



**Programa de las
Naciones Unidas
para el Medio Ambiente**

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COMITÉ EJECUTIVO DEL FONDO MULTILATERAL
PARA LA APLICACIÓN DEL
PROTOCOLO DE MONTREAL
Octogésima primera Reunión
Montreal, 18 – 22 de junio de 2018

PROPUESTAS DE PROYECTO: COLOMBIA

El presente documento consta de las observaciones y las recomendaciones de la Secretaría sobre las propuestas de proyecto siguientes:

Eliminación

- Plan de gestión de la eliminación de los HCFC (etapa II, segundo tramo) PNUD/PNUMA/Alemania

Refrigeración

- Conversión del HFC-134a al isobutano en la fabricación de refrigeradores domésticos en Mabe Colombia PNUD

HOJA DE EVALUACIÓN DE PROYECTO – PROYECTOS PLURIANUALES**Colombia**

I) TÍTULO DEL PROYECTO	ORGANISMO	REUNIÓN DE APROBACIÓN	MEDIDA DE CONTROL
Plan de gestión de la eliminación de los HCFC (etapa II)	PNUD (principal), PNUMA y Alemania	75 ^a	65% para 2021

II) DATOS MÁS RECIENTES CON ARREGLO AL ARTÍCULO 7 (Anexo C, Grupo I)	Año: 2016	136,54 (toneladas PAO)
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III) DATOS SECTORIALES DEL PROGRAMA DE PAÍS MÁS RECIENTES (toneladas PAO)								Año: 2017	
Sustancia química	Aerosol	Espumas	Lucha contra incendios	Refrigeración		Disolvente	Agente de procesos	Uso en lab.	Consumo total del sector
				Fabricación	Mantenimiento				
HCFC-22	0,19			0,63	43,53				44,34
HCFC-123			0,13		0,04				0,17
HCFC-141b	0,29	94,98	6,26		2,40				103,92
HCFC-142b					0,08				0,08
HCFC-141b en polioles premezclados importados		0,85							0,85

IV) DATOS SOBRE EL CONSUMO (toneladas PAO)			
Nivel de base en 2009-2010:	225,6	Punto de partida para las reducciones acumulativas sostenidas:	225,6
CONSUMO ADMISIBLE PARA LA FINANCIACIÓN (toneladas PAO)			
Ya aprobado:	201,21	Restante:	24,32

V) PLAN ADMINISTRATIVO		2018	2019	2020	Después de 2020	Total
PNUD	Eliminación de SAO (toneladas PAO)	29,70	14,89	0	6,02	50,61
	Financiación (\$EUA)	1 356 768	680 251	0	275 133	2 312 152
PNUMA	Eliminación de SAO (toneladas PAO)	1,17	1,17	0	0,59	2,93
	Financiación (\$EUA)	56 500	56 500	0	28 250	141 250
Alemania	Eliminación de SAO (toneladas PAO)	3,82	0	0	1,30	5,12
	Financiación (\$EUA)	183 819	0	0	61 273	245 092

VI) DATOS DEL PROYECTO		2015	2016	2017	2018	2019	2020	2021	Total	
Límites del consumo establecidos en el Protocolo de Montreal		203,01	203,01	203,01	203,01	203,01	146,62	146,62	n/d	
Consumo máximo permitido (toneladas PAO)		203,01	203,01	203,01	203,01	203,01	90,24	78,96	n/d	
Financiación acordada (\$EUA)	PNUD	Costos del proyecto	2 342 591	0	0	1 268 007	635 749	0	257 134	4 503 481
		Gastos de apoyo	163 981	0	0	88 761	44 502	0	17 999	315 244
	PNUMA	Costos del proyecto	50 000	0	0	50 000	50 000	0	25 000	175 000
		Gastos de apoyo	6 500	0	0	6 500	6 500	0	3 250	22 750
	Alemania	Costos del proyecto	325 800	0	0	162 900	0	0	54 300	543 000
		Gastos de apoyo	41 838	0	0	20 919	0	0	6 973	69 730
Fondos aprobados por el Comité Ejecutivo (\$EUA)	Costos del proyecto	2 718 391	0	0					2 718 391	
	Gastos de apoyo	212 319	0	0					212 319	
Total de fondos solicitados a la presente reunión para su aprobación (\$EUA)	Costos del proyecto				1 480 907				1 480 07	
	Gastos de apoyo				116 180				116 180	

Recomendación de la Secretaría:

Para aprobación general

DESCRIPCIÓN DEL PROYECTO

1. En nombre del Gobierno de Colombia, el PNUD, en calidad de organismo principal, ha presentado una solicitud de financiación del segundo tramo de la etapa II del Plan de gestión de la eliminación de los HCFC, por un costo total de 1 597 087 dólares de los Estados Unidos (\$EUA), compuesto por 1 268 007 \$EUA, más gastos de apoyo al organismo de 88 761 \$EUA para el PNUD, 50 000 \$EUA, más gastos de apoyo al organismo de 6 500 \$EUA para el PNUMA, y 162 900 \$EUA, más gastos de apoyo al organismo de 20 919 \$EUA para el Gobierno de Alemania¹. La presentación de dicha solicitud incluye un informe sobre los progresos realizados en la aplicación del primer tramo, y el plan de ejecución de tramos para el período de 2018-2019.

Informe sobre el consumo de HCFC

2. El Gobierno de Colombia notificó un consumo de 136,54 toneladas PAO de HCFC en 2016 y un consumo estimado de 148,51 toneladas PAO en 2017, que representan un 39 por ciento y un 34 por ciento menos que el nivel de base del consumo de HCFC establecido para el cumplimiento, respectivamente. En el cuadro 1, se indica el consumo de HCFC de 2013 a 2017.

Cuadro 1. Consumo de HCFC en Colombia (datos de 2013-2017 con arreglo al artículo 7)

HCFC	2013	2014	2015	2016	2017*	Nivel de base
Toneladas métricas						
HCFC-22	1 053,40	1 226,16	1 081,54	947,44	806,21	1 292,6
HCFC-123	104,30	103,58	93,91	78,81	8,31	110,4
HCFC-124	1,34	0,70	0,40	0	0	1,8
HCFC-141b	1 054,23	783,83	938,40	753,26	944,75	1 379,5
HCFC-142b	9,77	4,35	0,10	0	1,25	7,5
Total parcial (tm)	2 223,04	2 118,62	2,114,35	1 779,51	1 760,52	2 791,7
HCFC-141b en polioles premezclados importados	8,27	0,03	6,30	7,94	7,75	n/d
Total (tm)	2 231,31	2 118,65	2 120,65	1 787,45	1 768,27	2 791,7
Toneladas PAO						
HCFC-22	57,94	67,44	59,48	52,11	44,34	71,1
HCFC-123	2,09	2,07	1,88	1,58	0,17	2,2
HCFC-124	0,03	0,02	0,01	0	0,00	0,0
HCFC-141b	115,97	86,22	103,22	82,86	103,92	151,7
HCFC-142b	0,64	0,28	0,01	0	0,08	0,5
Total parcial (toneladas PAO)	176,65	156,03	164,60	136,54	148,51	225,6
HCFC-141b en polioles premezclados importados	0,91	0,003	0,69	0,87	0,85	n/d
Total (toneladas PAO)	177,56	156,033	165,29	137,41	149,36	225,6

*Datos sobre el programa del país presentados el 26 de abril de 2018.

3. El consumo de HCFC-22 sigue disminuyendo, con reducciones registradas tanto en los servicios de mantenimiento como en la fabricación. El consumo de HCFC-141b aumentó en 2017, y volvió aproximadamente al mismo nivel que en 2015, pues las actividades de conversión emprendidas durante la etapa II aún están en curso.

¹ Conforme a la carta de fecha 12 de abril de 2018 enviada al PNUD por el Ministerio de Ambiente y Desarrollo Sostenible de Colombia.

Informe sobre la ejecución del programa del país

4. El Gobierno de Colombia notificó datos de consumo de HCFC por sector en el marco del informe sobre la ejecución del programa del país de 2016 que concuerdan con los datos notificados con arreglo al artículo 7 del Protocolo de Montreal.

Informe sobre los progresos realizados en la aplicación del primer tramo del plan de gestión de la eliminación de los HCFC

Marco jurídico

5. El gobierno modificó el sistema de cupos para las importaciones de HCFC en el marco de las medidas de control vigentes para lograr una reducción del consumo de HCFC del 65 por ciento del nivel de base para 2021, de conformidad con lo establecido en su Acuerdo con el Comité Ejecutivo.

6. En 2019 se espera ultimar una propuesta de reglamentación para prohibir la liberación o emisión de SAO, incluidos los HCFC, y establecer medidas aplicables tanto a SAO como a HFC para evitar la liberación, la fuga o la emisión de esas sustancias durante la instalación, el funcionamiento, el mantenimiento o el desmantelamiento de equipos de refrigeración y aire acondicionado. La aplicación de la reglamentación permitiría incluir la certificación obligatoria en la norma de competencia laboral que entraría en vigor en 2020.

Asistencia técnica para actividades normativas

7. Se llevaron a cabo las siguientes actividades:

- a) Se expidieron licencias, permisos y cupos para las importaciones de HCFC y se supervisó su uso;
- b) Se diseñó un registro sobre la liberación y la transferencia de contaminantes en el que los importadores, fabricantes y usuarios finales estarán obligados a registrar información sobre el uso y las emisiones de SAO y HFC con una periodicidad anual;
- c) Se celebraron cuatro talleres para capacitar a 132 funcionarios de aduanas sobre la prevención del comercio ilícito y la identificación de refrigerantes, y una reunión con la aduana, el Instituto Nacional de Vigilancia de Medicamentos y Alimentos y el Ministerio de Comercio, Industria y Turismo para fortalecer los vínculos entre estas instituciones y mejorar la detección del comercio ilícito de sustancias controladas;
- d) Se realizaron dos talleres dirigidos a importadores de refrigerantes y agentes espumantes sobre etiquetado y requisitos de aduanas, incluida la aplicación de códigos de aduanas específicos para los hidrocarburos; y
- e) Se llevaron a cabo actividades de sensibilización, en particular la elaboración de una guía sobre el modo de integrar los temas relativos a la protección de la capa de ozono en los proyectos escolares sobre medio ambiente; se distribuyeron cuatro boletines digitales sobre nuevos equipos de aire acondicionado con bajo potencial de calentamiento atmosférico (PCA), sistemas centralizados de refrigeración, medidas adecuadas de mitigación a nivel nacional para el sector de la refrigeración doméstica y capacitación y certificación de técnicos; se elaboró y distribuyó una publicación para promover el funcionamiento de la red de recuperación, reciclaje y reclamación; y se entregó a los usuarios finales un documento técnico sobre alternativas inocuas para el medio ambiente en el sector de la refrigeración.

Actividades en el sector de la espuma

8. Tres empresas firmaron acuerdos con el Ministerio de Ambiente y comenzaron su proceso de conversión, tal como se ilustra en el cuadro 2. Se espera que los cuatro proveedores de sistemas (Espumlatex, GMP, Olaflex y QIC) firmen sus acuerdos antes de julio de 2018 y que comiencen con el desarrollo de formulaciones de hidrofluoruroolefinas (HFO) de menor concentración poco después.

