



United Nations Environment Programme

برنامج الأمم المتحدة للبيئة • 联合国环境规划署

PROGRAMME DES NATIONS UNIES POUR L'ENVIRONNEMENT • PROGRAMA DE LAS NACIONES UNIDAS PARA EL MEDIO AMBIENTE

ПРОГРАММА ОРГАНИЗАЦИИ ОБЪЕДИНЕННЫХ НАЦИЙ ПО ОКРУЖАЮЩЕЙ СРЕДЕ

Low-GWP, Energy-Efficient HCFC Replacement Technologies in the Refrigeration and Air Conditioning Sector - South America Regional Workshop



EXECUTIVE SUMMARY

Bogotá, Colombia

22nd and 23rd of April, 2010

CONTENT

I. INTRODUCTION

II. EXECUTIVE SUMMARY

III. CONCLUSIONS AND RECOMMENDATIONS

IV. ANNEXES

a. Agenda

b. List of Participants

c. Evaluation of the Meeting

d. Evaluation of Gender Participation

Low-GWP, Energy-Efficient HCFC Replacement Technologies in the Refrigeration and Air Conditioning Sector - South America Regional Workshop

I. Introduction

1. In 2007, the Parties to the Montreal Protocol agreed on the anticipation of the HCFCs phase out. Likewise, Parties decided to “promote the selection of alternatives to HCFCs that minimize environmental impacts, in particular impacts on climate, as well as meeting other health, safety and economic considerations” (Decision XIX/6 par. 9). South American countries are currently committed with the development of HCFC phase out strategies according to the anticipated schedule, through the HCFC Phase out Management Plans (HPMPs). In this context, there is a preponderant need in countries of the region to be aware about the range of cost-effective alternatives, with low Global Warming Potentials (GWP) and commercially available, with a strong approach towards energy efficiency of Refrigeration and Air Conditioning (RAC) equipment. Countries look for information on the last developments on technical and commercial feasibility and availability of the state-of-the-art technologies, including those being natural, with low GWP and energy efficient.

2. UNEP organized the workshop hosted by the government of Colombia for addressing said concerns. The workshop was part of a project con-funded by the European Commission. Its objective is to “facilitate information sharing on HCFCs and their alternatives, and build capacity for a smooth and efficient phase-out of HCFCs in developing countries to catalyze early action to comply with, or even move ahead of, the deadlines set by the Parties to the Montreal Protocol in encouraging the adoption of non ozone depleting, low or zero GWP and energy efficient technologies and alternatives.” This project aims to complement activities supported by MLF.

II. Executive Summary

3. The meeting was opened on Tuesday April 22, 2010, with words from the Minister of Environment, Housing and Land Development of Colombia, Mr. Carlos Costa Posada; from Mr. Rajendra Shende, Head of the OzonAction Branch of UNEP/DTIE; from Mr. Javier Camargo, from the Ministry of Environment, Housing and Land Development of Colombia and Chair of the Executive Committee of the Montreal Protocol Multilateral Fund; and from Mr. Janos Maté of Greenpeace International. All agreed on the importance of the next HCFC phase out stage under the Montreal Protocol and the success of the Protocol in not only healing the ozone layer but also in mitigating the effects of climate change.

4. The meeting used working group sessions in the first day and at the end of said day, there was a plenary session for discussion. The second day of the meeting involved only plenary sessions.

5. One of the international lecturers was Mr. Daniel Colbourne who provided information to the participants on the update of UNEP's report on refrigeration and air conditioning options, as well as on the use of hydrocarbons in commercial refrigeration and air conditioning equipment and on retrofit of equipment for the use of hydrocarbons. From his presentations, he highlighted that the use of natural refrigerants is rising globally and that there are low-GWP alternatives to HCFCs in almost all applications. He further stressed that the replacement decision in Article 5 countries will have to consider the technical know-how, a low cost of the capital cost, a low operation cost and that no further conversions are to be needed.

6. In workgroup A, the participants received presentations from Ms. Christianna Papazahariou, of the company Shecco, on commercial application of natural refrigerants in supermarket and point-of-sale cooling equipment; from Mr. Juan Francisco Alvarez, from SAB-Miller Colombia, on the commercial strategy for cooling equipment for a sustainable development; and from Mr. Efraín Baires of the company Fogel de Centroamérica on the development of hydrocarbon-based refrigerators in said company.

7. Some of the questions posed by the participants to this group included the concerns on availability of hydrocarbon refrigerants in the region, the operation conditions for supermarket applications using CO₂ and the safety about the use of hydrocarbons in point-of-sale refrigerators.

8. In workgroup B, Mr. Daniel Colbourne spoke about hydrocarbons as refrigerants and safety issues, underlining that they have excellent transport and thermodynamic properties that provide an excellent efficiency, that they do not have Ozone Depletion Potential (ODP) and an insignificant Global Warming Potential (GWP). He reported that the most commonly used hydrocarbon refrigerants are iso-butane, iso-butane/propane blend, propane, propylene, and the blend propane/ethane.

9. He also spoke about safety standards used in Europe for refrigeration, air conditioning and heat pumps applications and emphasized that it is necessary to know very well the system in order to identify the charge amounts that should be used in the system.

10. Concerns and comments from the participants addressed the barriers for implementing hydrocarbons in countries of the region (safety standards, for example), the need of trained technicians in these new technologies, and the limitations of hydrocarbon refrigerant charges for certain applications. Other interventions included the global situation of the HCFC-22 change towards alternatives, the increase of the R-290 global market share, and the use of HFCs by the United States in equipment being exported to countries of the region.

11. Regarding workgroup C, the lecturers were Mr. Klas Berglöf of Berglof Refrigeration Technology Ltd. from Sweden (who provided his presentation by Skype) who spoke about a UNEP case study report on the replacement of HCFCs in the refrigeration and air conditioning sector; and Mr. Daniel Colbourne who talked about equipment retrofitting to use hydrocarbon refrigerant.

12. Both presenters highlighted that a key factor is the important need of technicians training and of Good Practices codes in order to facilitate the use of new natural alternatives. Mr. Colbourne also emphasized that a conversion should only be performed by technical persons with broad experience and knowledge of the procedure and only if it is absolutely necessary, using the proper equipment and tools and using the safest and adequate methods.

