td>ΔV</td>
<td>D-6226</td>
<td>%</td>
<td>-2.04</td>
</tr>
<tr>
<td></td>
<td>ΔM</td>
<td>D1622</td>
<td>%</td>
<td>-7.84</td>
</tr>
<tr>
<td>Humid Age</td>
<td>Density</td>
<td>D-1622</td>
<td>Pcf</td>
<td>1.91</td>
</tr>
<tr>
<td></td>
<td>ΔV</td>
<td>D-6226</td>
<td>%</td>
<td>-1.53</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th>PHYSICAL PROPERTIES</th>
<th>ASTM TEST METHOD</th>
<th>UNITS</th>
<th>ECOMATE SYSTEM</th>
<th>HFC-134a SYSTEM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Density</td>
<td>Free Rise Core</td>
<td>Pcf</td>
<td>1.9-2.1</td>
<td>1.9-2.1</td>
</tr>
<tr>
<td>Compressive Strength</td>
<td>Perpendicular</td>
<td>Psi</td>
<td>24</td>
<td>20</td>
</tr>
<tr>
<td>Water Absorption</td>
<td>Weight Volume</td>
<td>lbs/ft³</td>
<td>0.01</td>
<td>0.02</td>
</tr>
<tr>
<td>Thermal Efficiency</td>
<td>Initial K factor</td>
<td>BTU-in/hr-ft F</td>
<td>0.14-0.16</td>
<td>0.15-0.16</td>
</tr>
<tr>
<td>Dimensial Stability</td>
<td>Wet</td>
<td>% Vol change</td>
<td>&lt;1</td>
<td>-1</td>
</tr>
<tr>
<td></td>
<td>Dry</td>
<td>% Vol change</td>
<td>n/d</td>
<td>n/d</td>
</tr>
<tr>
<td></td>
<td>Cold</td>
<td>% Vol change</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fire Resistance</td>
<td>UL94 HF1</td>
<td></td>
<td>Yes</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**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

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

+ 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

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

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

<table>
<thead>
<tr>
<th>CHEMICAL</th>
<th>PRICE (US$/kg)</th>
<th>BASELINE</th>
<th>Company A</th>
<th>Company B</th>
<th>Company C</th>
<th>Company D</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>Cost</td>
<td>%</td>
<td>Cost</td>
<td>%</td>
<td>Cost</td>
</tr>
<tr>
<td>Polyol</td>
<td>3.20</td>
<td>38</td>
<td>1.22</td>
<td>40</td>
<td>1.28</td>
<td>40.6</td>
</tr>
<tr>
<td>Isocyanate</td>
<td>3.00</td>
<td>50</td>
<td>1.50</td>
<td>53</td>
<td>1.59</td>
<td>53.4</td>
</tr>
<tr>
<td>HCFC-141b</td>
<td>2.40</td>
<td>12</td>
<td>0.29</td>
<td>--</td>
<td>--</td>
<td>--</td>
</tr>
<tr>
<td>MF</td>
<td>4.00</td>
<td>--</td>
<td>--</td>
<td>7</td>
<td>0.28</td>
<td>6</td>
</tr>
<tr>
<td>Cost</td>
<td></td>
<td>3.01</td>
<td>3.15</td>
<td>3.14</td>
<td>3.16</td>
<td>3.15</td>
</tr>
<tr>
<td>Difference</td>
<td></td>
<td>Base</td>
<td>0.14</td>
<td>0.13</td>
<td>0.15</td>
<td>0.14</td>
</tr>
</tbody>
</table>
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 ratio 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.
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>
<thead>
<tr>
<th>Foam Type</th>
<th>Application</th>
<th>Assessment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flexible and Integral Skin Foams</td>
<td>Hyper-soft molded</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Hyper-soft blocks</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Viscoelastic molded</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Viscoelastic blocks</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Steering wheels</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Structural (rigid)</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Semi-flexible</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Shoesoles</td>
<td>+</td>
</tr>
<tr>
<td>Rigid Foams</td>
<td>Residential Appliances</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Other Appliances</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Panels, Transportation, Reefers</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Spray</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Blocks</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Pipe-in-pipe</td>
<td>+</td>
</tr>
<tr>
<td></td>
<td>Buoyancies</td>
<td>+</td>
</tr>
</tbody>
</table>

* = 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 1a: 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.e.:

- 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 AS 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.
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.*
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 #2). **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 AS 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/m³ could be increased by 2-3 kg/m³ 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*

<table>
<thead>
<tr>
<th>TYPES OF HAZARD/EXPOSURE</th>
<th>ACUTE HAZARDS/SYMPOTOMS</th>
<th>PREVENTION</th>
<th>FIRST AID/FIRE FIGHTING</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>FIRE</strong></td>
<td>Extremely flammable.</td>
<td>NO open flames, NO sparks, and NO smoking.</td>
<td>Powder, alcohol-resistant foam, water spray, carbon dioxide.</td>
</tr>
<tr>
<td><strong>EXPLOSION</strong></td>
<td>Vapor/air mixtures are explosive.</td>
<td>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.</td>
<td>In case of fire: keep drums, etc., cool by spraying with water.</td>
</tr>
</tbody>
</table>

**EXPOSURE**

- **Inhalation**
  - 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**

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**

- Transport Emergency Card: TEC (R)-3051243 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

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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:

<table>
<thead>
<tr>
<th>OSHA PEL (ppm)</th>
<th>ACGIH TLV (ppm)</th>
<th>ACGIH STEL (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>100</td>
<td>100</td>
<td>150</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Application</th>
<th>Survey Date</th>
<th>Concentration Range</th>
<th>Average Concentration</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sprayfoam</td>
<td>02-18-2004</td>
<td>1.3 – 23 ppm</td>
<td>8.2 ppm</td>
</tr>
<tr>
<td>Vending Machines</td>
<td>03-13-2003</td>
<td>0.0 – 4.5 ppm</td>
<td>2.2 ppm</td>
</tr>
<tr>
<td>Vending Machines</td>
<td>02-18 2004</td>
<td>0.5 – 23 ppm</td>
<td>0.9 ppm</td>
</tr>
</tbody>
</table>

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 1 hour 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:

- **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". Methyl formate, on the other side, is, even as a liquid flammable—which does not necessarily imply explosive. It 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:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Heat of Combustion (kcal/g)</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>HCFC-141b</td>
<td>1.88</td>
<td></td>
</tr>
<tr>
<td>Methyl Formate</td>
<td>3.88</td>
<td></td>
</tr>
<tr>
<td>Pentane (commercial mix)</td>
<td>11.5</td>
<td>Cyclopentane estimated ~10% lower</td>
</tr>
</tbody>
</table>

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):

---

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:

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Mitigating Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>The LFL will not be approached</td>
<td>No action required</td>
</tr>
<tr>
<td>The LFL can be approached or exceeded</td>
<td>Exhaust will keep the space under LFL</td>
</tr>
<tr>
<td>The LFL will be exceeded</td>
<td>Spark arrestors will keep the space free of ignition sources</td>
</tr>
</tbody>
</table>

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 °C; substance emissions under legal exposure limits) as the following calculations show:

Methyl Formate

- LEL = 5% in air by volume = 125 g/m³ = 50,000 ppm
- Maximum concentration allowed by OSHA.NIOSH/ACGIH:
  - TWA = 100 ppm = 250 mg/m³ = 0.20% of LFL
  - STEL = 150 ppm = 375 mg/m³ = 0.30% of LFL

HCFC-141b

- LEL = 7.4% in air by volume = 925 g/m³ = 193,000 ppm
- Maximum concentration allowed (WEEL):
  - TWA = 500 ppm = 2,4 g/m³ = 0.26% of LFL
  - STEL = 3,000 ppm = 14.4 g/m³ = 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°C. The chests were fed from one energy source (= same voltage) for 24 hours. The temperature at that point was