Cuadro 2. Progresos en tres empresas de espumas

Empresas	Tecnología	Fecha prevista de entrega de los equipos	Fecha prevista de terminación
Espumlatex, láminas rígidas	Espumante acuoso/HFO de menor concentración	No aplicable	Julio de 2021
Olaflex, láminas rígidas	Ciclopentano	Agosto de 2018	Noviembre de 2019
Rojas Hermanos, paneles en discontinuo	Ciclopentano	Julio de 2018	Noviembre de 2019

Actividades en el sector de los servicios de mantenimiento de equipos de refrigeración

9. Se llevaron a cabo las siguientes actividades:

- a) Se preparó un proyecto de manual sobre mejores prácticas para técnicos de servicios de mantenimiento; se realizó un taller sobre servicios de mantenimiento de equipos de refrigeración industrial y comercial para 51 instructores; se seleccionó el beneficiario para el centro de capacitación en refrigerantes naturales; se avanzó en la adaptación de la norma técnica ISO sobre requisitos ambientales y de seguridad para sistemas de refrigeración y bombas de calor a una norma técnica nacional;
- b) Se celebraron siete reuniones para examinar y actualizar normas de competencia laboral para la certificación en el uso seguro de refrigerantes de bajo PCA, que se tradujeron en una propuesta de nueva norma que está siendo objeto de examen; se realizaron dos reuniones para determinar otras instituciones, aparte del Servicio Nacional de Aprendizaje (SENA), con autoridad para certificar la competencia laboral de técnicos de servicios de mantenimiento; se certificó a 1 281 técnicos en los centros de formación existentes del SENA, lo que significa que el número total de técnicos certificados en buenas prácticas de servicios de mantenimiento entre 2005 y 2017 alcanzó a 10 110; se llevaron a cabo 29 actividades de sensibilización en 24 ciudades para 1 000 técnicos y empresas del sector de la refrigeración y el aire acondicionado;
- c) Se fortaleció el programa de recuperación, reciclaje y reclamación mediante: la compra de 260 unidades de recuperación y 520 cilindros de almacenamiento correspondientes, así como ocho cilindros de 1 000 kg y 622 cilindros de 13,6 kg para los centros de reclamación, cuya distribución está aún en curso; y se organizaron 15 talleres de formación para 207 técnicos (de los cuales cuatro eran mujeres); y
- d) Se realizaron actividades para promover el uso de alternativas inocuas para el medio ambiente, en particular: seis reuniones regionales sobre gestión ambiental de SAO; colaboraciones con asociaciones empresariales para integrar alternativas ecológicas para equipos de refrigeración y aire acondicionado en sus estrategias, en particular, la Asociación Hotelera y Turística de Colombia en materia de sistemas de refrigeración favorables al medio ambiente y gestión de SAO, y divulgación de información a la Asociación Nacional de Empresas de Servicios Públicos y Comunicaciones, la Federación Nacional de Comerciantes, la Asociación Colombiana de Hospitales y Clínicas, la Cámara Colombiana de la Infraestructura, la Asociación Nacional de Industriales y Empresarios,

las Cámaras de la Industria de Bebidas y de Alimentos y la Cámara Sectorial de Salud, y la Asociación Colombiana de Exportadores de Flores; aprobación de una exención del impuesto sobre el valor añadido (IVA) para usuarios finales de sistemas de enfriamiento que apliquen criterios de eficiencia energética y bajo impacto ambiental; firma de un acuerdo entre una cadena de supermercados y una empresa de montaje para instalar el primer sistema transcrítico con CO₂ en el país; firma de un acuerdo para poner en marcha un proyecto de cogeneración y recuperación de calor con un sistema de refrigeración por absorción para los equipos de aire acondicionado de un hotel; y celebración de un congreso internacional de tres días de duración sobre la gestión integral de SAO y su contribución a la estabilidad climática, en septiembre de 2017.

Actividades en el sector de la protección contra incendios

10. Se llevaron a cabo las siguientes actividades:
- a) Se elaboró un documento técnico sobre cuestiones ambientales y de seguridad relativas a extintores de incendios portátiles;
 - b) Se realizó una evaluación de las actividades de mantenimiento y recarga en cinco empresas;
 - c) Se proporcionaron conocimientos técnicos para la publicación de una guía para la promoción de mejores prácticas en el mantenimiento y la recarga de extintores de incendios portátiles; y
 - d) Se organizaron tres talleres para divulgar los resultados de las evaluaciones sobre el impacto ambiental y la seguridad y buenas prácticas de carga, recarga y mantenimiento de extintores portátiles que utilizan HCFC-123.

Unidad de ejecución y vigilancia del proyecto

11. La unidad de ejecución y vigilancia del proyecto llevó a cabo, con la asistencia de cuatro consultores, actividades dirigidas al sector de las espumas, actividades de capacitación y certificación en el sector de la refrigeración y el aire acondicionado y el sector de los servicios de mantenimiento, y actividades relativas al control del comercio.

Nivel de desembolso de fondos

12. Al mes de mayo de 2018, de los 2 718 391 \$EUA aprobados hasta el momento (2 342 591 \$EUA para el PNUD, 50 000 \$EUA para el PNUMA y 325 800 \$EUA para el Gobierno de Alemania), se habían desembolsado 1 069 239 \$EUA (39,33 por ciento) (742 774 \$EUA para el PNUD, 12 579 \$EUA para el PNUMA y 313 886 \$EUA para el Gobierno de Alemania). El saldo de 1 649 152 \$EUA será desembolsado entre 2018 y 2019.

Plan de ejecución del segundo tramo del plan de gestión de la eliminación de los HCFC

13. Las siguientes actividades se llevarán adelante entre de 2018 y julio de 2021:
- a) Asistencia técnica para el fortalecimiento del marco reglamentario (PNUD) (10 000 \$EUA);

- b) Asistencia técnica para reforzar el control del comercio de sustancias y equipos a base de HCFC, incluida la participación en el intercambio electrónico de información sobre el comercio de SAO (i-PIC); y participación en la aplicación del Sistema Globalmente Armonizado (SGA) para los productos químicos, con especial atención al etiquetado de HCFC (PNUMA) (50 000 \$EUA);
- c) Conversión de empresas y proveedores de sistemas de espumas a tecnologías a base de hidrocarburos, HFO de menor concentración y espumantes acuosos en el sector de las espumas (PNUD) (1 137 247 \$EUA);
- d) Capacitación de 30 instructores sobre mejores técnicas de contención de HCFC en equipos de refrigeración y aire acondicionado; herramientas y equipos de demostración para el establecimiento de un centro de formación sobre refrigerantes naturales; capacitación de 30 instructores en el uso seguro de refrigerantes naturales y otros refrigerantes de bajo PCA; talleres de formación para instructores del SENA; y adaptación de los requisitos ambientales y de seguridad ISO para sistemas de refrigeración y bombas de calor a una norma técnica nacional (Alemania) (162 900 \$EUA);
- e) Desarrollo de nuevas normas de competencia laboral para la certificación en el uso seguro de refrigerantes de bajo PCA, con especial atención a los refrigerantes naturales, y talleres para promover la certificación de técnicos de equipos de refrigeración y aire acondicionado (PNUD) (25 000 \$EUA);
- f) Reuniones y actividades de supervisión de la red de recuperación, reciclaje y reclamación (PNUD) (10 000 \$EUA);
- g) Actividades, talleres y reuniones de coordinación con usuarios finales de equipos de refrigeración y aire acondicionado; apoyo a la capacitación de usuarios finales sobre el seguimiento de los procedimientos necesarios y el acceso al beneficio de la exención del IVA; y asistencia técnica para el uso seguro de alternativas inocuas para el medio ambiente en los proyectos piloto desarrollados en una cadena de supermercados y un hotel (PNUD) (55 000 \$EUA);
- h) Actividades de sensibilización, incluida la integración de las cuestiones relativas a la capa de ozono en proyectos educativos escolares sobre el medio ambiente, y campañas de divulgación permanentes dirigidas a usuarios finales (PNUMA) (15 000 \$EUA); y
- i) Aplicación y vigilancia permanentes del proyecto (PNUMA) (15 760 \$EUA).

OBSERVACIONES Y RECOMENDACIÓN DE LA SECRETARÍA

OBSERVACIONES

Informe sobre el consumo de HCFC

Informe de verificación

14. El informe de verificación correspondiente al período 2015-2017 fue presentado el 27 de mayo de 2018. La Secretaría examinará dicho informe tras la celebración de la 81ª reunión. En consonancia con la decisión 72/19, los fondos aprobados en el marco del segundo tramo no serán transferidos hasta que la Secretaría no examine el informe de verificación y confirme que el gobierno está en cumplimiento del Protocolo de Montreal y de su Acuerdo con el Comité Ejecutivo.

Estado de la aplicación de la etapa I del plan de gestión de la eliminación de los HCFC

15. De conformidad con la decisión 72/25 a), estaba previsto que el informe de terminación del proyecto para la etapa I se presentara a la segunda reunión de 2016; sin embargo, el informe aún no se ha presentado. Se ha notificado que el proyecto ha terminado y que los saldos restantes de 111 \$EUA, más gastos de apoyo al organismo de 8 \$EUA, se devolvieron² a la 81ª reunión.

Informe sobre los progresos realizados en la aplicación del primer tramo del plan de gestión de la eliminación de los HCFC

Marco jurídico

16. El Gobierno de Colombia ya estableció cupos de importación para los HCFC para 2018, de conformidad con los objetivos de control del Protocolo de Montreal.

Asistencia técnica para actividades normativas

17. Con respecto a la prohibición del uso de HCFC-141b en el sector de la protección contra incendios, que debía aplicarse antes del 31 de diciembre de 2017, de conformidad con la decisión 75/44 b) ii), el PNUMA explicó que el proyecto de resolución está siendo examinado por la Oficina Asesora Jurídica del Ministerio de Ambiente y Desarrollo Sostenible. Se espera que la prohibición entre en vigor a finales de 2018. La Secretaría observó que el uso de HCFC-141b para estos fines no era seguro, por lo que sugirió que no se presentara la solicitud de financiación del tercer tramo de la etapa II del plan de gestión de la eliminación de los HCFC hasta que la prohibición no estuviera en vigor.

Actividades en el sector de la espuma

18. En respuesta a la decisión 75/44 b) vi), el PNUD informó de que los costos adicionales de explotación correspondientes a la introducción de sistemas a base de HFO superará los 10 \$EUA/kg debido a los mayores costos de las materias primas y el trabajo adicional necesario para elaborar formulaciones de HFO de menor concentración. La Secretaría observó que los HFO aún no están disponibles comercialmente en el país, pero se espera que lo estén una vez que los proveedores de sistemas presenten sus órdenes de compra, y que los costos adicionales de explotación dependerán de las formulaciones y los precios en el momento de la conversión. Además, la Secretaría tomó nota del informe final sobre el proyecto de demostración para validar el uso de HFO para paneles en discontinuo en las Partes que operan al amparo del artículo 5 mediante el desarrollo de formulaciones eficaces en función de los costos³ en Colombia, en el que se indicaba que los costos adicionales de explotación podrían variar entre 9,17 \$EUA/kg y 3,48 \$EUA/kg para el HFO-1233zd(E) y entre 21,60 \$EUA/kg y 8,14 \$EUA/kg para el HFO-1336mzz(Z). Dado que los costos adicionales de explotación dependerán de las formulaciones utilizadas y, en particular, de la medida en que se utilicen las formulaciones de HFO de menor concentración, la Secretaría recomendó que el PNUD informara de los costos adicionales de explotación efectivos incurridos durante la conversión a esas formulaciones en el sector de las espumas cuando en el futuro solicite la financiación de un tramo de la etapa II del plan de gestión de la eliminación de los HCFC, en el entendimiento de que si los costos adicionales de explotación son inferiores a 2,13 \$EUA/kg, el Gobierno de Colombia devolvería los fondos correspondientes al Fondo Multilateral, de conformidad con la decisión 75/44 b) vi).