13. In workgroup D, the participants received lectures from Mr. Néstor Moseres of the company Supernova Energy Services de Colombia on sustainable constructions and the reduction of air conditioning using construction design; and from Mr. Jorge Ordoñez of TRANE Colombia, about the importance of the HVAC system efficiency in the design of sustainable constructions.

14. The speakers underscored the importance of using an integral approach including co-generation, renewable sources energy use, and the optimization of demand peaks. On design issues, Mr. Ordoñez stressed that key factors include the identification of losses through construction elements (such as windows, walls), the sun orientation and the exterior and interior design, and that decreasing these losses will allow the design of air conditioning equipment with lower charges.

15. For workgroup E, Mr. Tomaz Cleto from Brazil spoke about solutions for industrial applications with CO₂ as replacement; Mr. Walter Melgarejo talked about installation in Peru using ammonia; and Mr. Mauricio Rodríguez of the company Anrec Ltda. who reported on energy accumulation using sub-cooled water.

16. While Mr. Cleto highlighted that CO₂ is an adequate substance as a secondary refrigerant, Mr. Melgarejo pointed out that the lack of information is still a decision factor for many in Peru in order to make the change to ammonia as well as the lack of qualified and training schools providing training to technicians. Mr. Rodríguez stressed that sub-cooled water is used as secondary refrigerant in ammonia chillers achieving smaller equipment and less energy consumption.

17. Regarding workgroup F, the lecturers were Mr. Antonio Cabrera from Mexico who talked about absorption systems in HVAC systems; and Antonio Orozco from Colombia who informed on alternatives to HCFC use in split-type air conditioning

equipment. Mr. Cabrera reported that absorption equipment is an environmentally friendly alternative as well as economically feasible used in air conditioning only, that provides low costs and energy efficiency. Mr. Orozco's presentation was in the name of the company DAIKIN Industries and underlined that R-32 is the best alternative for split-type air conditioners since this substance does not have safety issues like R-290.

18. Questions and concerns from the participants included the use of ammonia instead of LiBr in absorption systems for obtaining lower temperatures, prices of absorption systems versus commonly used chillers, and corrosion levels in this type of systems.

19. After the workgroup sessions, Mr. Horace Nelson from Rexham Engineering Services Ltd. of Jamaica showed a case study in his country of retrofitting of a chiller and Split air conditioning equipment from HCFC-22 to hydrocarbons (R22a), from which he highlighted the savings obtained afterwards regarding energy costs.

20. Mr. Janos Maté from Greenpeace International also gave a presentation about cooling technologies based on hydrocarbons, in particular, about the 'Greenfreeze' initiative directed to domestic refrigeration using isobutene as refrigerant and cycle-pentane as blowing agent. He underscored that an HCFC strategic phase out must start in those sectors where technologies with natural refrigerants and foam blowing agents are available.

21. The concerns from the participants included the funding for implementing conversion projects with these new technologies, the destructions of ODS wastes, and the new refrigerant HFC-1234yf to be used in mobile air conditioning.

22. On Friday April 23, the first two presentations were given by Mr. Rafael Rau Vidal from the University Simón Bolívar of Venezuela on safety protocols and considerations regarding leak tightness, and by Mr. Klas Berglöf of the company Berglof Refrigeration Technology Ltd. of Sweden, on the importance of the energy efficiency in the refrigeration and air conditioning sector and of its documentation.

23. Mr. Rau Vidal stressed that the barriers that hinder the use of hydrocarbons in the refrigeration and air conditioning sector include the ignorance about the system, the training of industry's engineers and technicians, and a sustainable market in time for being able to use R-290 and R-600a as refrigerants. Comments and questions from the participants were directed to the availability of these refrigerants in the region as well as on the time that it would take to have them produced locally.

24. Mr. Berglöf, who gave his presentation using Skype, explained that 'ClimaCheck' is a system by which it is possible to measure the performance of a refrigeration or air conditioning system in standard service points, providing information for making adjustments and decreasing energy consumption. He also mentioned case studies where technical problems were detected in this type of equipment and with the corresponding corrections, the owners saved thousands of Euros in energy consumption.

25. Mr. Etienne Gonin, from UNEP /DTIE's office in Paris, presented the new regulations of the European Union on Ozone Depleting Substances and highlighted that these regulations are more ambitious in order to ensure that all substances were covered. He also mentioned that although these are strong, they still have pending challenges such as the management to be given to the HFC phase down as well as the control of unwanted ODS banks. Participants' concerns were mainly about the safety standards in the EU for the use of hydrocarbons as refrigerants.

26. To complement Mr. Gonin's lecture, Mr. Carlos Andrés Hernández, from the Ozone Unit of Colombia gave a presentation containing the different developments regarding legislation frameworks on HCFCs in different countries, specifically, the United States, Brazil, Japan, Switzerland and India. He pointed out that the experiences from other countries can aid the region in the adoption of regulations necessary for the phase out of HCFCs. Some of the concerns on this issue were related to China's regulations regarding the production of HCFC-based air conditioning equipment and the need to rapidly establish legislation in countries of the region in order to avoid any undesirable importations of this type of equipment.

27. Mr. Gonin also gave a brief presentation about the 'Jump-Start' project, informing that an anticipated phase out offers the opportunity to select environmentally-friendly HCFC substitutes and to obtain gains in energy efficiency. He also spoke about the different activities carried out under the project and about the workshops to be held in China and India during this year.

28. The next block of presentations was given by Mrs. Mirian Vega, UNEPS's regional coordinator for the OzonAction networks of Latin America and the Caribbean, on the HCFC Phase out Management Plans, and by Mr. Alejandro Ramírez Pabón, programme specialist from UNDP, on the potential funding options for climate benefits of ODS phase out under the Montreal Protocol.

29. Mrs. Vega underlined that under the HPMPs, the funding priorities are to phase out first HCFCs with the highest ODP, that substitutes and alternatives take into account the climate, global warming and energy efficiency, and to look into SMEs. She added that a participation mechanism should be established between the government and the civil society aiming to reach an agreement between stakeholders regarding the phase out plan that would be followed in the country. She also suggested continuing the search and evaluation of other funding sources, further to those provided by the MLF.