89.89°F for the HCFC-141b foam
88.66°F for the methyl formate foam

Difference 1.2°F or 0.7°C

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

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

Difference 1.27°F or 0.7°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:

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>24 hours</td>
<td>No change</td>
<td>1°F increase</td>
</tr>
<tr>
<td>48 hours</td>
<td>4°F increase</td>
<td>6°F increase</td>
</tr>
<tr>
<td>72 hours</td>
<td>6°F increase</td>
<td>8°F increase</td>
</tr>
</tbody>
</table>

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:

<table>
<thead>
<tr>
<th>Application</th>
<th>Test temperature (°F)</th>
<th>Δ k Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cold Vending Machine</td>
<td>75</td>
<td>+1.2%</td>
</tr>
<tr>
<td>Cold Vending Machine</td>
<td>77</td>
<td>+2.4%</td>
</tr>
<tr>
<td>Glass front reach-in Cabinet</td>
<td>55</td>
<td>+12.5%</td>
</tr>
</tbody>
</table>

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:rued 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

<table>
<thead>
<tr>
<th>Title</th>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved at</td>
<td>[ExCom Meeting] 47th</td>
</tr>
<tr>
<td>Country/countries/region covered</td>
<td>Brazil</td>
</tr>
<tr>
<td>MLF funding approved</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Minimum co-funding requirement</td>
<td>252,000</td>
</tr>
<tr>
<td>Source(s) of co-funding as envisaged in project proposal (amount envisioned)</td>
<td>GEF: US$ 1 Million</td>
</tr>
<tr>
<td>Number of chillers to be replaced</td>
<td>12</td>
</tr>
<tr>
<td>Lead agency</td>
<td>UNDP</td>
</tr>
<tr>
<td>MLF funding associated</td>
<td>1,000,000</td>
</tr>
<tr>
<td>Other agencies/bilaterals</td>
<td>Agency 1 Agency 2 Agency 3</td>
</tr>
<tr>
<td>Name</td>
<td>-</td>
</tr>
<tr>
<td>Responsibility</td>
<td>-</td>
</tr>
<tr>
<td>MLF funding associated</td>
<td>-</td>
</tr>
</tbody>
</table>

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

Remarks on interest by chiller owners / did you experience good cooperation / 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 reestablished.

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 project team. As mentioned in previous reports, the project experienced delays due to the need to complete the cofinancing and approval processes. The project timeline was extended due to delays in obtaining the necessary approvals from the funding agencies. The current project timeline is now more realistic and considering these delays, the project is on track to achieve its objectives.

Experience with funding organisations
See above

Experience with funding organisations

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

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

### Per co-funding presently sought

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

### Co-funding sources previously pursued but subsequently abandoned

<table>
<thead>
<tr>
<th>Co-funding institution</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>...</th>
<th>co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, purpose of programme</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount sought in total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much of that constitutes project costs in the MLF definition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When was the quest for co-funding from this institution/programme abandoned?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasons for the decision</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Additional external resources acquired for the chiller phase-out

<table>
<thead>
<tr>
<th>Co-funding institution</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>...</th>
<th>co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, purpose of programme</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount sought in total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much of that constitutes project costs in the MLF definition</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When was the quest for co-funding from this institution/programme abandoned?</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasons for the decision</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### General information

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

### Per (main) activity

<table>
<thead>
<tr>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Activity 4</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of activity</td>
<td>Enhancing EE investments through capacity building in public and private sector buildings</td>
<td>Access to EE services and commercial financing for public sector buildings enhanced with a public building initiative</td>
<td>Interest enhanced in the replacement of energy inefficient CFC-using chillers</td>
<td>Partial Performance Guarantee Mechanism (PPGM) made available to stimulate EE investment through ESCOs</td>
</tr>
<tr>
<td>Country</td>
<td>Brazil</td>
<td>Brazil</td>
<td>Brazil</td>
<td>Brazil</td>
</tr>
<tr>
<td>Status</td>
<td>GEF CEO endorsement received. Project document signed. Inception Workshop completed. Project manager appointed. Project Steering Committee planning meetings took place.</td>
<td>GEF CEO endorsement received. Project document signed. Inception Workshop completed. Project manager appointed. Project Steering Committee planning meetings took place.</td>
<td>GEF CEO endorsement received. Project document signed. Inception Workshop completed. Project manager appointed. Project Steering Committee planning meetings took place.</td>
<td>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)</td>
</tr>
</tbody>
</table>

### In case of chiller replacements

<table>
<thead>
<tr>
<th>Owner, use</th>
<th>e.g. “city of x”, “hospital cooling”</th>
</tr>
</thead>
<tbody>
<tr>
<td>When was the agreement with the owner concluded</td>
<td></td>
</tr>
<tr>
<td>(Expected) Status of completion</td>
<td></td>
</tr>
<tr>
<td>Actual cost with a break down by</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Equipment</td>
</tr>
<tr>
<td></td>
<td>Installation</td>
</tr>
<tr>
<td></td>
<td>Construction</td>
</tr>
<tr>
<td>Information on energy efficiency</td>
<td></td>
</tr>
<tr>
<td>Original technology</td>
<td></td>
</tr>
<tr>
<td>Age of chiller being replaced</td>
<td></td>
</tr>
<tr>
<td>Original capacity</td>
<td></td>
</tr>
<tr>
<td>Replacement technology</td>
<td>(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)</td>
</tr>
<tr>
<td>Replacement capacity</td>
<td>(please provide unit = kW or tons)</td>
</tr>
<tr>
<td>Assumed / measured change in energy efficiency</td>
<td>(from/unit to/unit)</td>
</tr>
<tr>
<td>Assumed annual saving in energy</td>
<td>(in kWh)</td>
</tr>
</tbody>
</table>
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/outline/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:

<table>
<thead>
<tr>
<th>Name</th>
<th>Responsibility</th>
<th>MLF funding associated</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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

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.

### 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? ...)

While removing the barriers for conversion to non-CFC energy efficient chillers, it is expected that other additional chillers will be benefitted 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). 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 PIP 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.
<table>
<thead>
<tr>
<th>Co-funding institution</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>... co-funding</th>
<th>Refers to all co-financing that materialised</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, purpose of programme</td>
<td>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.</td>
<td>Sales Taxes Exemption</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount approved in total (currency)</td>
<td>1,000,000</td>
<td>Reduction of the Sales taxes (16%) for the materials procured by chiller owners during chiller conversion. Final value will be known at the end of the project when all the conversions take place.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Was this co-funding foreseen in the original submission to the 47th/48th Meeting?</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes/no</td>
<td></td>
</tr>
<tr>
<td>If yes: Did the amount change (please provide from … to)</td>
<td>Minimum cofinancing as per Excom approval was 705,000.</td>
<td>No</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly</td>
<td></td>
<td></td>
<td>Explain briefly: 2, 3 sentences (separate below) or some bullet points</td>
<td></td>
</tr>
<tr>
<td>How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)</td>
<td>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.</td>
<td>It covers only activities directly related to the chillers replacement.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Date of approval</td>
<td>October 7 2009</td>
<td>Available to chiller owners when purchasing elements for the conversion.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major conditions associated</td>
<td>Signature of document in Oct 2009 (accomplished), closing date of the project July 2012 and Final Report 6 months after.</td>
<td>e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; ...</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)</td>
<td>Strengthening of government institutions in charge of promoting EE. Establish policies to promote EE in buildings. Enhance stakeholders technical knowledge.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Funds agreed by the MFS to be released based on that approval are 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