19. Con respecto a las conversiones en los cuatro proveedores de sistemas, la primera etapa, que durará hasta el 1 de diciembre de 2019, consistirá en la elaboración de formulaciones por parte de dichas empresas. La segunda etapa, que se extenderá hasta el 31 de julio de 2021, se centrará en la producción y

² UNEP/OzL.Pro/ExCom/81/4

³ Que figuran en los informes de situación y los informes sobre los proyectos con requisitos específicos de presentación de informes (UNEP/OzL.Pro/ExCom/81/10).

comercialización de poliésteres para diferentes aplicaciones, lo que supone su producción, la transferencia de tecnología para usuarios finales de diferentes aplicaciones y el comienzo de las ventas y su verificación.

Actividades en el sector de los servicios de mantenimiento

20. Las actividades realizadas son parte de un marco coherente orientado a fortalecer el sector de los servicios de mantenimiento y facilitar la introducción de alternativas inocuas para el medio ambiente y de bajo PCA, incluidas medidas –aplicables tanto a SAO como a los HFC– para evitar la liberación, la fuga o la emisión de dichas sustancias durante la instalación, el funcionamiento, el mantenimiento o el desmantelamiento de equipos de refrigeración y aire acondicionado, e incluyen, entre otras, las siguientes actividades: capacitación sobre el uso seguro de alternativas de bajo PCA; elaboración de códigos de prácticas y normas técnicas, así como normas de competencia laboral para la certificación en el uso seguro de alternativas de bajo PCA; trabajo con usuarios finales para integrar el uso de alternativas de bajo PCA y criterios de eficiencia energética en sus estrategias; y adopción de la exención del IVA para usuarios finales de sistemas de enfriamiento que apliquen criterios de eficiencia energética y de bajo impacto ambiental.

Conclusión

21. El plan de gestión de la eliminación de los HCFC está progresando, y el sistema de concesión de licencias y cupos a las importaciones del país está en funcionamiento y permitirá reducir el consumo de HCFC de conformidad con el calendario de eliminación establecido en el Protocolo de Montreal y el Acuerdo contraído por el país con el Comité Ejecutivo. Si bien el examen del informe de verificación por la Secretaría está aún pendiente, el consumo notificado está por debajo de los objetivos establecidos en el Acuerdo. El nivel de desembolso es del 39,33 por ciento. Las conversiones en las empresas de fabricación de espumas están progresando, y se prevé que los proveedores de sistemas comiencen sus actividades de conversión en breve. Se han realizado actividades para limitar el uso de HCFC-141b en la protección contra incendios, y pese a la demora en la aplicación de la prohibición del uso de esa sustancia en dicho sector, se prevé que la prohibición entre en vigor pronto. Las actividades realizadas en el sector de los servicios de mantenimiento se inscriben en un marco coherente y bien planificado, encaminado a fortalecer el sector y facilitar la introducción de alternativas inocuas para el medio ambiente y de bajo PCA. Se espera que con ello se garantice la sostenibilidad a largo plazo de las actividades, ayudando al país a cumplir sus obligaciones contraídas en virtud del Protocolo.

RECOMENDACIÓN

22. La Secretaría del Fondo recomienda que el Comité Ejecutivo tome nota del informe sobre los progresos realizados en la aplicación del primer tramo de la etapa II del plan de gestión de la eliminación de los HCFC de Colombia; y también recomienda la aprobación general del segundo tramo de la etapa II del plan de gestión de la eliminación de los HCFC de Colombia, y el correspondiente plan de ejecución de tramos para 2018-2019, con el nivel de financiación que se indica en el cuadro continuación, en el entendimiento de que:

- a) Los fondos aprobados no se transferirán al PNUD, el PNUMA o el Gobierno de Alemania hasta que la Secretaría no haya examinado el informe de verificación para 2015, 2016 y 2017 y confirmado que el Gobierno de Colombia está en cumplimiento del Protocolo de Montreal y el Acuerdo entre el Gobierno y el Comité Ejecutivo;
- b) El PNUD informará de los costos adicionales de explotación efectivos incurridos durante la conversión a formulaciones de HFO de menor concentración en el sector de las espumas cuando solicite la financiación de un tramo de la etapa II del plan de gestión de la eliminación de los HCFC en el futuro, con la condición de que si los costos adicionales de explotación son inferiores a 2,13 \$EUA/kg, el Gobierno de Colombia devolvería los fondos correspondientes al Fondo Multilateral, de conformidad con la decisión 75/44 b) vi); y

- c) El PNUD seguirá prestando asistencia al Gobierno de Colombia para promulgar la prohibición del uso de HCFC-141b en el sector de la protección contra incendios lo antes posible.

	Título del proyecto	Financiación del proyecto (\$EUA)	Gastos de apoyo (\$EUA)	Organismo de ejecución
a)	Plan de gestión de la eliminación de los HCFC (etapa II, segundo tramo)	1 268 007	88 761	PNUD
b)	Plan de gestión de la eliminación de los HCFC (etapa II, segundo tramo)	50 000	6 500	PNUMA
c)	Plan de gestión de la eliminación de los HCFC (etapa II, segundo tramo)	162 900	20 919	Alemania

HOJA DE EVALUACIÓN DE PROYECTO – PROYECTOS NO PLURIANUALES

COLOMBIA

TÍTULO DEL PROYECTO

ORGANISMO BILATERAL/DE EJECUCIÓN

a) Conversión del HFC-134a al isobutano en la fabricación de refrigeradores domésticos en Mabe Colombia	PNUD
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ORGANISMO DE COORDINACIÓN NACIONAL	Unidad Técnica Ozono, Ministerio de Ambiente y Desarrollo Sostenible
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ÚLTIMOS DATOS NOTIFICADOS SOBRE EL CONSUMO DE SAO QUE SON OBJETO DEL PROYECTO

A: DATOS CON ARREGLO AL ARTÍCULO 7 (TONELADAS MÉTRICAS, [INSERTAR AÑO], A [INSERTAR MES Y AÑO])*

HFC	tm	n/d
	tm CO ₂ -eq.	n/d

B: DATOS SECTORIALES DEL PROGRAMA DE PAÍS (TONELADAS MÉTRICAS, [INSERTAR AÑO], A [INSERTAR MES Y AÑO])*

HFC	tm	n/d
	tm CO ₂ -eq.	n/d

* En 2015 se estimó un uso total de 1 568 tm de HFC (incluidas 927 tm de HFC-134a) (fuente: “Survey of ODS and ODS alternatives in Colombia”, Gobierno de Alemania/Unidad Técnica Ozono del Ministerio de Ambiente y Desarrollo Sostenible, enero de 2017)

Consumo restante de HFC admisible para la financiación	tm	n/d
	tm CO ₂ -eq.	n/d

ASIGNACIONES DEL PLAN ADMINISTRATIVO DEL AÑO EN CURSO	Financiación (\$EUA)	Toneladas PAO para eliminación
a)	0	0

TÍTULO DEL PROYECTO:	Mabe	
HFC-134a utilizados en la empresa:	tm	67,28
	tm CO ₂ -eq.	96 210
HFC-134a que se eliminarán mediante este proyecto	tm	67,28
	tm CO ₂ -eq.	96 210
Alternativa que se introducirá mediante este proyecto R-600a:	tm	26,91
	tm CO ₂ -eq.	80,73
Duración del proyecto (meses):		12
Monto inicial solicitado (\$EUA):		3 829 127
Costos finales del proyecto (\$EUA):		
Costo adicional de capital:		1 074 350
Imprevistos (10%):		81 150
Costo adicional de explotación:		0
Costo total del proyecto:		1 114 350
Propiedad local (%):		100
Componente de exportación (%):		0
Donación solicitada (\$EUA):		1 114 350
Eficacia en función de los costos:	\$EUA/kg	16,56
	\$EUA/tm CO ₂ -eq.	11,58
Gastos de apoyo del organismo de ejecución (\$EUA):		78 005
Costo total del proyecto para el Fondo Multilateral (\$EUA):		1 192 355
Situación de la financiación de contraparte (S/N):		S
Hitos de supervisión del proyecto incluidos (S/N):		N

RECOMENDACIÓN DE LA SECRETARÍA	Para consideración individual
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Nota de la Secretaría

Antecedentes

23. En nombre del Gobierno de Colombia, el PNUD presentó a la 79ª reunión una propuesta de proyecto para la conversión de la fabricación de refrigeradores domésticos en Mabe Colombia de la tecnología a base de HFC-134a a tecnología que utiliza isobutano⁴, conforme a lo dispuesto en la decisión 78/3 g). Tras la decisión del Comité Ejecutivo de postergar el proyecto hasta la 80ª reunión (decisión 79/39), el PNUD volvió a presentar una propuesta revisada⁵ a la 80ª reunión. En dicha reunión, el Comité Ejecutivo aplazó el examen del proyecto hasta la 81ª reunión.

24. En nombre del Gobierno de Colombia, el PNUD volvió a presentar a la 81ª reunión la propuesta de proyecto que había presentado a la 80ª reunión, con las siguientes modificaciones: el HFC-134a pasó de 61,32 toneladas métricas (tm) (87 688 tm CO₂-eq.) a 67,28 tm (96 210 (tm CO₂-eq.), sobre la base de la información actualizada sobre el consumo en la empresa, tal como se muestra en el cuadro 1, y una reducción de la duración del proyecto de 18 a 12 meses.

Cuadro 1. Consumo de HFC-134a en Mabe Colombia (2014-2017)

Año	Consumo	
	tm	tm CO ₂ -eq.
2014	58,31	83 383
2015	49,52	70 814
2016	76,13	108 866
2017	76,18	108 937
Promedio 2015-2017	67,28	96 210

25. En la presentación se reitera el compromiso del Gobierno de Colombia de promulgar una prohibición de la fabricación y la importación de refrigeradores domésticos que utilicen HFC como refrigerante una vez que la empresa haya concluido la conversión de su producción.

26. Tras la presentación de la propuesta de proyecto a la 81ª reunión, el PNUD aclaró que la empresa ya había realizado la mayoría de las inversiones para las que había solicitado financiación cuando se presentó inicialmente el proyecto a las reuniones 79ª y 80ª.

27. El documento que contiene la propuesta de proyecto formulada por el Gobierno de Colombia a la 80ª reunión se adjunta a la presente nota de la Secretaría.

Observaciones de la Secretaría

28. El PNUD confirmó que, en consonancia con la decisión 78/3 g), el proyecto recogería datos sobre los costos adicionales de explotación, que se incluirían en el informe final del proyecto, incluso pese a no haberse solicitado la financiación de dichos costos; y que, de conformidad con la decisión 22/38 y decisiones posteriores del Comité Ejecutivo, los equipos que se reemplazarían en el marco del proyecto serían destruidos o declarados inutilizables.

29. La Secretaría pidió más aclaraciones respecto del estado de la conversión de la empresa. El PNUD aclaró que, desde 2016, Mabe Colombia había decidido adoptar un proceso de producción ambientalmente racional, en línea con el fuerte compromiso del Gobierno de Colombia con el medio ambiente, por el cual se alienta a las empresas del sector de la refrigeración y el aire acondicionado a utilizar tecnologías que reduzcan al mínimo el impacto ambiental a largo plazo. La decisión de Mabe Colombia se vio reforzada

⁴ UNEP/OzL.Pro/ExCom/79/31

⁵ UNEP/OzL.Pro/ExCom/80/38

por la aprobación de la Enmienda de Kigali. En consecuencia, la planificación y ejecución del proceso de conversión ha tenido lugar durante los últimos dos años, y solamente se han utilizado los fondos proporcionados por la empresa.

