

# **TERMINAL EVALUATION**

## **Project BRA/12/G77 Integrated Management for the Chillers Sector**

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## LIST OF ACRONYMS AND ABBREVIATIONS

<b>ABC</b>	Brazilian Cooperation Agency
<b>ABNT</b>	Brazilian Association of Technical Standards
<b>ABESCO</b>	Brazilian Association of Service Companies for Energy Conservation
<b>ASBRAV</b>	South Brazilian Association of Refrigeration, Air Conditioning, Ventilation and Heating
<b>ABRAVA</b>	Brazilian Association of Refrigeration, Air-Conditioning, Ventilation and Heating
<b>ASHRAE Brazil</b>	American Society of Heating, Refrigerating and Air-Conditioning Engineers
<b>ANPRAC</b>	National Association of Refrigeration, Air-Conditioning, Heating and Ventilation Professionals
<b>CAP</b>	Project Monitoring Committee
<b>CFC</b>	Chlorofluorocarbon
<b>CONAMA</b>	National Environment Council
<b>CTF/APP</b>	Federal Technical Registry of Potentially Polluting Activities and/or Users of Environmental Resources
<b>DEX</b>	Direct Execution
<b>ExCom</b>	MLF Executive Committee
<b>MLF</b>	Multilateral Fund for the Implementation of the Montreal Protocol
<b>GBC Brazil</b>	Green Building Council Brazil
<b>GEE</b>	Greenhouse Gas
<b>GEF</b>	Global Environment Facility
<b>GGR</b>	Outcomes Management Guide
<b>GIZ</b>	German Agency for International Cooperation
<b>GWP</b>	Global Warming Potential
<b>HCFC</b>	Hydrochlorofluorocarbon
<b>HFC</b>	Hydrofluorocarbon
<b>IBAMA</b>	Brazilian Institute of Environment and Renewable Natural Resources
<b>IDB</b>	Inter-American Development Bank
<b>MI</b>	Expression of Interest
<b>MMA</b>	Ministry of Environment
<b>MOP</b>	Meeting of the Parties to the Montreal Protocol
<b>NA</b>	Unavailable
<b>ODS</b>	Ozone Depleting Substances
<b>PBCO</b>	Brazilian Program for the Elimination of the Production and Consumption of Substances that Deplete the Ozone Layer
<b>PDO</b>	Ozone-Depleting Potential

<b>PBH</b>	Brazilian HCFC Phase-Out Program
<b>PNC</b>	National Plan for CFC Elimination
<b>PNRS</b>	National Policy on Solid Waste
<b>PROZON</b>	Inter-Ministerial Executive Committee for Protection of the Ozone Layer
<b>RAC</b>	Refrigeration and Air Conditioning
<b>SDG</b>	Sustainable Development Goal
<b>SIGAP</b>	Project Management Information System
<b>SINDRATAR</b>	Union of Refrigeration, Heating and Air Treatment Industries
<b>UIM</b>	Implementation and Monitoring Unit
<b>UNDP</b>	United Nations Development Program

## Executive Summary

**Table 1: Project Summary**

**Project Title: BRA/12/G77 – Demonstration Project for Integrated Management for the Chillers Sector**

Project:			<i>At endorsement (US\$)</i>	<i>At completion (US\$)</i>
UNDP Project ID:	00072266	MPU- Fund 63080 MP Mult Yr Nat Setr Phaseout	1,000,000.00	1,000,000.00
Country:	Brazil	IA/EA own:	0	0
Region:	RBLAC	Government:		
Focal Area:	CC	Other:	0	0
FA Objectives, (OP/SP):	EA	Co-Financing Total:		
Executing Agency:	UNDP	Project Total Cost:	1,000,000.00	1,000,000.00
Other Partners Involved:	MMA Coordinator of activities related to the implementation of the Montreal Protocol	PRODOC Signature (date project began): 2013  (Operational) Closing Date: Proposed: 2017 Start: January 2014		

Objective: According to the PRODOC, signed in April, 2013, the main objective of the Demonstration Project for the Integrated Management of the Chillers Sector - BRA/12/G77, is to stimulate the interest, in an integrated way, for improvement of energy efficiency (EE) in buildings, demonstrating the potential of energy efficiency in replacing CFC- and HCFC-based coolers.

The initial outcomes/outputs of the Project BRA/12/G77 according to the PRODOC were:

- ✓ National inventory of liquid chillers with CFCs and HCFCs carried out;
- ✓ Technical and informative materials to promote and disseminate the outcomes obtained by replacing CFC and HCFC liquid chillers, produced and distributed;
- ✓ Workshops, capacity-building and training for specialized professionals and professionals interested in replacing CFC and HCFC liquid chillers;
- ✓ Case study to demonstrate EE potential and the economic and environmental benefits obtained by replacing CFC liquid chillers in public buildings;
- ✓ Technical assistance for the development of projects to replace liquid chillers with CFCs and HCFCs to increase EE.

In 2014, a Substantive Review of the BRA/12/G77 Project was carried out, which resulted in the redesign of the project and had the following objectives:

- ✓ To extend the term of validity of the Project until December 31, 2016;

- ✓ Adapt the outputs, goals and activities of Project Outcomes 2 and 3 in their original form;
- ✓ Cancel Outcome 5 - Technical assistance to develop projects to replace CFC and HCFC liquid coolers to increase EE;
- ✓ Insert new Outcome 6 – Retro-commissioning processes of air conditioning systems with CFC and HCFC liquid chillers performed.

**Box 1** presents the expected outcomes and outputs targets modified after the aforementioned substantive review, as well as their implementation status:

**Outcome 1: National inventory of liquid chillers with CFC and HCFC performed.**

**Output:** Inventory of chillers with CFCs and HCFCs in operation in Brazil.

**Output completed**

**Outcome 2: Technical and informative materials to promote and disseminate the outcomes obtained by replacing CFC and HCFC liquid chillers produced and distributed.**

**Output targets modified**

**Output:**

- Information material: basic information and guidelines on cold water refrigeration systems.
- Technical manual: concepts of refrigeration, design, operation and maintenance; environmental and economic benefits, EE, commissioning and retro-commissioning, standards, measurement procedure and performance evaluation, according to national and international standards, safety and others.
- Promotional materials:
  - ✓ 1 Folder
  - ✓ 1 Flyer
  - ✓ 3 Posters (banner)
  - ✓ 1 Information article for the media (radio, TV, websites, magazines)
  - ✓ 1 Technical article. **Outputs completed.**

**Outcome 3: Workshops, training and training for specialized professionals and owners interested in replacing CFC and HCFC liquid chillers performed.**

**Output targets modified**

**Outputs:**

- 5 training events in different regions of Brazil.
- Training on cold water systems, approach to projects, installation, operation and others.
- New technologies: concepts, applications and refrigerant fluids.
- Encouraging replacement of CFC and HCFC chillers.
- Demonstration of economic and environmental benefits.
- Application of standards. **Outputs completed.**

**Outcome 4: Case studies to demonstrate EE potential and the economic and environmental benefits obtained by replacing CFC liquid chillers in public buildings carried out.**

*This outcome was implemented under the National Plan for the Elimination of CFCs (Project BRA/02/G76) and finalized in December 2013, with the objective of following the replacement of the Cold Water Plant (containing CFC liquid chillers, water pumps, pipes, electric panels and control systems) in a building of the Ministry of Finance.*

**Output:**

- Case studies to demonstrate EE potential and the economic and environmental benefits obtained by replacing CFC liquid chillers in public buildings under the PNC.  
**Completed and held in one existing building.**

*Note: Energy consumption analysis was performed before and after the intervention to show that the equipment replacement had contributed to the reduction of energy consumption. However, the results showed that the substitution process could have been enhanced by a retro-commissioning involving the entire air conditioning system.*

**Outcome 5: Technical assistance for preparation of chiller replacement proposals to increase EE.**

**Outcome Canceled**

**Reasons for cancellation:**

- ✓ Irrelevant amount of equipment with CFCs, damaging the expected outcome (elaboration of 22 Chillers replacement projects with CFCs).
- ✓ Energy efficiency problems associated with the entire refrigeration system and not just replacing chillers.
- ✓ Necessity of the market for technical materials and case studies that contemplated the retro-commissioning of the entire air conditioning installation of existing buildings.

**Outcome canceled by the Project Substantive Review**

**Outcome 6: Retro-commissioning processes of air conditioning systems with CFC and HCFC liquid coolers.**

**Outcome Added**

**Outputs:**

- ✓ 2 processes of retro-commissioning in public buildings in Fortaleza/Ceará and in Cuiabá/Mato Grosso.
- ✓ 2 processes of retro-commissioning in private buildings in São Paulo, SP.  
Defined from Expressions of Interest carried out under Project BRA/12/G77.

**Outputs completed**



## Box 2

Activities developed for the accomplishment of the indicative activities described in the PRODOC and in the Substantive Review of the Demonstration Project for Management of the Chillers Sector.

### **Outcome 1/Output 1.1:**

- Inventory of chillers with CFCs and HCFCs in operation in Brazil.

### **Indicative and Performed Activities**

#### **2013**

- Inventory of chillers with CFCs and HCFCs in operation in Brazil.
- Verification of companies listed in existing inventory.
- Identification of possible companies not yet identified in the existing inventory.
- Recording of data on identified equipment.
- On-site verification when necessary.
- Systematization of data collected.

#### **Inventory carried out.**

### **Outcome 2/Output 2.1**

- Technical and informative materials to promote and disseminate the outcomes obtained with the replacement of CFC and HCFC liquid chillers, produced and distributed.

### **Indicative and Performed Activities**

#### **2015-2016-2017**

- Elaboration of TOR;
- Production of materials;
- Review of the materials produced;
- Follow up of the diagramming, formatting and generation of graphic art;
- Distribution of materials in workshops and training to be carried out for professionals of companies installing and maintaining ice water systems, managers of public and private buildings, professionals etc.;
- Dissemination and availability in digital media for free access of the interested public.

#### **Technical and information materials produced and distributed**

### **Outcome 3/Output 3.1**

Workshops, trainings for specialized professionals and owners interested in replacing CFC and HCFC liquid chillers, demonstrating EE potential and economic and environmental benefits.

### **Indicative and Performed Activities**

#### **2015-2016**

- Preparation of TOR;

- Definition of training plan;
- Definition of workload and content;
- Selection of mediators and speakers (teachers or instructors) to act in the event;
- Collection and compilation of evaluation data for the event;
- Preparation of mailing list and invitation to participants;
- Definition and leasing of spaces and materials to carry out the event;
- Issuance of certificates.

Preparation of a report highlighting the lessons learned, recommendations, number of participants and evaluation of the courses.

**Training event developed**

**Outcome 3/Output 3.2**

Courses to improve the qualification and training of specialized professionals.

**Indicative and Performed Activities**

**2015-2016**

- Preparation of TOR;
- Definition of training plan;
- Definition of workload and content;
- Selection of mediators and speakers (teachers or instructors) to act in the event;
- Collection and compilation of evaluation data for the event;
- Preparation of mailing list and invitation to participants;
- Definition and leasing of spaces and materials to carry out the event;
- Issuance of certificates.
- Preparation of a report highlighting the lessons learned, recommendations, number of participants and courses evaluation.

**Training event carried out**

**Outcome 3/Output 3.3**

Training of ESCOs to replace obsolete CFC and HCFC refrigerators, aiming to promote EE in existing buildings.

**Indicative and Performed Activities**

**2015-2016**

- Preparation of TOR;
- Definition of training plan;
- Definition of workload and content;
- Selection of mediators and speakers (teachers or instructors) to act in the event;
- Collection and compilation of evaluation data for the event;
- Preparation of mailing list and invitation to participants;
- Definition and leasing of spaces and materials to carry out the event;
- Issuance of certificates.
- Preparation of a report highlighting the lessons learned, recommendations, number of participants and evaluation of the courses.

**Training event carried out**

**Outcome 3/Output 3.4**

Training for owners, technicians, maintainers and operators of chillers on operation and maintenance of chillers and air conditioning systems.

**Indicative and Performed Activities****2015-2016**

- Preparation of TOR;
- Definition of training plan;
- Definition of workload and content;
- Selection of mediators and speakers (teachers or instructors) to act in the event;
- Collection and compilation of evaluation data for the event;
- Preparation of mailing list and invitation to participants;
- Definition and leasing of spaces and materials to carry out the event;
- Issuance of certificates.
- Preparation of a report highlighting the lessons learned, recommendations, number of participants and evaluation of the courses.

**Training event carried out****Outcome 3/Output 3.5**

Final Seminar to present the outcomes achieved in the substitution/conversion of Chillers with CFC and HCFC.

**Indicative and Performed Activities****2015-2016**

- Formulation of the seminar;
- Preparation and delivery of invitations to the speakers and the public and the actors involved.

**Training event carried out****Outcome 6/Output 6.1**

Retro-commissioning processes of air conditioning systems (involving chilled water plant, air conditioners and air distribution circuits) in buildings that have liquid chillers (cold water system) in operation and with CFC and HCFC.

**Indicative and Performed Activities****2015-2016-2017**

- Preparation of TOR;
- Conduct of retro-commissioning processes;
- Preparation of conclusive technical reports containing the outcomes obtained and lessons learned;
- Availability of reports in digital media for free access by the interested public.

**4 Training events carried out**

## Rating for Project Design and Outcome Implementation

<b>Evaluation Ratings:</b>			
<b>1. Monitoring and Evaluation</b>	<b>Rating</b>	<b>2. IA&amp; EA Execution</b>	<b>Rating</b>
M&E design at entry	5 (S)	Quality of UNDP Implementation	6 (HS)
M&E Implementation Plan	5 (S)	Quality of Execution – Executing Agency	6 (HS)
Overall quality of M&E	5 (S)	Overall quality of Implementation/ Execution	6 (HS)
<b>3. Assessment of Outcomes</b>	<b>Rating</b>	<b>4. Sustainability</b>	<b>Rating</b>
Relevance	2 (R)	Financial resources	4 (L)
Effectiveness	5 (S)	Socio-political	4 (L)
Efficiency	5 (S)	Institutional framework and governance:	4 (L)
Overall Project Outcome Rating	5 (S)	Environmental	4 (L)
		Overall likelihood of sustainability:	4 (L)

<sup>1</sup> Evaluation Office, 2012, *United Nations Development Program*, p. 29.

According to the Evaluator, the Project rating as a whole is Highly Satisfactory (6 points).

## Conclusions and Recommendations

Despite delays caused by issues related to the initial linkages to the Energy Efficiency Market Transformation Project (BRA/09/G31) in which the Integrated Chillers Sector Management Demonstration Project (BRA/12/G77) was one of the components, as well as other factors related to the their dismemberment and the necessary reformulation, the Final Evaluation of the Project verified that its outcomes are relevant and have been fully achieved in relation to the proposed objectives.

Thus, Project BRA/12/G77 was finalized with satisfactory results that included economic and environmental benefits and, with the generation of knowledge and the dissemination of information on the environmentally adequate management of the chilled water system, in line with the precepts of EE. These systems, as explicit in the didactic materials produced by the Project, are used in cooling processes, so-called

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<sup>1</sup> According to “Guidance for Conducting Terminal Evaluations of UNDP-Supported, GEF-Financed Projects”:

Highly Satisfactory = 6 (HS); Satisfactory = 5 (S), Highly Unsatisfactory = 1 (HI)

Sustainability = 4 Probable, Moderately Likely (low risk) = 3, Substantial Risk = 1

M & A - General Quality of M&A = 6, M&A Design = 6, M&A Implementation Plan = 6

Quality of Implementation = 6 points, Quality of Execution = 6, Overall Quality = 6

Relevance = (R) or (NR) (score 2 points); Efficacy = 6 points; Effectiveness = 6 points; Financial Resources = 4 points; Socio-political = 4; Environment = 4 (4 being the highest score).

chillers. These, according to the Practical Guide on Cold Water Systems, are "complete closed-circuit refrigeration equipment mounted on a compact base and requiring only hydraulic interconnections with the ice water and cooling water pumping circuits and electrical interconnections to integrate them into the system." This system presents advantages that have been proven and disseminated through the didactic material presented in the capacity-building and training events carried out by the Project.

The advantages of an ice water system that uses chillers were thus explained and discussed during the implementation of the training programs. They concern the reduced fluid load, energy efficiency and the possibility of more precise control of the cooling processes, according to the Practical Guide on Cold Water Systems, product of Project BRA/12/G77, in final evaluation.

Among the outputs and outcomes proposed by the Project, the processes of retro-commissioning were highlighted by the fact that the implementation of the processes provided inputs for the training and training programs. In addition, its importance is also based on the fact that it was a fundamental element for the technicians and specialists responsible for the cooling system of the target buildings "to open their eyes" to knowledge about the need for replacements of equipment or about the material necessary for its better functioning.

Retro-commissioning, as defined in an article published in ABRAVA Magazine in October 2016, "is the commissioning process to be carried out in existing buildings, which consists of a detailed investigation of the system, including executive design, installation and current operating conditions and performance in order to identify problems and optimize the building's air conditioning system."

The importance of the retro-communication processes carried out in public and private buildings, as outputs/outcomes of the Project, became evident when taken as a total system, in its entirety, with complex operation, which is not only verified by the fluid necessary to generate air conditioning but also by the whole cooling system. Thus, the Appraiser concludes that the processes have achieved the main objective of collecting data for the recovery of comfort, air quality and efficiency of the retro-commissioning process. In addition, as mentioned above, the process provided relevant inputs for the preparation of training material, inputs for the discussions in training and construction events and the strengthening of knowledge for the integrated management of the chillers sector.

In conclusion, the Evaluator affirms that the outputs/outcomes, according to the monitoring and evaluation analysis performed and qualified by the Final Evaluation, have complied with the following assumptions:

- Consistent with the specific nature of the issues involved and presented in language accessible to the groups included in the Project partnerships and the target groups reached.
- Planned in accordance with indicative activities in the PRODOC and Substantive Project Review and relevant for compliance with the commitments established by the country in the Montreal Protocol.

- Compatible with the capacity of involved and relevant partners at the local, national and international levels, contributing to the priorities set out in the Montreal Protocol.
- Obtained in a way that the results were not an end in themselves, but the basis for continuous improvement of information, data and other findings, being aimed at reducing the impacts of harmful substances on the environment and damage to the ozone layer.

## **Recommendations**

Considering the complexity of the chilled water refrigeration sector and the targets for elimination of substances that damage the ozone layer, the Final Assessment concludes that the decision to recruit legal advice for the implementation of the activities proposed by the Project was highly positive.

This statement leads to the main recommendation that is based on the need for projects increasingly to improve the processes of selection and classification of companies (legal entities) to carry out specialized activities. Bidding also requires broader disclosure, getting more and better bids and leading to the best price instead of just the lowest price. This recommendation was highly emphasized by the participants and actors involved in the implementation of this Project.

Another recommendation concerns the implementation of the results of the retro-commissioning process. The lack of information about funding sources was identified to implement the recommendations of the retro-commissioning process. This is because there are high costs to implement the recommendations contained in the report of the retro-commissioning process, which sometimes leads to frustration both to those who applied the process and to the technicians involved, who recognized the urgency of implementing actions to restructure the cold-water refrigeration system and that they were unable to do so. However, the Project provided information on this subject, since, among the topics of the training program carried out, there was a specific module of information on financing, and this information was also passed on to representatives of buildings that were benefited by the Project.

The recommendation is based on the importance of the retro-commissioning process and thus, for the buildings benefited by the process within the scope of the Project, it is important that they seek, and some are already seeking, to make available resources to implement the recommendations contained in the report of the retro-commissioning process.

These are the main conclusions and recommendations identified in the final evaluation process of the Integrated Chillers Sector Management Demonstration Project that the Evaluator classified as having presented highly satisfactory results.

# **1 Introduction**

The Montreal Protocol on Substances that Deplete the Ozone Layer is an international environmental treaty established in 1987 and ratified by 197 countries. The Protocol aims to protect the ozone layer by eliminating the production and consumption of ODSs.

Brazil has been carrying out measures to protect and recover the ozone layer for more than two decades. It acceded to the Vienna Convention and the Montreal Protocol by means of Decree 99.280 of June 6, 1990, pledging to completely eliminate chlorofluorocarbons (CFCs), among other measures.

The National Plan for the Elimination of CFCs (PNC) was presented by the Brazilian Government in July of 2002 to the Executive Committee of the Montreal Protocol (ExCom). This Plan aiming to implement strategies for the elimination of CFC consumption in Brazil reached its goals of total elimination of CFCs in 2010, according to the schedule established for developing countries. With financial support from the Multilateral Fund for Implementation of the Montreal Protocol (MLF), previously consumed CFCs were completely eliminated in the polyurethane foam (PU) and Refrigeration and Air Conditioning (RAC) manufacturing industries as well as industrial applications in the solvent, sterilizing and pharmaceutical areas.