30. Mr. Ramírez reported about case studies on phase out funding on different sectors, such as domestic refrigeration, and provided examples of projects under the UNDP and GEF that consider energy efficiency. He recommended looking into synergies with climate change projects in order to have another funding source. He also talked about carbon markets and co-funding examples for ODS phase out.

31. Mr. Andrés Ruiz, secretary of the Ministry of Mines and Energy of Colombia spoke about the rational and efficient use of energy in the country and on the different policies that Colombia has adopted on this issue. He stressed that the refrigeration and air conditioning sector is a strategic component of the PROURE

(National Programme of Rational and Efficient Use of Energy and Non-Conventional Sources), that in the residential sector there is a national programme for substituting refrigerators for those being energy efficient, and that in the commercial sector there is a project of energy efficient in buildings and the project of CFC substitution in Chillers, as well as the energy efficiency labeling project.

32. Participants provided comments on the above, directed to the funding levels from the Multilateral Fund for phasing out HCFCs with low-GWP alternatives and on the possibility of finding other sources, like GEF, for co-funding of the national projects.

33. Mr. Girish Sethi, director of TERI in India, gave a presentation on energy efficiency case studies comprising the modification of different type of air conditioning equipment located in commercial buildings and plants. He also spoke about programmes directed to energy efficiency in his country and emphasized that it is necessary to highlight efficiency when new investments/conversions are planned in the air conditioning sector and that in developing countries, the refrigeration and air conditioning demand will rise due to the improvement of living levels of citizens. He concluded that accordingly, it is necessary to start energy efficiency programmes in this sector and that China is leading this issue because it is the largest producer of this equipment worldwide.

34. Mr. Gustavo Arnizaut, from GTZ Proklima in Brazil, spoke about case studies where natural alternatives have been used as replacement in HCFC-based air conditioning and refrigeration equipment. The cases involved the conversion of a company producing air conditioning equipment in China, a chillers producer that decided to use ammonia in low charges, and a German supermarket that decided to have a specific design of a chiller for using R-290.

35. The participants posed questions to the lecturers regarding the costs of the conversions to natural refrigerants versus an HFC conversion, the savings on energy costs and about the availability of this new equipment with natural refrigerants in the global market.

36. The final presentation was given by Mr. Janos Maté, together with Mr. Rafael Rivera and Mr. Carlos Guevara from the Ministry of Social Protection of Colombia, on the 'SolarChill' project related with the refrigeration of food and vaccines using solar energy for locations where there is no reliable electricity supply. They pointed out that this technology is environmentally friendly, that it does not use ozone depleting substances as refrigerant or foam blowing agent and it does not require lead batteries.

37. After all the presentations, the participants provided comments on the workshop's topics, directed to the need of addressing several issues for the adoption of hydrocarbons and natural refrigerants in countries of the region. In particular, these needs include the adoption of safety standards, awareness and training of technicians in the industry and in training schools, the limited funding by the MLF for the HCFC phase out and the costs and availability of these new technologies for adoption in the region.

38. There was a final session for discussion on the possibility of having in the region a platform for exchanging and increasing the information flow and involving international stakeholders. There was agreement in that such tool is very useful if it is permanently administered and updated. Several ideas were provided such as monthly video conferences where experts could be invited to talk about certain themes of common interest or the creation of a blog. UNEP explained that there is a possibility to establish a tool of this type under the 'Jump-Start' project but that afterwards, the management responsibility of said platform would be passed on to the countries.

39. At the end of the day, the workshop was formally closed at 18:30.

III. CONCLUSIONS AND RECOMMENDATIONS

1. Although there are several technically feasible alternatives for HCFCs substitution in almost all refrigeration and air conditioning applications, countries should consider the alternative refrigerants and systems availability issue as well as their economical feasibility when adopting the change towards low-GWP and energy efficient substances.
2. In the low-temperature commercial refrigeration subsector, carbon dioxide in cascade systems seems to be a viable option due to its technical and economical feasibility as well as to its availability and application global experience.
3. The companies in the Latin America and Caribbean region have begun to be aware about the adoption of low-GWP, energy efficient HCFC alternatives through the manufacturing and acquisition of equipment that do not contain ozone depleting refrigerants and that contribute to mitigate the climate change effects, particularly with the use of HC-290 (propane) and of R-717 (ammonia).
4. If there is to be conversion of systems to hydrocarbons, it must be done only by technicians with high levels of competence in this field and only if absolutely necessary for the system. Further, it must be carried out with the proper equipment and tools and using the most safe and adequate methods, taking into account that certain types of systems must not be converted.
5. Successful cases of natural refrigerants use in several countries of the region were shown for the refrigeration and air conditioning sector including, hydrocarbons, ammonia, carbon dioxide and absorption systems in chillers, further to cases outside of the region like the use of carbon dioxide in cascade systems for commercial refrigeration. Likewise, information was received on HFC-32 for use in multi-split air conditioning, although this is not a low-GWP refrigerant. Although the existence of these cases demonstrate the technical and economical feasibility of the adoption of alternatives for HCFC substitution, the region's countries must weigh up the advantages and disadvantages of each option in the different sectors according to the reality of each country, aiming to achieve a successful phase out of said substances.
6. Countries should be pro-active to ensure that low-GWP HCFC alternatives are adopted, informing the industry about the benefits of such substances, further to the protection of the ozone layer, such as mitigation of climate change and higher energy efficiencies.
7. The workshop's participants agreed that this historical moment is an opportunity to increase energy efficiency, reduce leakage/emissions and gain cost savings in buildings and that part of these may be obtained by the correct architectural design which reduced the refrigerant charge. Additionally, it was observed that most part of the actual energy consumption is due to air conditioning equipment and that though the initial investment in more efficient

equipment/infrastructure could be significant, this would translate into effective savings in the long term.

8. The barriers for introducing hydrocarbons as alternative in the refrigeration sector are not exclusively of technological nature but there are diverse factors including institutional, policy and market factors that have limited their massive introduction in the region. On the other hand, a determining factor for the adequate and safe utilization of these substances is the suitable training of technicians that work in the sector.