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

### Co-funding sources previously pursued but subsequently abandoned

<table>
<thead>
<tr>
<th>Co-funding institution</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>... co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, purpose of programme</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount sought in total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much of that constitutes project costs in the MLF definition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When was the quest for co-funding from this institution/programme abandoned?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasons for the decision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Additional external resources acquired for the chiller phase-out

<table>
<thead>
<tr>
<th>Co-funding institution</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>... co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, purpose of programme</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount sought in total</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much of that constitutes project costs in the MLF definition</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>When was the quest for co-funding from this institution/programme abandoned?</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reasons for the decision</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### General Information

<table>
<thead>
<tr>
<th>Question</th>
<th>Answer</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many chiller users have been identified in the country?</td>
<td>50</td>
</tr>
<tr>
<td>How many chillers remain?</td>
<td>TBD</td>
</tr>
<tr>
<td>How many belong to the public sector?</td>
<td>TBD</td>
</tr>
<tr>
<td>How many to the private sector?</td>
<td>TBD</td>
</tr>
<tr>
<td>What share of the country's chiller users have been identified/estimated</td>
<td>13 (This is the number of chillers expected to be included in the demonstration. 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.)</td>
</tr>
<tr>
<td>Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly</td>
<td>Yes</td>
</tr>
</tbody>
</table>

### Per (main) activity

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Activity 4</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Identification and mitigations of risks</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Validation business model</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Assess success of demo projects</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Put in place conditions for implementation</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Country

| Colombia |

### Status

- Co-financing obtained. Project documents for GEF and MLF 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.

### In case of chiller replacements

<table>
<thead>
<tr>
<th>Owner, use</th>
<th>Expected Status of completion</th>
</tr>
</thead>
<tbody>
<tr>
<td>e.g. &quot;city of x&quot;, &quot;hospital cooling&quot;</td>
<td></td>
</tr>
</tbody>
</table>

### Information on energy efficiency

- Age of chiller being replaced
- Original capacity
- Refrigerant and type, e.g. turbo-chiller, screw-chiller, absorption-chiller
- [Please provide unit = kW or tons] / [Unit to unit, from to from] / [in kW]
## Project data

<table>
<thead>
<tr>
<th>Title</th>
<th>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</th>
</tr>
</thead>
<tbody>
<tr>
<td>Approved at</td>
<td>[ExCom Meeting] 47th</td>
</tr>
<tr>
<td>Country/countries/region covered</td>
<td>Cuba</td>
</tr>
<tr>
<td>MLF funding approved</td>
<td>984,353 US$ plus support cost</td>
</tr>
<tr>
<td>Minimum co-funding requirement</td>
<td>410,125 US$</td>
</tr>
<tr>
<td>Source(s) of co-funding as envisaged in project proposal (amount envisioned and currency in brackets)</td>
<td>Canada (public and private), UNDP Thematic Trust Fund on Energy, and Cuban Government</td>
</tr>
<tr>
<td>Number of chillers to be replaced</td>
<td>Replace 7 chillers and convert 5 chillers (this target was revised with the Secretariat before ExCom 53 in 2007)</td>
</tr>
<tr>
<td>Lead agency</td>
<td>UNDP</td>
</tr>
<tr>
<td>MLF funding associated</td>
<td>All funds are now with UNDP. Funds initially approved to Environment Canada has been transferred to UNDP at ExCom 51.</td>
</tr>
<tr>
<td>Other agencies/bilaterals</td>
<td>Agency 1 Agency 2 Agency …</td>
</tr>
</tbody>
</table>

## 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 lengthy 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. 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.

### 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? …)

### Reasons for delays
See above - Co-finance issues, bureaucratic challenges, technical challenges, hurricane Ike.

### 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

<table>
<thead>
<tr>
<th>Co-funding institution</th>
<th>Name, purpose of programme</th>
<th>Amount approved in total (currency)</th>
<th>Was this co-funding foreseen in the original submission to the 47th/48th Meeting?</th>
<th>If yes: Did the amount change (please provide from … to)</th>
<th>How much of the co financing constitutes project costs in the MLF definition (see letter from MFS)</th>
<th>Date of approval</th>
<th>Major conditions associated</th>
<th>Additional activities covered (if any): (E.g.: Energy efficiency program for building, …)</th>
<th>Funds agreed by the MPS to be released based on that approval</th>
<th>Date of related release of Funds by the MPS</th>
</tr>
</thead>
<tbody>
<tr>
<td>Government of Canada</td>
<td>Technology Early Action Measures (TEAM) by the Government of Canada</td>
<td>$655,000 CAD</td>
<td>Not explicitly. Co-finance from public and private sector in Canada was mentioned.</td>
<td>Yes/No</td>
<td>All of it</td>
<td>2007</td>
<td>Must demonstrate Canadian technology, and must generate climate benefits. Support the implementation of the Chillers project in Cuba. E.g. for replacing chillers in hospitals in country x; for replacing one system in institution y.</td>
<td>No</td>
<td>984,353 US$</td>
<td>Oct-07</td>
</tr>
<tr>
<td>Private Sector Canada</td>
<td>Chiller producer</td>
<td>$335,000 CAD</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Yes, training of Cuban technicians in Canada, translation of technical manuals, site visits in Cuba, etc. Regional workshop to disseminate results from project.</td>
<td></td>
<td>984,353 US$</td>
</tr>
<tr>
<td>UNDP</td>
<td>Thematic Trust Fund for Energy</td>
<td>$40,000 US$</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>984,353 US$</td>
<td></td>
</tr>
</tbody>
</table>

### Co-funding Sources Previously Pursued but Subsequently Abandoned

- **First co-funding**
- **Second co-funding**
- **Third co-funding**
- **Explanations**

<table>
<thead>
<tr>
<th>Co-funding institution</th>
<th>Name, purpose of programme</th>
<th>Amount sought in total</th>
<th>How much of that constitutes project costs in the MLF definition</th>
<th>When was the quest for co-funding from this institution/programme abandoned?</th>
<th>Reasons for the decision</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Additional External Resources Acquired for the Chiller Phase-out

- **First co-funding**
- **Second co-funding**
- **Third co-funding**
- **Explanations**

<table>
<thead>
<tr>
<th>Co-funding institution</th>
<th>Name, purpose of programme</th>
<th>Amount sought in total</th>
<th>How much of that constitutes project costs in the MLF definition</th>
<th>When was the quest for co-funding from this institution/programme abandoned?</th>
<th>Reasons for the decision</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
**General information**

<table>
<thead>
<tr>
<th>How many chiller users have been identified in the country</th>
<th>According to the original documents there are about 200 chillers in Cuba.</th>
</tr>
</thead>
<tbody>
<tr>
<td>What share of the country’s chiller users have been identified (estimated)</td>
<td>9 new chillers will be installed.</td>
</tr>
<tr>
<td>Have there been agreements planned with other institutions to facilitate implementation or lending?</td>
<td>Environment Canada is playing a key role in project implementation and in securing co-finance.</td>
</tr>
</tbody>
</table>

**Per (main) activity**

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Activity 4</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inspection of chillers sites</td>
<td>Completed. All Chiller sites have been inspected.</td>
<td>Completed. All Chiller sites have been prepared.</td>
<td>Completed. First four chillers were commissioned in 2009 and after a period of troubleshooting, they are now functioning fine.</td>
<td>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.</td>
<td>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.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Cuba</th>
<th>Cuba</th>
<th>Cuba</th>
<th>Cuba</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Status</th>
<th>Completed. All Chiller sites have been inspected.</th>
<th>Completed. All Chiller sites have been prepared.</th>
<th>Completed. First four chillers were commissioned in 2009 and after a period of troubleshooting, they are now functioning fine.</th>
<th>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.</th>
</tr>
</thead>
</table>