For implementation of actions aimed at the elimination of CFCs, the PNC received financial support from the Fund. The MLF was created in 1990 and became a financial mechanism for technical and financial assistance to the Parties to Article 5 of the Montreal Protocol.

Since the MLF provides financial assistance to developing countries through multilateral and bilateral agencies and government institutions, the United Nations Development Program in Brazil (UNDP/Brazil) has acted as a leading agency in the implementation of projects supported by the MLF in Brazil and the Ministry of Environment (MMA) has acted as coordinating body.

The MMA, as the ozone agency under the Montreal Protocol and jointly with the Inter-ministerial Executive Committee for the Protection of the Ozone Layer (PROZON), has promoted policies and guidelines regarding the protection of the ozone layer in Brazil. The Committee was created through the Decree of March 2003 and is composed of the Ministries of Environment, Agriculture, Livestock and Supply (MAPA); Foreign Relations (MRE); Development, Industry and Foreign Trade (MDIC); Finance (MF); Science, Technology, Innovation and Communications (MCTIC) and Health (MS).

The Brazilian Institute for the Environment and Renewable Natural Resources (IBAMA), an agency linked to MMA, is responsible for controlling the production, import, export and consumption of ODSs in Brazil. Among its attributions, IBAMA is responsible for controlling the Federal Technical Register of Potentially Polluting Activities and/or Users of Environmental Resources (CTF/APP) and for monitoring the trade and use of ODSs, as well as the prevention and control of trade of ODS.

The Draft Project for Integrated Management of the Chillers Sector, BRA/12/G77, the subject of this Final Evaluation, was approved at the 47th Meeting of the Executive

Committee (ExCom) of the MLF in 2005, involving MLF financial resources of US\$1,000,000 to implement the activities proposed in the Project Document (PRODOC), with emphasis on the application of energy-efficient, CFC-free technologies to replace chillers involving CFCs. This approval was, however, conditional on a financial contribution from other resources for the implementation of other activities related to the improvement of energy efficiency (EE) in buildings. This counterpart was provided by resources from the Global Environment Facility (GEF) and the Inter-American Development Bank (IDB) in 2009, under the project called “Market Transformation Project for Energy Efficiency” (BRA/09/G31).

The primary purpose of the Project was to develop and demonstrate sustainable institutional, economic and environmental mechanisms capable of facilitating the integrated management of centrifugal chillers in Brazil through the application of energy-efficient alternative ODS-free technologies for the replacement of CFC-based Chillers. The outcomes of Project BRA/12/G77 were focused on:

- a) creating favorable conditions for the removal of technological, financial and regulatory barriers to the replacement of Chillers with CFCs;
- b) elimination of the residual consumption of CFCs;
- c) creation of a stock of regenerated CFCs from the replacement of Chillers;
- d) demonstration of energy savings through the application of efficient substitution technologies; and
- e) demonstration of reductions in greenhouse gas emissions through the application of energy-efficient technologies.

However, since Energy Efficiency involves other uses of energy in a building, such as lighting and water consumption, among others, the beginning of the Project required approval of financial counterpart from another project. To encompass and support these actions, reinforcing interest in the issue of EE in buildings, Project BRA/09/G77 received resources in the amount of US\$25 million.

The overall objective of the Project was to influence, transform and develop the market for EE operation in buildings in Brazil, seeking more sustainable low-carbon consumption. BRA/09/G31 was composed of six outcomes, with Outcome 3 being reallocated to activities financed with MLF resources.

Project BRA/09/G31 led to the approval of the implementation of the Demonstration Project for the Integrated Management of the Chillers Sector, BRA/12/G77, in 2012, with investment, non-investment, technical assistance and knowledge transfer activities regarding the national and international market, including technical standards for the sector. For this purpose, resources approved by the MLF were allocated to Outcome 3 of Project BRA/09/G31, which, after a proposal for an approved Substantive Review, was dismembered from the original project.

In the BRA/12/G77 Project Document (PRODOC) signed in 2013, the HCFCs were included in addition to the CFCs. In 2014, the Project submitted a Substantive Review, later approved, to adapt its outcomes to the needs and characteristics of the national market.



## **1.1 Purpose of the Terminal Evaluation**

The purpose of this Final Evaluation is to analyze the implementation and outcomes of Project BRA/12/G77 between 2013 and 2017.

Through the analysis of the outcomes achieved, the Final Evaluation seeks to extract lessons learned that can lead to the sustainability of the objectives and actions proposed and to the strengthening of the management of this and other related projects. It also aims to identify problems of planning, execution and monitoring, assessing its progress towards the objectives and identifying successes and non-successes in its implementation for learning lessons from the Project.

In addition, the Project seeks compatibility and correspondence with the "Sustainable Development Goals" defined by the United Nations, specifically the following:

**Goal 9:** Build resilient infrastructures, promote inclusive and sustainable industrialization and foster innovation.

**Goal 12:** Ensure sustainable production and consumption patterns.

**Goal 13:** Take urgent action to combat climate change and its impacts.

**Goal 17:** Strengthen the means of implementation and revitalize the global partnership for sustainable development.

## **1.2 Scope & Methodology**

### **1.2.1 Project Scope**

Through the identification and analysis of the documentation of the activities of Project BRA/12/G77, the Final Evaluation also identifies evidence and formulates recommendations to other related projects, as contributions emerging from the execution of the activities and the outcomes obtained, as proposed in the PRODOC.

In addition to the above mentioned purposes, the Final Evaluation aims to present to the public and private institutions involved in the scope of the Project all the evidence and recommendations that emerge from the analysis of the documents and procedures recommended and adopted, visits to the institutions involved in the implementation of the Project and interviews with specialists and those responsible for the actions and outcomes of the Project BRA/12/G77.

### **1.2.2 Terminal Evaluation Methodology**

Carrying out this Final Evaluation was made possible through the selection of a consultant by UNDP, as per pre-established terms of reference. The duties and qualifications of this consultant are included in Annex 1 of the Terms of Reference. The Final Evaluation methodology established a Work Plan based on the inputs described in Annex 2 of the Terms of Reference.

During the evaluation period, data were collected through interviews, meetings, visits to institutions, analysis of relevant technical and administrative-financial documents provided by the Project teams and information on the execution procedures. The data collected made it possible to formulate questions and obtain reliable answers.

The Project and implementation team main actors of both the implementing agency (UNDP) and coordination agency (MMA) were interviewed, as listed in Annex 3.

The analysis of the mission and progress reports and other project implementation documents of Project BRA/12/G77, as well as some relevant technical documentation, were the basis and input for the analysis and preparation of this Final Evaluation Report.

As for ethical aspects, the informants are not mentioned by name in the report.

### **1.3 Structure of the Terminal Evaluation Report**

#### **1.3.1 Report Structure**

The structure of the Final Evaluation Report follows guidelines, standards and procedures established by UNDP and contained in the Handbook on Planning, Monitoring and Evaluating for Development Results. The structure contains:

- Executive summary;
- Introduction with an overview of the evaluation process and a brief description of the project document, the problems the Project seeks to achieve, the objectives to be achieved, the established indicators, the main stakeholders and the outcomes achieved;
- Findings that emerged from the implementation of the Project; and
- Conclusions and Recommendations.

#### **1.3.2 Criteria for Evaluation and Key Issues to be analyzed**

The report analyzes the five evaluation criteria established in the Handbook on Planning, Monitoring and Evaluating for Development Results, which are: relevance, effectiveness, efficiency, impact and sustainability of the Project actions.

The key question that permeates the Final Assessment report is to address the proposition: how to respond and make every effort to understand and act to promote the protection of the ozone layer since its destruction results in significant socioeconomic and environmental vulnerabilities? These concerns are part of Brazil's commitments as part of the Montreal Protocol and the Sustainable Development Goals, specifically goals 9, 12, 13 and 17.

In its scope, the project constitutes an important contribution to the UN Sustainable Development Goals and to mitigating emissions, minimizing vulnerabilities and reducing events from climate change. The implementation of BRA/12/G77 sought to

take into account the criteria of relevance, effectiveness, efficiency, sustainability and impact of the Project actions, such as:

- **Relevance:** This criterion is evaluated in relation to economic, social, environmental and institutional conditions and the context in which the Project is inserted. The relevance also arises from the purpose of the Project in developing actions that prevent the leakage of substances that have Ozone Depletion Potential (ODP), such as CFCs and HCFCs. The project sought to take actions to reduce or eliminate the damages of old equipment by the introduction of technologies appropriate to the Chillers systems. The relevance was also demonstrated by the optimization of energy efficiency and established an Integrated Management of the Chillers Sector.

- **Project Efficiency or Management:** Efficiency of implementation of the Project should be demonstrated by the analysis of the outcomes obtained. Have the Project and its activities led to the disbursement of financial resources and actions of personnel resources with the least waste, in order to achieve the outcomes and outputs with regard to the totality? This criterion implies analysis of Project management.

- **Project Effectiveness:** Has the Project been implemented efficiently? Has the development of capacity through specific training and training programs contributed to the ultimate goal, demonstrating the effectiveness and effectiveness of the Project? The outcomes should demonstrate that the objectives and goals have been fully achieved. Thus, its outcomes should provide demonstration effects for other experiences.

- **Sustainability:** Has the Project offered financial, institutional and governance conditions for its continuity through efforts during and after the implementation period? Do socioeconomic and environmental trends suggest continuity in the implementation of actions foreseen in the Montreal Protocol, according to the commitments assumed by the Country, that is, the reduction of consumption of ODS? Do conditions exist or are they foreseen to obtain the sustainability and replicability of the benefits and outcomes of the Project?

- **Impact and Dissemination of Information:** Has the Project promoted conditions for generating knowledge about possible environmental impacts and socio-economic benefits if there is no adequate handling and management of Chillers based on cold water? Were the information and its dissemination adequate in relation to the implementation of the Project's actions? Were the outputs obtained in relation to the dissemination and exchange of information compatible with the target groups to be reached?

## **2 Project Description and Development Context**

This item explains the situations that were the basis for the formulation of the Project, identifying problems that led to the definition of its components, activities and outputs aimed at the achievement of the proposed objectives.

### **2.1 Project Start and Duration**

According to the Project Document for BRA/12/G77, the Project was approved in 2013 and the Substantive Review was approved in November, 2014, when the Project was effectively started, with conclusion in 2017. The Revision had as objectives: a) extend the term until December 31, 2016; b) adjust the outputs, goals and activities of outcomes 2 and 3; c) cancel Outcome 5 - technical assistance to prepare proposals to replace CFC and HCFC liquid chillers to increase EE; and d) insert a new Outcome 6 – Retro-commissioning processes for air conditioning systems with CFC and HCFC liquid chillers performed. Further administrative reviews were made especially for the extension of the end date until 2017.

### **2.2 Problems that the Project Sought to Address**

The context and the approach to the problems that constitute the elements of the present Project require the return to the interaction and analysis of data, with plans, programs and projects developed or developing that seek or sought Energy Efficiency (EE).

As mentioned in 2005 at the 47th Montreal Protocol Executive Committee Meeting (ExCom), the MLF approved financial resources for the implementation of the Integrated Chillers Sector Management Demonstration Project to replace CFC-based centrifugal chillers. The BRA/12/G77 Project was approved within the context of the Energy Efficiency Market Transformation Project (BRA/09/G31), which received US\$25 million from the Global Environment Facility (GEF) and the Inter-American Development Bank (IDB). This Project was composed of six outcomes, and Outcome 3 was related to the activities financed with MLF resources. This result was intended to motivate CFC replacement initiatives in Chillers operating in buildings with energy inefficiency and using refrigerants with high Ozone Depletion Potential (ODP) and Global Warming Potential (GWP).

The resources available for this Outcome 3, according to the Substantive Review, proposed that they be used to promote Energy Efficiency training by replacing existing and CFC-based liquid Chillers and raising the economic and environmental benefits that would be obtained through this process.

The main focus of the Project was to stimulate interest in improving EE in buildings in an integrated manner and thus demonstrate the potential of Energy Efficiency in replacing chillers using CFCs and HCFCs. To achieve the proposed objectives, the Project included investment, non-investment, and technical assistance and knowledge transfer activities on national and international markets. To that end, resources of US\$1

million were approved by the MLF and previously allocated to Outcome 3 of Project BRA/09/G31, which were then used in the Substantive Review approved in 2014.

Among the expected outcomes, the Project proposed to initially complete the national inventory of Chillers with CFCs, aiming to implement the activities in conjunction with the ongoing Brazilian HCFC Program (PBH), with the objective of replacing the CFC for non-ozone-depleting technology.

Considering the time elapsed between the approval of Project BRA/09/G31 and the beginning of its activities, Brazil considered it important to include the replacement of equipment with HCFC in Project Outcome 3, since this substance was included in the list of ODSs of Montreal Protocol. The Multilateral Fund duly approved the request for the inclusion of HCFC equipment.

During the 71st Meeting, ExCom granted the deadline for Brazil to finalize the Project financially until the last Executive Committee meeting to be held in 2017 and to submit the Project Completion Report (PCR) at the first executive meeting of 2018 (ExCom Decision 71/10).

Outcome 1, the National Inventory, identified an irrelevant amount of CFC equipment and demand for HCFC-containing equipment designs. The Inventory pointed out and suggested that, according to the country's scenario, it would be important to record the data in tons of refrigeration (TR) and not in quantity of equipment installed (Outcome 1 of the Project).

Outcome 3 of the Project BRA/09/G31 foresees technical assistance for the replacement of Chillers with CFC and was executed in conjunction with Outcome 4, that is, with the guarantee of financial resources. Due to the complexity of its implementation, Outcome 4 was delayed and for this reason, Brazil negotiated with MLF to decouple Outcome 3 from Project BRA/09/G31. In addition, Project BRA/09/G31 did not define how the resources of Outcome 3 would be applied (budget lines), nor how the activities would be implemented. As a result, outcome 3 became an independent project in the form of Project BRA/12/G77.

A Substantive Review of BRA/12/G77 was then prepared and signed in November 2014, providing conditions for the necessary adjustments and having as objectives:

1. To extend the term of the Project by 24 months, that is, until December 31, 2016;
2. Adjust the outputs, goals and activities of Outcomes 2 and 3;
3. Cancel Outcome 5 - Technical assistance to develop projects to replace CFC and HCFC liquid coolers to increase EE; and
4. Insert new Outcome 6 – Retro-commissioning processes of air conditioning systems with liquid chillers with CFCs and HCFCs performed.

Currently, the activities of the BRA/12/G77 project are finalized and the analysis of its outcomes is part of this Project's Final Evaluation.

### **2.3 Immediate and Development Objectives of the Project**

According to the PRODOC, the objective of the BRA/12/G77 Project, within the context of the Energy Efficiency Market Transformation Project (BRA/09/G31), is to stimulate interest, in an integrated way, in the improvement of EE in buildings, demonstrating the potential of EE with the replacement of Chillers based on CFCs and HCFCs. The Project aimed to implement actions to achieve the goals of Outcome 3, with financial resources of the MLF, which are:

- a) Carry out the national inventory of chillers using CFCs and HCFCs and establish a priority list for replacement;
- b) Carry out a cost-effectiveness analysis of said substitutions;
- c) To analyze the favorable conditions for the removal of barriers for the replacement of chillers operating on the basis of CFCs and HCFCs;
- d) Demonstrate the energy savings obtained by replacing chillers with CFCs and HCFCs;
- e) To carry out training related to the environmental and economic impacts related to the replacement of Chillers with CFCs and HCFCs for owners, specialized professionals, government and ESCOs;
- f) To carry out training and training for the installation, operation and maintenance of chillers free of CFCs and HCFCs for Energy Saving Companies (ESCOs), for specialized professionals and owners; and
- g) Provide technical assistance for the development of the exchange/conversion project for public and private chillers.

As already mentioned, these actions proposed to achieve Outcome 3 of BRA/09/G31 were adequate according to the proposals included in the Substantive Revision of Project BRA/12/G77.

In this way, the BRA/12/G77 Outcomes Matrix is presented below according to data from the project document and the aforementioned Substantive Review.

### **2.4 Outcomes, Outputs and Indicatives Activities Established**

Table 2 presents the outcomes/outputs and indicative activities established for the implementation of the Project:

**Table 2: Outputs, Outcomes and Indicators of the Project BRA/12/G77**

<b>Objective: According to PRODOC, BRA/12/G77's main objective is to stimulate interest, in an integrated way, in the improvement of Energy Efficiency in buildings, demonstrating the potential of energy efficiency in the replacement of CFC and HCFC based chillers.</b>		
<b>Outcome/Output</b>	<b>Output Goals</b>	<b>Outcome Indicators</b>
<b>Outcome 1:</b> - National Inventory of CFC and HCFC liquid chillers.		
<b>Output 1.1</b> National inventory of CFCs and HCFCs in operation in Brazil	- Database of liquid chillers with CFCs and HCFCs active in Brazil updated.	- Diagnosis of the amount of liquid chiller equipment with CFCs in operation in Brazil.
<b>Outcome 2:</b> - Training manual and information materials prepared and distributed.		
<b>Output 2.1</b> - Technical and informative materials to promote and disseminate the outcomes obtained with the replacement of CFC and HCFC liquid chillers produced and distributed.	- 01 Information material; - 01 Technical manual; - 01 Set of dissemination materials	Promotional materials - 400 training manuals for specialized professionals; - 300 manuals on operation and maintenance; - 2,000 booklets prepared, printed and distributed.
<b>Outcome 3:</b> - Workshops, capacity-building and training for specialized professionals and owners interested in replacing CFC and HCFC liquid chillers carried out.		
<b>Output 3.1</b> - Workshops, capacity-building and training programs for specialized professionals and owners interested in replacing CFC and HCFC liquid chillers prepared and implemented.	- 4 training events  - 1 seminar to disseminate the outcomes achieved	- Technical events
<b>Outcome 4:</b> - Case studies to demonstrate EE potential and the social, economic and environmental benefits of replacing CFC and HCFC liquid chillers in public and private buildings.		
<b>Output 4.1</b> - Case studies to demonstrate EE potential and the social, economic and environmental benefits of replacing CFC and HCFC liquid chillers in public and private buildings implemented.	- Implementation in the scope of the PNC, Project BRA/02/G76, with the objective of replacing the cold water plant (containing liquid chillers, water pumps, pipes, electrical panels and control systems) in a building of the Ministry of Finance. - Analysis of energy consumption before and after the intervention, showing that the replacement of equipment contributed to the reduction of energy consumption.	- Case studies on EE obtained with the replacement of liquid coolers published.

<b>Outcome 5:</b> - Technical assistance for the development of projects to replace CFC and HCFC liquid coolers to increase EE performed. <b>(Outcome canceled).</b>		
<b>Output 5.1</b> - Technical assistance for the development of projects to replace CFC and HCFC liquid chillers to increase EE prepared and implemented. <b>(canceled)</b>	- 22 projects to replace liquid chillers with CFCs and HCFCs prepared.	- 22 projects to replace liquid chillers with CFCs and HCFCs prepared.
<b>Outcome 6:</b> - 04 Retro-commissioning processes of air conditioning systems with CFC and HCFC liquid chillers performed. <b>(Result added by the Substantive Review)</b>		
<b>Output 6.1</b> - 04 Retro-commissioning processes of air conditioning systems with CFC and HCFC liquid chillers prepared, implemented and disseminated.	- 04 Retro-commissioning processes, with 02 in public buildings and 02 in private buildings.	- Contracting of consulting company.

## 2.5 Main Stakeholders

The main stakeholders were institutions of the federal government and governments of the states of Mato Grosso and Ceará and private companies involved in the processes of retro-commissioning and training programs, training of specialized professionals and owners, as well as associations related to issues of refrigeration, air conditioning, ventilation and heating, primarily to support the processes of retro-commissioning of buildings with liquid refrigeration (Chillers), in the capacities and the dissemination of information on the subject. The SOMAR Engenharia company and the ABRAVA association were the main partners in the actions aimed at stimulating optimized water systems and retro-commissioning processes for air conditioning systems in public and private buildings.

The project was also supported by the following associations/entities: ABRAFAC (Brazilian Facilities Association), ANPRAC (National Association of Refrigeration and Air Conditioning Professionals, Ventilation and Heating), ASHRAE Brasil Chapter (American Society of Heating, Refrigerating and Air-Conditioning Engineers), BCA Brasil (Building Commissioning Association - Brazil Chapter), ABESCO (Brazilian Association of Energy Conservation Services Companies), ASBRAV (Southern Brazilian Association of Refrigeration, Air Conditioning, Heating and Ventilation); GBC Brazil (Green Building Council Brazil) and SINDRATAR (Union of the Refinery Generation, Heating and Air Treatment).