30. El PNUD añadió que el proceso de conversión estaba en una fase avanzada: los equipos necesarios para la conversión descritos en la propuesta de proyecto presentada al Comité Ejecutivo ya se habían entregado e instalado en la empresa. La empresa sigue trabajando en el nuevo diseño y la certificación de los productos, así como en la garantía de la calidad, las pruebas prácticas y la capacitación. La labor restante podrá completarse en el período convenido de 12 meses, y la fabricación basada en la nueva tecnología comenzaría inmediatamente después.

Recomendación

31. El Comité Ejecutivo quizás desee considerar:

- a) La propuesta de proyecto para la conversión del HFC-134a al isobutano en la fabricación de refrigeradores domésticos en Mabe Colombia, en el contexto de su examen de los proyectos independientes sobre HFC presentados a la 81ª reunión de conformidad con la decisión 78/3 g), que figura en la Reseña de las cuestiones identificadas durante el examen de proyectos (UNEP/Oz.L.Pro/ExCom/81/14);
- b) Si aprueba o no la propuesta de proyecto indicada en el inciso a) *supra* por la suma de 1 114 350 \$EUA, más gastos de apoyo al organismo de 78 005 \$EUA para el PNUD, en el entendimiento de que, si se aprobara el proyecto:
 - i) No se facilitaría más financiación hasta tanto el instrumento de ratificación fuese presentado por el Gobierno de Colombia al depositario en la Sede de las Naciones Unidas en Nueva York;
 - ii) Se descontarían 67,28 tm (96 210 tm CO₂-eq.) de HFC-134a del punto de partida para las reducciones acumulativas sostenidas de HFC una vez establecido;
 - iii) El proyecto concluiría en un plazo de 12 meses contados a partir de la transferencia de los fondos al PNUD, y se presentaría un informe completo de terminación del proyecto, con información detallada sobre los costos de capital adicionales y costos adicionales de explotación admisibles, así como posibles ahorros realizados durante la conversión y factores pertinentes que hubiesen facilitado la ejecución, dentro de los seis meses siguientes a la terminación del proyecto; y
 - iv) Todos los fondos restantes se devolverían al Fondo Multilateral a más tardar un año después de la fecha de terminación del proyecto.



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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Eightieth Meeting
Montreal, 13-17 November 2017

PROJECT PROPOSAL: COLOMBIA

This document consists of the comments and recommendation of the Secretariat on the following project proposal:

Refrigeration

- Conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia

UNDP

PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT

COLOMBIA

PROJECT TITLE(S) BILATERAL/IMPLEMENTING AGENCY

(a) Conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia	UNDP
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NATIONAL CO-ORDINATING AGENCY	Ozone Technical Unit of the Ministry of Environment and Sustainable Development
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LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT

A: ARTICLE-7 DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	*
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B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	*
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HFC consumption remaining eligible for funding (ODP tonnes)	n/a
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CURRENT YEAR BUSINESS PLAN ALLOCATIONS		Funding US \$	Phase-out ODP tonnes
	(a)	0	0

PROJECT TITLE:	Mabe
HFC-134a used at enterprise (mt):	61.32
HFC-134a to be phased out (mt):	61.32
HFC-134a to be phased out (mt CO ₂ equivalent):	87,688
Project duration (months):	18
Initial amount requested (US \$):	3,024,067
Final project costs (US \$):	
Incremental capital cost:	1,033,200
Contingency:	81,150
Incremental operating cost:	0
Total project cost:	1,114,350
Local ownership (%):	100
Export component (%):	0
Requested grant (US \$):	1,114,350
Cost-effectiveness (US \$/kg):	18.17
Implementing agency support cost (US \$):	78,005
Total cost of project to Multilateral Fund (US \$):	1,192,355
Status of counterpart funding (Y/N):	Y
Project monitoring milestones included (Y/N):	N

SECRETARIAT'S RECOMMENDATION	For individual consideration
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* A total use of 1,568 mt of HFC (including 927 mt of HFC-134a) was estimated in 2015 (source ODS survey)

PROJECT DESCRIPTION

Background

1. On behalf of the Government of Colombia, UNDP submitted to the 79th meeting a project proposal to convert the manufacturing of domestic refrigerators at Mabe Colombia from HFC-134a to isobutane,¹ pursuant to decision 78/3(g).
2. At the same meeting, UNDP submitted an additional project proposal for the phase-out of HFC-134a used in the manufacturing of domestic refrigerators in Bangladesh.²
3. The two project proposals were included in the document on the Overview of issues identified during project review³ as they were submitted for individual consideration.

Discussion between UNDP and the Secretariat prior to the 79th meeting⁴

4. UNDP had submitted to the 79th meeting a proposal for US \$3,829,157 (including incremental capital cost (ICC) of US \$3,059,760 and incremental operational cost (IOC) of US \$769,397).⁵ Upon discussions with the Secretariat, UNDP provided a revised proposal for US \$2,929,267 consisting of ICC of US \$1,959,870, IOCs of US \$769,397 and US \$200,000 to implement a ban on manufacturing and importing HFC-134a-based equipment, of which US \$1,426,400 was requested from the Fund and US \$1,502,867 co-financed by Mabe.
5. Based on its analysis, the Secretariat estimated the ICC of conversion at US \$992,970, and suggested an additional US \$30,000 to implement a ban on HFC-134a-based equipment. The Secretariat did not propose changes to the IOC of US \$769,397, noting that it did not have sufficient experience to assess those costs. Based on the revised costs estimated by the Secretariat (i.e., US \$1,792,367), the enterprise needed additional time to consider those costs and an appropriate level of co-funding, if any.

Discussion at the 79th meeting⁶

6. At the 79th meeting, the Executive Committee agreed to consider the two project proposals (from Bangladesh and Colombia) in the contact group established under agenda item 11(c)(i), Matters related to the Kigali Amendment to the Montreal Protocol: draft criteria for funding. However, discussions at the contact group focussed on additional criteria for the consideration of HFC-related investment project proposals, rather than on the actual proposals. Consequently, the Executive Committee agreed to defer the consideration of the two HFC-related projects to the 80th meeting.⁷

¹ UNEP/OzL.Pro/ExCom/79/31

² UNEP/OzL.Pro/ExCom/79/28.

³ UNEP/OzL.Pro/ExCom/79/19.

⁴ The full text of the discussions is contained in paragraphs 14 to 27 of document UNEP/OzL.Pro/ExCom/79/31, attached to this note.

⁵ The proposal also included additional costs associated (US \$3,075,261) with improving the energy efficiency of equipment manufactured that would be borne by enterprise.

⁶ The full text of the discussions is contained in paragraphs 87 to 89 and 143 of document UNEP/OzL.Pro/ExCom/79/51.

⁷ Decision 79/39 and decision 79/40.

Resubmission of the HFC-related investment project for Colombia

7. On behalf of the Government of Colombia, UNDP resubmitted to the 80th meeting the project proposal submitted to the 79th meeting with a reduction in requested funding from the Multilateral Fund from US \$3,829,175 to US \$3,024,067, as submitted. The duration of the project is 18 months.

8. The project document submitted to the 79th meeting, including project description and Secretariat's comments and recommendation has been attached to the present document.

SECRETARIAT'S COMMENTS AND RECOMMENDATION

COMMENTS

9. The Secretariat noted that while the funding requested in the revised proposal was below that originally submitted to the 79th meeting, it was above the latest proposed by UNDP at the 79th meeting (US \$2,929,267 of which US \$1,426,400 requested from the Fund). It was therefore agreed to use the costs estimated by the Secretariat at the 79th meeting as a basis for discussing the level of funding for the project. On that basis, UNDP and the Secretariat entered into a detailed discussion about the costs of the project.

10. A key difference between the costs estimated by the Secretariat and the proposal made by UNDP at the 79th meeting was the level of additional co-financing provided by the enterprise. Further to the discussion, it was agreed that the IOCs be considered as co-financing provided by the enterprise, noting that the provision of incremental costs was intended as an incentive for early adoption of technologies and the other two enterprises manufacturing domestic refrigerators in the country had already converted to R-600a using their own resources. The Secretariat would emphasize that the agreement for not requesting IOCs should not be considered as a precedent; while the Secretariat considers this appropriate in this circumstance, it may not be appropriate in other circumstances.

11. With regard to the ICC proposed by the Secretariat at the 79th meeting, based on the revised proposal submitted to the 80th meeting, review of additional information and further discussions with UNDP, the following changes of some of the equipment items were agreed:

- (a) The incremental cost of the storage and feeding system was increased from US \$135,000 to US \$142,500 as the layout at the enterprise will require the R-600a storage tank to be located several hundred meters from the manufacturing facility, requiring long pipes, additional shut-off valves and accumulators for R-600a;
- (b) The cost of the helium vacuum and leak test was increased from US \$24,000 to US \$45,000 per unit, for a total of US \$135,000 considering a review of additional information, including from other projects submitted to the 80th meeting;
- (c) The cost of an R-600a charging station was increased from US \$43,333 to US \$50,000 per unit for a total of US \$150,000;
- (d) Contingencies were adjusted to US \$81,150 in line with the revised costs related to capital equipment (only); and
- (e) Funding for the implementation of a ban on manufacturing and importing HFC-134a-based equipment was agreed at US \$40,000.

12. On that basis, the agreed level of funding requested from the Multilateral Fund was US \$1,114,350 (US \$18.17/kg). Implementation of the project would result in the phase-out of 61.34 mt of HFC-134a

(87,688 CO₂-eq tonnes), the complete phase-out of HFC-134a in the manufacturing of domestic refrigerators in the country and a ban on the manufacture and import of such equipment, noting that domestic refrigerators manufactured in Colombia are exported to neighbouring countries.

Table 1. Agreed costs for Mabe Colombia project

Item	Agreed cost (US \$)
<i>Sub-total storage and feeding system</i>	142,500
<i>Vacuum and leak test</i>	135,000
<i>Refrigerant charge system</i>	
HC charging station (3)	150,000
Ultrasonic welding equipment (3)	90,000
HC leak detectors (3)	90,000
<i>Zone of functional repairs</i>	9,000
<i>Associated works</i>	
Civil works	15,000
Safety system	120,000
Ventilation system (fans, motors, ducts and platforms)	60,000
Sub-total production lines modification	811,500
<i>Installation and start-up</i>	50,000
<i>Trials, test, product certification, safety audit</i>	
Refrigerator for trials	24,200
Field tests	5,000
Certification of new products	27,500
General safety certification	25,000
<i>Human resources</i>	
Training	20,000
Technical assistance	30,000
Sub-total general	181,700
Sub-total	993,200
Contingencies (10%)	81,150
Total ICC	1,074,350
Total IOC	0
Implementation of ban on HFC-134a-based equipment	40,000
Funding request to the Multilateral Fund	1,114,350

13. While agreeing to the level of funding requested from the Multilateral Fund, the Government of Colombia noted that it considered the total cost of conversion to be above the agreed level. The Secretariat notes that the enterprise will implement with its own funds a component of the project aimed at improving the energy efficiency of most of their models produced, with an expected efficiency improvement of approximately 25 per cent. However, the Secretariat has not assessed the costs associated with that component. In addition, the Secretariat notes that the purpose of implementing projects under decision 78/3(g) is to gain experience in the ICCs and IOCs that might be associated with phasing down HFCs. Based on available information at the time of review, the Secretariat considers that the agreed costs are its best estimates of the overall incremental costs of conversion, but those estimates might change as more information becomes available, and according to the specific characteristics of the enterprises. The Secretariat therefore considers that the agreed costs would not constitute a precedent.