**In case of chiller replacements**

<table>
<thead>
<tr>
<th>Owner, use</th>
<th>Government, 1 scientific institute, one Theater, 2 hospitals.</th>
<th>Government, 5 hospitals.</th>
<th>e.g. “city of x”, “hospital cooling”</th>
</tr>
</thead>
</table>

**When was the agreement with the owner concluded**

All sites are owned by the government of Cuba

**Expected status of completion**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>No data</th>
<th>No data</th>
</tr>
</thead>
<tbody>
<tr>
<td>Installation</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>Construction</td>
<td>No data</td>
<td>No data</td>
</tr>
</tbody>
</table>

**Information on energy efficiency**

<table>
<thead>
<tr>
<th>Original technology</th>
<th>Centrifugal Chillers</th>
<th>Centrifugal Chillers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of chiller being replaced</td>
<td>Must be verified. In several cases two old chillers will be replaced with one new.</td>
<td></td>
</tr>
<tr>
<td>Replacement technology</td>
<td>Direct drive variable-speed oil-free centrifugal chiller, incorporating magnetic bearing technology (refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)</td>
<td></td>
</tr>
<tr>
<td>Replacement capacity</td>
<td>1 x 250 TR, 3 x 150 TR, 5 x 150 TR</td>
<td>[please provide unit = kW or tons]</td>
</tr>
<tr>
<td>Assumed / measured change in energy efficiency</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>Assumed annual saving in energy</td>
<td>No data</td>
<td>No data</td>
</tr>
<tr>
<td>Project data</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td><strong>Title</strong></td>
<td>Demonstration project on the replacement of CFC centrifugal chillers</td>
<td></td>
</tr>
<tr>
<td>Approved at [ExCom Meeting]</td>
<td>AF</td>
<td></td>
</tr>
<tr>
<td>Country/countries/region covered</td>
<td>Syria / West Asia</td>
<td></td>
</tr>
<tr>
<td>MLF funding approved</td>
<td>585,961</td>
<td></td>
</tr>
<tr>
<td>Minimum co-funding requirement</td>
<td>27,195</td>
<td></td>
</tr>
<tr>
<td>Source(s) of co-funding as envisaged in project proposal (amount envisioned and currency in brackets)</td>
<td>Counterpart co-financing (US$ 179,000)</td>
<td></td>
</tr>
<tr>
<td>Number of chillers to be replaced</td>
<td>3 to be replaced and 4 to be retrofitted</td>
<td></td>
</tr>
<tr>
<td>Lead agency</td>
<td>UNIDO</td>
<td></td>
</tr>
<tr>
<td>Other agencies/bilaterals</td>
<td>Agency 1</td>
<td>Agency 2</td>
</tr>
<tr>
<td>Name</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>Responsibility</td>
<td>N/A</td>
<td>N/A</td>
</tr>
<tr>
<td>MLF funding associated</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Results / assessment (provide some brief text, please; bullet points also possible)</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>General experience</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Greatest challenges</strong></td>
<td>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 chillers are old!</td>
</tr>
<tr>
<td><strong>Lessons learned</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Remarks on interest by chiller owners / did you experience good co-operation / did the quality of interaction change with time?</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Remarks on interest by chiller owners</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>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? …)</strong></td>
<td>It is expected that after the completion of the regional seminar and the dissemination of the demonstration results, more chillers would be replaced.</td>
</tr>
<tr>
<td><strong>Reasons for delays</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Experience with funding organisations</strong></td>
<td>N/A</td>
</tr>
<tr>
<td><strong>Impact on the chiller market in the relevant country/countries; market transformation observed</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>How do you see the potential of replication of this approach for other sectors?</strong></td>
<td>Yes a project for an early replacement programme of chiller or other equipment would be useful to deal with the HCFC service sector.</td>
</tr>
<tr>
<td><strong>Would you say that this co-funding experience was positive?</strong></td>
<td>Yes however there is no replication impact.</td>
</tr>
<tr>
<td><strong>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.</strong></td>
<td>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.</td>
</tr>
<tr>
<td><strong>Other remarks and/or explanations</strong></td>
<td>12</td>
</tr>
</tbody>
</table>
## Co-funding Information

<table>
<thead>
<tr>
<th>Co-funding Institution</th>
<th>Name, Purpose of Programme</th>
<th>1st Co-funding</th>
<th>2nd Co-funding</th>
<th>...</th>
<th>Co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Le Meridien Latakia</td>
<td>(Ministry of Tourism)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>El-Basel Hospital</td>
<td>(Ministry of Health)</td>
<td></td>
<td></td>
<td></td>
<td></td>
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</table>

### Per Approved Co-funding

<table>
<thead>
<tr>
<th>Co-funding Institution</th>
<th>Name, Purpose of Programme</th>
<th>Amount Approved in Total (Currency)</th>
<th>Was this co-funding foreseen in the original submission to the 47th/48th Meeting?</th>
<th>If yes: Did the amount change (please provide from ... to)</th>
<th>Date of Approval</th>
<th>Major Conditions Associated</th>
<th>Additional Activities Covered (if any): (E.g.: Energy Efficiency Program for Building, ...)?</th>
<th>Funds Agreed by the MFS to be Released Based on that Approval</th>
<th>Date of Related Release of Funds by the MFS</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>$120,000</td>
<td>yes</td>
<td>yes/no</td>
<td>Nov - 06</td>
<td>None</td>
<td>e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; ...</td>
<td>$585,961</td>
<td>Dec-06</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>$150,000</td>
<td></td>
<td></td>
<td>Funds disbursed in July 2007</td>
<td>Replacement of cooling towers, pipes and water pumps.</td>
<td></td>
<td></td>
<td></td>
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### Per Co-funding Presently Sought

<table>
<thead>
<tr>
<th>Co-funding Institution</th>
<th>Name, Purpose of Programme</th>
<th>Amount Sought in Total</th>
<th>How Much of That Constitutes Project Costs in the MLF Definition</th>
<th>Expected Approval</th>
<th>Reasons for the Delay</th>
<th>Major Conditions Associated</th>
<th>Additional Activities Covered (if any): (E.g.: Energy Efficiency Program for Building, ...)?</th>
<th>Notes</th>
</tr>
</thead>
</table>

### Co-funding Sources Previously Pursued but Subsequently Abandoned

<table>
<thead>
<tr>
<th>Co-funding Institution</th>
<th>Name, Purpose of Programme</th>
<th>Amount Sought in Total</th>
<th>How Much of That Constitutes Project Costs in the MLF Definition</th>
<th>When the Quest for Co-funding from this Institution/Programme Abandoned?</th>
<th>Reasons for the Decision</th>
<th>Notes</th>
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</thead>
</table>

### Additional External Resources Acquired for the Chiller Phase-out

<table>
<thead>
<tr>
<th>Co-funding Institution</th>
<th>Name, Purpose of Programme</th>
<th>Amount Sought in Total</th>
<th>How Much of That Constitutes Project Costs in the MLF Definition</th>
<th>When the Quest for Co-funding from this Institution/Programme Abandoned?</th>
<th>Reasons for the Decision</th>
<th>Notes</th>
</tr>
</thead>
</table>
How many chiller users have been identified in the country? 32 CFC-based centrifugal chillers (including those considered under the project).