These partners were extremely important in the activities of Project BRA/12/G77 related to the training and training process, supporting not only the implementation but also the dissemination of data and information on cold-water refrigeration systems and retro-commissioning processes.

Thus, these stakeholders were informed about participation in Project activities and contributed to the achievement of the outcomes proposed in the project document and in the substantive revision that involved adjustments to the original project.



## 2.6 Expected Outcomes

According to the PRODOC and the Substantive Project Revision, the expected outcomes are as follows:

### **Outcome 1:**

- National inventory of liquid chillers with CFC and HCFC carried out.
  - *Output 1.1:*
- National inventory of CFC and HCFC refrigerators in operation in Brazil.

### **Outcome 2:**

- Technical and informative materials to promote and disseminate the outcomes obtained with the replacement of CFC and HCFC liquid chillers produced and distributed.
  - *Output 2.1:*
- Technical materials on replacement of CFC and HCFC liquid chillers demonstrating the potential of EE.

### **Outcome 3:**

- Workshops, capacity-building and training for specialized professionals and owners interested in replacing CFC and HCFC liquid chillers.
  - *Output 3.1*
- Workshops to increase the interest in replacing or converting the refrigerant fluid from CFC and HCFC liquid chillers, demonstrating EE potential and economic and environmental benefits.
  - *Output 3.2*
- Courses to improve the qualification and training of specialized professionals.
  - *Output 3.3*
- Capacity-building and training of ESCOs to replace obsolete CFC and HCFC chillers, aiming to promote energy efficiency in buildings.
  - *Output 3.4*
- Capacity-building and training for owners, technicians, maintainers and operators of chillers on operation and maintenance of chillers and air conditioning system.
  - *Output 3.5*
- Final Seminar to present the outcomes achieved in the replacement/conversion of Chillers with CFCs and HCFCs.

### **Outcome 6:**

- Retro-commissioning processes of air conditioning systems with CFC and HCFC liquid chillers performed.
  - *Output 6.1:*
- Retro-commissioning processes of air conditioning systems (involving chilled water plant, air conditioners and air distribution circuits) in buildings that have liquid chillers (cold water system) in operation with CFC or HCFC.

## **3 Project Findings**

### **3.1 Project Design Formulation**

The formulation of the Demonstration Project for the Integrated Management of the Chillers Sector was based on Brazil's commitment to carry out actions to protect the ozone layer, with emphasis on the application of energy-efficient technologies, free of ODS, by replacing chillers using CFCs.

The BRA/12/G77 Project had its formulation linked to the "Market Transformation for Energy Efficiency" Project, BRA/09/G31, which sought to achieve six outcomes, among which Outcome 3 was related to activities financed with MLF. This resulted in the replacement of chillers with CFCs that were inefficient and contained refrigerants with high potential for ozone depletion and global warming.

The BRA/12/G77 Project was designed to implement activities to improve Energy Efficiency by conducting a survey on the number of CFC and HCFC liquid chillers in Brazil, as well as implementing training and capacity-building about the need for such substitution and its economic and environmental benefits. Other activities included in the Project formulation foresaw case studies to demonstrate the potential of EE and the implementation of retro-commissioning processes.

Therefore, the scope of the Project outcomes reflected its objectives and activities, although they were redesigned after the mid-term evaluation of the BRA/09/G77 Project, which recommended revision of Outcome 3. This redesign was presented in the Substantive Review of the BRA/12/G77 Project, approved in 2014.

The Substantive Review of the BRA/12/G77 Project had as its main focus the stimulation of interest in improving EE in public and private buildings, as an independent project with its own objectives and outcomes. The ultimate objective would be to qualify professionals in the refrigeration sector based on cold water and dissemination of the economic and environmental benefits.

The PRODOC and the Substantive Review were prepared specifying the activities to be carried out over a three-year period, with completion scheduled for December 2016 and then December 2017. This deadline was set at the 71st meeting of the MLF Executive Committee, by means of Decision 71/10.

#### **3.1.1 Analysis of the LFA/Outcomes Framework**

The Outcomes and Resources Matrix, the Annual Work Plan and the Management Arrangements make up the Project Logical Framework focused on achieving the objectives. The Project formulation includes arrangements for carrying out management and monitoring and evaluation activities and means of monitoring the execution of the financial budget.

According to the Project Terminal Evaluation, the Demonstration Project for Integrated Management of the Chillers Sector, BRA/12/G77, and its procedures for achieving

effective outcomes provided for discussion of the importance and relevance of achieving its objectives and carried out activities with partners and stakeholders involved in the air conditioning sector using cold water systems.

In this sense, the Project Logical Framework was a useful tool for monitoring implementation as well as disseminating information, as proposed among the Project activities.

The Logical Framework provided a basis for the activities implementation, reaching the outputs and outcomes by establishing means of intervention, procedures and working methods and also to meet commitments made under the Montreal Protocol.

The objectives and indicators of the logical structure of the PRODOC and the Substantive Revision of Project BRA/12/G77 made it possible to point out problems to be faced, such as those related to the execution requirement through outsourced services performed by individuals or organizations.

According to the Terminal Evaluation, the analysis of the Project structure shows that the elements contained in the Logical Framework were clear and feasible to achieve the Project's outputs and outcomes. The proposed indicative activities allowed for periodic monitoring of activities.

### **3.1.2 Assumptions and Risks**

According to the analysis of data obtained about the activities carried out in the Project implementation, the Terminal Evaluation did not identify challenges and risks that could have prevented the successful of the Project implementation.

However, it became evident that BRA/12/G77 had delays in its implementation related to the initial issues that arose in the "Market Transformation for Energy Efficiency" Project. The MLF approved resources for the Project in the amount of US\$1 million in 2005, while negotiations for the mobilization of financial resources for BRA/09/G31 Project from GEF and IDB were only obtained in 2009. These delays, therefore, were motivated not only by the concrete risks of success or failure in finding financial resources, but also by the assumptions defined in the original Project.

Despite the initial delays, following the signing of the PRODOC of Project BRA/12/G77, the actions foreseen in Outcome 1 began. The National Inventory of CFC and HCFC liquid chillers were implemented and identified the risks of focusing execution on CFC chillers. The data collection actions performed for the Inventory showed that the amount of equipment in operation with CFCs was negligible, but that there were approximately 130,000 devices with HCFC-22 in operation in Brazil.

Other risks were identified in the Terminal Evaluation process as the actions intended to carry out training and technical assistance for implementing projects to replace equipment and operations with efficient technology that is not harmful to the ozone layer through Outcome 4 of Project BRA/09/G31. The complexity of these actions coupled with financial cost issues was identified in advance, eliminating the risk of non-execution of the proposed result.

These initial actions avoided implementation risks and contributed to the definition of putting focus on conducting training events for specialists in the sector and to work with the entire air conditioning system, not just the liquid chiller using cold water. Thus, by avoiding these risks, it was also possible to include another result of the Project implementation regarding the development of the retro-commissioning processes.

Also, to compensate for the above delays, a retrofit activity was implemented, avoiding the risks to Project BRA/12/G77 of replacing equipment. This activity related to the chillers sector was executed through Project BRA/02/G76, "National Plan for the Elimination of CFCs". This case study contemplated the comparison of energy and cooling efficiency between new and old equipment, analyzing electricity costs. It also analyzed questions about the replacement of liquid coolers in a public building of the Ministry of Finance showing risks that led to the redirection of the Project's actions.

Other risks that have been identified and overcome are related to the difficulties in hiring specialists to the project implementation. After several attempts to select individual consultancies, it was decided to contract consulting organizations, avoiding risks of more delay in the implementation of the activities, although the bidding processes took a reasonable time. This consultancy was aimed at hiring specialists in energy efficiency and retro-commissioning of air conditioning systems. The risks were overcome, avoiding contracting of non-specialists without experience with the complexity of the sector subject.

According to the Appraiser's observation, there was some lack of definition of risks to the Project implementation. These risks should be related to the expected and previously planned outcomes in the project document. However, there were risks of delays and lack of credibility that were not predicted in terms of problems caused by difficulties in achieving Outcomes 2, 3 and 5 and which led to attempts to hire specialists in systems with liquid coolers (chillers), resulting in hiring of a company instead of an individual consultant. In addition, the evaluation result of the technical and financial proposals still ran the risk of not being approved by the Regional Approval Committee of the RBLAC, since it involved the hiring of the only company that obtained technical scores.

Another risk that arose but was overcome is related to the change in Outcome 5 of the BRA/12/G77 Project. The Substantive Review proposed replacing technical assistance activities with the implementation of retro-commissioning processes. It identified a risk related to the low energy savings obtained with the activities of Outcome 5. The overcoming of risks was obtained with the introduction of Outcome 6, which involves the implementation of retro-commissioning processes.

### **3.1.3 Lessons from Other Relevant Projects**

Project BRA/12/G77 on "Integrated Management of the Chillers Sector" obtained inputs from lessons learned from other projects of both the PNC and the Brazilian HCFC Elimination Program (PBH) and especially from the Project "Market Transformation for Energy Efficiency". The approval and beginning of Project BRA/12/G77 in 2005 was conditional upon the financial contribution of BRA/09/G31, defining its components and outcomes and assigning Outcome 3 to BRA/12/G77. This included actions capable

of facilitating the integrated management of centrifugal chillers in Brazil through the application of free ODS technologies.

According to the lessons learned from the Mid-Term Evaluation of Project BRA/09/G31, adjustments were recommended according to scenarios presented in the survey of liquid chillers still in operation in Brazil and the negligible amount of equipment in operation with CFCs, redirecting actions towards those with HCFCs. Another lesson from these MTE had to do with the orientation for the reduction of technical assistance projects to be carried out.

The results of the inventory survey carried out with the support of the National Plan for the Elimination of CFCs (PNC) showed the irrelevance of the number of liquid chillers containing CFC operating in Brazil in order to carry out training and technical assistance for the implementation of the replacement projects by energy efficient technology, Outcome 4 of the BRA/09/G31 Project. The Inventory provided lessons from implementation that made evident the importance of working with approximately 130,000 pieces of HCFC equipment and contemplating the air conditioning system as a whole and not just the liquid cooler.

In addition, the case study carried out through Project BRA/02/G76 did not result in satisfactory results in relation to energy savings, and modernization of the air conditioning system of the building as a whole was necessary. The lessons learned from the results of the case study provided concrete justifications for the implementation of retro-commissioning processes.

These lessons learned from other related projects led, according to the Evaluator of Project BRA/12/G77, to the achievement of the proposed outcomes and the economic and environmental benefits foreseen in this Project.

The lessons learned from this appropriateness process allowed by the lessons learned from other related projects showed the importance of diffusion of ODS-free technologies.

On the other hand, the administrative procedures arising from lessons learned as forms of bidding and the establishment of service contracts were also inputs and lessons learned from previously developed projects that were important to BRA/12/G77. Decisions arising from PBH projects implemented administratively and financially by UNDP, the implementing agency of these projects, could be considered in the procedures applied to Project BRA/12/G77. In addition, the administrative and financial processes to support Project implementation, although lengthy, resulting in delays in the implementation of the Project, its outputs and outcomes, were offset in terms of quality and economic and environmental impact in the scope of its results.

In short, the lessons learned and the successful experiences of other projects are highlighted in this Terminal Evaluation process of the Project BRA/12/G77. Many lessons learned from the projects mentioned were fundamental to the implementation of this Project, incorporating and seeking to exchange experiences and promoting conditions for knowledge and actions to address vulnerabilities in protection of the ozone layer.

### **3.1.4 Planned Stakeholder Participation**

The partnerships established by the Demonstration Project for the Integrated Management of the Chillers Sector were the result of the process of careful selection of companies qualified to participate in the process for the integrated management of the Chillers sector. Here, too, the lessons learned from other projects mentioned above were important for the consolidation of the partnerships, especially those established with the private sector, such as the work developed by SOMAR Engenharia and the partnerships established with the Brazilian Government in conjunction with UNDP implementation of Project BRA/12/G77.

The partnerships established with the Brazilian Government, in which the Ministry of Environment is the coordinator of the Project, have demonstrated their efficacy and effectiveness through the imposition of national regulations and standards that have guided the companies involved in the implementation of this Project now in Terminal Evaluation.

Among these partnerships, the evaluator highlights the work of MMA agencies with refrigeration associations such as the Brazilian Association of Refrigeration, Air Conditioning, Ventilation and Heating (ABRAVA) in the discussions and suggestions for the formulation of standards and procedures for the refrigeration sector and conditioning air.

ABRAVA's partnership with the MMA General Coordination of Ozone Layer Protection (CGPO), the unit responsible for implementation of the Montreal Protocol in Brazil, played an important role in the review of technical norms and standards for the Chillers sector. Other recommendations on the substitution of chillers and on the legislation to be adopted, as well as the consultative role played by this association, were of great importance for the partnership involving the private sector, government and UNDP in the implementation of the Project for the Integrated Management of the Chillers Sector.

### **3.1.5 Replication Approach**

According to the present Final Evaluation, it is verified that the execution of the activities of Project BRA/12/G77 could provide ample replication, mainly through the dissemination of information at the national and local levels and in other developing countries.

The publications are outputs/outcomes of the Project implementation that could be widely used in seminars, courses and workshops where the target audience could be specialized engineers and technicians, managers and operators in maintenance of cold water systems in chillers of public and private buildings. Thus, the publications, the Project webpage on the MMA site and the Montreal Protocol are instruments for dissemination and promotion of replication approaches to the activities and outcomes of the Project, showing the integrated management processes of the chillers sector that are a solid foundation for replication at the national and regional levels, as well as the international level.

The project included the implementation of retro-commissioning processes in air conditioning systems with chilled water systems using chillers in four existing buildings, aiming to identify opportunities for improvements in the system to obtain energy efficiency, reduction of operational costs and benefits for the protection of the ozone layer and the climate system.

The four buildings, two from the private sector and two from the public sector, have already become replicated experiences, since the dissemination of information in the written media and through seminars and courses have promoted interest in ways to carry out replication.

This whole experience for integrated management in the chillers sector has been the object of dissemination of information about procedures and processes that are and may become important means for replication. Therefore, for these replications, the training and capacity building program and the manuals, books, guides and folders developed by Project BRA/12/G77 are of great relevance for replication in other buildings using equipment of cold water systems.

### **3.1.6 UNDP Comparative Advantage**

UNDP is known in Brazil for its efficiency in the implementation of international technical cooperation projects. The existence of a Project implementation unit with a team dedicated to Montreal Protocol projects confers a comparative advantage to UNDP, working in close coordination with the Ministry of Environment, which is responsible for coordinating actions to protect the ozone layer in Brazil.

It is evident that UNDP has extensive and long experience in project implementation. In the case of the Demonstration Project for the Integrated Management of the Chillers Sector, the agency had a strong comparative advantage due to its credibility in the selection and hiring of a company for the development of activities proposed by Project BRA/12/G77.

The service contract established between UNDP and SOMAR Engenharia for implementation of activities proposed by the Project resulted from a selection process in which the MMA/CGPO had effective participation. However, sometimes the results of the professionals selection or companies are due to lower price instead of the best price, leading to problems in the quality of the professionals involved. However, these procedures follow national laws. The comparative advantage of UNDP with its procedures and application of transparent standards is clear in relation to other project implementation entities.

Although this advantage is evidenced by the Project Terminal Evaluation, the management of administrative and financial activities and others at the execution level may have caused delays in the implementation of activities. The process of co-managing project outputs and outcomes in the time frame determined in the Work Plan always encounters challenges. However, it is important to assess the capacity of partner institutions to perform technical and administrative functions in a timely manner. It is therefore clear that UNDP had a comparative advantage for the implementation of activities proposed by the Project under evaluation.

### **3.1.7 Linkages between Project and Other Interventions within the Sector**

The Demonstration Project for Integrated Management of the Chillers Sector has technical and conceptual links with projects related to the elimination of ozone-depleting substances and issues of energy efficiency.

The field visits carried out to prepare the BRA/12/G77 Final Evaluation Report were very illustrative in demonstrating the importance of the activities carried out and the links with associations related to cold water systems in chillers.

The activities and outputs contained in the agreement between UNDP and SOMAR had the support and cooperation of ABRAVA, which, in particular, was willing to collaborate in the dissemination of information through distribution of folders and manuals and publication of a technical article on the experience.

Other partnerships and collaboration with the activities and outcomes of the Project were identified by the Final Evaluation, such as those carried out with the institutions:

1. Private Sector Associations:

- ABESCO (Brazilian Association of Energy Conservation Services Companies);
- ABRAVA (Brazilian Association of Refrigeration, Air Conditioning, Heating and Ventilation);
- ASBRAV (South Brazilian Association of Refrigeration, Air Conditioning, Heating and Ventilation);
- GBC Brazil (Green Building Council Brazil);

2. Professional Associations:

- ANPRAC (National Association of Refrigeration, Air Conditioning, Heating and Ventilation Professionals);
- ASHRAE Brazil (American Society of Heating, Refrigerating and Air-Conditioning Engineers);

3. SINDRATAR (Union of Refrigeration, Heating and Air Treatment Industries);

4. Specialized Magazines: ABRAVA, ASBRAV and GBC Brazil Magazine;

5. Faculties of Mechanical Engineering:

- Federal University of Rio de Janeiro;
- PUC-Rio;
- Federal University of Ceará;
- University of São Paulo;
- Mauá Institute of Technology.

### **3.1.8 Management Arrangements**

The actions planned and foreseen in the Project BRA/12/G77 PRODOC were executed and are part of the activities developed by the Brazilian government regarding the management of substances that destroy the ozone layer. For the integrated management



of the chillers sector that deals with the management of air conditioning equipment containing CFCs and HCFCs, the proposed organizational structure is as shown below.

Figure 1 shows the management arrangements, according to PRODOC, namely:

**Figure 1: Organizational Structure of Project BRA/12/G77**

<b>Project Accompaniment Committee (CAP)</b>		
<b>International Cooperation MRE/ABC</b>	<b>National Direction and National Coordination Ministry of Environment</b>	<b>UNDP Executing Agency  UIM/UNDP Implementation Team</b>

UNDP was the implementing agency for Project BRA/12/G77 in the direct execution modality and its implementation arrangement was guided by the Results Management Guide (GGR), with its norms and procedures.

According to PRODOC, the Brazilian Government was represented by the Brazilian Agency for Cooperation (ABC of the Ministry of Foreign Affairs) and the Ministry of Environment.

MMA through the General Coordination of Ozone Layer Protection was responsible for monitoring the actions of this Project, through the registration and analysis of annual reports in electronic form (RPE) of the Monitoring Information System of Projects (SIGAP) and periodic visits and meetings with UNDP and partners to implement the activities, verifying achievement of the Project's objectives, targets and outcomes.

In addition, ABC approved the Substantive Reviews when the Project proposed substantive and administrative adjustments for better performance toward the reality of the country context and the Montreal Protocol guidelines as well as other tripartite reviews and meetings. These adjustments in the Project Document were proposed by both MMA and UNDP.

According to the performance analysis of the Project, the Final Evaluation identified that joint work was done in the elaboration and approval of terms of reference, in the technical specifications for the hiring of individual and organizational consultants and in the activities of rendering necessary services to Project implementation. The MMA and UNDP teams evaluated the outputs and services provided by companies and consultants according to technical and qualitative criteria. In addition, the MMA participated in committees for the selection and evaluation of companies and consultants, in accordance with UNDP rules.

UNDP acted as the implementing agency responsible for implementing the actions as described and explained in the PRODOC. UNDP was responsible for the following activities: a) it coordinated and implemented the technical and administrative implementation of the Project actions, in accordance with the activities planned and

approved in the Annual Work Plan; b) jointly with the MMA, it developed the project activity plans (PTA/UNDP) and annual budgets, suggesting reallocation of resources and budget revisions when necessary; c) it provided specialist services within its regular framework and/or by hiring consultants to monitor the implementation of the Project in accordance with the Annual Work Plan and the activities included in the PRODOC; d) it processed administrative actions necessary for the achievement of the BRA/12/G77 Project, observing criteria of technical quality, costs and estimated deadlines; e) it managed the Project's financial resources following its accounting and financial procedures, in accordance with UNDP rules and standards; f) it proposed to ABC/MRE and MMA the necessary modifications and adjustments need for satisfactory progress of the Project; g) quarterly reports to MMA on the financial execution of the Project; h) it prepared, in conjunction with the MMA, the Annual Implementation Report (Progress Report) and Annual Work Plan, which has been annually submitted to the ABC/MRE and ExCom and other stakeholders analysis and organized the Project Terminal Evaluation.

### **Project Monitoring Committee (CAP)**

According to the PRODOC, the Parties involved in the Project formed the Project Monitoring Committee (CAP) with representatives of UNDP, MMA and ABC/MRE and their respective substitutes.