14. The Secretariat further notes as follows:

- (a) The project that was submitted to the 79th meeting fulfilled the requirements under decision 78/3(g); and
- (b) The project re-submitted to the 80th meeting fulfills all the additional requirements under decision 79/45, i.e., the project is submitted by an individual domestic refrigerator

enterprise to convert from HFC-134a to isobutane, a mature technology that have been introduced in similar enterprises in other Article 5 countries when replacing CFC-12 as refrigerant. The results of the project could be replicated in other HFC-134a-based domestic refrigerator manufacturing enterprises in Article 5 countries. The project will be fully implemented in less than two years, a comprehensive report will be issued once it is completed with detailed information on the eligible ICCs and IOCs, and any remaining funds would be returned to the Fund no later than one year after the date of project completion.

RECOMMENDATION

15. The Executive Committee may wish to consider the project for conversion from HFC-134a to isobutane in the manufacture of domestic refrigerators at Mabe Colombia in relation to decision 79/45 and discussions under Overview of issues identified during project review in document UNEP/OzL.Pro/ExCom/80/22.



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Seventy-ninth Meeting
Bangkok, 3-7 July 2017

PROJECT PROPOSAL: COLOMBIA

This document consists of the comments and recommendation of the Secretariat on the following project proposal:

Refrigeration

- Conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia UNDP

PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT

COLOMBIA

PROJECT TITLE(S)

BILATERAL/IMPLEMENTING AGENCY

(a) Conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia	UNDP
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NATIONAL CO-ORDINATING AGENCY

Ozone Technical Unit of the Ministry of Environment and Sustainable Development

LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT

A: ARTICLE-7 DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	n/a
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B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	n/a
------	-----

HFC consumption remaining eligible for funding (ODP tonnes)

n/a

CURRENT YEAR BUSINESS PLAN ALLOCATIONS

Funding US \$

Phase-out ODP tonnes

(a)	0	0
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PROJECT TITLE:	Mabe
HFC-134a used at enterprise (mt):	61.32
HFC-134a to be phased out (mt):	61.32
HFC-134a to be phased in (mt CO ₂ equivalent):	87,688
Project duration (months):	24
Initial amount requested (US \$):	3,829,157
Final project costs (US \$):	
Incremental capital cost:	1,781,700
Contingency (10 %):	178,170
Incremental operating cost:	769,397
Total project cost:	2,729,267
Local ownership (%):	100
Export component (%):	0
Requested grant (US \$):	1,426,400
Cost-effectiveness (US \$/kg):	23.26
Implementing agency support cost (US \$):	99,848
Total cost of project to Multilateral Fund (US \$):	1,526,248
Status of counterpart funding (Y/N):	Y
Project monitoring milestones included (Y/N):	N

SECRETARIAT'S RECOMMENDATION

For individual consideration

PROJECT DESCRIPTION

1. On behalf of the Government of Colombia, UNDP has submitted to the 79th meeting a project proposal to convert the manufacturing of domestic refrigerators at Mabe Colombia from HFC-134a to isobutane (R-600a) at a total cost of US \$3,829,157, plus agency support costs of US \$268,041, as originally submitted.

2. In line with decision 78/3(g), the endorsement letter from the Government of Colombia for the project indicates the Government's intention to ratify the Kigali Amendment; that the Government is aware that no further funding would be available until the instrument of ratification of the Kigali Amendment had been received by the depositary at the United Nations Headquarters in New York, if this project would be approved by the Executive Committee; and that the Government acknowledges that in case this project is approved, any HFC reduced would be deducted from its starting point (which may be agreed in the future). The Secretariat also notes with appreciation that this proposal was submitted without preparation funding.

Project objective

3. The project will eliminate the annual consumption of 61.32 metric tonnes (mt) (87,688 of CO₂ tonnes) of HFC-134a at three lines manufacturing domestic refrigerators at Mabe Colombia. The energy efficiency of the domestic refrigerators will also be improved by 25 per cent through modifications of the production lines and components.

HFC consumption and sector background

4. In 2015, a consumption of 1,613 mt of HFCs was identified in the refrigeration and air-conditioning (RAC) sector in Colombia, of which 98.16 mt (6.1 per cent) was in the manufacturing of domestic refrigerators by three enterprises. About 1.1 million domestic refrigerators were manufactured, of which 21 per cent were exported to neighbouring countries with approximately the same amount being imported. Of the imported domestic refrigerators, approximately 68 per cent are HFC-134a-based and 32 per cent are R-600a-based. Since 2015, two of the domestic refrigeration manufacturing enterprises have completed their conversion to R-600a and no longer consume HFC-134a; the only domestic refrigerator manufacturer in the country currently consuming HFC-134a is Mabe. The 2015 consumption of ODS alternatives in the RAC sector as estimated by the Government of Colombia as part of the survey of ODS alternatives submitted to the 79th meeting is summarized in Table 1.

Table 1. Refrigerant consumption in the RAC sector in 2015 (mt) as reported in the survey of ODS alternatives

Sectors	HCFC-22	HFC-134a	R-404A	R-407C	R-410A	R-507A	R-717	R-437A	Other
Refrigeration									
Domestic refrigeration manufacturing	-	98.16	-	-	-	-	-	-	1.24
Commercial refrigeration manufacturing	134.65	140.12	17.03	0.21	-	39.11	-	-	1.88
Industrial refrigeration manufacturing	91.12	80.08	21.10	3.95	-	43.86	458.85	-	0.23
Transportation refrigeration	0.42	0.56	1.65	-	-	-	-	0.08	-
Servicing	492.20	219.65	80.01	17.80	-	126.78	152.95	32.86	18.10
Air conditioning									
AC manufacturing	164.92	21.06	-	3.64	95.19	-	-	0.16	0.89
Mobile AC manufacturing	-	75.01	-	-	-	-	-	-	-
AC servicing	81.63	33.96	-	22.77	80.85	-	-	4.32	11.70
Mobile AC servicing	-	159.55	-	-	-	-	-	0.18	-
Total	964.95	828.15	119.79	48.38	176.04	209.74	611.80	37.60	34.03

Sectors	HCFC-22	HFC-134a	R-404A	R-407C	R-410A	R-507A	R-717	R-437A	Other
% of consumption in mt	32	27	4	2	6	7	20	1	1
% of consumption in CO ₂ equiv	36	24	10	2	8	17	-	1	2

Enterprise background

5. Mabe Group (Controladora Mabe) is one of the largest producers of domestic refrigerators in Latin America and has Mexican and Chinese ownership. Mabe Colombia (Mabe), which is part of Mabe Group, has produced kitchen appliances since 1955 and is 100 per cent Article 5 owned.

6. All three production lines at Mabe manufacturing 11 models of domestic refrigerators have the same lay-out and similar installed capacity. In 1997 Mabe received Multilateral Fund assistance to convert its manufacturing capacity from CFC-11 to HCFC-141b and HCFC-22 (insulation foam component) and from CFC-12 to HFC-134a (refrigeration component). Subsequently, at the 60th meeting Mabe received Multilateral Fund assistance to convert the insulation foam component from HCFC-141b and HCFC-22 to cyclopentane. The project has been successfully implemented resulting in the phase-out of 381.10 mt (32.10 ODP tonnes) of HCFC-141b/HCFC-22.

HFC consumption by the enterprise

7. The 2014-2016 HFC-134a consumption at Mabe Colombia is shown in Table 2.

Table 2. Consumption of HFC-134a at Mabe Colombia (2014-2016)

Year	Quantity (mt)
2014	58.31
2015	49.52
2016	76.13
Total consumption	183.96
Average consumption	61.32
Average consumption (CO₂ tonnes)	87,688

Selection of alternative technology

8. Isobutane (R-600a) was selected as the alternative technology as it is 30 per cent cheaper than HFC-134a in terms of the charge per appliance and with a higher coefficient of performance and energy efficiency ratio compared to HFC-134a; the cooling system requires less purification; and the technology is proven and widely used in Colombia.

Project description

9. Given the high flammability of R-600a, changes are foreseen to the production process at the three manufacturing lines and the end-products, as well as modifications to its testing laboratory to work with hydrocarbon-based (HC) refrigerants. The project contains three components for which funds are requested from the Multilateral Fund:

- (a) Modifications to the storage and feeding of refrigerant include explosion proof pumping and pipeline system to download, store and distribute the refrigerant at the plant; a storage tank; a safety system (i.e., leak detectors, fire-fighting equipment, shut-off valves and flux and pressure sensors, water sprinkler, smoke detectors); equipment installation and civil works (i.e., construction of pump and transfer rooms); and relevant certifications;

- (b) Production line modifications include introduction of helium in the pre-charge leak detection; three new refrigerant charging stations suitable for R-600a and ATEX¹ certified; introduction of ultrasound sealing of the refrigeration system; two post-charge leak detectors per line; safety system and ATEX certified equipment for the repair zone; civil works; and installation of a safety system and a ventilation system in the manufacturing area; and
- (c) General activities include the modification of the laboratory for development and testing (i.e., addition of an ATEX certified refrigerant charging station, a refrigeration test booth, air extraction system, ultrasonic welding equipment and leak detectors); modifications to the electrical controls of the HC-based fridges to ensure safe operation; installation and start-up of all the new equipment in the plant; trials and tests; training of personnel; relevant final HC-based product certification; plant safety certification; technical assistance by international experts including supervision of conversions; and others (a set of ATEX certified tools to avoid possible source of sparks and portable HC detectors to conduct inspections and tests both to the production line and the products).

10. In addition, the enterprise will implement with its own funds a fourth component aimed to improve the energy efficiency of most of their models to the level band A in accordance with RETIQ 2015² (this is equivalent to an energy consumption improvement of 25 per cent from their HFC-134a based refrigerators). Since no changes to the cabinet or doors of the refrigerators are proposed, no capital investments would be needed. Table 3 shows the average improvement in energy efficiency expected by each of the refrigerant system components.

Table 3. Expected energy efficiency gains

Component	Expected efficiency improvement (%)
Efficiency improvement of R-600a compressor	12
Defrosting cycle improvement	4
Efficiency improvement of R-600a fan	5
Improvement of heat exchangers and airflow	4
Total	25

Project costs and co-financing

11. The incremental capital costs (ICC), as originally submitted, were at US \$3,059,760, as shown in Table 4.

Table 4. ICC for the conversion at Mabe Colombia

Item	Quantity	Unit cost (US \$)	Total cost (US \$)
Storage and feeding system			
Storage tank	1	120,000	120,000
Tank charging system	1	150,000	150,000
Pumping system	1	30,000	30,000
Safety system	1	30,000	30,000
Civil works	1	35,000	35,000
HC distribution to plant (piping, gangway and mounting)	1	90,000	90,000
Installation (tank, pipes, valves, pumping system and safety system)	1	50,000	50,000
Piping welding certification	1	18,000	18,000
Safety installation certification	1	12,000	12,000

¹ (Appareils destinés à être utilisés en ATmosphères EXplosibles): Directives on equipment and work environment allowed in an environment with an explosive atmosphere.