9. It was proposed for the industrial sector of the countries to work jointly with the government bodies related with the ozone depleting substances and climate change, as well as with the Montreal Protocol implementing agencies, for the promotion of the development of natural refrigerants and equipment, taking into account that the manufacturing of said refrigerants should be sustainable and continuous in time aiming to maintain the adequate supply of such substances in the region.

10. The existent exchange and availability of information on legislations and standards on the controls of ozone depleting substances and alternatives to the same in other countries inside and outside the region, and the exchange of the same will aid the countries' governments to adopt the necessary policies to attain a successful and smooth HCFC phase out.

11. With the objective of having successful HCFC Phase Out Management Plans (HPMPs) in their formulation and implementation, participation mechanisms should be established and fostered between the government and the civil society with the aim of reaching a consensus among stakeholders regarding the different commitments that each one of them must comply with to achieve the phase out objectives of these substances.

12. Countries of the region should develop/cultivate local experts on certain low-GWP alternatives through focused training, discussions with other experts, attending conferences, directly handling practical implementation, so that they can "bring" these technologies to the enterprises within the countries.

13. The governments of the region's countries should study the possibility of looking for financial support additional to the one provided by the Montreal Protocol Multilateral Fund for their HCFC phase out plans, through different mechanisms as those related with GEF and the voluntary carbon markets, focused towards improving energy efficiency and reducing the impact on climate. On this regard, the Ozone Unit Officers will receive training on project management under these funding mechanisms, emphasizing on components related to climate benefits.

14. The need to emphasize on energy efficiency features when new investments/replacements are planned in the air conditioning sector was identified, including the optimization of cooling demand in the design stage. Further, due to the higher standards of living of developing countries that demand a larger amount of air conditioning and refrigeration equipment, there is the need

of starting programmes on energy efficiency focused to the refrigeration and air conditioning sector.



IV. Annexes

a. Agenda

Thursday April 22, 2010			
Registration 08:00 - 09:00	REGISTRATION OF PARTICIPANTS		
Welcome 09:00 - 09:30	<p>WELCOME: Mr. Carlos Costa Posada, Ministry of Environment, Housing and Land Development of Colombia.</p> <p>WELCOME WORDS: Philippe Owen, CLIMA.C 2, Head Transport and Ozone Division (video).</p> <p>Mr. Rajendra Shende, Head OzonAction Programme of UNEP.</p> <p>Mr. Javier Camargo, Chair of the Executive Committee of the Montreal Protocol Multilateral Fund.</p>		
09:30 - 09:45	PRESS CONFERENCE		
Organization 09:45 - 10:00	<p>OBJECTIVES OF THE WORKSHOP: Mirian Vega, UNEP/ROLAC.</p> <p>INTRODUCTION AND ORGANIZATION OF THE WORK: Jorge Sánchez, Technical Ozone Unit, Colombia.</p>		
10:00 - 10:30	COFFEE BREAK		
Session 1 10:30 - 10:50	<p>THE CONTEXT: INTERNATIONAL PERSPECTIVE.</p> <p>Update of UNEP Report on refrigeration and air conditioning options, 2006-2010.</p> <p>Perspective from the Technology and Economic Assessment Panel of the Montreal Protocol (Mr. Daniel Colbourne, Consultant).</p>		
Session 2 (Two parallel groups) 10:50 - 11:50	<table border="0" style="width: 100%;"> <tr> <td style="width: 50%; vertical-align: top;"> <p>Workgroup A</p> <p>Commercial application of natural refrigerants on cooling in supermarkets and point of sale equipment.</p> <ul style="list-style-type: none"> • Case study of a conversion to low-GWP alternatives in commercial refrigeration (Ms. Christianna Papazahariou, Shecco). • Applicability in the region: Conversion to hydrocarbons of the company FOGEL de Centroamérica SA (Mr. Efraín Baires). </td> <td style="width: 50%; vertical-align: top;"> <p>Workgroup B</p> <p>Hydrocarbon solutions for refrigeration and air conditioning</p> <ul style="list-style-type: none"> • Use of hydrocarbons in commercial refrigeration and air conditioning equipment (Mr. Daniel Colbourne, Consultant). • Commercial strategy for cooling equipment for a sustainable development (Juan Francisco Álvarez Vila, SAB-Miller Colombia) </td> </tr> </table>	<p>Workgroup A</p> <p>Commercial application of natural refrigerants on cooling in supermarkets and point of sale equipment.</p> <ul style="list-style-type: none"> • Case study of a conversion to low-GWP alternatives in commercial refrigeration (Ms. Christianna Papazahariou, Shecco). • Applicability in the region: Conversion to hydrocarbons of the company FOGEL de Centroamérica SA (Mr. Efraín Baires). 	<p>Workgroup B</p> <p>Hydrocarbon solutions for refrigeration and air conditioning</p> <ul style="list-style-type: none"> • Use of hydrocarbons in commercial refrigeration and air conditioning equipment (Mr. Daniel Colbourne, Consultant). • Commercial strategy for cooling equipment for a sustainable development (Juan Francisco Álvarez Vila, SAB-Miller Colombia)
<p>Workgroup A</p> <p>Commercial application of natural refrigerants on cooling in supermarkets and point of sale equipment.</p> <ul style="list-style-type: none"> • Case study of a conversion to low-GWP alternatives in commercial refrigeration (Ms. Christianna Papazahariou, Shecco). • Applicability in the region: Conversion to hydrocarbons of the company FOGEL de Centroamérica SA (Mr. Efraín Baires). 	<p>Workgroup B</p> <p>Hydrocarbon solutions for refrigeration and air conditioning</p> <ul style="list-style-type: none"> • Use of hydrocarbons in commercial refrigeration and air conditioning equipment (Mr. Daniel Colbourne, Consultant). • Commercial strategy for cooling equipment for a sustainable development (Juan Francisco Álvarez Vila, SAB-Miller Colombia) 		