The Committee carried out the following activities:

- a) analyzed and discussed the development of the Project activities and suggested modifications as needed;
- b) discussed and approved the Annual Work Plan;
- c) discussed and approved the Progress Reports and approve the Project Final Report;
- d) analyzed the outcomes achieved; and
- e) settled disputes.

UNDP was responsible for convening the meetings of the Project Monitoring Committee.

### **Implementation Strategy**

According to the Final Evaluation, the MMA technical team worked in coordination with the UIM/UNDP technical team to carry out the Project activities approved in the Annual Work Plans.

In agreement with a specialist from UIM/UNDP, the MMA technical team was responsible for identifying and developing partnerships and linkages with other government projects/programs that supported the results of BRA/12/G77 as established in the PRODOC.

As a Direct Execution (DEX) Project, the implementation of administrative and financial services, including the authorization of expenditures, followed UNDP rules, standards and procedures. The UIM/UNDP, in close coordination with the MMA, was responsible for the planning and execution of the technical actions, the operational

actions, the supervision of the contracts and other administrative actions, as well as for the financial and administrative management of the approved activities.

### **Project Audit Arrangements**

According to this modality of design, the UNDP Brazil office was responsible for the full implementation of the UNDP rules and procedures in the implementation, monitoring and evaluation of the Project. The office made available and maintained the records on the Project in the corporate databases for the audit and investigation of the UNDP itself, as foreseen in the PRODOC.

It is important to highlight that, although not foreseen under the PRODOC, the project was evaluated by the evaluators designated by the Secretariat of the Multilateral Fund for the Implementation of the Montreal Protocol <sup>2</sup>.

### **Review Mechanisms**

It was verified that the financial reviews were signed by the UNDP Resident Representative in Brazil, which were: a) revisions reflecting more realistic estimates of financial implementation for the current year to reprogram the remaining resources for the following year when they did not involve change in the total amount of the budget; b) annual mandatory revisions were made, reflecting expenditures made during the previous year and not representing a change in the total amount of the budget, of the validity or substantive nature of the Project; c) simplified reviews were also carried out. The other revisions provided for the signature of the three parties involved in the implementation and coordination of the Project.

### **Monitoring and Evaluation**

According to the Evaluator, monitoring included regular briefings to MMA technical team. The Annual Implementation Report (Progress Report) and the Annual Work Plan were prepared and submitted for evaluation by the Multilateral Fund Secretariat, followed by an Annual Tripartite Meeting (TPR) among the parties involved in the Project.

The MMA elaborated the Electronic Progress Report (RPE) on the technical module of the SIGAP every six months, reflecting the physical performance of the Project, that is, the achievement of the programmed physical goals.

The monitoring of indicators of the Outcomes and Resources Matrix was carried out by the UIM/UNDP and its inputs guided adjustments to the Project activities, providing the basis for decision making. This fact enabled monitoring and evaluation results that supported the planning and implementation of other actions at the implementation sites.

In accordance with the program policies and procedures described in the UNDP GGR, the project was monitored by: a) regular meetings between the UIM/UNDP and the MMA team, monitoring the progress of the Project; b) semi-annual quality assessment

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<sup>2</sup> "Evaluation of Chiller Projects with co-financing modalities", Mission Report – Field visit to Brazil, 8May – 12 May 2017, prepared for: Multilateral Fund Secretariat – Montreal/Canadá, by the consultant, Marta Comte.

recording the progress made based on quality criteria and methods defined in the Quality Management framework and the ATLAS system; c) the Project Issues log was activated in Atlas and updated by the Project Manager in UNDP; d) risk records were updated in Atlas; e) based on the information recorded in Atlas, the Project was monitored by a Semiannual Progress Report prepared by the Project Manager through Project Quality Control using the standard report available in the Executive Snapshot (Atlas); e) monitored through a Lessons Learned Log that was activated and updated in Atlas, ensuring learning and constant adaptation within the organization, and facilitating the preparation of the Lessons Learned Report at the end of the Project; d) a Monitoring Plan was activated and updated in Atlas that tracked the main actions and management events.

The present Terminal Evaluation also verified whether the objectives were achieved and whether the sustainability of the outcomes is and will be effective and identified lessons learned as inputs to other projects.

## **3.2 Project Implementation**

### **3.2.1 Adaptive Management**

Adaptive management is a structured and systematic process to improve management during project implementation, as well as to make improvements to management decisions, policies and practices, learning from outcomes and outputs related to Project objectives.

The Integrated Management for the Chillers Sector, the BRA/12/G77 Project, was formulated with specific objectives and means to obtain outcomes and outputs, as defined in the Project Document.

When initiating the Project implementation and after analyzing the activities to be developed, it was necessary to request the separation of activities linked to the original project "Market Transformation for Energy Efficiency", BRA/09/G31. The Substantive Review in November 2014 provided the conditions for readjusting BRA/12/G77 outcomes and separation from the original project, becoming independent. Other revisions were also carried out, but this was an adaptive management framework based on the analysis of the outcomes to be achieved. The revisions were submitted to and approved by the Brazilian Cooperation Agency (ABC).

According to the Project Evaluator and considering that this item relates to changes in the Project design and its outcomes, as well as according to CGPO expert, the substantive revision proposal did not present substantial changes, but rather adjustments according to the scenarios presented in the studies performed and also according to the number of liquid chillers in operation in Brazil at that time.

As is known, this is a Demonstration Project with involvement of private and public sector actors from different locations around the country and the outputs depended on the credibility and transparency of the Project for information dissemination, which was adequately achieved.

### 3.2.2 Partnership Arrangements

According to the Terminal Evaluation of Project BRA/12/G77, partnership agreements have been important for the implementation of the Demonstration Project for the Integrated Management of the Chillers Sector and are part of the proposal. It is also important to highlight that the partnership agreements under this project have been an important strategy for information dissemination, as an effective focus on the target audience of the project.

There was involvement of associations, private companies, public institutions and other entities in the discussions, capacity-building and trainings carried out by the Project and led by the contracted company and representatives of UNDP and MMA. This involvement means that information on actions for economic and environmental benefits and specifically for the protection of the ozone layer is obtained and internalized through ways of disseminating information on CFC and HCFC-free liquid coolers, transparency and safe treatment of residues of ODSs.

The partnership arrangements analyzed by the Evaluator showed the importance of the established partnerships. A highlight is the role played by the activities provided by the National Plan for CFC Elimination Project, which led to the identification and registration of the insignificant number of CFC chillers. Based on these data, a revision of Project BRA/12/G77 began with adjustments that led to effective outcomes in terms of the proposed objectives.

The search and selection strategies of private sector partnerships encountered some difficulties in response to calls for expressions of interest both in relation to individuals and companies to carry out the proposed activities. Following the selection of individuals and companies, the proposal presented by SOMAR Engenharia was approved by both the selection committee and CAP in September 2014. This company was approved for having the necessary professional requirements, personnel and resources for the performance of the services specified in both the call for proposals and the selection committees.

The evaluation identified that the activities included in the commitment established among the parties were related to the implementation of Outcomes 3, 4 and 5 of Project BRA/12/G77 and defined in accordance with the terms of reference of the service agreement established between SOMAR Engenharia and UNDP. The expected outputs, according to the outcomes and objectives of the Project, are described below:

**Output 1:** Information guide containing basic information on cold water systems without CFC or HCFC and 01 technical article for dissemination in the media.

**Output 2:** Manual on central cold water system for existing buildings.

**Output 3:** Technical and informative texts, including: 01 folder, 01 flyer, 03 posters, 01 technical article for the media (radio, TV, websites, magazines).

**Output 4:** Reports containing the outcomes obtained in the 05 technical events/training courses, highlighting the lessons learned and recommendations, number of participants

and their evaluation of courses. Information from the discussions at the events should also be considered.

**Output 5:** Execution of 02 retro-commissioning processes in public buildings located in Fortaleza/Ceará and in Cuiabá/Mato Grosso, presenting final technical reports, as described in Activity 5. This product was later modified and expressions of interest were extended at the national level.

**Output 6:** Execution of 02 retro-commissioning processes in private buildings located in the city of São Paulo-SP, presenting final technical report, as described in Activity 5.

Another partnership that the Terminal Evaluation highlights is the collaboration provided by the Brazilian Association of Refrigeration, Air Conditioning, Ventilation and Heating (ABRAVA). The entity based in São Paulo coordinates the activities at the national level. It has offices in some states of the country like Minas Gerais and in the Northeast. Still, it plans to set up regional offices throughout Brazil. In order to increase the effectiveness of its actions and allow for adequate institutional interrelations with its counterparts, ABRAVA also developed partnerships with several national and international entities and, in this case, collaborated with the BRA/12/G77 Project.

The entity participated in a series of initiatives related to issues for the Integrated Management for the Chillers Sector, mainly supporting in the capacities and the dissemination of information about the results of the Project, in favor of energy efficiency. In addition to ABRAVA, other associations and institutions were also important partners in the dissemination of information resulting from the outputs obtained by the Project.

The Evaluator verified that these partnerships and specifically the partnership established among SOMAR Engenharia, UNDP and MMA were of great relevance for the efficient performance of the Project and that the actions developed benefited not only the parties involved but also local and national actors through increased knowledge about the sector.

It is concluded that Project BRA/12/G77 was also implemented based on retro-commissioning processes carried out and the establishment of means of dissemination of information on obtaining energy efficiency and user comfort provided by the use of cold water systems for efficient air conditioning with economic and environmental benefits, especially with regard to the importance of appropriate disposal of ODSs removed from cold water systems.

Thus, the partnership arrangements established commitments of the parties involved in the implementation of activities aimed at achieving the outcomes established in the PRODOC of Project BRA/12/G77.

### **3.2.3 Feedback from M&E Activities used for Adaptive Management**

Considering that the Demonstration Project for the Integrated Management of the Chillers Sector, BRA/12/G77, has a demonstrative pilot character, as already explained, in accordance with the commitments made by the countries that are Parties to the

Montreal Protocol, with approval of resources for implementation of proposed activities, approved by the MLF at the 47th ExCom Meeting, in 2005, the procedures for adaptive management were not applied. The objectives were established by this Meeting, which defined that the pilot projects could cover the actions of the Chillers sector, seeking efficiency for Chillers refrigerators with CFC and HCFC.

These demonstration projects also presuppose their feasibility with management procedures that lead to the protection of the ozone layer, with previously planned actions. Since the commitments established by the Country are being fulfilled, according to the Terminal Evaluation, comments on M&E activities are not necessary for the application of adaptive management procedures.

### **3.2.4 Project Finance**

The Demonstration Project for the Integrated Management of the Chillers Sector in Brazil, as already mentioned, has the MMA as coordinating agency and UNDP as implementing agency. Thus, ExCom, in approving the Brazilian proposal to implement the Project at the 47th ExCom Meeting in 2005, allocated MLF resources in the amount of US\$1 million with defined objectives of:

- a) Demonstration Project to replace Chillers (Project BRA/12/G77);
- b) Application of efficient and CFC-free technology; and
- c) Composing Outcome 3 of Project BRA/09/G31.

As already mentioned, this approval required a financial contribution of US\$25 million from GEF and the IDB, which would be used in Outcome 6. With the need to adapt the activities of Outcome 3, the Substantive Review submitted and approved by ABC promoted the separation of Project BRA/12/G77 from the original project. However, it maintained the resources already approved and presented the Annual Work Plan with the allocation of financial resources for 2013, 2014, 2015 and 2016, as shown in the tables below.

The proposals for adjustments involved improvements that used cost-effectiveness parameters. The financial resources were used in accordance with the budget approved by MMA/ABC/UNDP and planned and disbursed according to Annual Work Plans.

The funds were used in accordance with the outcome/output budget provisions and were monitored by UNDP as the Project implementing agency. The Project Management Unit was responsible for financial monitoring and administrative coordination, overseeing and monitoring expenditures and product delivery, in accordance with M&E Plan inputs.

The tables with Project budget and performance specifications are presented below.

**Table 3: Project Budget – PRODOC/2013**

<b>Project 00072266</b> <b>Project Title: BRA/12/G77 – Demonstration Project for Integrated Management of the Chillers Sector</b>				
<b>Output</b>	<b>Key Activities</b>	<b>Start/ Year</b>	<b>End/ Year</b>	<b>Planned Budget US\$</b>
00085445 – Integrated Management for the Chillers Sector	Case Studies	01/31/2013	12/31/2013	71400 Service.Ind. Contract: <b>30,000.00</b> 72100 Company Service Contracts: <b>70,000.00</b>
	Inventory of Chillers with CFCs and HCFCs	01/31/2013	12/31/2013	71400 Individual Service Contracts: <b>50,000.00</b>
	Dissemination of Information to the public	01/31/2013	12/31/2013	71100 Company Serv. Contracts: <b>120,000.00</b>
	Technical service for replacing chillers	01/31/2013	12/31/2013	71.100 Company Service Contracts: <b>440,000.00</b> 71400 Service.Ind. Contract: <b>50,000.00</b>
	Workshops & training	01/31/2013	12/31/2013	71400 Service.Ind. Contract: <b>80,000.00</b> 72100 Company Service Contracts: <b>160,000.00</b>
<b>TOTAL</b>				<b>1,000,000.00</b>
<b>GRAND TOTAL</b>				<b>1,000,000.00</b>

Source: Annual Work Plan, PRODOC/2013

See Table 4 - Financial Performance per Year on the following page:



**Table 4 Financial Performance per Year**

Outcome	Activities	Expenditure (USD) per Year						TOTAL Expenditure	Total Project	Balance
		2013	2014	2015	2016	2017	2017 (committed)*			
National Inventory of Chillers	1	18,539,52	8,000,38	64,24	5,703,27	699,35		<b>33,006,76</b>		
Public Dissemination	2	13,695,23	53,88	-	34,280,87	17,275,06	22,020,28	<b>87,325,32</b>		
Retro-commissioning process, workshops & training	3 e 6	-	325,43	103,402,33	586,456,03	165,732,67	15,368,77	<b>871,285,23</b>		
<b>TOTAL</b>		<b>32,234,75</b>	<b>8,379,69</b>	<b>103,466,57</b>	<b>26,440,17</b>	<b>183,707,08</b>	<b>37,389,05</b>	<b>991,617,31</b>	<b>1,000,000.00</b>	<b>8,382,69</b>

*\* committed*

1) *Printing of publications (4x3000 copies + edition) + Distribution of publications*

2) *Final evaluation (according to item 1.4 Project Audit Arrangements (Project Substantive Review): USD 9,385.94*

3) *Travel, accomplishment of missions (OPs): USD 5,982.83*

Source: ATLAS System

Activities/Outcomes: Breakdown:

- 1 National Inventory of CFC and HCFC Liquid Chillers
- 2 Technical and information material for promotion and dissemination of outcomes obtained with the replacement of CFC and HCFC based liquid refrigerators
- 3 Retro-commissioning of Chiller in public and private buildings, workshops, training and training for specialized professionals and owners interested in replacing CFCs and heaters liquid under HCFC-based
- 4 (conducted under the PNC) - Case studies to demonstrate EE potential and economic and environmental benefits from the replacement of CFC-based liquid Chillers in public buildings
- 5 (canceled) Technical assistance for the development of CFC and HCFC replacement projects
- 6 (transferred to activity 3 - previous retro-commissioning process

Balance - US\$

Travel (Daily) 3,000

Direct Project Cost - DPC 5,300

### **3.2.5 Monitoring and Evaluation: Design at Entry and Implementation**

As explained in the PRODOC, monitoring and evaluation were carried out by UNDP under the Direct Execution (DEX) modality and through implementation actions of the Implementation and Monitoring Unit (UIM/UNDP), in coordination with MMA.

The monitoring consisted in the systematic follow-up of the activities implementation to obtain the outcomes proposed in the PRODOC and the Substantive Review of Project BRA/12/G77. The activities were developed according to the objectives and directed to the outputs and outcome contained in the Project and monitored through the preparation of periodic reports. The data for the reports were obtained by the contacts with the partners involved in the Project, meetings and field visits that were included in the work plans.

UNDP prepared progress reports in accordance with its standards, and CGPO/MMA prepared project monitoring reports by entering data and information into the Project Monitoring Management Information System (SIGAP) by electronic means. This SIGAP technical module was completed every six months, when the Project physical performance was measured, that is, when verification of the planned physical targets was performed. The report for the first half was added to SIGAP from July 15 to August 15, and the report for the second half was added from January 15 to February 15.

In addition, the monitoring and evaluation of the Project implementation have been systematically carried out through the partial progress reports that are presented to the MLF.

The UIM/UNDP and the MMA worked closely to record information and provide data for the preparation of the Final Evaluation report, reflecting the monitoring and evaluation activities contained in the project document and the monitoring and analysis of the outputs, so as to reach the objectives within the timeframe proposed by the work plan. The guarantee of obtaining and delivering the Project's outputs and outcomes also depended on compliance with the proposed indicators, baseline data and final objectives that were satisfactorily achieved.

The activities developed, according to the Evaluator, were managed in a way that involved the Project's partnerships and the commitment of the MMA/UNDP team, seeking to systematize and record the data and information to obtain the outputs and outcomes of the Project. The collaboration of the various actors involved in Project implementation ensured the monitoring and periodic evaluation of the activities proposed by Project BRA/12/G77.

In conclusion, the outputs/outcomes obtained by the implementation of Project BRA/12/G77 were oriented to reach those proposed by the PRODOC and the Substantive Review signed in November 2014 and in accordance with the SMART criteria as well as complying with the procedures proposed in the Results Management Guide.

### **3.2.6 UNDP and Implementing Partner Implementation/Execution, Coordination and Operational Issues**

#### **UNDP and Partners Implementation**

As already mentioned, UNDP is an institution recognized in Brazil for its efficiency in the implementation of international technical cooperation projects. Some operational problems were identified during the Project implementation in relation to delays arising from specific needs for contracting consultancy and requirements included in the contract. In addition, other rigid administrative procedures on bidding rules, although necessary, led to delays in implementation and financial performance. These problems have sometimes caused delays in obtaining the outputs and outcomes. Other problems were identified, although these were due to difficulties in finalizing selective and classificatory processes of individual or legal consultancies, leading to delays in the execution and fulfillment of deadlines for closing the Project.

However, according to the Terminal Evaluation, these problems have been offset by the outcomes obtained and the relevant information that has been and will still be disseminated at the national level. Thus the difficulties and delays identified in implementation by UNDP, in close coordination with the MMA and partners, were minor in relation to the scope and complexity of the activities proposed and implemented by established partnerships and by participants in government and private institutions and in relation to commitments.

Also, according to the evaluation consultant, the UIM/UNDP carried out activities to support the implementation of partners' activities, assisting in the development of a Memorandum of Understanding, in selection of building for the process of retro-commissioning and in the preparation of meetings and trips for the collection of data and information and participating in events, among other activities. While some delays have been identified in these and other procedures, they have not obstructed progress towards achieving outputs and outcomes.

As mentioned above, the progress reports were prepared with UIM/UNDP support to CGPO/MMA and its contents corresponded to the facts and factors involved in Project implementation. As still mentioned, the MMA was responsible for the bi-annual preparation of the Electronic Progress Report (RPE) referring to the SIGAP technical module, reflecting physical performance of the Project.

Regarding the length of the Project execution, UNDP and MMA sought to meet the deadlines, even considering that there was a delay in the beginning of the implementation and that there was a need for adjustments in the Project, as already mentioned, and difficulties in finding suitable professionals and companies for execution of the proposed actions. Therefore, as already evaluated, the delays were offset by the quality of the outputs and outcomes and showed the effectiveness of the activities in achieving the Project's outcomes in relation to its objectives.

According to the conclusion of the Final Evaluation, the implementation and monitoring of the activities can be considered **Highly Satisfactory (6 pts)**.

## **Coordination of implementation and operational issues**

As for the coordination of the partner's execution, the SOMAR Engenharia Company selected through a bidding process was monitored in its activities by both the implementation team and the project coordination team. According to information from these implementation and coordination teams, the company carried out the activities specified in the contract and complied with its commitments with the Project, namely:

- ✓ commitment to develop informative material, guides, manuals, technical and informational texts for dissemination in the various media on cold-water based refrigeration systems without CFC or HCFC;
- ✓ commitment to the preparation of reports containing the results of technical events/training courses; and
- ✓ commitment to the execution of 04 processes of retro-commissioning in existing public and private buildings, presenting technical reports at the end of the process.

In addition, the SOMAR Engenharia Company complied with the deadline commitments, in accordance with dates established in Project reviews, the implementation was monitored by the UIM/UNDP and the actions were coordinated by the MMA Ozone Unit team.

### **3.3 Project Outcomes**

The Project outputs and outcomes, object of this Terminal Evaluation, were constructed through planning of the activities that were considered fundamental to obtain the efficiency and effectiveness of the results and that promoted the participation of partner institutions.