² Reglamento técnico de etiquetado: Colombian technical regulation on equipment labelling

Item	Quantity	Unit cost (US \$)	Total cost (US \$)
Sub-total storage and feeding system			535,000
Production lines modification			
<i>Vacuum and leak test</i>			
Nitrogen purge, vacuum and helium charging system	3	35,000	105,000
Helium leak detectors	6	26,000	156,000
Helium recovery unit	3	50,000	150,000
<i>Refrigerant charge system</i>			
HC charging station	3	75,000	225,000
Ultrasonic welding equipment	3	50,000	150,000
HC leak detectors	6	35,000	210,000
<i>Zone of functional repairs</i>			
HC recovery units	3	20,000	60,000
Vacuum units	3	6,000	18,000
<i>Associated works</i>			
Civil works	3	15,000	45,000
Installation and supply pipelines	3	35,000	105,000
Safety system	3	45,000	135,000
Ventilation system (fans, motors, ducts and platforms)	3	25,000	75,000
Sub-total production lines modification			1,434,000
General			
<i>Modification of the laboratory for development and test</i>			
Equipment	1	160,000	160,000
Safety system	1	35,000	35,000
Ventilation system	1	20,000	20,000
<i>Changes in the electrical control</i>			
Equipment for testing electronic controls	1	210,900	210,900
Electronic control dies	1	60,000	60,000
<i>Installation and start-up</i>			
Installation and start-up	1	100,000	100,000
<i>Trials, test, product certification, safety audit</i>			
Refrigerator for trials	121	200	24,200
Field tests	1	5,000	5,000
Certification of new products	11	2,500	27,500
General safety certification	1	30,000	30,000
<i>Human resources</i>			
Training	1	30,000	30,000
Technical assistance	1	100,000	100,000
<i>Other costs</i>			
Tools and quality assurance equipment	1	5,000	5,000
Portable HC detectors	2	2,500	5,000
Sub-total general			812,600
Sub-total			2,781,600
Contingencies (10%)			278,160
Total cost			3,059,760

12. The incremental operating costs (IOC) were estimated based on the cost of raw materials, considering safety and rearrangement of electric components, and improvement in energy efficiency. The price of HFC-134a and R-600a was reported at US \$4.45/kg and US \$8.00/kg, respectively. The IOC for the four types of refrigerators (single door, two doors cyclical, non-frost from 230 to 300 litres (*l*) and 360*l* to 420*l*) based on the units produced by Mabe (average 2014-2016) are presented in Table 5, noting that IOCs related to the energy efficiency will be covered by the enterprise.

Table 5. IOC for the conversion at Mabe Colombia

IOC	Single door	Two doors cyclical	Non-frost (230/ to 300/)	Non-frost (360/ to 420/)	Total (US \$)
Due to change to R-600a	12,402	8,774	395,910	352,311	769,397
Due to energy efficiency gains	49,138	34,619	1,582,259	1,409,245	3,075,261
Total	61,540	43,393	1,978,169	1,761,556	3,844,658

13. The total cost of the project is US \$6,904,418, of which US \$3,829,157 is requested from the Multilateral Fund, as originally submitted, while the remaining US \$3,075,261 (i.e., the IOC associated with the energy efficiency gains) would be co-funded by the enterprise. The total cost-effectiveness of the project, excluding co-financing by the enterprise, is US \$62.45/kg. The duration of the project is 24 months.

SECRETARIAT'S COMMENTS AND RECOMMENDATION

COMMENTS

Eligibility

14. This project has been submitted in line with decision 78/3(g). The Secretariat reviewed the project proposal based on current policies and decisions of the Multilateral Fund and the review of similar conversion projects for CFC phase-out approved (i.e., conversion of refrigerant component from CFC-12 to R-600a involving product and manufacturing process redesign).

Regulatory framework

15. The Secretariat noted that all domestic refrigeration manufacturing in the country would be converted to R-600a with the conversion of Mabe, and inquired whether the Government of Colombia had considered regulatory measures to ensure the sustainability of the conversion. It was agreed that with approval of the project, the country would ban the import and manufacturing of domestic refrigerators with HFC-134a by 2020. The Secretariat considers that such a ban would not only help in phasing down the consumption of HFC-134a in the local market, but would also reduce future servicing demand of HFC-based equipment in the regional market as the country exports domestic refrigerators.

Selection of enterprise

16. The Secretariat notes that Mabe received funding from the Multilateral Fund in 1997 to convert from CFC-11 as a blowing agent and CFC-12 as a refrigerant to HCFC-141b/HCFC-22 and HFC-134a, respectively. As such, the Secretariat considers that this conversion falls under paragraph 18(b) of decision XXVIII/2.

17. The Secretariat noted that the two other enterprises in the sector had already converted to R-600a, and inquired why Mabe had not done so. UNDP clarified that the one enterprise converted during a relocation of the manufacturing facility, which allowed the conversion to take place at a substantially reduced cost, and the other due to a business decision of the enterprise.

Proposed costs

18. The Secretariat noted the project for the conversion of the domestic refrigerator manufacturing at Walton Hitech Industries Limited (Walton) in Bangladesh from HFC-134a to R-600a submitted by UNDP to the 79th meeting³ had a cost-effectiveness of US \$11.97/kg, as submitted, while the cost-effectiveness of the conversion at Mabe was US \$62.45/kg, and inquired whether cost savings at Mabe could be considered. On this basis, UNDP undertook a detailed review of the project submission, and proposed adjusting the ICC as follows:

- (a) Storage and feeding system: a reduction to US \$350,000 (from US \$535,000) through reductions in the cost of the R-600a storage tank, feeding system, and associated equipment, installation and certification;
- (b) Production lines modification: a reduction to US \$1,200,000 (from US \$1,434,000) through reductions in the cost of vacuum and leak test, the refrigerant charge system, zone for functional repairs, and associated works;
- (c) Not to request funding for: modification of the laboratory for development and test noting the baseline equipment currently in the laboratory; changes in the electrical control and tools; quality assurance equipment; and portable HC detectors; and
- (d) Rationalization of costs for installation and start-up (to US \$50,000 from US \$100,000), general safety certification (to US \$25,000 from US \$30,000), and technical assistance and training (to US \$100,000 from US \$120,000).

19. On this basis, the revised ICC of the conversion is US \$1,959,870, including 10 per cent for contingencies. Combined with the IOC of US \$769,397, the total project costs are estimated at US \$2,729,267 (US \$44.51/kg). Noting that a ban on the manufacture and import of HFC-134a-based domestic refrigerators had not originally been planned, and that implementing such a ban could be complex, an additional US \$200,000 in technical assistance to establish the ban was requested.

20. The enterprise was prepared to provide co-financing of US \$1,502,867 beyond the co-funding related to the IOC associated with the energy efficiency gains (US \$3,075,261). On this basis, the funding requested of the Multilateral Fund amounts to US \$1,426,400 (US \$23.26/kg).

21. Noting the revised costs with appreciation, the Secretariat undertook a detailed analysis of the revised proposed ICC, taking into consideration previously approved projects to flammable alternatives in RAC sector, and the agreed costs for the project at Walton in Bangladesh, and suggested the following changes:

- (a) Funding requested for the storage and feeding system (US \$350,000) was adjusted to US \$135,000, as the enterprise already consumes cyclopentane and the R-600a tank would be adjacent to the cyclopentane tank; and rationalizing costs for installation for tank, pipes, valves, pumping system, and safety system, piping welding certification, and safety installation certification;
- (b) The cost for a vacuum and helium leak test as agreed for the project at Walton in Bangladesh (US \$24,000 each) could similarly be applied by Mabe reaching a total value of US \$72,000;
- (c) Of the three HFC-134a charging machines in the enterprise, two are 23 years old and

³ UNEP/OzL.Pro/ExCom/79/28

likely nearing the end of their useful life. Therefore, incremental costs should be based on the cost, from the same supplier, of a new machine, from which has been deducted a proportion of the cost of a replacement HFC-134a machine, in line with decision 18/25, resulting in a reduction from US \$195,000 to US \$130,000;

- (d) A unit cost of US \$15,000 for a HC leak detector based on previously approved projects in the RAC sector, and based on the agreed costs for the project at Walton in Bangladesh US \$30,000 for the unit cost of ultrasonic welding equipment;
- (e) Adjustment to the explosion proof vacuum pump costs from US \$5,000/pump to US \$3,000/pump, and exclusion of the HC recovery system (US \$15,000/unit) as when leakage of R-600a is detected, the faulty refrigerator is sent to the functional repair zone where R-600a is extracted and vented to the exhaust system; the leak is then fixed and the refrigerator sent to the helium leak test station prior to being recharged. Common industrial practice is to use an explosion proof vacuum pump to vent the leaked HC in the exhaust system rather than to recover the R-600a; and
- (f) Rationalizing the costs associated with civil works (US \$30,000 to US \$15,000), installation and supply pipelines (included in installation and start-up) and technical assistance (US \$80,000 to US \$30,000).

22. The revised costs are shown in Table 6.

Table 6. Revised costs for Mabe Colombia project

Item	Quantity	UNDP's revised proposal (US \$)	Secretariat's cost estimation (US \$)
Storage and feeding system			
<i>Sub-total storage and feeding system</i>		350,000	135,000
Production lines modification			
<i>Vacuum and leak test</i>			
Nitrogen purge, vacuum and helium charging system	3	90,000	72,000
Helium leak detectors	6	120,000	
Helium recovery unit and all	3	120,000	
<i>Refrigerant charge system</i>			
HC charging station	3	195,000	130,000
Ultrasonic welding equipment	3	135,000	90,000
HC leak detectors	6	180,000	90,000
<i>Zone of functional repairs</i>			
HC recovery units	3	45,000	-
Vacuum units	3	15,000	9,000
<i>Associated works</i>			
Civil works	3	30,000	15,000
Installation and supply pipelines	3	90,000	-
Safety system	3	120,000	120,000
Ventilation system (fans, motors, ducts and platforms)	3	60,000	60,000
<i>Sub-total production lines modification</i>		1,200,000	586,000
General			
<i>Installation and start-up</i>			
Installation and start-up	1	50,000	50,000
<i>Trials, test, product certification, safety audit</i>			
Refrigerator for trials	121	24,200	24,200
Field tests	1	5,000	5,000
Certification of new products	11	27,500	27,500
General safety certification.	1	25,000	25,000

Item	Quantity	UNDP's revised proposal (US \$)	Secretariat's cost estimation (US \$)
<i>Human resources</i>			
Training	1	20,000	20,000
Technical assistance	1	80,000	30,000
<i>Other costs</i>			
Tools and quality assurance equipment	1	-	-
Portable HC detectors	2	-	-
Sub-total general		231,700	181,700
Sub-total		1,781,700	902,700
Contingencies (10%)		178,170	90,270
Total ICC		1,959,870	992,970
Total IOC		769,397	769,397
Implementation of ban on HFC-134a-based equipment		200,000	30,000
Co-financing by the enterprise		-(1,502,867)	n/a*
Estimated cost to the Multilateral Fund		1,426,400	1,792,367

* The enterprise needed additional time to consider the costs proposed by the Secretariat and an appropriate level of co-funding, if any.

23. Based on those changes, and accounting for 10 per cent for contingencies, the incremental capital costs of the conversion of the three lines are estimated at US \$992,970. The Secretariat did not propose changes to the IOC of US \$769,397 (US \$12.54/kg), noting that it did not have sufficient experience to assess those costs. On that basis, the total cost of conversion is estimated at US \$1,762,367, noting that investment projects submitted in line with decision 78/3(g) were intended in part to gain experience in the incremental costs that might be associated with phasing down HFCs in Article 5 countries.

24. The Secretariat noted the request for technical assistance to establish the ban on the import and manufacturing of HFC-134a-based domestic refrigerators. The Secretariat considers the ban a key component to ensure the sustainability of the conversion and enhance the likelihood of also affecting the regional market, and considers that US \$30,000 instead of US \$200,000 for technical assistance could usefully be provided for that purpose.

25. UNDP and the Secretariat discussed the costs suggested by the Secretariat. Based on the revised costs proposed by the Secretariat, the enterprise needed additional time to consider those costs and an appropriate level of co-funding.