<p>Session 3 (Two parallel groups) 11:50 - 13:20</p>	<p>Workgroup C Technological options for HCFC replacement – retrofits and conversions, adoption of new equipment.</p> <ul style="list-style-type: none"> • Replacing HCFCs in the refrigeration and air conditioning sector. Technology and introduction to a UNEP case study report (Klas Berglof, Consultant). • Guide for equipment conversion to hydrocarbons use (Daniel Colbourne, Consultant). 	<p>Workgroup D Sustainable constructions: reducing the use of Air Conditioning through design.</p> <ul style="list-style-type: none"> • Supernova Energy Services. <ul style="list-style-type: none"> • 'Natural' cooling options/solutions. • Coupling of renewable energy sources with cooling equipment (Nestor Moseres, Colombia). • Building efficiency and the importance of the HVAC system efficiency in designing sustainable constructions (Jorge A. Ordoñez, TRANE de Colombia).
<p>13:20 - 14:20</p>	<p>LUNCH</p>	
<p>Session 4 (Two parallel groups) 14:20 - 15:45</p>	<p>Workgroup E Industrial and commercial applications: CO₂ and ammonia as replacement technologies.</p> <ul style="list-style-type: none"> • CO₂, industrial applications (L. Tomaz Cleto, Brazil). • Ammonia installations (Walter Melgarejo, Peru). • Chillers with ammonia (ASHRAE, Colombia). 	<p>Workgroup F New technology options for phasing out HCFCs in air conditioning.</p> <ul style="list-style-type: none"> • Absorption Chillers (Antonio Cabrera, Mexico). • Alternatives to HCFCs in air conditioning equipment (Antonio Orozco). • HCFC conversion case study to hydrocarbons of the University of Technology of Jamaica (Dr. Horace Nelson, University of Technology).
<p>Session 5 15:45 - 16:30</p>	<p>SAFETY PROTOCOLS AND CONSIDERATIONS ON LEAK TIGHTNESS. (Professor Rafael Rau Vidal, Universidad Simón Bolívar, Venezuela). Presentation and questions from participants.</p>	
<p>Session 6 16:30 - 17:15</p>	<p>COOLING TECHNOLOGIES: WORKING WITHOUT HFCs. (Mr. Janos Maté. Greenpeace).</p> <ul style="list-style-type: none"> • The environmental and economical imperative. • General view and examples of HFC-free cooling technologies in several applications • Practical strategies for phasing out HFC and avoiding HFC. 	
<p>Session 7 17:15 - 18:00</p>	<p>GENERAL SESSION Facilitator: Jorge Sanchez</p> <ul style="list-style-type: none"> • Feedback from workgroups and discussion. • Conclusions from Day 1. 	

Celebration 18:30 - 20:30	CELEBRATION OF INTERNATIONAL EARTH DAY
Friday April 23, 2010	
Session 1 08:30 - 09:30	<p>Moderator: Jorge Sánchez.</p> <p>LEGISLATION DEVELOPMENTS: COMPARISON AND INSPIRATION</p> <ul style="list-style-type: none"> • The new EU regulation on ozone depleting substances, under the implementation of the Montreal Protocol (Etienne Gonin, UNEP/DTIE) • Other legislation frameworks (Carlos Andrés Hernández, UTO, Colombia). • Questions and answers on legislation.
09:30 - 9:45	<p>PRESENTATION OF NEW PUBLICATIONS:</p> <ul style="list-style-type: none"> • HCFC Policy & legislative options – a guide for developing countries (Etienne Gonin, UNEP/DTIE). • Brochures on HCFCs phase out (Etienne Gonin, UNEP/DTIE).
Session 2 9:45 - 11:15	<p>FUNDING OF HCFCs PHASE OUT</p> <p>2.1. Status of developing countries within the Montreal Protocol framework. (Mrs. Mirian Vega, UNEP/ROLAC).</p> <ul style="list-style-type: none"> • Uses phase out schedule for HCFCs. • HCFC Phase out Management Plans (HPMP). • Climate and energy efficiency dimension of the HPMP process. • Participation of the different sectors at national level. <p>2.2. Funding options of climate benefits. (Mr. Alejandro Ramírez, UNDP).</p>
11:15 - 11:30	COFFEE BREAK
Session 3 11:30 - 12:00	<p>PRESENTATION OF THE NATIONAL ENERGY STRATEGY. Efficient energy use – National advances, Ministry of Mines and Energy of Colombia.</p>
Session 4 12:00 - 12:45	<p>DUAL BENEFITS: BENEFITS OF IMPROVEMENTS ON ENERGY EFFICIENCY & PROTECTION OF THE OZONE LAYER</p> <p>Importance of the energy efficiency in refrigeration and air conditioning and possibilities of documentation of the results in the field (Klas Berglöf, Consultant).</p>
12:45 - 13:45	LUNCH
Session 4 13:45 - 14:30	<p>DUAL BENEFITS: BENEFITS OF IMPROVEMENTS ON ENERGY EFFICIENCY & PROTECTION OF THE OZONE LAYER</p> <p>Energy efficiency in the refrigeration and air conditioning sector (Girish Sethi, TERI).</p>

Session 5 14:30 - 16:00	REGIONAL AND INTERNATIONAL INITIATIVES <ul style="list-style-type: none"> • New projects in the Refrigeration and Air Conditioning sector (Gustavo Arnizaut, GTZ). • Innovative technology: <i>SolarChill</i>. Vaccine refrigerator that works with solar energy. (Rafael Rivera, Ministry of Social Protection of Colombia and Janos Maté from Greenpeace).
16:00 - 16:15	COFFEE BREAK
Session 6 16:15 - 17:15	CONCLUSIONS <ul style="list-style-type: none"> • Opportunities for continuous exchanges on technologies and capacities development. • Plans for increasing the exchange of information and the establishment of an electronic network. <ul style="list-style-type: none"> • Between international and main stakeholders of South America. • Platform for exchanges inside Latin America • Conclusions of Day 2.
17:15 - 17:30	CLOSING OF THE WORKSHOP