How many remain? [Blank]

How many belong to the public sector? [Blank]

How many to the private sector? [Blank]

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

<table>
<thead>
<tr>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Activity 4</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type of activity</td>
<td>Chiller Replacement</td>
<td>Chiller retrofit</td>
<td>Supplier Seminar</td>
<td>e.g.: Chiller replacement / Chiller retrofit / Workshop / …</td>
</tr>
<tr>
<td>Country</td>
<td>Syria</td>
<td>Syria</td>
<td>Austria</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>Completed</td>
<td>Completed</td>
<td>Completed</td>
<td></td>
</tr>
</tbody>
</table>

The retrofit of the chillers operating at Al-Base 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.

In case of chiller replacements

Owner, use

Hotel Le Meridien, Cooling of hotel rooms, offices and public areas

Al-Base Hospital, Latakia "Hospital Cooling"

e.g. “city of x”, "hospital cooling"

When was the agreement with the owner concluded? Nov-08

(Actual) Status of completion Dec-08

(Actual) Status of completion Jun-11

Actual cost with a break down by

<table>
<thead>
<tr>
<th>Item</th>
<th>Equipment</th>
<th>Installation</th>
<th>Construction</th>
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<tbody>
<tr>
<td>Cost</td>
<td>435,000</td>
<td>180,000</td>
<td>0</td>
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Information on energy efficiency

<table>
<thead>
<tr>
<th>Original technology</th>
<th>CFC-12, centrifugal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age of chiller being replaced</td>
<td>39 years (1978)</td>
</tr>
<tr>
<td>Original capacity</td>
<td>320 tons</td>
</tr>
<tr>
<td>Replacement technology</td>
<td>HFC134a, screw chiller</td>
</tr>
<tr>
<td>Replacement capacity</td>
<td>1120 kW</td>
</tr>
<tr>
<td>Assumed / measured change in energy efficiency</td>
<td>From COP = 2.5 to COP=4.5</td>
</tr>
<tr>
<td>Assumed annual saving in energy</td>
<td>1750 kWh</td>
</tr>
</tbody>
</table>
Title
Approved at [ExCom Meeting]
The 47th ExCom Meeting
Country/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
$516,345
Other agencies/bilaterals
Agency 1
Agency 2
Agency 3
Responsibility
N/A
N/A
Results / assessment (provide some lead 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.

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 EEE 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 Jordan. 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 several issues including: a) however a KiWi 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/region; 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 proc.

The co-financing experience was generally positive. Private owners do not see co-financing 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. Given that funding is for improvement, it is 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.

Other remarks and/or explanations
Jordan’s approach is different than for India and the Philippines because of its small EFC-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 HFC-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.

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### Co-funding information

| Co-funding institution | Name, purpose of programme | Amount approved in total (currency) | Was this co-funding foreseen in the original submission to the 47th/48th Meeting? | 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 | How much of the co-financing constitutes project costs in the MLF definition (see letter from MFS) | Date of approval | Major conditions associated | Additional activities covered (if any): (E.g.: Energy efficiency program for building, …) | Funds agreed by the MFS to be released based on that approval | Date of related release of Funds by the MFS | Additional external resources acquired for the chiller phase-out |
|------------------------|---------------------------|-----------------------------------|-----------------------------------------------|-----------------------------------------------------|---------------------------------------------------------------------------------|---------------------------------------------------------------------------|--------------------|-----------------------------------------------|------------------------------------------------------------------------------|--------------------------------------------------------------------|---------------------------------------------------------------------|
| GEF                   | Chiller Energy Efficiency Project | US$6,300,000                      | yes                                            | yes, from 10.4 to 6.3 million                       | n/a                                                                                      | US$5,700,000                                                                 | Apr-08               | None                                         | TA; Monitoring and Verification                                            | US$1,000,000                                                      | 26-Aug-09                                                          | US EPA |

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.

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### Co-funding information

<table>
<thead>
<tr>
<th>Per approved co-funding</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>…</th>
<th>co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-funding institution</td>
<td>GEF</td>
<td>CDM (KfW)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Name, purpose of programme</td>
<td>Chiller Energy Efficiency Project</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Amount approved in total (currency)</td>
<td>US$2,600,000</td>
<td>$6,000,000</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Was this co-funding foreseen in the original submission to the 47th/48th Meeting?</td>
<td>yes</td>
<td>yes</td>
<td></td>
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<tr>
<td>If yes: Did the amount change (please provide from … to)</td>
<td>yes, from 3.655 to 2.6 million</td>
<td>yes, from $3.623 to $7.77 to $6 million.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly</td>
<td>n/a</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>How much of the co-financing constitutes project costs in the MLF definition (see letter from MFS)</td>
<td>US$2,600,000</td>
<td>US$6,000,000</td>
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<td>Date of approval</td>
<td>Nov. 2008</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Major conditions associated</td>
<td>None</td>
<td>n/a</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Additional activities covered (if any): (E.g.: Energy efficiency program for building, …)</td>
<td>TA; Monitoring and Verification</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Funds agreed by the MFS to be released based on that approval</td>
<td>US$1,000,000</td>
<td>n/a</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Date of related release of Funds by the MFS</td>
<td>not yet released</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Co-funding sources previously pursued but subsequently abandoned</td>
<td>1st co-funding</td>
<td>2nd co-funding</td>
<td>…</td>
<td>co-funding</td>
<td>Explanations</td>
</tr>
<tr>
<td>Co-funding institution</td>
<td>US EPA</td>
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<tr>
<td>Name, purpose of programme</td>
<td>Technical Assistance</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Amount sought in total</td>
<td>$150,000 (in kind)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>How much of that constitutes project costs in the MLF definition</td>
<td>100%</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The amount of carbon financing expected was $7.77 million. Actual purchaser, Kfw, has agreed 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. 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.
Co-funding information

<table>
<thead>
<tr>
<th>Per approved co-funding</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>…</th>
<th>co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-funding institution</td>
<td>GEF</td>
<td>Concessional Loan</td>
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<tr>
<td>Name, purpose of programme</td>
<td>Chiller Energy Efficiency Project</td>
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<tr>
<td>Amount approved in total (currency)</td>
<td>US$3,300,000</td>
<td>$20,000,000</td>
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<tr>
<td>Was this co-funding foreseen in the original submission to the 47th/48th Meeting?</td>
<td>no</td>
<td>no</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>If yes: Did the amount change (please provide from … to)</td>
<td></td>
<td></td>
<td>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).</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly</td>
<td>In June 2009. See explanation.</td>
<td>In late 2009.</td>
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<td>US$3,300,000</td>
<td>US$20,000,000</td>
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<td>Mar. 2010</td>
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<td>Major conditions associated</td>
<td>None</td>
<td>n/a</td>
<td>e.g. for replacing chillers in hospitals in country x; for replacing one system in institution y; …</td>
<td></td>
<td></td>
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<tr>
<td>Additional activities covered (if any): (E.g.: Energy efficiency program for building, …)</td>
<td>TA; Monitoring and Verification</td>
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<td></td>
<td></td>
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<tr>
<td>Funds agreed by the MFS to be released based on that approval</td>
<td>US$1,000,000</td>
<td>n/a</td>
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</tr>
<tr>
<td>Date of related release of Funds by the MFS</td>
<td>not yet released</td>
<td></td>
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</table>

Per co-funding presently sought

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

Co-funding sources previously pursued but subsequently abandoned

<table>
<thead>
<tr>
<th>Co-funding institution</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>…</th>
<th>co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, purpose of programme</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Amount sought in total</td>
<td></td>
<td></td>
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<tr>
<td>How much of that constitutes project costs in the MLF definition</td>
<td></td>
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</tr>
<tr>
<td>When was the quest for co-funding from this institution/programme abandoned?</td>
<td></td>
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<tr>
<td>Reasons for the decision</td>
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</table>