These actions, according to the Evaluator, are relevant because, to a certain extent, they have promoted inputs for training and assimilation of knowledge to those involved, thus preparing material for the construction of an integrated management of the chillers sector and for the dissemination of data and information.

The actions identified and analyzed by the Terminal Evaluation were coherent with the Project main focus and also reflected the fulfillment of Brazil's commitments and obligations regarding elimination of ODSs and protection of the ozone layer.

#### **3.3.1 Outcomes and General Activities**

The outputs and outcomes of the BRA/12/77 Project specified in the Substantive Review resulted from the proposed adaptations and are contained in the objectives of the aforementioned revision, namely:

- ✓ To extend the term of validity of the Project until December 31, 2016;
- ✓ Adapt the outputs, goals and activities of Project Outcomes 2 and 3 in their original form;

- ✓ Cancel Outcome 5 - Technical assistance to projects to replace CFC and HCFC liquid coolers to increase EE;
- ✓ Insert a new Outcome 6 – Retro-commissioning processes of air conditioning systems with CFC and HCFC liquid chillers performed.

**Outcome 1: National inventory of liquid chillers with CFC and HCFC performed.**

**Output 1.1:** Inventory of chillers with CFCs and HCFCs in operation in Brazil.  
**Completed**

**Outcome 2: Technical and informative materials to promote and disseminate the results obtained by replacing CFC and HCFC liquid chillers produced and distributed.**

**Modified Outcome**

This result, in the beginning, encountered difficulties in estimating the number of cold water refrigerators using CFC and HCFC fluid, due to the resistance of the companies that manufacture and maintain refrigeration chiller equipment to provide data, because of competition in the market. However, with the support of ABRAVA, an approximate number of chillers in operation were established. This survey ascertained that the number of chillers in operation with CFCs was negligible.

**Outputs:**

- Information material: basic information and guidance on cold water systems.
- Technical manual: concepts of refrigeration, design, operation and maintenance; environmental and economic benefits, EE, commissioning and retro-commissioning, standards, procedures for measurement and performance evaluation, according to national and international standards, safety and others.
- Promotional materials:
  - ✓ 1 Folder
  - ✓ 1 Flyer
  - ✓ 3 Posters (banner)
  - ✓ 1 Information article for the media (radio, TV, websites, magazines)
  - ✓ 1 Technical article. **Outputs completed.**

**Outcome 3: Workshops, capacity-building and training for specialist professionals and owners interested in replacing CFC and HCFC liquid chillers performed.**

**Modified Result**

**Outputs:**

- 5 training events in different regions of Brazil.
- Training on cold-water systems, addressing projects, installation, operation and others.
- New technologies: concepts, applications and refrigerant fluids.

- Encouraging the replacement of chillers using CFC and HCFC.
- Demonstration of economic and environmental benefits.
- Application of standards. **Outputs completed.**

Three seminars were held in Rio de Janeiro, Fortaleza and São Paulo, and two training courses were held in Brasília and São Paulo, addressing, among other subjects:

- ✓ Main types of water cooling systems;
- ✓ Energy efficiency concepts related to refrigeration;
- ✓ Energy efficiency and adaptation aspects for obsolete systems;
- ✓ Refrigerant fluids that are alternatives to CFCs and HCFCs;
- ✓ Reduction of the recharge of refrigerants in the equipment;
- ✓ Methodologies for the elaboration of projects related to the efficient operation of water cooling equipment;
- ✓ Commissioning and retro-commissioning processes;
- ✓ Automatic refrigeration control and monitoring systems;
- ✓ New concepts for water cooling systems with chillers; and
- ✓ Environmental and economic aspects related to new and obsolete refrigeration systems.

The events involved presentations by specialists and managers of public and private buildings, industrial associations, manufacturers of cold water refrigeration systems, university experts and others. Participation was high and active. Event evaluation reports made clear the interest and involvement of the participants. The lack of information on the sector was revealed through analysis of the evaluation reports.

As for the publications prepared and edited are listed below:

- ✓ Technical manual on cold water systems for engineers and specialists in the chillers sector presented in three volumes that address:  
**Volume I:** Concepts about Chillers and Cold Water Systems;  
**Volume II:** Applications - Design, Installation and Operation;  
**Volume III:** Technical-Economic Analyzes and Systems Optimization Strategies.
- ✓ Practical Guide on Cold-Water Systems specially designed for construction managers; and
- ✓ Two technical articles published in Revista ABRAVA (magazine of the refrigeration sector).

It is important to note that all the material and videos on the cold water refrigeration sector that were developed as Project BRA/12/G77 outputs are available with free access on the website of MMA and the Montreal Protocol/UNDP.

In addition, the Final Evaluation verified that these technical materials can be used for other training on the Chillers sector both at national and local level and as a source of technical information for consultations by technicians and specialists. The material is rich in technical information, lessons learned and project-related guidelines for installation, operation and maintenance, as well as cost and energy efficiency evaluation of chillers with water chillers.

**Outcome 4: Case studies to demonstrate the EE potential and the economic and environmental benefits obtained by replacing CFC liquid chillers in public buildings performed.**

*This result was implemented under the National Plan for the Elimination of CFCs (Project BRA/02/G76), finalized in December 2013, and had as its objective to follow the project to replace the Cold-Water Plant (containing liquid chillers, water, pipes, electrical panels and control systems) at the Ministry of Finance in Brasilia.*

**Output:**

- Case studies to demonstrate EE potential and the economic and environmental benefits obtained by replacing CFC liquid chillers in public buildings under the PNC. **Completed.**

*Note: Energy consumption analysis was performed before and after the intervention, showing that the replacement of the equipment contributed to the reduction of energy consumption, but that the results could have been boosted by retro-commissioning involving the whole air-conditioning installation.*

The Evaluator visited a public building in Brasília, where the coolers and some other engine room mechanisms were replaced using resources from the National CFC Elimination Plan (PNC). The replacement of the chillers was positive because, at the moment, CFC-11 was difficult to obtain. However, replacing the chillers has not resulted in a significant gain in energy efficiency and comfort and will need to be complemented with other equipment and distribution changes so that the refrigeration system can provide economic, environmental and social benefits with improved air conditioning quality for beneficiaries of the chillers refrigeration system.

The new chillers installed are two R 134a units (one centrifuge and one screw). The Evaluation found that one of the new refrigerators is working properly and the other broke down and needs financial resources from the Ministry of Finance for repair or replacement. Problems related to lack of financial resources and bureaucratic issues increasingly lead to the critical situation of the building and the refrigeration system, according to the person responsible for the sector. In addition, issues related to the law of bidding prevent selection based on the quality of services and replacement materials, always preferring the lowest price, which is not always the best in quality.

**Outcome 5: Technical assistance for preparation of Chillers replacement projects to increase EE.**

**Canceled Result**

- **Reasons:**
  - ✓ Irrelevant amount of equipment with CFCs, preventing achievement of the expected outcome (preparation of 22 Chiller replacement projects)
  - ✓ Energy efficiency problems associated with the entire refrigeration system and not just replacing the chiller
  - ✓ Necessity for technical materials and case studies involving retro-commissioning of the entire installation of air conditioning of buildings.

## **Outcome 6: Retro-commissioning processes of air conditioning systems with CFC and HCFC liquid chillers.**

### **Result Added to the BRA/12/G77**

#### **Outputs:**

- 02 processes of retro-commissioning in public buildings in Brasília, but after the selection process through the Manifestations of Interest disclosed, the buildings that competed were not classified because they did not meet the eligibility criteria. It was decided to launch a call for proposals at the national level, for which one building in Cuiabá and one in Fortaleza were classified to undergo the process of retro-commissioning;
- 02 retro-commissioning processes in private buildings in São Paulo/SP (Centennial Plaza and Birman 21 Building).

These were defined from Expressions of Interest (MI) carried out within the scope of Project BRA/12/G77. **Completed**

The retro-commissioning procedures were the same for both public and private buildings. The results of the process were disclosed both through the technical material prepared and the technical events carried out, but without citing the names of the buildings or the owners, so as to avoid problems regarding public exposure. In addition to these facilities, the results were disseminated during national and international events in the refrigeration and air conditioning sector, such as: Air Conditioning, Ventilation and Heating Fair (FEBRAVA 2014 and 2016) and National Energy Efficiency Congress (COBEE 2016).

For the public building in Cuiabá, Mato Grosso, where retro-commissioning was carried out, according to a report by the Evaluation Mission from May 8 to 12, 2017, the building management already knew the existing policies and regulations related to ODSs, building codes and energy efficiency. The acceptance of the proposal to undergo the retro-commissioning process was immediate, since the high cost of electricity and equipment was also evident and the budget of the Ministry of Finance was insufficient.

According to the managers of the MF refrigerator interviewed, the system has a capacity of 677 TR, including three HCFC-22 Hitachi screw refrigeration appliances. Each chiller consists of three compressors and the refrigerant charge per cooler is 99 kg of HCFC-22 for a total refrigerant charge for the three 297 kg chillers. The system does not have individual automatic controls. The result of the retro-commissioning, in its report, recommended a total reconstruction of the entire facility for improvement and gain of energy efficiency and thermic comfort of the refrigeration system using chillers.

Still according to the interviewees, the recommendations of retro-commissioning were valuable. However, the need for voluminous financial resources for the necessary adjustments, about US\$2 million, prevents many of the recommended items from being implemented. The building intends to recruit a company to draft an executive project to rebuild the air conditioning system, but it is hoped that the MF will have resources for this purpose.

It is therefore concluded that continuity of the process depends on available resources and, furthermore, existing legislation does not allow, for example, the results of energy



savings from energy efficiency projects to be used to finance the replacement of equipment with ODSs in cold water systems that use chillers. However, those in charge of the building have been trying to implement some of the retro-commissioning recommendations such as switching some automatic controls to the system and some building walls have been isolated to achieve higher EE, according to the interviewees. The triggering of these actions by the MF is considered by the Evaluator as a direct benefit generated by the Project.

In relation to private buildings, the Evaluator visited the Birmann 21 Building, belonging to the Pension Fund of the Bank of Brazil (PREVI), with floors and rooms rented to several companies. Both building owners and companies that rent rooms in the building are interested in high energy efficiency. Thus, the proposal to carry out the process of retro-commissioning, after dialogues with the owners and the trustee of the building, was accepted. The retro-commissioning process began in 2015 and presented a series of recommendations along with an estimate of the costs to implement them.

According to interviewees' information, in one of the buildings, the original system had a capacity of 1130 RT, including two HCFC-22 refrigerators with 400 TR each, in addition to thermal ice accumulators. Each charge of Johnson Controls chillers refrigerant was 560 kg of HCFC-22. Thereafter, the ice-thermo-accumulator was discarded and a third liquid cooler with R134a was added. The building owner was aware about the electricity consumption of the entire system and also about comfort issues.

Therefore, according to interviewees, the recommendations presented by the retro-commissioning process began to be implemented from the preparation of an executive project. Two HCFC-22 coolers were replaced by two new coolers with R134a during 2016, among several other recommended changes. The building spent roughly US\$876,000 on pre-commissioning changes, including replacing the two coolers. An automatic system to record the cooling load consumption of each floor has been installed and each tenant can now monitor consumption per floor through the internet. HCFC-22 from the old chillers was recovered by Johnson controls. Those responsible for the building, when questioned about the subject of disposal, could not say what would have been the final destination of the refrigerant.

Coolers have been replaced and 80 percent of retro-commissioning recommendations have already been implemented. Gains in energy efficiency are estimated at about 42 percent, once the entire process is completed. The triggering of these actions by PREVI is considered by the Evaluator as a direct benefit generated by the Project.

In the other private building, according to interviewees, the original system had a capacity of 1286 TR and each cooler was composed of three compressors and a total charge of 179 kg refrigerant per HCFC-22 cooler. One of the chillers was adapted with a drop-in mix, but the results were positive. However, there was a reduction in cooling capacity and energy efficiency. It was recommended to replace the six coolers. The original design of the whole system was considered a problem because it did not have automatic controls. Therefore, the entire system must be refurbished for energy efficiency and thermic comfort. Installing two coolers on each of the two floors was also recommended. An estimated 50 percent gain in energy efficiency and comfort is

expected if all retro-commissioning recommendations are implemented. The total cost for all recommended modifications, including the replacement of the chillers, was estimated at US\$1,091,000.

The implementation of retro-commissioning recommendations has begun and planning is being done with the complete modification of the system (including the replacement of the chillers), which is expected to be completed within the next two to three years. The triggering of these actions by PREVI is considered by the Evaluator as a direct benefit generated by the Project.

It is important to emphasize that operational managers of the four buildings that underwent the retro-commissioning process participated in seminars organized with resources from Project BRA/12/G77. The evaluation of these participants was that the experience was highly positive.

The outputs and outcomes of implementation of the Demonstration Project for the Integrated Management of the Chillers Sector were considered by the Evaluator as **Highly Satisfactory (6 pts)** in relation to the objectives and activities carried out, as presented in Table 5.

Next, see Table 5, which presents the outcomes achieved in relation to the objectives and activities proposed by Project BRA/12/G77.

**Table 5: Outcomes achieved in relation to the Project Objectives and Activities**

Project Title: Integrated Management for the Chillers Sector – BRA/12/G77 Institution responsible: UNDP Identification in the ATLAS (Atlas ID): 72 266					
<b>Objectives:</b> - Stimulate interest, in an integrated way, in the improvement of Energy Efficiency in buildings. - Demonstrate the potential for energy efficiency in replacing CFC and HCFC based chillers.					
<b>Partnership Strategy:</b> Associations and companies in the refrigeration and air conditioning sector, ESCOs, public and private building managers, educational institutions and other stakeholders.					
Outcome/Output	Outcomes/Indicators	Output Goals/Year	Indicative Activities	Inputs	Outcomes achieved
<b>Outcome 1:</b> - National inventory of CFC and HCFC liquid chillers.  <b>Output:</b> - Inventory of chillers with CFCs and HCFCs in operation in Brazil.	- Diagnosis of the amount of liquid chillers equipment with CFCs operating in Brazil.	- Database of equipment in operation (data of chillers, location, owners, refrigerant fluid).	(Year 1) - Verification of the companies listed in existing inventory. - Identification of possible companies not yet identified in the existing inventory. - Data recording of identified equipment. - On-site verification when necessary. - Systematization of collected data .	- Refrigeration Specialist	- Accomplished
<b>Outcome 2:</b> - Technical and informational materials to support the replacement of	- Training Manual  - Information materials	2015 <i>01 Information material containing:</i> • Basic information and guidance on cold water systems; • Guidance on existing technological alternatives for the modernization of the old air conditioning system, with	2015-2016  • Preparation of TOR; • Production of materials; • Review of the materials produced; • Follow up of the diagramming, formatting and generation of graphic	• Contract of company with experience in EE projects and retro-commissioning of	- Work contracted and carried out.  - EE study on substitution/retrofit:

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- Demonstrate the potential for energy efficiency in replacing CFC and HCFC based chillers.

Partnership Strategy: Associations and companies in the refrigeration and air conditioning sector, ESCOs, public and private building managers, educational institutions and other stakeholders.

Outcome/Output	Outcomes/ Indicators	Output Goals/Year	Indicative Activities	Inputs	Outcomes achieved
Chillers. Output 2.1 - Technical and informative materials to promote and disseminate the outcomes obtained with the replacement of CFC and HCFC liquid chillers produced and distributed.		EE; • Alternatives to CFC and HCFC, considering technical, environmental and economic aspects. <b>2016</b> <i>01 Technical manual, addressing:</i> • Advantages of using cold water systems compared to other systems available on the market; • Operation and maintenance; • Environmental benefits; • EE • Economic benefits; • Main concepts of EE related to aspects of refrigeration, such as COP (Performance Coefficient), IPLV (Integrated Part Load Value) and TEWI (Total Equivalent Warming Impact); • Control and monitoring systems for automation; • Project formulation methodology; • Procedures for the environmentally adequate disposal of discarded	art; • Distribution of materials in workshops and training to be carried out for professionals of companies installing and maintaining ice water systems, managers of public and private buildings, professionals, etc.; • Dissemination and availability in digital media for free access of the interested public.	liquid chillers; • Hiring company and/or individual for diagramming, production and printing of the produced materials.	support the publication of technical materials for the sector - carried out.  - Training manual: 08 modules (EE, environmental and economic benefits, operation, optimization, retrofit design and work methodology) - carried out.  - Handout for training: operation and maintenance of Chillers - accomplished.  - Booklet: advantages of replacement /

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Outcome/Output	Outcomes/ Indicators	Output Goals/Year	Indicative Activities	Inputs	Outcomes achieved
		<p>obsolete equipment and contaminated refrigerated fluids;</p> <ul style="list-style-type: none"> <li>• Commissioning and retro-commissioning, in accordance with national and international standards;</li> <li>• Safety procedures, in accordance with national and international standards;</li> <li>• Potential funding lines and mechanisms to facilitate the replacement of air conditioning systems (to clarify procedures for applying to the IDB EE Facility (EEGM)).</li> </ul> <p><b>2016</b>  <i>01 set of dissemination materials, composed of:</i> <ul style="list-style-type: none"> <li>• 01 folder</li> <li>• 01 flyer</li> <li>• 03 Banners</li> <li>• 01 Information article for the media (radio, TV, websites, magazines)</li> </ul> </p>			<p>chillers - carried out.</p> <p>- Report to disseminate the outcomes achieved in the replacement of chillers in the Ministry of Finance building - with resources from the PNC - Accomplished.</p>

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Partnership Strategy: Associations and companies in the refrigeration and air conditioning sector, ESCOs, public and private building managers, educational institutions and other stakeholders.

Outcome/Output	Outcomes/Indicators	Output Goals/Year	Indicative Activities	Inputs	Outcomes achieved
		<ul style="list-style-type: none"> <li>• 01 Technical article</li> </ul> <p>The materials aim to inform about cold water systems, promote technical and training events and disseminate the materials produced.</p>			
<p>Outcome 3: Workshops, training for specialized professionals and owners interested in replacing CFC and HCFC liquid chillers developed.</p> <p>Output 3.1 Workshops, trainings for specialized professionals and owners interested in replacing CFC</p>	- Technical events	<p>2015</p> <ul style="list-style-type: none"> <li>• 01 training event accomplished.</li> </ul>	<p>2015</p> <ul style="list-style-type: none"> <li>- Preparation of TOR;</li> <li>- Definition of training plan;</li> <li>- Definition of workload and content;</li> <li>- Selection of mediators and lecturers (teachers or instructors) for the event;</li> <li>- Preparation and compilation of evaluation research of the event;</li> <li>- Preparation of mailing list and invitation to participants;</li> <li>- Definition and leasing of spaces and materials to carry out the event;</li> <li>- Issuance of certificates;</li> <li>- Preparation of a report highlighting the lessons learned, recommendations, number of participants and evaluation of the</li> </ul>	<p>(2016)</p> <ul style="list-style-type: none"> <li>• Recruitment of a legal entity with experience in EE projects and Chillers retro-commissioning.</li> <li>• Hiring of company specialized in events.</li> </ul>	<ul style="list-style-type: none"> <li>• 05 Events, of which:</li> <li>• 02 courses with 120 participants with the objective of: training and theoretical and practical training on: a) substitution of CFC and HCFC chillers; b) Operation and Maintenance - <b>Performed.</b></li> <li>• 02 courses with 100 people from the private sector and 20 people</li> </ul>

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- Demonstrate the potential for energy efficiency in replacing CFC and HCFC based chillers.

Partnership Strategy: Associations and companies in the refrigeration and air conditioning sector, ESCOs, public and private building managers, educational institutions and other stakeholders.