⌘ ⌘ ⌘ ⌘

b. List of Participants

Name:	Position:	Entity:	E - Mail:
Agustín Adarve	Advisor	natural Cooling	
Alberto Coyoc	Consultant	AC Tecnica	albertocoyoc63@yahoo.com
Alejandro Arbelaez	Trainer	SENA	aarbelaez@misena.edu.co
ALEJANDRO RAMÍREZ PABÓN			alejandro.ramirez-pabon@undp.org
Ana María Loaiza	Environmental specialist	Isagen S.A.	aarias@isagen.com.co
Andrea Patricia Soler		Ministerio de la protección social	asoler@minproteccionsocial.gov.co
Ángela Ramírez Ospina	Quality manager	RPH Ingeniería	hseq@rphingenieria.com
Antonio Barrera	Engineer	Asocolfiores	micofilo@hotmail.com
Antonio Cabrera	Consultant		acabrera@saajal.com
Antonio Orozco			
Antonio Ospina	Trainer	SENA	afospina@misena.edu.co
Armando Espinosa Hernández	Professor	Universidad Nacional	aespinosah@unal.com.co
Armando Gómez Díaz	Environmental specialist	Oficina técnica de ozono CITMA	agomezdieso05@hotmail.com
Armando Sierra	Trainer	SENA	arsierra@misena.edu.co
Arnulfo Alvarez Oliveros	Trainer	SENA	arnulfoalvarez@misena.edu.co
Atanasio Ríos Córdoba	Trainer	SENA	atanasiorios@gmail.com
Augusto Besedichek G	General manager	Polipanel	gerenciageneral@polipanel.com
Augusto Cáceres	Consultant	UTO Perú	caceres@reonextel.com.pe
Augusto Cáceres Otarola	Advisor	Oficina de ozono de Venezuela	ceausana@hotmail.com
Augusto Gómez Martínez	Trainer	SENA	agomezma@misena.edu.co
Cadmon Marroquín	Journalist	Ministerio de Ambiente y Recursos Naturales	aronmarroquin@marn.gob.gt
Camilo Pardo	Press director	Colombia es pasión	cpardo@colombiaespasion.com
Carina Cosimo	Consultant	Oficina prog. Ozono Argentina	ccosimo@ambiente.gob.ar
CARLOS ALBERTO OROZCO	Faculty of Mechanical Engineering	Universidad Tecnológica de Pereira	corozco@utp.edu.co
Carlos Andrés Carmona	Trainer	SENA	carmona@misena.edu.co
Carlos Andrés Hernández			CMendez@minambiente.gov.co
Carlos Costa Posada	Ministry of Environment, Housing and Land Development of Colombia		
Carlos Ferney	Trainer	SENA	carlosferney@misena.edu.co
Carlos Guevara	Commercial manager	Interhospitalaria	carlosguevara@ihltda.com

Carlos Humberto Nuncira Gallo	Trainer	SENA	cnuncira@misena.edu.co
Carmen Mora	Ozone officer	Ministerio de la Producción , Perú	carmen.mora@gmail.com
César Salamanca			
Christianna Papazahariou			christianna.papazahariou@shecco.com
Cipriano Esguerra	National Head technical department of vending machines	Postobon	cesguerra@postobon.com.co
Daniel Colbourne	Consultant		d.colbourne@re-phridge.co.uk
Daniel Perú Rivera	Ozone specialist	Oficina Técnica de Ozono	peru@ama.cu
David Eduardo Guzmán Cañas	Trainer	SENA	dguzman@sena.edu.co
Diana Gardeazabal	Intern	Delcol	degardeazabals@gmail.com
Diego Ascuntar Benavides	Trainer	SENA	diegoascuntar@misena.edu.co
Diógenes Sartorio	Technical consultant	Unidad Técnica de Ozono de Paraguay	dsartorio@elimec.com.py
Edgar Quisobon	Trainer	SENA	equisobonig@aena.edu.co
Edgar Rojas Gabilan	Trainer	SENA	erojasg@misena.edu.co
Edgar Zúñiga	Technical assistant	SERNA	eaz94@yahoo.com
Eduardo Solano	Trainer	SENA	esolano@sena.edu.co
Edwin Amnuel García	Environmental Management Coordinator	ETB	edwin.garciad@etb.com.co
Efraín Baires	Engineering manager in Research and Development	Fogel de Centroamérica S.A.	ebaires@fogel-group.com
Elsa Vivas	Coordinator Ozone Project	Ministerio Ambiente Nicaragua	evivas@marena.gob.ni
Enrique Arias	Coordinator UTO Honduras	SERNA	proyicc@yahoo.com
Erwin Gómez	Coordinator Technical Ozone Unit Guatemala	Ministerio de Ambiente	egomez@marn.gob.gt
Etienne Gonin	Consultant	PNUMA	etienne.gonin@unep.org
Fabio Sierra	Mechanical Engineering Professor	Universidad Nacional	fesierrav@unal.edu.co
Fernando del Castillo	Trainer	SENA	
Francy Carolina Bolaños	Environmental professional	Energía integral andina S.A	hseg@energiaintegralandina.com
Frank Jhonny Pérez	Trainer	SENA	frankpe01@gmail.com
Gabriel Espinosa Vergara	Trainer	SENA	gespinosa@sena.edu.co
Gerardo Guevara Baquero	Trainer	SENA	gguevarab@sena.edu.co

Germán Arturo Orrego Muñoz	Trainer	SENA	gorrego@misena.edu.co
Germán de Jesús Caro Gómez	Trainer	SENA	
Giovanny Fonseca	Lab coordinator	Challenger S.A	gifome18@hotmail.com
Girish Sethi	Director	The Energy and Resources Institute (TERI)	girishs@teri.res.in
Gonzalo Asencio	Consultant HPMP	u. Ozono	Gonzalo@gisma.cl
Gonzalo Camacho	Technical manager	Indusel S.A	gt@indusel.com.co
Gonzalo Maldonado	General supervisor of Ozone Government Commission	Ministerio de Ambiente y Agua de Bolivia	gonzalo_maan@yahoo.com.mx
Guido Landa Durán	Sub-management of Industrial Promotion	Cámara Nacional de Industrias de Bolivia	glanda@bolivia-industry.com
Gustavo Arnizaut	Project manager	GTZ	gustavo.arnizaut@proklima.net
Harold Salazar Pineda	Trainer	SENA	hsalazarp@misena.edu.co
Harvey Enrique Pérez González	Trainer	SENA	hperzg@misena.edu.co
Henry Giraldo	Technology head	Haceb S.A	henrygir@haceb.com
Horace Nelson	Mech engineer	UTECH	horacen@msn.com
Hugo Garzón	Commercial manager	Novakem S.A	hugarzon@novakem.com.co
Idelfonso Clavijo Cipagauta	Maintenance Coordinator	Almacenes Éxito S.A	idelfonso.clavijo@grupo.exito.com
Ingid Karaman	Submanager	Incopar Ltda	incopar@yahoo.com
Jaime Alberto David Ariza	Maintenance Supervisor	Ecopetrol S.A.	jaime.david@ecopetrol.com.co
Jaime Moreno		CSL Bogotá S.A	
Jairo Abril	Maintenance Coordinator	Almacenes Éxito S.A	jairo.abril@grupo.exito.com
Jairo Cubillos Canal	Trainer	SENA	jcubillosc@sena.edu.co
Jairo Orozco	Trainer	SENA	jorozco@misena.edu.co
Janos Mate		Greenpeace Internacional	jmate@telus.net
Javier Camargo	Advisor	MAVDT	jecamargo@minambiente.gov.co
Javier Ladino	Journalist	Colombia es pasión	jladino@colombiaespasion.com
Jeaneth Solano Galvis	Specialized professional	Ministerio de la protección social	
Jesús Alberto Zuluaga	Trainer	SENA	
Jhon Jairo Díaz Gómez	Electro-mechanical engineer	Telmex	jhon.diaz@telmex.com
Jhonyt Ferney Buitrago	Trainer	SENA	jhonnyferney983@misena.edu.co
Joella Hayams		PNUMA	joella.hayams@unep.org
Johanna Arriagada Díaz	Consultant ozone Unit	CONARA - Chile	jarriagada@conama.cl
Jorge Amrío García Molina	Trainer	SENA	