Climate benefits

26. The direct climate benefits of the conversion are the avoidance of emissions into the atmosphere of about 87,618 of CO₂ tonnes per year based on a consumption of 61.32 mt of HFC-142a (GWP = 1,430) and the expected introduction of 23.36 mt of R-600a (GWP = 3). The climate benefits of the energy efficiency enhancement are estimated at 19,759 of CO₂ tonnes per year based on a grid emission factor of 0.374 kg of CO₂equiv/kWh, annual production of 536,025 units, and annual energy consumption per unit of 492.81 kWh prior to conversion and 394.25 kWh after conversion (20 per cent improved energy efficiency).

Conclusion

27. The project would enable the phase-out of HFC-134a in domestic refrigerator manufacturing in Colombia, introduce more energy-efficient equipment, and influence the regional market. The enhancement in the energy efficiency of the manufactured refrigerators would be undertaken at the enterprise's expense.

Business plan 2017 -2019

28. This project does not fall under the regular business plans submitted to the Secretariat and is presented to the Executive Committee as it falls under the purview of decision 78/3(g).

RECOMMENDATION

29. The Executive Committee may wish to consider the project for conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia in relation to decision 78/3(g) and discussions under Overview of issues identified during project review in document UNEP/OzL.Pro/ExCom/79/19.



**United Nations
Environment
Programme**

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EXECUTIVE COMMITTEE OF
THE MULTILATERAL FUND FOR THE
IMPLEMENTATION OF THE MONTREAL PROTOCOL
Seventy-ninth Meeting
Bangkok, 3-7 July 2017

PROJECT PROPOSAL: COLOMBIA

This document consists of the comments and recommendation of the Secretariat on the following project proposal:

Refrigeration

- Conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia UNDP

PROJECT EVALUATION SHEET – NON-MULTI-YEAR PROJECT**COLOMBIA****PROJECT TITLE(S)****BILATERAL/IMPLEMENTING AGENCY**

(a) Conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia	UNDP
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NATIONAL CO-ORDINATING AGENCY

Ozone Technical Unit of the Ministry of Environment and Sustainable Development

LATEST REPORTED CONSUMPTION DATA FOR ODS ADDRESSED IN PROJECT**A: ARTICLE-7 DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])**

HFCs	n/a
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B: COUNTRY PROGRAMME SECTORAL DATA (ODP TONNES, [INSERT YEAR], AS OF [INSERT MONTH AND YEAR])

HFCs	n/a
------	-----

HFC consumption remaining eligible for funding (ODP tonnes)	n/a
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CURRENT YEAR BUSINESS PLAN ALLOCATIONS		Funding US \$	Phase-out ODP tonnes
	(a)	0	0

PROJECT TITLE:	Mabe
HFC-134a used at enterprise (mt):	61.32
HFC-134a to be phased out (mt):	61.32
HFC-134a to be phased in (mt CO ₂ equivalent):	87,688
Project duration (months):	24
Initial amount requested (US \$):	3,829,157
Final project costs (US \$):	
Incremental capital cost:	1,781,700
Contingency (10 %):	178,170
Incremental operating cost:	769,397
Total project cost:	2,729,267
Local ownership (%):	100
Export component (%):	0
Requested grant (US \$):	1,426,400
Cost-effectiveness (US \$/kg):	23.26
Implementing agency support cost (US \$):	99,848
Total cost of project to Multilateral Fund (US \$):	1,526,248
Status of counterpart funding (Y/N):	Y
Project monitoring milestones included (Y/N):	N

SECRETARIAT'S RECOMMENDATION	For individual consideration
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PROJECT DESCRIPTION

1. On behalf of the Government of Colombia, UNDP has submitted to the 79th meeting a project proposal to convert the manufacturing of domestic refrigerators at Mabe Colombia from HFC-134a to isobutane (R-600a) at a total cost of US \$3,829,157, plus agency support costs of US \$268,041, as originally submitted.

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Domestic refrigeration manufacturing	-	98.16	-	-	-	-	-	-	1.24
Commercial refrigeration manufacturing	134.65	140.12	17.03	0.21	-	39.11	-	-	1.88
Industrial refrigeration manufacturing	91.12	80.08	21.10	3.95	-	43.86	458.85	-	0.23
Transportation refrigeration	0.42	0.56	1.65	-	-	-	-	0.08	-
Servicing	492.20	219.65	80.01	17.80	-	126.78	152.95	32.86	18.10
Air conditioning									
AC manufacturing	164.92	21.06	-	3.64	95.19	-	-	0.16	0.89
Mobile AC manufacturing	-	75.01	-	-	-	-	-	-	-
AC servicing	81.63	33.96	-	22.77	80.85	-	-	4.32	11.70
Mobile AC servicing	-	159.55	-	-	-	-	-	0.18	-
Total	964.95	828.15	119.79	48.38	176.04	209.74	611.80	37.60	34.03

Sectors	HCFC-22	HFC-134a	R-404A	R-407C	R-410A	R-507A	R-717	R-437A	Other
% of consumption in mt	32	27	4	2	6	7	20	1	1
% of consumption in CO ₂ equiv	36	24	10	2	8	17	-	1	2

Enterprise background

5. Mabe Group (Controladora Mabe) is one of the largest producers of domestic refrigerators in Latin America and has Mexican and Chinese ownership. Mabe Colombia (Mabe), which is part of Mabe Group, has produced kitchen appliances since 1955 and is 100 per cent Article 5 owned.

6. All three production lines at Mabe manufacturing 11 models of domestic refrigerators have the same lay-out and similar installed capacity. In 1997 Mabe received Multilateral Fund assistance to convert its manufacturing capacity from CFC-11 to HCFC-141b and HCFC-22 (insulation foam component) and from CFC-12 to HFC-134a (refrigeration component). Subsequently, at the 60th meeting Mabe received Multilateral Fund assistance to convert the insulation foam component from HCFC-141b and HCFC-22 to cyclopentane. The project has been successfully implemented resulting in the phase-out of 381.10 mt (32.10 ODP tonnes) of HCFC-141b/HCFC-22.

HFC consumption by the enterprise

7. The 2014-2016 HFC-134a consumption at Mabe Colombia is shown in Table 2.

Table 2. Consumption of HFC-134a at Mabe Colombia (2014-2016)

Year	Quantity (mt)
2014	58.31
2015	49.52
2016	76.13
Total consumption	183.96
Average consumption	61.32
Average consumption (CO₂ tonnes)	87,688

Selection of alternative technology

8. Isobutane (R-600a) was selected as the alternative technology as it is 30 per cent cheaper than HFC-134a in terms of the charge per appliance and with a higher coefficient of performance and energy efficiency ratio compared to HFC-134a; the cooling system requires less purification; and the technology is proven and widely used in Colombia.

Project description

9. Given the high flammability of R-600a, changes are foreseen to the production process at the three manufacturing lines and the end-products, as well as modifications to its testing laboratory to work with hydrocarbon-based (HC) refrigerants. The project contains three components for which funds are requested from the Multilateral Fund:

- (a) Modifications to the storage and feeding of refrigerant include explosion proof pumping and pipeline system to download, store and distribute the refrigerant at the plant; a storage tank; a safety system (i.e., leak detectors, fire-fighting equipment, shut-off valves and flux and pressure sensors, water sprinkler, smoke detectors); equipment installation and civil works (i.e., construction of pump and transfer rooms); and relevant certifications;

- (b) Production line modifications include introduction of helium in the pre-charge leak detection; three new refrigerant charging stations suitable for R-600a and ATEX¹ certified; introduction of ultrasound sealing of the refrigeration system; two post-charge leak detectors per line; safety system and ATEX certified equipment for the repair zone; civil works; and installation of a safety system and a ventilation system in the manufacturing area; and
- (c) General activities include the modification of the laboratory for development and testing (i.e., addition of an ATEX certified refrigerant charging station, a refrigeration test booth, air extraction system, ultrasonic welding equipment and leak detectors); modifications to the electrical controls of the HC-based fridges to ensure safe operation; installation and start-up of all the new equipment in the plant; trials and tests; training of personnel; relevant final HC-based product certification; plant safety certification; technical assistance by international experts including supervision of conversions; and others (a set of ATEX certified tools to avoid possible source of sparks and portable HC detectors to conduct inspections and tests both to the production line and the products).

10. In addition, the enterprise will implement with its own funds a fourth component aimed to improve the energy efficiency of most of their models to the level band A in accordance with RETIQ 2015² (this is equivalent to an energy consumption improvement of 25 per cent from their HFC-134a based refrigerators). Since no changes to the cabinet or doors of the refrigerators are proposed, no capital investments would be needed. Table 3 shows the average improvement in energy efficiency expected by each of the refrigerant system components.

Table 3. Expected energy efficiency gains

Component	Expected efficiency improvement (%)
Efficiency improvement of R-600a compressor	12
Defrosting cycle improvement	4
Efficiency improvement of R-600a fan	5
Improvement of heat exchangers and airflow	4
Total	25

Project costs and co-financing

11. The incremental capital costs (ICC), as originally submitted, were at US \$3,059,760, as shown in Table 4.

Table 4. ICC for the conversion at Mabe Colombia

Item	Quantity	Unit cost (US \$)	Total cost (US \$)
Storage and feeding system			
Storage tank	1	120,000	120,000
Tank charging system	1	150,000	150,000
Pumping system	1	30,000	30,000
Safety system	1	30,000	30,000
Civil works	1	35,000	35,000
HC distribution to plant (piping, gangway and mounting)	1	90,000	90,000
Installation (tank, pipes, valves, pumping system and safety system)	1	50,000	50,000
Piping welding certification	1	18,000	18,000
Safety installation certification	1	12,000	12,000

¹ (Appareils destinés à être utilisés en ATmosphères EXplosibles): Directives on equipment and work environment allowed in an environment with an explosive atmosphere.

² Reglamento técnico de etiquetado: Colombian technical regulation on equipment labelling

Item	Quantity	Unit cost (US \$)	Total cost (US \$)
Sub-total storage and feeding system			535,000
Production lines modification			
<i>Vacuum and leak test</i>			
Nitrogen purge, vacuum and helium charging system	3	35,000	105,000
Helium leak detectors	6	26,000	156,000
Helium recovery unit	3	50,000	150,000
<i>Refrigerant charge system</i>			
HC charging station	3	75,000	225,000
Ultrasonic welding equipment	3	50,000	150,000
HC leak detectors	6	35,000	210,000
<i>Zone of functional repairs</i>			
HC recovery units	3	20,000	60,000
Vacuum units	3	6,000	18,000
<i>Associated works</i>			
Civil works	3	15,000	45,000
Installation and supply pipelines	3	35,000	105,000
Safety system	3	45,000	135,000
Ventilation system (fans, motors, ducts and platforms)	3	25,000	75,000
Sub-total production lines modification			1,434,000
General			
<i>Modification of the laboratory for development and test</i>			
Equipment	1	160,000	160,000
Safety system	1	35,000	35,000
Ventilation system	1	20,000	20,000
<i>Changes in the electrical control</i>			
Equipment for testing electronic controls	1	210,900	210,900
Electronic control dies	1	60,000	60,000
<i>Installation and start-up</i>			
Installation and start-up	1	100,000	100,000
<i>Trials, test, product certification, safety audit</i>			
Refrigerator for trials	121	200	24,200
Field tests	1	5,000	5,000
Certification of new products	11	2,500	27,500
General safety certification	1	30,000	30,000
<i>Human resources</i>			
Training	1	30,000	30,000
Technical assistance	1	100,000	100,000
<i>Other costs</i>			
Tools and quality assurance equipment	1	5,000	5,000
Portable HC detectors	2	2,500	5,000
Sub-total general			812,600
Sub-total			2,781,600
Contingencies (10%)			278,160
Total cost			3,059,760

12. The incremental operating costs (IOC) were estimated based on the cost of raw materials, considering safety and rearrangement of electric components, and improvement in energy efficiency. The price of HFC-134a and R-600a was reported at US \$4.45/kg and US \$8.00/kg, respectively. The IOC for the four types of refrigerators (single door, two doors cyclical, non-frost from 230 to 300 litres (*l*) and 360*l* to 420*l*) based on the units produced by Mabe (average 2014-2016) are presented in Table 5, noting that IOCs related to the energy efficiency will be covered by the enterprise.