Outcome/Output	Outcomes/ Indicators	Output Goals/Year	Indicative Activities	Inputs	Outcomes achieved
and HCFC liquid chillers, demonstrating EE potential and economic and environmental benefits.			courses.		from the public sector with training and training objectives on chillers maintenance and maintenance. <b>Performed.</b> • Seminar with 200 people to disseminate the results achieved. <b>Accomplished</b>
Output 3.2 Courses to improve the qualification and training of specialized professionals.	- Technical events	2015 • 01 Training event accomplished.	2015 - Preparation of TOR; - Definition of training plan; - Definition of workload and content; - Selection of mediators and lecturers (teachers or instructors) for the event; - Preparation and compilation of evaluation research of the event; - Preparation of mailing list and invitation to participants;	• Recruitment of a legal entity with experience in EE projects and Chillers retro-commissioning.  • Hiring of company specializing in events.	Accomplished

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Objectives: - Stimulate interest, in an integrated way, in the improvement of Energy Efficiency in buildings. - Demonstrate the potential for energy efficiency in replacing CFC and HCFC based chillers.					
Partnership Strategy: Associations and companies in the refrigeration and air conditioning sector, ESCOs, public and private building managers, educational institutions and other stakeholders.					
Outcome/Output	Outcomes/Indicators	Output Goals/Year	Indicative Activities	Inputs	Outcomes achieved
			- Definition and leasing of spaces and materials to carry out the event; - Issuance of certificates; - Preparation of a report highlighting the lessons learned, recommendations, number of participants and evaluation of the courses.		
Output 3.3 Training of ESCOs to replace obsolete CFC and HCFC chillers, aiming to promote EE in buildings.	- Technical events	2015 - 01 Training event carried out.	2015 - Preparation of TOR; - Definition of training plan; - Definition of workload and content; - Selection of mediators and lecturers (teachers or instructors) for the event; - Preparation and compilation of evaluation research of the event; - Preparation of mailing list and invitation to participants; - Definition and leasing of spaces and materials to carry out the event; - Issuance of certificates; - Preparation of a report highlighting the lessons learned,	• Recruitment of a legal entity with experience in EE projects and Chillers retro-commissioning.  • Hiring of company specializing in events.	Accomplished



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- Demonstrate the potential for energy efficiency in replacing CFC and HCFC based chillers.

Partnership Strategy: Associations and companies in the refrigeration and air conditioning sector, ESCOs, public and private building managers, educational institutions and other stakeholders.

Outcome/Output	Outcomes/ Indicators	Output Goals/Year	Indicative Activities	Inputs	Outcomes achieved
			recommendations, number of participants and evaluation of the courses.		
Output 3.4 Training for owners, technicians, maintainers and operators of chillers on operation and maintenance of chillers and air conditioning systems.	- Technical events	2016 - 01 Technical events carried out.	2016 - Preparation of TOR; - Definition of training plan; - Definition of workload and content; - Selection of mediators and lecturers (teachers or instructors) for the event; - Preparation and compilation of evaluation research of the event; - Preparation of mailing list and invitation to participants; - Definition and leasing of spaces and materials to carry out the event; - Issuance of certificates; - Preparation of a report highlighting the lessons learned, recommendations, number of participants and evaluation of the courses.	<ul style="list-style-type: none"> <li>• Recruitment of a legal entity with experience in EE projects and Chillers retro-commissioning.</li> <li>• Hiring of company specializing in events.</li> </ul>	Accomplished

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Objectives: - Stimulate interest, in an integrated way, in the improvement of Energy Efficiency in buildings. - Demonstrate the potential for energy efficiency in replacing CFC and HCFC based chillers.					
Partnership Strategy: Associations and companies in the refrigeration and air conditioning sector, ESCOs, public and private building managers, educational institutions and other stakeholders.					
Outcome/Output	Outcomes/Indicators	Output Goals/Year	Indicative Activities	Inputs	Outcomes achieved
Output 3.5 Final Seminar to present the outcomes achieved in the substitution / conversion of Chillers with CFC and HCFC.	- Technical event	2016 - 01 Seminar to disseminate the outcomes.	2016 • Formulation of the seminar; • Elaboration and delivery of invitations to the lecturers and the public, actors involved.	• Recruitment of a legal entity with experience in EE projects and Chillers retro-commissioning. • Hiring of company specializing in events.	Accomplished
Outcome 6: Retro-commissioning processes of air conditioning systems (involving central chilled water, air conditioners and air distribution circuits) in buildings that have liquid chillers (cold water	- 04 retro-commissioning process	<b>2015 – 2016</b> - 02 retro-commissioning processes in public buildings in the city of Cuiabá/MT and in the city of Fortaleza/Ceará -02 refitting processes in private buildings in São Paulo.  Note: The Retro-commissioning will follow the standards of the NEBB (Procedural Standards for Refitting for Existing Buildings - Part 2 and 3) involving only the phases: (i) Research and Analysis; and (ii)	2015-2016 • Formulation of TOR; • Conduct of retro-commissioning processes; • Preparation of conclusive technical reports containing the outcomes obtained and lessons learned; • Availability of reports in digital media for free access to the interested public.	• Recruitment of a legal entity with experience in EE projects and Chillers retro-commissioning. • Hiring of company specializing in events.	- Retro-commissioning processes performed in: - 02 public buildings, one in Cuiabá/Mato Grosso and one in Fortaleza/Ceará; - 02 private buildings in São Paulo/SP. <b>Performed</b>

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- Demonstrate the potential for energy efficiency in replacing CFC and HCFC based chillers.

Partnership Strategy: Associations and companies in the refrigeration and air conditioning sector, ESCOs, public and private building managers, educational institutions and other stakeholders.

Outcome/Output	Outcomes/ Indicators	Output Goals/Year	Indicative Activities	Inputs	Outcomes achieved
system) in operation and with CFC and HCFC.		Correction Implementation Plan.			

Source: Project Document, 2013 and Substantive Revision Document, 2014.

### **3.3.2 Relevance**

The relevance of the "Demonstration Project for the Integrated Management of the Chillers Sector", BRA/12/G77, in Final Evaluation, is of paramount importance as it seeks to protect the ozone layer by disseminating information about the importance of replacement of chillers with CFCs and HCFCs in the country, completing the efforts made and in accomplishment of the National Plan for the Elimination of CFCs and by the Brazilian HCFC Phase-Out Program. In addition, the results showed the relevance of the scope of action that involved not only the local level but also the national level and the established partnerships promoted the wide participation of people and organizations related to the chillers sector.

Therefore, the relevance of Project BRA/12/G77 is based on the outcomes obtained by the economic and environmental benefits provided and the awareness of the importance of the retro-commissioning processes carried out. These benefits also reflect the knowledge acquired with the implementation of capacity-building and training implemented through the Project. Thus, the execution of the proposed activities was implemented aiming at the energy efficiency of the chillers action with elimination of ODSs and with protection of the ozone layer. It is important to note that the risk of ozone depletion and the solution through restrictive protocols, such as Montreal, are seen as examples of success by prioritizing environmental issues and efficiently addressing economic issues.

The execution of the PNC and PBH Projects involved the establishment and application of norms and regulations by the Brazilian Government and greater knowledge about procedures adequate to the change of industrial processes in the Country, and were fundamental requirements for the reduction of ODS objectives to be achieved. The knowledge and changes of industrial processes provided by the MLF resources were important inputs for the results of the activities developed to meet the criteria of efficiency and sustainability in the preservation of the ozone layer.

According to the Evaluator, industrial restructuring and technological adaptation to the efficiency of chillers involves high costs and requires time to complete, as well as a qualitatively well-structured training program that provides relevant information for the reduction and elimination of ODSs. These elements were treated efficiently by the actions of the Demonstration Project for the Integrated Management of the Chillers Sector in Brazil.

The partnerships were important for the efficiency of the proposed activities, especially those with SOMAR Engenharia and ABRAVA. It is clear that these partnerships were possible through the redesign of the Project obtained by the adjustments in its outcomes, as a result of data emerging from the reality of the operation of the Chillers sector in Brazil.

Other policies, such as those linked to sustainable development objectives, were also relevant assumptions within the scope of the Project's objectives to stimulate interest in improving energy efficiency in buildings, demonstrating the potential of this efficiency through diagnostics for the replacement of Chillers using CFCs or HCFC.

Considering that the Multilateral Fund also recognized the relevance of the actions proposed by the Project by granting financial resources for its implementation and for fulfilling commitments made by Brazil with the Montreal Protocol, BRA/12/G77 actions proved to be highly relevant. This relevance is mainly due to the results of the Chillers inventory, which led to changes in the design of the Project and reorientation of execution as well as the results of the training process with materials produced that reflected the lessons learned mainly from the retro-commissioning process. The activities proposed by Project BRA/12/G77 can therefore be considered as: **Highly Relevant (2 pts).**

### **3.3.3 Effectiveness and Efficiency**

The report of this Final Evaluation shows that the activities developed towards the achievement of the Project's outputs and outcomes were carried out effectively and efficiently.

According to the Evaluator, the selective processes for contracting services by organizations instead of individuals were highly efficient and the effectiveness of the actions for the outcomes obtained are presented through the activities to achieve the objectives proposed by the Project. Contributions of financial resources to the effectiveness of the actions and their disbursements ensured success in execution. In this sense, the actions of both the implementing team and the coordination of the Project played an important role in supporting and strengthening the partnerships involved. The estimated and actual costs corresponded to those planned in the Annual Work Plans and the applied management model was efficient and reflected the effectiveness of the technical and administrative financial actions.

Monitoring and effective actions for the proper execution of the activities of both the established partnerships and the implementation and coordination teams demonstrate the effectiveness of project management.

The effectiveness and efficiency of the Project were considered **Satisfactory (5 pts).**

### **3.3.4 Mainstreaming**

According to the Final Evaluation, the key and central issue of Project BRA/12/G77 is knowledge about and internalization of the importance of replacing chiller fluids containing CFCs or HCFCs, considering the system as a whole, to promote energy efficiency with economic and environmental benefits. To achieve this objective, Brazil established standards and regulations that comprise a legal system for the integrated management of the chillers sector, a base of trained professionals and guidelines for investments in facilities suitable for the best operation and maintenance of air conditioning systems in which the secondary fluid is cold water. Concerns about the environment and its proper management are part of Brazil's commitments to international treaties and have been adequately met with regard to the Montreal Protocol.

The Project aimed at contributing in a relevant way to Brazil's policies of reducing emissions and vulnerabilities and finding ways to adapt to climate change. Above all, the Project sought to comply with and follow national standards, such as legislation on liquid-based cooling, and in this sense the Brazilian Association of Technical Standards (ABNT) has been and is always following legislation for the sector. The Brazilian government through CONAMA and MMA/IBAMA, with the support of associations such as ABRAVA, regulates, controls and monitors the use of harmful substances to the environment and, at the international level, the processes of retro-commissioning followed the norms of National Environment Balancing Bureau (NEBB), as quoted in the report "Evaluation of Chillers Projects with Co-financing Modalities" of the mission held May 8-12, 2017.

### **3.3.5 Sustainability**

Sustainability can be defined as the likelihood of continuous benefits after project completion.

According to the analysis carried out by the Final Evaluation, Project BRA/12/G77 offered financial, institutional and governance conditions to continue work during and after its implementation.

Considering the period after the execution of the Project, the Evaluator affirms that there can be continuity of actions through the proper functioning of the system of liquid refrigeration, since the accumulation of knowledge acquired about the sector, through the training and information dissemination programs, can guarantee better economic and environmental conditions for the sector. The information obtained through interviews and field visits showed this accumulation of knowledge about the issues of cold water refrigeration and the retro-commissioning process, which can lead to the continuity of more adequate operation of the system, leading to the sustainability of the Project.

The Evaluator analyzed the sustainability of Project BRA/12/G77 and concluded that it is guaranteed by the network of professionals and technicians specialized in the sector that is currently able to evaluate air conditioning equipment and systems using chillers. In addition, they can also influence beneficiaries of the air conditioning system with chillers to improve the economic and environmental conditions of existing buildings, thus promoting sustainability to the actions and outcomes of the Project.

### **Sustainability Classification**

The Evaluator has identified that government, business and representatives of associations of the refrigeration sector are strongly committed to put into practice the knowledge acquired and to support the fulfillment of obligations assumed by the Country regarding the protection of the ozone layer as has been established by the Montreal Protocol. These representatives now know that having a refrigeration system without ODSs can bring about a healthy environment by preserving the ozone layer at the local, national and global levels.

The outputs and outcomes of the Demonstration Project for Integrated Management of the Chillers Sector required effective action aimed at institutional strengthening through the dissemination of knowledge about the sector and how a demonstrative project has conditions for replication and, therefore, sustainability of its actions. Therefore, the Evaluator grants a score consistent with the arguments, which is **Probable (4 pts)**.

### **3.3.6 Impact**

The BRA/12/G77 Project provided knowledge needed for the promotion of impacts in the chillers sector, energy efficiency and, mainly, the improvement of environmental conditions. The processes of retro-commissioning, retro-commissioning and capacity-building and training programs with results that promoted information dissemination conditions had an impact on professionals in the chillers sector, bringing economic and environmental benefits. These results have an impact on the operation, maintenance and institutional and legal control of the system, leading to the benefits provided in the Project objectives. The legal system established and the standards that emerged from the actions taken have an impact on the protection of the ozone layer.

Therefore, the Evaluator states that the implementation of the Project and its actions generated data and information that were reflected in impacts among the professionals and beneficiaries of the chillers sector, and could result in reduction of vulnerabilities of the existing refrigeration systems for buildings. The impact of the Project was considered positive at the local, national and international levels. The impact, therefore, is **Significant (5 pts)**.

### **3.3.7 Evaluation Rating of the Outcomes**

The UNDP evaluation policy stipulates that ratings should be assigned to the relevance, effectiveness, efficiency and quality of the activities implemented by the Project and the monitoring and evaluation system. Table 7 lists all the ratings provided by the Evaluator of Project BRA/12/G77, based on the considerations already mentioned.

**Table 6: Rating for Project Design and Outcome Implementation**

<b>Evaluation Ratings:</b>			
<b>1. Monitoring and Evaluation</b>	<b>Rating</b>	<b>2. IA&amp; EA Execution</b>	<b>Rating</b>
M&E design at entry	5 (S)	Quality of UNDP Implementation	6 (HS)
M&E Implementation Plan	5 (S)	Quality of Execution – Executing Agency	6 (HS)
Overall quality of M&E	5 (S)	Overall quality of Implementation/Execution	6 (HS)
<b>3. Assessment of Outcomes</b>	<b>Rating</b>	<b>4. Sustainability</b>	<b>Rating</b>
Relevance	2 (R)	Financial resources	4 (L)
Effectiveness	5 (S)	Social-political	4 (L)
Efficiency	5 (S)	Institutional framework and governance:	4 (L)
Overall Project Outcome Rating	5 (S)	Environmental	4 (L)
		Overall likelihood of sustainability:	4 (L)

Source: *Evaluation Office, 2012, United Nations Development Programme, p. 29.*

According to “*Guidance for Conducting Terminal Evaluations of UNDP-Supported, GEF-Financed Projects*”:

Highly Satisfactory = 6 (HS); Satisfactory = 5 (S), Highly Unsatisfactory = 1 (HI)

Sustainability = 4 Probable, Moderately Likely (low risk) = 3, Substantial Risk = 1

M & A - General Quality of M&A = 6, M&A Design = 6, M&A Implementation Plan = 6

Quality of Implementation = 6 points, Quality of Execution = 6, Overall Quality = 6

Relevance = (R) or (NR) (score 2 points); Efficacy = 6 points; Effectiveness = 6 points; Financial Resources = 4 points; Socio-politic = 4; Environment = 4 (4 being the highest score).

According to the Evaluator, the classification of the Project Demonstration for Integrated Management of the Chillers Sector as a whole is **Highly Satisfactory (6 pts)**.



## 4 Conclusions and Recommendations

Despite delays caused by issues related to the initial linkages to the Energy Efficiency Market Transformation Project (BRA/09/G31) in which the Integrated Chillers Sector Management Demonstration Project (BRA/12/G77) was one of the components, as well as other factors related to their dismemberment and the necessary reformulation, the Final Evaluation of the Project verified that its outcomes are relevant and have been fully achieved in relation to the proposed objectives.

Thus, Project BRA/12/G77 was finalized with satisfactory results that included economic and environmental benefits and, with the generation of knowledge and the dissemination of information on the environmentally adequate management of the chilled water system, in line with the precepts of EE. These systems, as explicit in the didactic materials produced by the Project, are used in cooling processes, so-called chillers. These, according to the Practical Guide on Cold Water Systems, are "complete closed-circuit refrigeration equipment mounted on a compact base and requiring only hydraulic interconnections with the ice water and cooling water pumping circuits and electrical interconnections to integrate them into the system." This system presents advantages that have been proven and disseminated through the didactic material presented in the capacity-building and training events carried out by the Project.

The advantages of an ice water system that uses chillers were thus explained and discussed during the implementation of the training programs. They concern the reduced fluid load, energy efficiency and the possibility of more precise control of the cooling processes, according to the Practical Guide on Cold Water Systems, product of Project BRA/12/G77, in final evaluation.

Among the outputs and outcomes proposed by the Project, the processes of retro-commissioning were highlighted by the fact that the implementation of the processes provided inputs for the training and training programs. In addition, its importance is also based on the fact that it was a fundamental element for the technicians and specialists responsible for the cooling system of the target buildings "to open their eyes" to knowledge about the need for replacements of equipment or about the material necessary for its better functioning.

Retro-commissioning, as defined in an article published in ABRAVA Magazine in October 2016, "is the commissioning process to be carried out in existing buildings, which consists of a detailed investigation of the system, including executive design, installation and current operating conditions and performance in order to identify problems and optimize the building's air conditioning system."

The importance of the retro-communication processes carried out in public and private buildings, as outputs/outcomes of the Project, became evident when taken as a total system, in its entirety, with complex operation, which is not only verified by the fluid necessary to generate air conditioning but also by the whole cooling system. Thus, the Appraiser concludes that the processes have achieved the main objective of collecting data for the recovery of comfort, air quality and efficiency of the retro-commissioning

process. In addition, as mentioned above, the process provided relevant inputs for the preparation of training material, inputs for the discussions in training and construction events and the strengthening of knowledge for the integrated management of the chillers sector.

In conclusion, the Evaluator affirms that the outputs/outcomes, according to the monitoring and evaluation analysis performed and qualified by the Final Evaluation, have complied with the following assumptions:

- Consistent with the specific nature of the issues involved and presented in language accessible to the groups included in the Project partnerships and the target groups reached.
- Planned in accordance with indicative activities in the PRODOC and Substantive Project Review and relevant for compliance with the commitments established by the country in the Montreal Protocol.
- Compatible with the capacity of involved and relevant partners at the local, national and international levels, contributing to the priorities set out in the Montreal Protocol.
- Obtained in a way that the results were not an end in themselves, but the basis for continuous improvement of information, data and other findings, being aimed at reducing the impacts of harmful substances on the environment and damage to the ozone layer.

## **Recommendations**

Considering the complexity of the chilled water refrigeration sector and the targets for elimination of substances that damage the ozone layer, the Final Assessment concludes that the decision to recruit legal advice for the implementation of the activities proposed by the Project was highly positive.

This statement leads to the main recommendation that is based on the need for projects increasingly to improve the processes of selection and classification of companies (legal entities) to carry out specialized activities. Bidding also requires broader disclosure, resulting in more and better bids and leading to the best price instead of just the lowest price. This recommendation was highly emphasized by the participants and actors involved in the implementation of this Project.

Another recommendation concerns the implementation of the results of the retro-commissioning process. The lack of information about funding sources was identified to implement the recommendations of the retro-commissioning process. This is because there are high costs to implement the recommendations contained in the report of the retro-commissioning process, which sometimes leads to frustration both to those who applied the process and to the technicians involved, who recognized the urgency of implementing actions to restructure the cold-water refrigeration system and that they were unable to do so. However, the Project provided information on this subject, since, among the topics of the training program carried out, there was a specific module of

information on financing, and this information was also passed on to representatives of buildings that were benefited by the Project.

The recommendation is based on the importance of the retro-commissioning process and thus, for the buildings benefited by the process within the scope of the Project, it is important that they seek, and some are already seeking, to make available resources to implement the recommendations contained in the report of the retro-commissioning process.

These are the main conclusions and recommendations identified in the final evaluation process of the Integrated Chillers Sector Management Demonstration Project that the Evaluator classified as having presented highly satisfactory results.

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## **5.1 Terms of Reference**

### **Termos de Referência**

**RC 30873**

**CONSULTOR NACIONAL IC PNUD (*IC Contractor*)**

**PROGRAMA DAS NAÇÕES UNIDAS PARA O DESENVOLVIMENTO**

**“Avaliação de Meio Termo do Projeto BRA/14/G72 - Gerenciamento e  
Destinação Final de Resíduos de SDOs”**

## **1. Introdução**

O objetivo do Projeto BRA/14/G72 é desenvolver um sistema de gerenciamento e destinação final ambientalmente adequada, eficiente e economicamente rentável de Sustâncias que Destroem a Camada de Ozônio (SDOs), mediante o estabelecimento de um Sistema de Gerenciamento de Resíduo de SDOs em âmbito nacional, com investimento do Fundo Multilateral para a Implementação do Protocolo de Montreal (FML).

O Protocolo de Montreal sobre Sustâncias que Destroem a Camada de Ozônio é um tratado internacional criado em 1987 para proteger a camada de ozônio por meio da eliminação da produção e consumo das SDOs. Em 2009, este acordo entrou para a história ao se tornar o primeiro tratado sobre meio ambiente a ser universalmente ratificado pelos 197 países (Partes).