Additional external resources acquired for the chiller phase-out

<table>
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<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>…</th>
<th>co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Name, purpose of programme</td>
<td></td>
<td></td>
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<td></td>
<td></td>
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<td>How much of that constitutes project costs in the MLF definition</td>
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### General information

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</tr>
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<tbody>
<tr>
<td>Type of activity</td>
<td>Chiller Replacement</td>
<td>Technical Assistance</td>
<td>Monitoring and Verification</td>
<td>Project Management</td>
</tr>
<tr>
<td>Country</td>
<td>India</td>
<td>India</td>
<td>India</td>
<td>India</td>
</tr>
<tr>
<td>Status</td>
<td>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 ERP 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.</td>
<td></td>
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</tr>
<tr>
<td>Per (main) activity</td>
<td>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)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>In case of chiller replacements</td>
<td>No chillers replaced as of Sep. 10.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Owner, use</td>
<td>e.g. “city of x”, “hospital cooling”</td>
<td></td>
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<tr>
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<tr>
<td>Actual cost with a break down by</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>equipment</td>
<td></td>
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<tr>
<td>installation</td>
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</tr>
<tr>
<td>construction</td>
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<tr>
<td>Information on energy efficiency</td>
<td></td>
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<tr>
<td>Original technology</td>
<td></td>
<td></td>
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<tr>
<td>Age of chiller being replaced</td>
<td></td>
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<tr>
<td>Original capacity</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replacement technology</td>
<td>(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replacement capacity</td>
<td>[please provide unit = kW or tons]</td>
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<td></td>
<td></td>
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<tr>
<td>Assumed / measured change in energy efficiency</td>
<td>(from/unit to /unit)</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Assumed annual saving in energy</td>
<td>(in kWh)</td>
<td></td>
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195 chillers have been targeted initially (first phase) for replacement through GEF, MLF and KfW assistance under the Chiller Replacement Project.

The inventory of CFC centrifugal chillers was developed on the basis of information provided by chiller suppliers. 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

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</table>
### General information

<table>
<thead>
<tr>
<th>How many chiller users have been identified in the country</th>
<th>20</th>
</tr>
</thead>
<tbody>
<tr>
<td>What share of the country’s chiller users have been identified (estimated)</td>
<td>100%</td>
</tr>
<tr>
<td>Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly</td>
<td>No</td>
</tr>
</tbody>
</table>

### Per (main) activity

<table>
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<tr>
<th>Type of activity</th>
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<table>
<thead>
<tr>
<th>Country</th>
<th>Jordan</th>
</tr>
</thead>
</table>

| 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. Building owners have or are in the process of 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. Sighting 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. |

<table>
<thead>
<tr>
<th>In case of chiller replacements</th>
<th>N/A</th>
</tr>
</thead>
<tbody>
<tr>
<td>Owner, use</td>
<td>e.g. “city of x”, “hospital cooling”</td>
</tr>
</tbody>
</table>

| When was the agreement with the owner concluded | |
| (Expected) Status of completion | |
| Actual cost with a break down by | |
| equipment | |
| installation | |
| construction | |

### Explanations

- 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.
- Four CFC-based chillers remain.
- 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.

### Activity 1

- Activity 2
- Activity 3

<table>
<thead>
<tr>
<th>Original technology</th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Age of chiller being replaced</td>
<td></td>
</tr>
<tr>
<td>Original capacity</td>
<td></td>
</tr>
<tr>
<td>Replacement technology</td>
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<tbody>
<tr>
<td>How many chiller users have been identified in the country</td>
<td>160</td>
<td></td>
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<tr>
<td>Actual cost with a break down by</td>
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<tr>
<td>equipment</td>
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<tr>
<td>installation</td>
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<tr>
<td>construction</td>
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<tr>
<td>Information on energy efficiency</td>
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<td></td>
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<tr>
<td>Original technology</td>
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<tr>
<td>Age of chiller being replaced</td>
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<tr>
<td>Original capacity</td>
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<tr>
<td>Replacement technology</td>
<td></td>
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</tr>
<tr>
<td>[refrigerant type, e.g. turbo-chiller, screw-chiller, absorption-chiller]</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Replacement capacity</td>
<td></td>
<td></td>
<td></td>
<td>[please provide unit = kW or tons]</td>
</tr>
<tr>
<td>Assumed / measured change in energy efficiency</td>
<td></td>
<td></td>
<td></td>
<td>[from/unit to /unit]</td>
</tr>
<tr>
<td>Assumed annual saving in energy</td>
<td></td>
<td></td>
<td></td>
<td>(in kWh)</td>
</tr>
</tbody>
</table>
### Project data

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

### Results / assessment (provide some brief text, please; bullet points also possible)

<table>
<thead>
<tr>
<th>General experience</th>
<th>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 Pac.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Greatest challenges</td>
<td>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</td>
</tr>
<tr>
<td>Lessons learned</td>
<td>Remarks on interest by chiller owners / did you experience good cooperation / did the quality of interaction change with time? Not yet started</td>
</tr>
<tr>
<td>Remarks on interest by chiller owners</td>
<td>N/A</td>
</tr>
<tr>
<td>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? …)</td>
<td>One component under the projects deals with the elaboration of a chiller replacement policy and replication of the demonstration results</td>
</tr>
<tr>
<td>Reasons for delays</td>
<td>N/A</td>
</tr>
<tr>
<td>Experience with funding organisations</td>
<td>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.</td>
</tr>
<tr>
<td>Impact on the chiller market in the relevant country/countries; market transformation observed</td>
<td>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.</td>
</tr>
<tr>
<td>How do you see the potential of replication of this approach for other sectors?</td>
<td>N/A</td>
</tr>
<tr>
<td>Would you say that this co-funding experience was positive?</td>
<td>N/A</td>
</tr>
<tr>
<td>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.</td>
<td>N/A</td>
</tr>
<tr>
<td>Other remarks and/or explanations</td>
<td>In accordance with the approval conditions, Senegal was added to the list of countries covered by the project.</td>
</tr>
<tr>
<td>Per approved co-funding</td>
<td>1st co-funding</td>
</tr>
<tr>
<td>-------------------------</td>
<td>----------------</td>
</tr>
<tr>
<td>Co-funding institution</td>
<td>French Global Environment Facility (FGEF)</td>
</tr>
<tr>
<td>Name, purpose of programme</td>
<td>Energy efficiency and climate change</td>
</tr>
<tr>
<td>Amount approved in total (currency)</td>
<td>EUR 750,000</td>
</tr>
<tr>
<td>Was this co-funding foreseen in the original submission to the 47th/48th Meeting?</td>
<td>yes</td>
</tr>
<tr>
<td>If yes: Did the amount change (please provide from ... to)</td>
<td>The funding approved increased from US$ 500,000 to EUR 750,000</td>
</tr>
<tr>
<td>If no: When (approx.) did you become aware of this possibility, and how? Please explain briefly</td>
<td>N/A</td>
</tr>
<tr>
<td>Explain briefly: 2, 3 sentences (separate below) or some bullet points</td>
<td></td>
</tr>
<tr>
<td>How much of the co-financing constitutes project costs in the MLF definition (see letter from MFS)</td>
<td>EUR 750,000</td>
</tr>
<tr>
<td>Date of approval</td>
<td>Jul-07</td>
</tr>
<tr>
<td>Major conditions associated</td>
<td>None</td>
</tr>
<tr>
<td>Additional activities covered (if any): (E.g.: Energy efficiency program for building, ...)</td>
<td>None</td>
</tr>
<tr>
<td>Funds agreed by the MFS to be released based on that approval</td>
<td>2,000,000</td>
</tr>
<tr>
<td>Date of related release of funds by the MFS</td>
<td>Sep-07</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Co-funding sources previously pursued but subsequently abandoned</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>... co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-funding institution</td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Name, purpose of programme</td>
<td></td>
<td></td>
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<tr>
<td>Amount sought in total</td>
<td></td>
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<tr>
<td>How much of that constitutes project costs in the MLF definition</td>
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<tr>
<td>Reasons for the decision</td>
<td></td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Additional external resources acquired for the chiller phase-out</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>... co-funding</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td>Co-funding institution</td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>Name, purpose of programme</td>
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<tr>
<td>Amount sought in total</td>
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<tr>
<td>How much of that constitutes project costs in the MLF definition</td>
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<tr>
<td>When was the quest for co-funding from this institution/programme abandoned?</td>
<td></td>
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<tr>
<td>Reasons for the decision</td>
<td></td>
<td></td>
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</tbody>
</table>
### General Information