Jorge Cabrera Domínguez	Trainer	SENA	jojocado@misena.edu.co
Jorge Carvajal	Ozone Coordinator	Ministerio Industrias	jcarvajal@mipro.gov.ec
Jorge Ordoñez	General manager	Trane	jordonez@trane.com
Jorge Rocca			jhrocca@etb.net.co
JORGE SÁNCHEZ			jsanchez@minambiente.gov.co
José A Vargas	Trainer	SENA	joanva@misena.edu.co
José Eusebio Gualdron	Trainer	SENA	jegualdron@misena.edu.co
José I Sánchez	Cooling advisor	Bavaria	famisan@hotmail.com
Juan Francisco Álvarez Vila			
Juan Pablo Hernández		Dupont	juan.pablo.hernandez@dupont.com
Julián Franco	Contractor	Ministerio de minas y energía	jfranco@minminas.gov.co
Julián López Ospina	Trainer	SENA	jlopez@sena.edu.co
Karen González	Bioclimate professional	natural Cooling	naturalcooling@gmail.com
KLAS BERGLOF			
Leonides Sosa	Ozone officer	Ministerio de Ambiente	leo_sosa25@yahoo.com; noubelize@gmail.com
Levy Bonilla Izquierdo	Trainer	SENA	
Luis Alberto García	Head maintenance section	Cafam	lagarcia@cafam.com.co
Luis Arday Bedoya	Trainer	SENA	luiardayedu@yahoo.es
Luis Fernando López	Professional	Ministerio de minas y energía	lflopez@mnnminas.gov.co
Luis Fernando López	Journalist	MAVDT	llopez@minambiente.gov.co
Luis Fernando Ortiz	Engineering head	Indurama S.A.	lfortiz@indurama.com.ec
Luis Ignacio Melo	Procurement Director	Inducol	limelo@inducol.com.co
Luis Villegas Gonzales	Professor	Lab. Refrigeración UMSS	Laborefrinec@hotmail.com
Luz Helena Hoyos	Sales manager	Calaires S.A	ventas@calaires.com
Manuel Montenegro	Methodologist	SENA	mmontenegro@misena.edu.co
Marco Calderón	Consultant	Mac refrigeración	marcalgz34@live.com.mx
Marco Pinzón	Programme officer	PNUMA	marco.pinzon@unep.org
María Luisa Triana Yepes	Coordinator Air quality Department	Universidad Tecnológica de Pereira	marialuisatriana@utp.edu.co
Mariam Hadra	Communications Coordinator	MAVDT	mhadra@minambiente.gov.co
Marta Comte	Consultant		marta.comte@gmail.com
Martha Rincón	Consultant	PNUMA	rinconmartha@yahoo.com
Mauricio Rodríguez	Services manager	Anrec Ltda Mycom	mauricio.rodriguez@mycom.com.co
Michelle Cabrera	Consultant	SAASA	mcabrera@starr.com.mx
Miguel Alfonso Oviedo Gómez	Trainer	SENA	maoviedog@hotmail.com

Miguel Ángel Núñez		Industrias Haceb	miguelnun@haceb.com
Miguel Antonio Ortiz Rodríguez	Trainer	SENA	maortizr6@hotmail.com
Miller Monsalve	Post sales head	Fogel Andina	miller.monsalve@fogelandina.com
Mirian Vega	OzonAction networks Regional Coordinator	PNUMA, ROLAC	mirian.vega@unep.org
Moisés Mejía	Trainer	CECNA	
Néstor Moseres	Manager	Supernova Energy	nestor.moseres@supernova.es.com
Ómar Betancourt González	Trainer	SENA	omarbego@gmail.com
Orlando Mican Buitrago	Trainer	SENA	omica@hotmail.com
Osmer Castillo	President	FONDOIN	osmercastillo@hotmail.com
Rafael Rau Vidal	Professor Thermodynamics and transfer phenomena department	Universidad Simón Bolívar	rrau@telcel.net.ve
Rafael Rivera	Advisor cold chain	Ministerio de la protección social	rrivera@minproteccionsocial.gov.co
Rajendra Shende		UNEP/DTIE	
Ramón Toscano Cabrales	Trainer	SENA	ratoca@misena.edu.co
Raúl Díaz Torres	Trainer	SENA	rauldito@hotmail.com
Raúl Rodríguez	Designer	Inversiones Cold Star	rodriflachas@hotmail.com
Reynaldo Alemán Zaldivar		Oficina técnica de ozono	
Ricardo Iván Castañeda	Environmental Coordinator	Telefónica	ricardo.castañeda@telefonica.com
Roberto Marvid	Consultant ozone unit	UTO Uruguay	rmarvid@ozono.gub.uy
Roberto Morales Heilbron	trainer	SENA	rmoralesh@misena.edu.co
Rodrigo Balaguer Sáenz	Camera producer	Fundación Albatros	rodrigobalaguer@gmail.com
Rubén Arévalo		Cabarria y Cia	ruarevalo@cabarria.com
Rubén Llanes	Coordinator environmental committee	Acaire	rllanesm@ucentral.edu.co
Rubén Marchand	Consultant	MB Ingeniería	marchand@prodigy.net.mx
Samoel Viera de Souza	Vice-chair	ABRAVA	samoel@cacr.com.br
Satoshi Nakasat	Engineer	Anrec	satoshi.nakasato@mycom.com.co
Serdio Enrique Cartagena	Trainer	SENA	semingeniero@misena.edu.co
Sergio Bahamondez Rivera	Professor	INACAP	sergio.bahamondez@docentes.inacap.cl thssergio@gmail.com
Sergio Oddone	Coordinator HPMP	Secretaria de ambiente	odonne.sergio@gmail.com
Tomaz Cleto	Consultant	Yawatz Engenharia	tomazcleto@yawatz.com.br
Vanesa Restrepo	Editor	ACR Latinoamérica	vrestrepo@latinpressinc.com
Víctor Carrillo	Trainer	SENA	vcarrillo@misena.edu.co