O FML é o mecanismo financeiro criado para prover assistência técnica e financeira aos países em desenvolvimento (Partes que operam sob a égide do Artigo 5) para eliminar o consumo de SDOs de acordo com os cronogramas de eliminação.

Apesar das diversas iniciativas bem-sucedidas de eliminação do consumo de SDOs, em especial dos CFCs e, atualmente, dos HCFCs, há ainda um passivo que permanece presente como fluido frigorífico em equipamentos de refrigeração e ar-condicionado (RAC) ou como agente de expansão em espuma de poliuretano, e que pode acabar sendo liberado na atmosfera em algum momento da vida útil dos equipamentos, acarretando em danos à camada de ozônio. Países em desenvolvimento, incluindo o Brasil, possuem bancos remanescentes de SDOs com alto potencial de destruição do ozônio (PDO) (principalmente de CFCs), que constituem um passivo ambiental preocupante a ser administrado e eliminado.

Conforme Decisão MOP XX/7, os Estados Partes solicitaram ao Comitê Executivo do FML (ExCom) que considerasse apoio técnico e financeiro a projetos demonstrativos de gerenciamento e destinação final de SDOs inservíveis nos países do Artigo 5. Em face do disposto, a Decisão ExCom 58/19 aprovou um conjunto de diretrizes para o financiamento de projetos demonstrativos visando o gerenciamento e destinação final ambientalmente adequada de resíduos de SDOs nos países em desenvolvimento.

Na 57ª reunião, o ExCom aprovou recursos para a preparação de um projeto piloto demonstrativo de gerenciamento e destinação final de resíduos de SDOs para o Brasil (Projeto BRA/DES/57/PRP/288). A proposta do projeto foi elaborada pelo Programa das Nações Unidas para o Desenvolvimento (PNUD), sob a coordenação do Ministério do Meio Ambiente, e submetida para aprovação do ExCom na 72ª reunião, realizada em maio de 2014. O projeto, posteriormente nomeado BRA/14/G72, foi aprovado no valor de USD 1.490.600, considerando o estoque atual de resíduos de SDOs e o aperfeiçoamento de instalações de incineração de alta temperatura, seguindo os padrões internacionais para esse tipo de atividade.

O Projeto BRA/14/G72 abarca todas as etapas do gerenciamento de resíduos, como regeneração, armazenamento de SDOs contaminadas, logística e transporte, bem como a qualificação e adequação de incineradores brasileiros para a destruição segura das SDOs inservíveis. Espera-se que ao final do projeto, seja estabelecido um modelo de gerenciamento de resíduos de SDOs para que os setores públicos, privados e consumidores finais possam devidamente se orientar e fazer com que esta atividade se torne uma prática regulamentada e frequente.

## 2. Objetivos da Consultoria

Realizar avaliação de meio termo do Projeto BRA/14/G72 – Projeto Demonstrativo para o Gerenciamento e Destinação Final de Resíduos de SDOs.

Avaliar os Resultados do PRODOC abaixo listadas, observar o cumprimento dos objetivos do projeto, necessidades de alteração e/ou inclusão de novas atividades, adequação dos prazos para a implementação e recomendações de melhorias:

- Resultado do Componente 1: Sistema Integrado de Gerenciamento de Resíduos de SDOs estabelecido, contemplando assistência técnica para o recolhimento, capacitação, armazenamento, consolidação e transporte;
- Resultado do Componente 2: Incineração de resíduos de SDOs demonstrada.

O PRODOC na íntegra será disponibilizado (via e-mail) para todos os candidatos, para a devida consulta.

A Avaliação de Meio Termo se realizará segundo as pautas, normas e procedimentos estabelecidos pelo PNUD, segundo estabelecido no “*Handbook on Planning, Monitoring and Evaluating For Development Outcomes*” (a ser enviado via e-mail para os candidatos).

Os objetivos da avaliação é analisar os sucessos alcançados e dificuldades enfrentadas pelo projeto, assim como extrair lições aprendidas que possam melhorar a sustentabilidade de benefícios deste projeto e ajudar a melhorar de maneira geral o cronograma de execução pelo PNUD.

## 3. Escopo da Avaliação

Avaliação da implementação dos **resultados do Projeto no período de 08 de Junho de 2015 até a data atual**, que correspondeu à primeira fase do Projeto, com a execução dos Resultados 1 e 2.

O consultor poderá avaliar, mas não se limitando a:

- Visitas técnicas realizadas para assistência técnica do projeto;
- Planos de Trabalho;

- Manifestações de interesse;
- Instrumentos de contratação com as empresas participantes do projeto;
- Requisições de compra de materiais, equipamentos e ferramentas;
- Solicitações de contratação de serviços correspondentes ao gerenciamento ambiental integrado;
- Relatórios de consultoria contratada para suporte ao projeto;
- Posição dos beneficiários do projeto (CRAs e Incineradores).

O Consultor também poderá realizar entrevistas com as pessoas e entidades envolvidas no projeto:

- Analista de programa;
- Gerente de projeto;
- Assessora Técnica;
- Consultor Internacional;
- Gerência de Proteção da Camada de Ozônio do Ministério do Meio Ambiente (GPCO/MMA);
- IBAMA;
- Associação Brasileira de Refrigeração, Ar condicionado, Ventilação e Aquecimento (ABRAVA);
- Centrais de Regeneração e Armazenamento (CRAs);
- Incineradores.

#### **4. Produtos esperados da Avaliação**

##### **Produto I – Plano de Trabalho:**

O Plano de Trabalho deve conter:

- Caracterização do Plano de Trabalho;
- Detalhamento do objeto e do escopo de trabalho;
- Metodologia de desenvolvimento dos trabalhos e de relacionamento com a equipe do Projeto e do PNUD;
- Definição das questões a serem analisadas;
- Definição das fontes de coleta de dados (mapeamento documental, identificação e seleção dos *stakeholders* relevantes/prioritários);
- Desenvolvimento dos instrumentos de coleta de dados (roteiros para realização de entrevistas);
- Cronograma de Trabalho.

##### **Produto II – Relatório de Coleta e Análise de Dados, contendo:**

- Descrição do processo de coleta de dados e de entrevistas, explicitando eventuais dificuldades para o desenvolvimento dos trabalhos; e
- Análise do material coletado.

##### **Produto III – Relatório de Avaliação de Meio-Termo do Projeto:**

O Relatório de Avaliação deve conter:

- Sumário Executivo (descrição sucinta do Projeto, descrição sucinta dos propósitos da avaliação, das questões-chave analisadas e dos resultados obtidos);
- Introdução (propósito detalhado da avaliação e questões-chave que foram analisadas, metodologia e estrutura do relatório de avaliação);
- Avaliação da implementação dos resultados do Projeto, incluindo análise físico-financeira da execução;

- Descrição das lições aprendidas (indicação de lições passíveis de serem aplicadas genericamente e melhores e piores práticas de formulação, implementação, monitoramento e avaliação de projetos similares);
- Anexos (entrevistas, questionários, etc.).

**Este Relatório deverá ser redigido em Português e em Inglês.**

## **5. Sugestão de Metodologia ou Abordagem de Avaliação**

A avaliação deve proporcionar informação baseada em evidência que seja comprovada. Espera-se que o avaliador siga um enfoque participativo e consultivo que assegure estreita participação com o Ministério do Meio Ambiente, o Escritório do PNUD, a equipe do projeto (Gerente de Projeto, Assessora Técnica) e interessados chave. Espera-se que o avaliador realize entrevistas às Áreas de Referência que serão oportunamente indicadas pela equipe do projeto. O consultor deverá entrevistar as empresas beneficiárias do projeto. As informações sobre as empresas serão fornecidas pela Assessora Técnica Nacional.

O avaliador revisará todas as fontes de informação relevantes, tais como:

- Documentos e arquivos de projeto;
- Relatórios do projeto e outros relatórios;
- Revisões orçamentárias;
- Documentos nacionais estratégicos e legais.

## **6. Requisitos Obrigatórios (eliminatórios) - Registrados no CV**

- Formação superior com pós-graduação;
- Ter realizado pelo menos duas avaliações de meio termo ou final de Projetos de Cooperação Técnica Internacional;
- Conhecimentos da Língua Inglesa (working knowledge).

**O candidato que não atender aos requisitos obrigatórios acima será desclassificado.**

## **7. Requisitos Desejáveis (pontuáveis) - Registrados no CV**

- Experiência em atividades relacionadas ao gerenciamento de resíduos no Brasil.
- Experiência em elaboração, acompanhamento ou avaliação de projetos de cooperação técnica desenvolvidos com o PNUD.
- Experiência na avaliação de projetos de apoio ao Protocolo de Montreal.
- Experiência na avaliação de projetos de apoio a outros Protocolos e Convenções (Protocolo de Quioto, Protocolo de Minamata e Convenção de Estocolmo).

## **8. Prazo de Execução**

O trabalho deverá ser realizado em 45 dias corridos, a partir da assinatura do contrato.

## **9. Cronograma de Entrega e Pagamento de Produtos**

<b>Produtos</b>	<b>Previsão entrega dos Produtos</b>	<b>Pagamento</b>
1 – Plano de Trabalho	15 dias a partir assinatura Contrato	20%
2 – Relatório de Coleta e Análise de Dados	30 dias a partir assinatura Contrato	30%
3 – Relatório Avaliação de Meio Termo do Projeto (em português e inglês)	45 dias a partir assinatura Contrato	50%

## **10. Supervisão e Condições de Pagamento**

O acompanhamento das atividades e aprovação dos produtos decorrentes deste contrato serão feitos pela Gerência do Projeto BRA/14/G72, em articulação com o PNUD.

- a) O aceite dos produtos levará em consideração a qualidade dos mesmos e o atendimento aos critérios previstos.
- b) Os pagamentos estão condicionados ao aceite dos produtos descritos nesses Termos de Referência.

## **11. LOCAL DE TRABALHO**

Não há local definido para a prestação da consultoria. No entanto, o consultor deverá estar disponível para reuniões nas dependências do PNUD, em Brasília.

## **12. COMPROVAÇÃO DE REQUISITOS**

Para participar do processo seletivo e para assinatura do contrato, o candidato deverá possuir material disponível comprobatório dos requisitos especificados para o respectivo perfil. Somente será contratado o consultor que apresentar o material comprobatório do atendimento integral aos requisitos mínimos estabelecidos no edital, no momento em que isto for exigido.

**Formação acadêmica:** A formação/titulação será comprovada por meio de cópia do Diploma ou Certificado de Conclusão de Curso de Graduação e pós-Graduação *lato sensu* e/ou *stricto sensu* (mestrado e doutorado).

**Idiomas:** A fluência em língua inglesa (eliminatória) será aferida por meio da apresentação de certificado de comprovação de proficiência e/ou certificado de conclusão de curso em língua inglesa. A fluência oral em língua inglesa será ainda avaliada durante entrevista com os candidatos.

**Experiência:** A experiência profissional deverá ser comprovada por meio de currículo (CV) assinado e informando, no mínimo, o local onde foram realizados os serviços, a função desempenhada, o período de realização e o nome e telefone de pessoa para contato e comprovação das informações fornecidas. Ao currículo poderão ser anexados outros documentos que auxiliem a comprovação da experiência profissional, tais como informações detalhadas sobre o escopo de serviços realizados, estudos ou relatórios realizados, etc.

## **13. REMUNERAÇÃO DA CONSULTORIA**

O candidato deverá propor o valor global para os serviços de consultoria, em arquivo PDF, separadamente do currículo. O valor a ser considerado deve ser bruto, incluindo todos os impostos pertinentes à legislação brasileira.

Se houver necessidade de viagens, estas serão definidas pela Gerente de Projetos e ficará a cargo do Projeto BRA/14/G72 as despesas relativas às passagens aéreas e diárias, a partir do município-base do consultor. Portanto, esse custo não deverá constar na proposta.



Qualquer despesa para cobertura de deslocamento e estadia fora das condições acima especificadas deverão ser expressas e previamente autorizadas pela Coordenação Nacional do Projeto.

#### **14. DISPONIBILIDADE**

O candidato deve ter disponibilidade para início imediato dos trabalhos.

### Anexo III – Critérios de Seleção / Avaliação

De acordo com as normas do PNUD aplicáveis à contratação de consultores na modalidade IC, as candidaturas deverão conter Proposta Técnica (CV) e Proposta de Preço (honorários).

Será desconsiderada a proposta enviada em desconformidade com o previsto no presente Edital:

**1. Proposta Técnica: Currículo** (anexado de eventuais comprovantes das competências e experiências relatadas) e

**2. Proposta de Preço** (valor global).

OBS: CV e Proposta de Preço (assinada em DF) em arquivos separados.

Será utilizado o critério de **TÉCNICA E PREÇO** para a classificação final dos candidatos e seleção do consultor.

#### 1.1 1. CLASSIFICAÇÃO DAS PROPOSTAS TÉCNICAS (ANÁLISE/PONTUAÇÃO DO CV & ENTREVISTA)

A nota máxima na Qualificação Técnica é 100 (cem) pontos.

Os critérios de Qualificação Técnica serão divididos em 02 (duas) etapas:

**a) 1ª etapa (eliminatória/não pontuável):** Análise do CV referente ao cumprimento dos requisitos obrigatórios exigidos nos Termos de Referência.

Os candidatos que não atenderem aos critérios mínimos obrigatórios descritos nos Termos de Referência serão desclassificados nesta etapa. Também serão desclassificados na 1ª etapa os candidatos que não enviarem a Proposta e Preço.

**b) 2ª etapa (classificatória/pontuável):** Análise Curricular & Entrevista.

Os critérios para análise curricular estão dispostos no quadro abaixo. Somente serão analisados os currículos dos candidatos classificados na 1ª Etapa da Qualificação Técnica.

Critérios de Pontuação - 2ª Etapa da Qualificação Técnica (CV & Entrevista)			
CRITÉRIOS	Pontuação*	Peso	Subtotal (max)
<b>ANÁLISE CURRICULAR</b>			
Experiência em atividades relacionadas ao gerenciamento de resíduos no Brasil.	0 a 5	3	15
Experiência em elaboração, acompanhamento ou avaliação de projetos de cooperação técnica desenvolvidos com o PNUD.	0 a 5	5	25
Experiência na avaliação de projetos de apoio ao Protocolo de Montreal.	0 a 5	4	20
Experiência na avaliação de projetos de apoio a outros Protocolos e Convenções (Protocolo de Quioto, Protocolo de Minamata e Convenção de Estocolmo).	0 a 5	2	10
<b>ENTREVISTA</b>			
Avaliação das experiências específicas nas áreas relacionadas aos Termos de Referência e fluência no idioma inglês.	0 a 5	6	30
<b>▪ Nota Máxima da 2ª Etapa da Qualificação Técnica</b>	<b>▪</b>	<b>▪</b>	<b>100</b>

\* A pontuação será aferida de acordo com o seguinte conceito:

5 pontos	excelente
4 pontos	muito bom
3 pontos	bom
2 pontos	satisfatório
1 ponto	inferior
0 ponto	inexistente

#### Sobre a avaliação:

O Comitê de Avaliação será composto por, no mínimo, três membros (Staff PNUD) que atribuirão notas individuais de avaliação. A nota final do candidato será a média ponderada das notas individuais dos avaliadores.

As pontuações individuais serão atribuídas de acordo com as informações apresentadas pelo candidato no *Curriculum Vitae* (CV) e de acordo com seu desempenho durante a entrevista. Para tanto, é importante que o candidato indique claramente em seu CV as experiências profissionais requeridas, tanto na parte obrigatória como na parte pontuável, de forma que o Comitê de Avaliação possa realizar a análise adequada.

A entrevista será pontuada, de acordo com os critérios previstos no quadro acima. Durante a fase de entrevistas, será verificada ainda a fluência oral em inglês, conforme declarado pelo consultor em seu CV. O não atendimento a este requisito, por se tratar de requisito obrigatório, implicará na eliminação do candidato.

A entrevista será realizada por telefone, Skype ou presencial. Os candidatos serão comunicados com antecedência mínima de 24h, via e-mail ou telefone, da data e horário para a entrevista. As entrevistas terão a duração estimada de 30 minutos a 1 hora e serão no mesmo formato para todos os candidatos.

### **1.2 2. CLASSIFICAÇÃO DAS PROPOSTAS COMERCIAIS (PREÇO) – Classificação Final**

Serão abertas as propostas comerciais apenas dos candidatos que obtiverem a **Nota Técnica Final com um mínimo de 70 pontos na 2ª Etapa da Qualificação Técnica (Análise Curricular & Entrevista).**

A Nota da Proposta Comercial – NC será calculada de acordo com o seguinte:

$$NC = 100 \times \text{MinPP} / \text{Ppi}$$

Onde:

NC = Nota da proposta comercial

MinPP = Proposta de menor preço

Ppi = Proposta de preço em avaliação

À proposta de menor preço será atribuída nota 100 (cem).

O Resultado Final - RF do processo do candidato será dado pelo somatório da Nota Técnica Final (NT) multiplicada pelo fator 0,70, com a Nota da Proposta Comercial (NC) multiplicada pelo fator 0,30, ou seja:

$$RF = (NT \times 0,70) + (NC \times 0,30)$$

**Será selecionada a proposta que alcançar o maior Resultado Final.**

### **1.3 3. CONSIDERAÇÕES ESPECIAIS**

Esta contratação será conduzida pelo PNUD, seguindo as normas e diretrizes deste organismo (seleção simplificada e contratação na modalidade de IC – *Individual Contractors*).

***“De acordo com as regras das Nações Unidas, a contratação de servidores ativos da Administração Pública Federal, Estadual, do Distrito Federal ou Municipal, direta ou indireta, bem como empregados de suas subsidiárias ou controladas, é permitida somente em condições especiais.”***

## 5.2 Plano de Trabalho

### Plano de Trabalho

#### **BRA/14/G72 – Projeto Demonstrativo para o Gerenciamento e Destinação Final de Resíduos de SDO**

##### **1. Lista de Documentos**

- Documento de Document (PRODOC)
- Termos de Referência
- Relatório Anual de Progresso
- Plano Nacional de Eliminação de CFC no Brasil
- Relatório de Atividades do Projeto ou balanço de atividades e execução financeira de 2015 até o presente momento
- Planos de Trabalho
- Manifestações de Interesse
- Relatórios de Missão
- Contratos com empresas ou com CRAs
- Relatórios de Licitações e Requisições de Compras em geral
- Solicitações de contratações de serviços e consultorias
- Relatórios de produtos de Consultores
- Outros documentos pertinentes
- Boletins e Folders
- Apresentações do Projeto BRA14/G72
- UNDP/GEF Guidance for Evaluation

##### **2. Coleta de Dados, com Entrevistas e Questionário**

- 2.1. Entrevistas com especialistas que informam sobre o Gerenciamento e Destinação Final de Resíduos de SDOs e outras questões relacionadas aos critérios e aplicação do questionário.

##### **Questionário**

As entrevistas com especialistas que informam sobre o Gerenciamento e Destinação Final de Resíduos de SDOs por meio de questionário, incluindo outras questões relacionadas aos critérios definidos pelo *Handbook on Planning and Evaluating for Development Results*.

A Coleta de dados também incluirá a identificação de fontes de informação e questões como:

- 1) questões relativas à efetividade do monitoramento dos indicadores que devem medir o progresso do projeto;
- 2) Qual seu parecer sobre a sustentabilidade das ações do Projeto em relação ao PNC?
- 3) Qual, em sua opinião, seria o papel catalítico ou de impulsionador dos objetivos do Projeto?
- 4) Quais seriam, a seu ver, as melhores práticas e as piores práticas advindas da execução do Projeto? E o impacto de seus resultados?

A análise de dados permitirá avaliar os resultados e as lições aprendidas pelo Projeto e também permitir recomendações para políticas públicas relacionadas com os objetivos do Protocolo de Montreal?

Considerando o escopo da AMT, ou seja, avaliação das atividades e resultados dos componentes definidos nos Termos de Referência, os resultados definidos no projeto estão descritos abaixo:

**Resultado do Componente 1:** Sistema Integrado de Gerenciamento de Resíduos de SDOs estabelecido, contemplando assistência técnica para o recolhimento, capacitação, armazenamento, consolidação e transporte;

**Resultado do Componente 2:** Incineração de resíduos de SDOs demonstrada.

Iniciamos com a duas questões chave:

- Quando se deu o início do Projeto? Teve demora em iniciar sua implementação?
- O Sistema Integrado de Gerenciamento de Resíduos de SDOs está em funcionamento?
- A seu ver, o Sistema poderia ser estabelecido antes mesmo de se ter consolidado as SDOs e de se ter incineradores implantados?