<table>
<thead>
<tr>
<th>How many chiller users have been identified in the country</th>
<th>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)</th>
</tr>
</thead>
<tbody>
<tr>
<td>How many chillers remain?</td>
<td>0 N/A 200 7 13 18 60</td>
</tr>
<tr>
<td>How many belong to the public sector? How many to the private sector?</td>
<td>60% of the chillers are privately owned</td>
</tr>
<tr>
<td>What share of the country's chiller users have been identified (estimated)</td>
<td>All</td>
</tr>
<tr>
<td>Have there been agreements planned with other institutions to facilitate implementation or lending? If yes, please elaborate briefly</td>
<td>No</td>
</tr>
</tbody>
</table>

### Per (main) activity

<table>
<thead>
<tr>
<th>Type of activity</th>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Activity 4</th>
<th>Activity 5</th>
<th>Activity 6</th>
<th>Activity ...</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Chiller Replacement</td>
<td>Regional Workshop</td>
<td>Setup of a financial mechanism</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>e.g.: Chiller replacement / Chiller retrofit / Workshop / …</td>
</tr>
<tr>
<td></td>
<td>Namibia</td>
<td>Egypt</td>
<td>Egypt</td>
<td>Senegal</td>
<td>Sudan</td>
<td>Cameroon</td>
<td>Nigeria</td>
<td></td>
</tr>
<tr>
<td>Status</td>
<td>Completed</td>
<td>The workshop was held in September 2008 and the results were published by GTZ (copy attached)</td>
<td>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.</td>
<td></td>
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</tr>
<tr>
<td>Output</td>
<td>Katatura Hospital, hospital cooling</td>
<td>Hotel (government owned)</td>
<td>Textile Industries</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>e.g. &quot;city of x&quot;, &quot;hospital cooling&quot;</td>
</tr>
<tr>
<td>When was the agreement with the owner concluded</td>
<td>Jan-08</td>
<td></td>
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</tr>
<tr>
<td>Expected Status of completion</td>
<td>Dec-08</td>
<td></td>
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<tr>
<td>Actual cost with a break down by</td>
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<td>equipment</td>
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<td>installation</td>
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<td>construction</td>
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<tr>
<td>Information on energy efficiency</td>
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<tr>
<td>Original technology</td>
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<tr>
<td>Age of chiller being replaced</td>
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<tr>
<td>Original capacity</td>
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<tr>
<td>Replacement technology</td>
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<tr>
<td>replacement capacity</td>
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<td></td>
</tr>
<tr>
<td>Assumed / measured change in energy efficiency</td>
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<tr>
<td>Assumed annual saving in energy</td>
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</tr>
</tbody>
</table>

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
### Project data

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

### Results / assessment

**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.

2) 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!

**Lessons learned**

1) Replacement of the chillers alone do not yield the expected energy savings. To obtain optimal energy savings, other components in the chiller plant including the cooling towers, piping and pumps should be replaced. This is usually very costly and acts as a disincentive for the replacement.

2) 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!

**Remarks on interest by chiller owners / did you experience good cooperation / 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:**

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

**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 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**

N/A
### Co-funding Information

<table>
<thead>
<tr>
<th>Co-funding Source</th>
<th>Amount Approved</th>
<th>Total Project Costs</th>
<th>Date of Approval</th>
<th>Co-funding Institution</th>
<th>Name, Purpose of Programme</th>
<th>Other Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Counterpart 1</td>
<td>US$ 230,000</td>
<td>US$ 183,000</td>
<td>Nov-06</td>
<td>A</td>
<td>Hospital Upgrade</td>
<td></td>
</tr>
<tr>
<td>Counterpart 2</td>
<td>US$ 240,000</td>
<td>US$ 195,000</td>
<td>Nov-06</td>
<td>B</td>
<td>Facility Improvement</td>
<td></td>
</tr>
</tbody>
</table>

**Co-funding Details**

- **Per Co-funding Request**
  - **Co-funding Institution**: A, B
  - **Name, Purpose of Programme**: Hospital Upgrade, Facility Improvement
  - **Amount Sought in Total**: US$ 230,000, US$ 240,000
  - **How Much of That Constitutes Project Costs in the MLF Definition**: US$ 183,000, US$ 195,000
  - **Date of Approval**: Nov-06, Nov-06

- **Additional Co-funding**
  - **Co-funding Institution**: C
  - **Name, Purpose of Programme**: Energy Efficiency Program
  - **Amount Sought in Total**: US$ 300,000
  - **How Much of That Constitutes Project Costs in the MLF Definition**: US$ 230,000
  - **Date of Approval**: Dec-06

**Additional Activities Covered**

- Energy Efficiency Program for Building

**Funds Agreed by the MFS**

- **Amount Agreed by MFS to be Released Based on Co-funding Request**: US$ 471,679
- **Date of Related Release of Funds by MFS**: May-07
## General Information

<table>
<thead>
<tr>
<th>Country</th>
<th>Chiller Identification Details</th>
</tr>
</thead>
<tbody>
<tr>
<td>Romania: 7 CFC-based centrifugal chillers (including those considered under the project)</td>
<td></td>
</tr>
<tr>
<td>Croatia: 22 CFC-based centrifugal chillers (including those considered under the project)</td>
<td></td>
</tr>
<tr>
<td>Macedonia FYR: 23 CFC-based centrifugal chillers (including those considered under the project)</td>
<td></td>
</tr>
<tr>
<td>Serbia and Montenegro: 34 CFC-based centrifugal chillers (including those considered under the project)</td>
<td></td>
</tr>
</tbody>
</table>