Walter Melgarejo	Consultant	UTO Perú	wmelgarejo@gmail.com
Wilson Ramírez Zuluaga	Trainer	SENA	wramirez@misena.edu.co
Yasuhiro Okuyama	Professional	Anrec	Yasuhirookuyaha@mycom.com.co
Yerzhan Aisabayev	Programme officer	PNUMA	yerzhan.aisabayev@unep.org

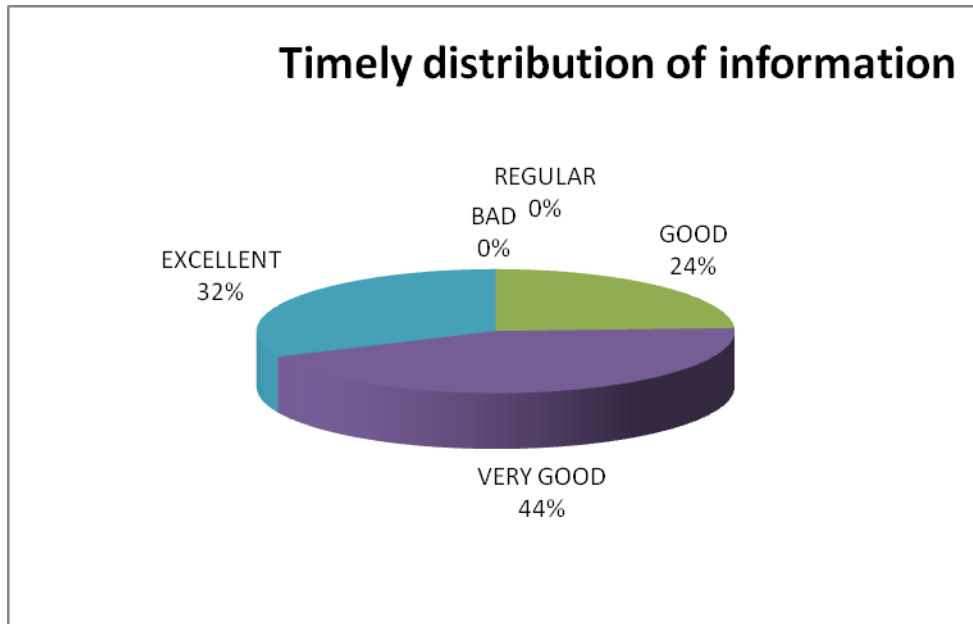
c. Evaluation of the meeting

EVALUATION SOUTH AMERICAN REGIONAL WORKSHOP ON LOW-GWP, ENERGY-EFFICIENT HCFC REPLACEMENT TECHNOLOGIES IN THE REFRIGERATION AND AIR CONDITIONING SECTOR

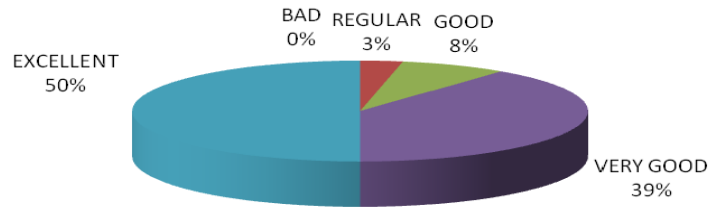
BOGOTA, COLOMBIA, APRIL 22 AND 23, 2010

HOW WE DID?

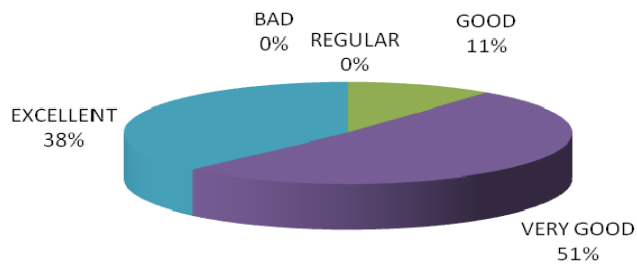
	BAD	REGULAR	GOOD	VERY GOOD	EXCELLENT	AVER
1. Timely distribution of information	0	0	16	29	21	4.08
2. Planning and development of the meeting (logistics)	0	2	5	26	33	4.36
3. Planning and development of presentations	0	0	7	34	25	4.27
4. Usefulness/Applicability of the meeting	0	0	4	23	39	4.53
OVERALL QUALIFICATION:						4.31



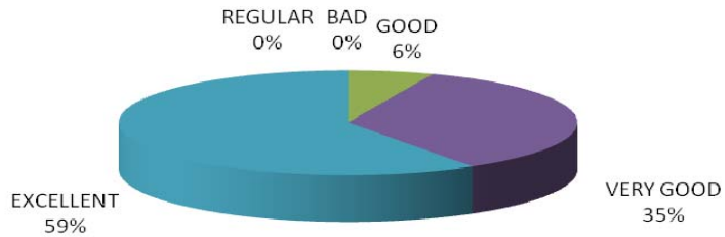
Planning and development of the meeting (logistics)



Planning and development of presentations



Usefulness/applicability of the meeting



d. Evaluation Gender Participation