Table 5. IOC for the conversion at Mabe Colombia

IOC	Single door	Two doors cyclical	Non-frost (230/ to 300/)	Non-frost (360/ to 420/)	Total (US \$)
Due to change to R-600a	12,402	8,774	395,910	352,311	769,397
Due to energy efficiency gains	49,138	34,619	1,582,259	1,409,245	3,075,261
Total	61,540	43,393	1,978,169	1,761,556	3,844,658

13. The total cost of the project is US \$6,904,418, of which US \$3,829,157 is requested from the Multilateral Fund, as originally submitted, while the remaining US \$3,075,261 (i.e., the IOC associated with the energy efficiency gains) would be co-funded by the enterprise. The total cost-effectiveness of the project, excluding co-financing by the enterprise, is US \$62.45/kg. The duration of the project is 24 months.

SECRETARIAT'S COMMENTS AND RECOMMENDATION

COMMENTS

Eligibility

14. This project has been submitted in line with decision 78/3(g). The Secretariat reviewed the project proposal based on current policies and decisions of the Multilateral Fund and the review of similar conversion projects for CFC phase-out approved (i.e., conversion of refrigerant component from CFC-12 to R-600a involving product and manufacturing process redesign).

Regulatory framework

15. The Secretariat noted that all domestic refrigeration manufacturing in the country would be converted to R-600a with the conversion of Mabe, and inquired whether the Government of Colombia had considered regulatory measures to ensure the sustainability of the conversion. It was agreed that with approval of the project, the country would ban the import and manufacturing of domestic refrigerators with HFC-134a by 2020. The Secretariat considers that such a ban would not only help in phasing down the consumption of HFC-134a in the local market, but would also reduce future servicing demand of HFC-based equipment in the regional market as the country exports domestic refrigerators.

Selection of enterprise

16. The Secretariat notes that Mabe received funding from the Multilateral Fund in 1997 to convert from CFC-11 as a blowing agent and CFC-12 as a refrigerant to HCFC-141b/HCFC-22 and HFC-134a, respectively. As such, the Secretariat considers that this conversion falls under paragraph 18(b) of decision XXVIII/2.

17. The Secretariat noted that the two other enterprises in the sector had already converted to R-600a, and inquired why Mabe had not done so. UNDP clarified that the one enterprise converted during a relocation of the manufacturing facility, which allowed the conversion to take place at a substantially reduced cost, and the other due to a business decision of the enterprise.

Proposed costs

18. The Secretariat noted the project for the conversion of the domestic refrigerator manufacturing at Walton Hitech Industries Limited (Walton) in Bangladesh from HFC-134a to R-600a submitted by UNDP to the 79th meeting³ had a cost-effectiveness of US \$11.97/kg, as submitted, while the cost-effectiveness of the conversion at Mabe was US \$62.45/kg, and inquired whether cost savings at Mabe could be considered. On this basis, UNDP undertook a detailed review of the project submission, and proposed adjusting the ICC as follows:

- (a) Storage and feeding system: a reduction to US \$350,000 (from US \$535,000) through reductions in the cost of the R-600a storage tank, feeding system, and associated equipment, installation and certification;
- (b) Production lines modification: a reduction to US \$1,200,000 (from US \$1,434,000) through reductions in the cost of vacuum and leak test, the refrigerant charge system, zone for functional repairs, and associated works;
- (c) Not to request funding for: modification of the laboratory for development and test noting the baseline equipment currently in the laboratory; changes in the electrical control and tools; quality assurance equipment; and portable HC detectors; and
- (d) Rationalization of costs for installation and start-up (to US \$50,000 from US \$100,000), general safety certification (to US \$25,000 from US \$30,000), and technical assistance and training (to US \$100,000 from US \$120,000).

19. On this basis, the revised ICC of the conversion is US \$1,959,870, including 10 per cent for contingencies. Combined with the IOC of US \$769,397, the total project costs are estimated at US \$2,729,267 (US \$44.51/kg). Noting that a ban on the manufacture and import of HFC-134a-based domestic refrigerators had not originally been planned, and that implementing such a ban could be complex, an additional US \$200,000 in technical assistance to establish the ban was requested.

20. The enterprise was prepared to provide co-financing of US \$1,502,867 beyond the co-funding related to the IOC associated with the energy efficiency gains (US \$3,075,261). On this basis, the funding requested of the Multilateral Fund amounts to US \$1,426,400 (US \$23.26/kg).

21. Noting the revised costs with appreciation, the Secretariat undertook a detailed analysis of the revised proposed ICC, taking into consideration previously approved projects to flammable alternatives in RAC sector, and the agreed costs for the project at Walton in Bangladesh, and suggested the following changes:

- (a) Funding requested for the storage and feeding system (US \$350,000) was adjusted to US \$135,000, as the enterprise already consumes cyclopentane and the R-600a tank would be adjacent to the cyclopentane tank; and rationalizing costs for installation for tank, pipes, valves, pumping system, and safety system, piping welding certification, and safety installation certification;
- (b) The cost for a vacuum and helium leak test as agreed for the project at Walton in Bangladesh (US \$24,000 each) could similarly be applied by Mabe reaching a total value of US \$72,000;
- (c) Of the three HFC-134a charging machines in the enterprise, two are 23 years old and

³ UNEP/OzL.Pro/ExCom/79/28

likely nearing the end of their useful life. Therefore, incremental costs should be based on the cost, from the same supplier, of a new machine, from which has been deducted a proportion of the cost of a replacement HFC-134a machine, in line with decision 18/25, resulting in a reduction from US \$195,000 to US \$130,000;

- (d) A unit cost of US \$15,000 for a HC leak detector based on previously approved projects in the RAC sector, and based on the agreed costs for the project at Walton in Bangladesh US \$30,000 for the unit cost of ultrasonic welding equipment;
- (e) Adjustment to the explosion proof vacuum pump costs from US \$5,000/pump to US \$3,000/pump, and exclusion of the HC recovery system (US \$15,000/unit) as when leakage of R-600a is detected, the faulty refrigerator is sent to the functional repair zone where R-600a is extracted and vented to the exhaust system; the leak is then fixed and the refrigerator sent to the helium leak test station prior to being recharged. Common industrial practice is to use an explosion proof vacuum pump to vent the leaked HC in the exhaust system rather than to recover the R-600a; and
- (f) Rationalizing the costs associated with civil works (US \$30,000 to US \$15,000), installation and supply pipelines (included in installation and start-up) and technical assistance (US \$80,000 to US \$30,000).

22. The revised costs are shown in Table 6.

Table 6. Revised costs for Mabe Colombia project

Item	Quantity	UNDP's revised proposal (US \$)	Secretariat's cost estimation (US \$)
Storage and feeding system			
<i>Sub-total storage and feeding system</i>		350,000	135,000
Production lines modification			
<i>Vacuum and leak test</i>			
Nitrogen purge, vacuum and helium charging system	3	90,000	72,000
Helium leak detectors	6	120,000	
Helium recovery unit and all	3	120,000	
<i>Refrigerant charge system</i>			
HC charging station	3	195,000	130,000
Ultrasonic welding equipment	3	135,000	90,000
HC leak detectors	6	180,000	90,000
<i>Zone of functional repairs</i>			
HC recovery units	3	45,000	-
Vacuum units	3	15,000	9,000
<i>Associated works</i>			
Civil works	3	30,000	15,000
Installation and supply pipelines	3	90,000	-
Safety system	3	120,000	120,000
Ventilation system (fans, motors, ducts and platforms)	3	60,000	60,000
<i>Sub-total production lines modification</i>		1,200,000	586,000
General			
<i>Installation and start-up</i>			
Installation and start-up	1	50,000	50,000
<i>Trials, test, product certification, safety audit</i>			
Refrigerator for trials	121	24,200	24,200
Field tests	1	5,000	5,000
Certification of new products	11	27,500	27,500
General safety certification.	1	25,000	25,000

Item	Quantity	UNDP's revised proposal (US \$)	Secretariat's cost estimation (US \$)
<i>Human resources</i>			
Training	1	20,000	20,000
Technical assistance	1	80,000	30,000
<i>Other costs</i>			
Tools and quality assurance equipment	1	-	-
Portable HC detectors	2	-	-
Sub-total general		231,700	181,700
Sub-total		1,781,700	902,700
Contingencies (10%)		178,170	90,270
Total ICC		1,959,870	992,970
Total IOC		769,397	769,397
Implementation of ban on HFC-134a-based equipment		200,000	30,000
Co-financing by the enterprise		-(1,502,867)	n/a*
Estimated cost to the Multilateral Fund		1,426,400	1,792,367

* The enterprise needed additional time to consider the costs proposed by the Secretariat and an appropriate level of co-funding, if any.

23. Based on those changes, and accounting for 10 per cent for contingencies, the incremental capital costs of the conversion of the three lines are estimated at US \$992,970. The Secretariat did not propose changes to the IOC of US \$769,397 (US \$12.54/kg), noting that it did not have sufficient experience to assess those costs. On that basis, the total cost of conversion is estimated at US \$1,762,367, noting that investment projects submitted in line with decision 78/3(g) were intended in part to gain experience in the incremental costs that might be associated with phasing down HFCs in Article 5 countries.

24. The Secretariat noted the request for technical assistance to establish the ban on the import and manufacturing of HFC-134a-based domestic refrigerators. The Secretariat considers the ban a key component to ensure the sustainability of the conversion and enhance the likelihood of also affecting the regional market, and considers that US \$30,000 instead of US \$200,000 for technical assistance could usefully be provided for that purpose.

25. UNDP and the Secretariat discussed the costs suggested by the Secretariat. Based on the revised costs proposed by the Secretariat, the enterprise needed additional time to consider those costs and an appropriate level of co-funding.

Climate benefits

26. The direct climate benefits of the conversion are the avoidance of emissions into the atmosphere of about 87,618 of CO₂ tonnes per year based on a consumption of 61.32 mt of HFC-142a (GWP = 1,430) and the expected introduction of 23.36 mt of R-600a (GWP = 3). The climate benefits of the energy efficiency enhancement are estimated at 19,759 of CO₂ tonnes per year based on a grid emission factor of 0.374 kg of CO₂equiv/kWh, annual production of 536,025 units, and annual energy consumption per unit of 492.81 kWh prior to conversion and 394.25 kWh after conversion (20 per cent improved energy efficiency).

Conclusion

27. The project would enable the phase-out of HFC-134a in domestic refrigerator manufacturing in Colombia, introduce more energy-efficient equipment, and influence the regional market. The enhancement in the energy efficiency of the manufactured refrigerators would be undertaken at the enterprise's expense.

Business plan 2017 -2019

28. This project does not fall under the regular business plans submitted to the Secretariat and is presented to the Executive Committee as it falls under the purview of decision 78/3(g).

RECOMMENDATION

29. The Executive Committee may wish to consider the project for conversion from HFC-134a to isobutene in the manufacture of domestic refrigerators at Mabe Colombia in relation to decision 78/3(g) and discussions under Overview of issues identified during project review in document UNEP/OzL.Pro/ExCom/79/19.