### Per (main) activity

<table>
<thead>
<tr>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Activity 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chiller Replacement</td>
<td>Chiller Replacement in concrete pipeline phase</td>
<td>Supplier Seminar</td>
<td>Germany</td>
</tr>
<tr>
<td>Country</td>
<td>Romania (1), Macedonia (2), Serbia (1), Montenegro (1)</td>
<td>Croatia (4), Serbia (2)</td>
<td>Austria</td>
</tr>
<tr>
<td>Status</td>
<td>Completed</td>
<td>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.</td>
<td>Completed</td>
</tr>
<tr>
<td>Owner, use</td>
<td>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</td>
<td>1) Zagrebčanka Business Tower, Cooling, 2) SRDJ Galeria, Cooling, 3) Clinic Osejek, hospital cooling, 4) Ministry of Economy, cooling 5) Viskoza Kord, cooling, 6) Radio Television Serbia (RTS), cooling of technical rooms and studios</td>
<td>VMA</td>
</tr>
<tr>
<td>When the agreement with the owner concluded</td>
<td>Sep-06</td>
<td>Apr-08</td>
<td></td>
</tr>
<tr>
<td>Actual cost with a break down by</td>
<td>Morocco 28</td>
<td>Morocco 28</td>
<td></td>
</tr>
<tr>
<td>Equipment</td>
<td>585,000</td>
<td>680,000</td>
<td></td>
</tr>
<tr>
<td>installation (startup only)</td>
<td>20,000</td>
<td>30,000</td>
<td></td>
</tr>
<tr>
<td>construction</td>
<td>Counterpart responsibility locally!</td>
<td>Counterpart responsibility locally!</td>
<td></td>
</tr>
<tr>
<td>Age of chiller being replaced</td>
<td>1) 30 years (1978)</td>
<td>2) 32 years (1976)</td>
<td>3) 34 years (1974)</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------</td>
<td>-------------------</td>
<td>-------------------</td>
</tr>
<tr>
<td>Original capacity</td>
<td>1) 580 kW</td>
<td>2) 900 kW</td>
<td>3) 605 kW</td>
</tr>
<tr>
<td>Replacement technology</td>
<td>All five are HFC-134a, screw</td>
<td>1) HFC-134a, screw</td>
<td>2) HFC-134a, screw</td>
</tr>
<tr>
<td>Replacement capacity</td>
<td>1) 580 kW</td>
<td>2) 1100 kW</td>
<td>3) 600 kW</td>
</tr>
<tr>
<td>Assumed / measured change in energy efficiency</td>
<td>1) from COP = 3.2 to COP = 6.1</td>
<td>2) from COP = 2.8 to COP = 6.35</td>
<td>3) from COP = 3.5 to COP= 6.24</td>
</tr>
<tr>
<td>Assumed annual saving in energy</td>
<td>(in kWh)</td>
<td>(in kWh)</td>
<td>(in kWh)</td>
</tr>
</tbody>
</table>
## 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 USD |
| Number of chillers to be replaced | 14 |
| Lead agency | UNDP |

### 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.

- **Greatest challenges**: To locate CFC based centrifugal chillers in the countries

- **Lessons learned**: 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.

- **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.

### Experience with challenges

| Source(s) of co-funding as envisaged in project proposal (amount envisioned) | Regional GEF MSP of 1,000,000 USD + 160,000 USD UNDP Trust Fund |
| Number of chillers to be replaced | 14 |

### Other remarks and/or explanations

- Project data

- MLF funding associated

- Other agencies/bilaterals

- Agency 1

- Agency 2

- Agency …
### Co-funding information

<table>
<thead>
<tr>
<th>Per approved co-funding</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>…</th>
<th>co-funding</th>
<th>Explains</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Co-funding institution</strong></td>
<td>UNDP Energy TTF</td>
<td>Jamaica</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Name, purpose of programme</strong></td>
<td>Regional Caribbean demonstration project on application of CFC-free energy efficient technologies for replacement of CFC-based centrifugal chillers</td>
<td>Replacement of chillers in Public and Private Sector</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Amount approved in total (currency)</strong></td>
<td>160,000</td>
<td>not quantified</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Was this co-funding foreseen in the original submission to the 47th/48th Meeting?</strong></td>
<td>yes</td>
<td>no</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>If yes: Did the amount change (please provide from … to)</strong></td>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Explain briefly</strong></td>
<td>This was foreseen in the original proposal</td>
<td>High energy prices promoted the process</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>How much of the cofinancing constitutes project costs in the MLF definition (see letter from MFS)</strong></td>
<td>Most of it</td>
<td>All of it.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Date of approval</strong></td>
<td>2006</td>
<td>2006 - 2008</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Major conditions associated</strong></td>
<td>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.</td>
<td>no specific conditions</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Additional activities covered (if any): (e.g.: Energy efficiency program for building, …)</strong></td>
<td>see above</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Funds agreed by the MFS to be released based on that approval</strong></td>
<td>0</td>
<td>0</td>
<td></td>
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</tbody>
</table>

### Co-funding sources previously pursued but subsequently abandoned

<table>
<thead>
<tr>
<th>Per co-funding presently sought</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>…</th>
<th>co-funding</th>
<th>Explains</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Co-funding institution</strong></td>
<td>GEF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Name, purpose of programme</strong></td>
<td>Regional Energy Efficiency Programme</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Amount sought in total</strong></td>
<td>100,000</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>How much of that constitutes project costs in the MLF definition</strong></td>
<td>Most of it.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>When was the quest for co-funding from this institution/programme abandoned?</strong></td>
<td>The idea of presenting a proposal to the GEF was abandoned when the RAF was implemented.</td>
<td></td>
<td></td>
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</tr>
<tr>
<td><strong>Reasons for the decision</strong></td>
<td>To coordinate a four country regional MSP country with RAF is quite complicated</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

### Additional external resources acquired for the chiller phase-out

<table>
<thead>
<tr>
<th>Per co-funding presently sought</th>
<th>1st co-funding</th>
<th>2nd co-funding</th>
<th>…</th>
<th>co-funding</th>
<th>Explains</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Co-funding institution</strong></td>
<td>GEF</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Name, purpose of programme</strong></td>
<td>Regional Energy Efficiency Programme</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Amount sought in total</strong></td>
<td>100,000</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>How much of that constitutes project costs in the MLF definition</strong></td>
<td>Most of it.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>When was the quest for co-funding from this institution/programme abandoned?</strong></td>
<td>The idea of presenting a proposal to the GEF was abandoned when the RAF was implemented.</td>
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<tr>
<td><strong>Reasons for the decision</strong></td>
<td>To coordinate a four country regional MSP country with RAF is quite complicated</td>
<td></td>
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</tbody>
</table>
### General information

**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.

**What share of the country’s chiller users have been identified (estimated)**
- 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 financial 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 it impossible to reach a critical mass, and it would therefore not be cost efficient to implement the scheme in Jamaica.

### Per (main) activity

<table>
<thead>
<tr>
<th>Activity 1</th>
<th>Activity 2</th>
<th>Activity 3</th>
<th>Activity ...</th>
<th>Explanations</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type of activity</strong></td>
<td>Development of financial scheme</td>
<td>Identification of CFC based chillers</td>
<td>Replacement of 7 chillers</td>
<td>Potential replacement of 2 chillers</td>
</tr>
<tr>
<td><strong>Country</strong></td>
<td>Jamaica</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Status</strong></td>
<td>Principles for financial scheme developed and shared with main stakeholders. Low quantity of chillers made it impossible to implement the scheme.</td>
<td>9 chillers in 7 locations identified in Jamaica. Seven have been replaced. No CFC based chillers found in Dominican Republic and Trinidad and Tobago.</td>
<td>Seven chillers replaced in Jamaica</td>
<td>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)</td>
</tr>
<tr>
<td><strong>In case of chiller replacements</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Owner, use</strong></td>
<td>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.</td>
<td>The Ministry of Health main building in Kingston, Jamaica has two CFC based chillers. We have no additional information on these chillers.</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>When was the agreement with the owner concluded?</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>(Expected) Status of completion</strong></td>
<td>Completed</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Actual cost with a break down by</strong></td>
<td>Equipment</td>
<td>Funded by company</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Installation</td>
<td>Funded by company</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Construction</td>
<td>Funded by company</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Information on energy efficiency</strong></td>
<td>Original technology</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Age of chiller being replaced</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Original capacity</td>
<td>N/A</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement technology</td>
<td>All chillers replaced with 134 a chillers from Carrier, York and Trane.</td>
<td>(refrigerant AND type, e.g. turbo-chiller, screw-chiller, absorption-chiller)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Replacement capacity</td>
<td></td>
<td>(please provide unit = kW or tons)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assumed / measured change in energy efficiency</td>
<td>From (unit to unit)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Assumed annual saving in energy</td>
<td></td>
<td>(in kWh)</td>
<td></td>
</tr>
</tbody>
</table>