Em relação ao PRODOC, seus indicadores e procedimentos para implementação:

- 1) Os indicadores de monitoramento que possam medir o progresso do projeto são eficazes? Como se dá a eficácia?;
- 2) Como foi a participação das empresas nas Manifestações de Interesse e partes envolvidas?
- 3) A implementação do projeto, a seu ver, tem elementos que podem ser replicáveis?
- 4) A implementação do Projeto estabelece ou define links com outros projetos ou programas?
- 5) Existe a possibilidade de incluir e incorporar mais parceiros ao Projeto? O que você recomendaria?
- 6) Como ve a sustentabilidade das ações do Projeto?
- 7) Você acha que o Projeto poderia ter uma correção em sua implementação ou em sua formulação?
- 8) Como tem sido realizada a disseminação das informações sobre a importância da destinação final das SDOs?  
Considera importante divulgar os resultados parciais do projeto?
- 9) Quanto ao nível de participação dos envolvidos na implementação dos componentes do projeto? Como você tem avaliado?

**Buscar também responder às questões de Avaliação de Meio Termo (ANEXO C do TOR) Questões**

**1) Relevância:** Como se relaciona o projeto com os objetivos principais da área de interesse do Protocolo de Montreal e com as prioridades ambientais e de desenvolvimento a nível local, regional e nacional?

.....  
.....  
**2) Efetividade:** Em que medida se tem alcançado os resultados e objetivos previstos do Projeto?

.....  
**3) Eficiência:** O Projeto tem sido implementado de maneira eficiente em conformidade com as normas e os padrões internacionais e nacionais?

.....  
**4) Sustentabilidade:** Em que medida há riscos financeiros, institucionais, socioeconômicos ou ambientais para sustentar os resultados do Projeto a longo prazo?

.....  
**5) Impacto:** Há indícios de que o Projeto está contribuindo para reduzir a tensão ambiental ou melhorar o estado ecológico, ou que tenha permitido avanços para esses resultados?

.....  
Outras questões relativas ao Esquema da Avaliação de Meio Termo:

- Indicadores de Linha de Base: Empresas contatadas etc
- Formulação do Projeto ou desenho do Projeto
- Lições de outros projetos relevantes (Colômbia ou outro?)
- Como vê a Replicação do Projeto?
- Gestão Adaptativa

### **3. Viagem de Campo:**

- São Paulo: 16 -18 de julho
- Elaboração de relatórios de campo, com análise das atividades desenvolvidas ou em desenvolvimento.
- Relatórios das reuniões – *briefing*

#### **4. Esquema do Relatório de Avaliação de Meio Termo**

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  - 5.7 Evaluation Consultant Agreement Form**

## **5. Cronograma de Trabalho**

De acordo com o Contrato de Consultoria, a duração ou tempo de realização do trabalho de Avaliação de Meio Termo do Projeto BRA/14/G72 é de 45 dias.

<b>Produtos</b>	<b>Junho/2017</b>	<b>Julho/2017</b>
Produto I – Plano de Trabalho	De 01 a 06/06	
Produto II – Análise dos documentos do Projeto	De 01 a 10/06	
Versão Preliminar do Relatório de Avaliação de Meio Termo	De 11/06 a 24/06	
Versão Final com discussão de comentários	De 25/06 a	12/07

## **5.3 Lista de Pessoas Entrevistadas e Sumário das Entrevistas Realizadas**

### **5.3.1 Lista de Entrevistados**

<b>Nome</b>	<b>Instituição</b>	<b>Localidade/Telefone</b>
Ana Paula Pinho Rodrigues Leal	PNUD	Brasília 55-61 3038-1095
Rosenely Diegues	PNUD/ Oficial de Programa	Brasília 55-61 3038-9035
Frank Amorim	MMA/Unidade de Ozônio	Brasília 55-61 2028-2274
Gabriela Teixeira Rodrigues Lira	MMA/Unidade de Ozônio	Brasília



		55-61 2028-2604
Magna Ludovice	MMA/Unidade de Ozônio/CPCO	Brasilia 55-61 2028-2248
Mauricio Rodrigues	SOMAR Engenharia	São Paulo 55-11 3763-6964
Tomaz Cleto	SOMAR Engenharia	São Paulo 55-11 3567-3977
Emerson Melo	Edifício Birmann 21 Gerente de Operações/ Property Management	São Paulo 55-11 3019-2212
Rogério A. de Mello	Síndico Geral do Edifício Birmann 21	São Paulo 55-11 3019-2211
Elizeu Nascimento Silva	Divisão de Logística/COGRL/MF	Brasilia 55-11 2021-5337
Breno da Costa Barros	Divisão de Logística/COGRL/MF	Brasilia 55-11 2021-5684

### **5.3.2 Summary of Interviews and Field Visits Made for**

#### **Final Evaluation of the BRA/12/G77 Project**

**Date: August 14, 2017**

**Place: Montreal Protocol Room/UNDP**

**Interviewees: Ana Paula P. R. Leal (Program Office of the Montreal Protocol and Frank Amorim, environmental analyst of the Ozone Unit / MMA**

Matters discussed:

What is retro-commissioning:

- It is a survey of water-based refrigeration equipment as a whole to identify whether they are working efficiently. It is an assessment of the air conditioning.
- Commissioning is carried out as a project at the time of construction, and retro-commissioning is like looking back.
- Chiller / part / pressure vessels based on circulating water to make the heat exchange.
- The project focused on private and public buildings and not on industrial applications.

Results:

- The retro-commissioning was carried out under a contract with SOMAR Engenharia, which implemented four processes:

- 02 in public buildings (01 in Fortaleza / Ceará and another in Cuiabá / MT) and
- 02 in private buildings, in São Paulo / SP.

The training was carried out by means of:

- 03 International seminars held in Fortaleza / São Paulo and Rio de Janeiro, dealing with new technologies and new fluids.
- 02 Courses held in São Paulo and Brasília, with technical material available on the Montreal Protocol / UNDP website.
- For the qualifications, technical material was elaborated as well as recordings of the course in modules.
- Publications:
- Information Guide and Technical Manual in 03 volumes.
- Folders produced
- Multi-media material like videos and photos.
- A retrofit was also made in a building of the Ministry of Finance, but with resources from the PNC.
- Testimonials of Emerson and Rogério.
- Videos with Martha, Angelica and Maurício.
- See article in ABRAVA Magazine.

**Date: August 29, 2017**

**Place: Montreal Protocol Room / UNDP**

**Interviewees: Ana Paula P. Leal, Montreal Protocol Program Office/UNDP**

Request for a meeting to clarify matters read and analyzed in the basic documents of Project BRA / 12 / G77.

- When was the equipment replaced in MF? Was it done in 2013? What about retro-commissioning?

On this occasion, the contracts and reports of SOMAR Engenharia Company were cited and made available.

In this process, the engineer Maurício Rodrigues led and Thomas Cleto was the professional responsible mainly for the training events.

- Did the contracts have additive terms? Only in term, because the process of selecting the buildings where the retro-commissioning would be carried out took a long time. The surprise was that there were no candidates because there was little knowledge on the subject.

Ana Paula suggested interviewing the Ministry of Finance officials:

- Eliseu and Breno who could clarify about the refrigerators replacement process that was carried out in the MF building;
- Magna of the Ozone Unit / MMA and Frank; and
- Maurício Rodrigues da SOMAR Engenharia and Thomas Cleto who would be in Brasília for the commemorations of the International Day for the Preservation of the Ozone Layer, September 15.
- Ana Paulo was willing to get in touch with the people mentioned and check availability for interviews.
- He also suggested visits to the buildings where retro-commissioning processes were carried out, Edifício Birman 21 and Centenário Plaza, also called Robocop, in São Paulo.

At the end of the interview, Ana contacted the MF staff via e-mail, so it was possible to have an agenda for interviewing them.

**Date: September 1, 2017**

**Place: Room of the Ministry of Finance, Esplanade of Ministries, Annex B of the MF**

**Interviewees: Elizeu Nascimento Silva. Phone: 2021 5337**

**Breno da Costa Barros: phone: 2021 5684**

When starting the interview in the room of the MF with Elizeu and Breno asked about the benefits obtained with the substitutions carried out in the chilled water-based refrigeration system.

- the benefits were both economic and environmental and mainly for the welfare of the user. This is because they were equipment with 40 years of installation and are already outdated.

The replacements were performed on the old system with 40 years of existence and new equipment was placed as specified below:

**Old System:**

- 40 years
- 02 400 TR centrifugal chillers (CFC-11)
- Average cooling capacity of 238 TR (0.79 kW / TR)

**New System**

- 01 Centrifugal 400 TR Chiller (R134a)
- 01 Screw Chiller 400 TR (R134a)
- 04 chilled water pumps
- 04 condensed water pumps
- CAG Automation System
- New pipes
- New electrical panel.

- According to Breno, the problem is that these equipment's have been replaced, but it has not been tampered with in the distribution system. He said that they have the project already prepared to make the complete replacement, but lack the financial resources to implement the project.

I asked if there was economic gain and EE are identified after the substitutions made.

- The answer was that it is difficult to check this point, since there were stopped and non-functioning equipment and is now working. So now it may be consuming more energy, but there was broken equipment and not there is anymore.

Consumption was 0.7 TR, before it was 1.2 KW to generate 0.7.

**Recommendation:**

- Replacement of the system as a whole, based on retro-commissioning results;
- Since the rest of the system was pending, we have a project to complete the substitutions;
- It is necessary to carry out the rest of the work that has not been completed;
- More training because they were excellent and very illustrative. We know we need more knowledge about the industry.

**Date: September 05, 2017**

**Place: Room of the Ministry of Environment, W-2 Norte, 3rd. Floor.**

**Interviewees: Magna Luduvica - Phone: 2028-2248**

**Frank Amorin - phone: 2028-2274**

The interview was held in the room of the Coordinator of the Ozone / MMA Unit, with Magna, Frank.

The meeting began with the question: How do you identify the answer to the question about the sustainability of the Project? Would the actions have continuity?

- The answers were very in the sense that, since the products were didactic materials for training, the work of disseminating information and using the Guide and the volumes of Air Conditioning System already edited will do the continuity work of the Project. However, the material alone would not be sufficient, but one can think of the elaboration of other seminars within other projects. But it should be emphasized that Project BRA/12/G77 leaves a very consistent legacy.

- Questions about implementation difficulties and problems were also addressed and some recommendations were also presented by respondents.
- Problems in contracting both individuals and corporations, as part of excessively rigid norms and administrative procedures on the part of UNDP and that are applied by all the units of the globe and that do not fit the Brazilian reality.
- It was the difficulty of applying the UNDP rules that are based on the lowest price and not the best price.
- This means that the quality is impaired and the quality of the activities and products of the MMA / UNDP projects have been met by the need to have qualified professionals and specialists.
- It is said that the whole process was very rewarding and that we learned a lot along with the participants of the seminars and courses, besides the introjection of knowledge coming from the whole process of implementation of the Project.
- The results were satisfactory because we made a lot of effort so that the hirings were carried out with the selection of specialists of the area and not only of project managers.

The meeting was both informative and enlightening, since both Magna and Frank have been working on Montreal Protocol projects for years, and excellent knowledge of how to protect the ozone layer of both are requirements that have highly satisfactory results of the projects developed.

**Date: September 15, 2017**

**Place: Sala Maria da Penha / UNDP**

**Interviewees: Maurício Rodrigues - Company Director SOMAR Engenharia**

**Thomas Cleto - SOMAR Company Consultant**

On 15 September, the International Day for the Preservation of the Ozone Layer was celebrated. I participated in the event held at the Auditorium of the Ministry of the Environment, SEP 505 Norte, Block "B", Marie Prendi Building, Brasília-DF.

The event had included a breakfast in which I was able to meet people involved in SOMAR, Mauritius and Consultant Thomas.

In this place, in the morning, we began to talk about the implementation of the Project and how the company was selected and how the contract was performed.

In the afternoon, 2.30 pm, we met in the UNDP meeting room and we were able to talk about how the implementation process of the activities that were under the responsibility of the company occurred. Some recommendations were raised, but above all it was the process of retro-commissioning, whose subsidies were of paramount importance for training and capacity building activities.

On the selection of buildings for the implementation of the retro-commissioning process:

- The selection of buildings, according to the Director of SOMAR Engineering Mauritius, was a time-consuming but effective and efficient process. In addition, the surprise to the company was that it was

very difficult to find a building that wanted and accept that the cooling system passed through the process of retro-commissioning.

Thus, the Manifestation of Interest for both public and private buildings was launched in public notice several times. After the republishments, it was possible to enter into the classification process of the buildings that presented themselves.

The report describing the case was submitted to the UNDP / Montreal Protocol and then the document "Memorandum of Understanding" was submitted for the classified. This document described the mutual commitments between the parties for the implementation of the retro-commissioning process.

As described in the classification report of buildings, even after this classification there was a building that requested to decline to accept the process because the owners would have signed a commitment to sell the building. Thus, the SOMAR Engenharia had to launch a new Statement of Interest document and start the process again, since the third place in the classification did not accept that the process was carried out. It is only after these formalities and delays waiting for decisions of the third-ranked building that the new IM Public Notice has been republished. As there was no other answer to the IM, other than the Plaza Centenario Building, the classification process was started to ascertain the criteria and prerequisites to be accepted and go through the process of retro-commissioning of its refrigeration system to cold water, chillers.

In this way, it can be verified that the selection and classification of the buildings so that they could receive the process of retro-commissioning was delayed and surprised those responsible for the process. The surprise was that even if the process was presented as something to be received by the building and that it was without burden to the owners, those responsible either did not accept or took time to respond if they wanted the building to undergo the diagnosis of retro-commissioning offered.

In the interview with representatives of SOMAR Engineering I asked about the reasons for the delay and if it happened because they were not informed about the process. The answers given were that the technical staff that was in charge of the maintenance and care of the refrigeration system equipment were interested in knowing the system's faults and how to improve. But the trustee did not understand the reasons for accepting the case, and for him it was not a priority, and therefore, the issue was not presented at condo meetings that actually occurred once a month or even less frequently. The trustee needed to be more involved in the process and have more knowledge about the importance of the retro-commissioning process.

As for public buildings, the reality required acceptance of the process since not only was the building old, more or less 40 years of construction, but the entire refrigeration system was obsolete. Thus, retro-commissioning has identified all the problems, but it is known that little will be done. The resources for system improvement are scarce and would almost require replacing the system as a whole.

In this way, both the Cuiabá and Fortaleza buildings, and especially the latter, according to SOMAR Engenharia, presented the whole facility degraded not only by weather and sea air but also by the lack of maintenance of the refrigeration system. The results of the retro-commissioning process in public buildings, in fact, presented themselves as frustrating. Those in charge of the building know that it will not be possible to do almost anything to improve the system, but they know that something must be done to continue the process. The evolution of technology has not reached these buildings and the system is highly obsolete.

In spite of all these problems and difficulties faced by the Company in carrying out the processes that they proposed, the results and the accumulation of knowledge acquired are of the utmost importance. Thus, respondents say, not only the refrigeration technicians but also all those who participated in the process could present their experiences and knowledge in the training programs. All these experiences and acquired knowledge were inputs for all didactic material presented as a product by the Company.

Respondents in their testimonies said they had no idea of the problem and the frustrations both on the side of those who "had their eyes open to the problems" as well as for those who carried out the process of retro-commissioning who were frustrated to know that those in charge of the building, especially the public, could not do anything with all the data raised. The lack of financial resources would paralyze initiatives to improve the refrigeration system.

However, the interviewees said that private buildings (two located in São Paulo) are already using the results of the retro-commissioning process to improve the system. The improvements will be for the system as a whole and seek economic, environmental and social benefits for the users of the buildings that received the results of the retro-commissioning process.

As for training and capacity building, the opinion of the interviewees is that there is an immense lack of knowledge about the refrigeration and air conditioning sector and that the seminars and courses carried out have demonstrated this lack. The results were highly positive and the evaluations demonstrate the need to continue training programs on refrigeration and air conditioning.

Regarding the sustainability of Project BRA / 12 / G77, the interviewees affirm that the legacy left with all the material produced and with the involvement of associations, mainly ABRAVA, is undoubtedly elements that will promote the sustainability of the Project.

The interviewees affirm that the visits that will be made by the Evaluator to the private buildings will confirm the positive satisfaction with the process of retro-commissioning developed. This satisfaction will be identified by the results of the process that are already leading to replacements of equipment and elements of the refrigeration system, bringing benefits to the environment and users.

**Date: September 19, 2017**

**Place: Building Birmann 21 / Building Meeting Room**

**Interviewees and Participants:**

**Rogério A. de Mello - General Trustee of the Birmann Building 21**

**Emerson Melo - Operations Manager**

**Maurício Rodrigues - Director of the Company SOMAR Engenharia**

**Ana Paula P. R. Leal - Montreal Protocol / UNDP**

**Frank Amorin - Ozone Unit / MMA**

The meeting began with the presentations and soon afterwards Mr. Emerson Melo presented a summary of the activities carried out during the retro-commissioning process and the modifications already made after the implementation of the process.

During the presentation Mr. Rogério was clarifying data from the presentation. He explained that the role of the condominium of a building is also to watch over the healthy environment and without impacts.

The Birmann 21 Building belongs to the Banco do Brazil Pension Fund (PREVI) and the rooms are rented to several companies. Both building owners and companies that rent rooms in the building are interested in maintaining a high energy efficiency. Thus, the proposal to carry out the retro-commissioning process, after dialogues with the owners and with the trustee of the building, was accepted. The retro-commissioning process began in 2015 and presented a series of recommendations along with an estimate of the costs to implement them.

Thus, in 2012 a new chiller with HFC 134<sup>a</sup> with new technology was placed in the building and therefore, with less expense and EE. In 1997 there were 02 chillers with HCFC fluid that were replaced in 2016 by ecological fluid HFC 134<sup>a</sup>, having been spent the amount of R \$ 2 million. In 2017, the system has undergone modifications and is now electrostatic having finished with chemical treatment of the cold water and now having an automation system - CAG, explained Mr. Rogério. After the retro-commissioning process, in addition to these substitutions already mentioned, some valves have been changed. The refrigeration system showed improvements in CO<sub>2</sub> / CFC controls, thus investing in system economics.

The Birmann 21 Building has 26 floors and occupies 96 percent and all these adjustments have brought economic, environmental benefits with cooled air quality and mainly benefits for building users.

Respondents emphasize the importance of having gone through the process of retro-commissioning, since they not only learned a lot and understood the objectives of the process. It emphasizes that each enterprise has its own situation and appropriate management. According to Mr. Rogério's opinion, the Centennial Building that also underwent the retro-commissioning process is a case of a scrapped building and will

need to replace almost all the equipment. One must also be aware of the risks that the condominium has with such a deteriorated system. Risk management also needs to be taken into account by the Receiver and his team. Automation control is imperative.

Thus, in relation to private buildings, the Appraiser visited the Building Birmann 21 and noted the importance of having received the implementation of the retro-commissioning process.

According to interviewee information, the original building system had a capacity of 1130 RT, including two HCFC-22 refrigerators with 400 TR each, in addition to thermal ice accumulators. Each charge of Johnson Controls chillers refrigerant was 560 kg of HCFC-22. Thereafter, the ice-thermo-accumulator was discarded and a third R134a cooler was added. The building owner was aware about the electricity consumption of the entire system and also about comfort issues.

In short, and still according to the interviewees, the recommendations presented by the retro-commissioning process began to be implemented from the preparation of an executive project. Two HCFC-22 coolers have been replaced by two new R134a coolers during 2016, among several other recommended changes. The building spent roughly \$ 876,000 on pre-commissioning changes, including replacing the two coolers. An automatic system to record the cooling load consumption of each floor has been installed and each tenant can now monitor consumption per floor through the internet. HCFC-22 from the old coolers was recovered by Johnson's controls, but those in charge of the building do not know the final destination of the coolant.

Coolers have been replaced and 80 percent of retro-commissioning recommendations have already been implemented. Gains in energy efficiency are estimated at about 42 percent, once the entire process is completed.

In the other private building, according to interviewees, the original system had a capacity of 1286 RT and each cooler was composed of three compressors and a total refrigerant charge per 179 kg of HCFC-22 cooler. One of the chillers was adapted with a drop-in mix, but the results were poor with a dramatic decrease in cooling capacity and energy efficiency. It was recommended to replace the six coolers. The original design of the whole system was considered a problem because it did not have automatic controls. Therefore, the entire system must be refurbished for energy efficiency and comfort. Installing two coolers on each of the two floors was also recommended. An estimated 50 percent gain in energy efficiency and comfort is expected if all retro-commissioning recommendations are implemented. The total cost for all recommended modifications, including the replacement of the chillers, was estimated at about \$ 1,091,000.

Implementation of the retro-commissioning recommendations has already begun and planning is being done with the complete modification of the system (including the replacement of the chillers), which is expected to be completed within the next two to three years.

It is important to emphasize that operational managers of the four buildings that underwent the retro-commissioning process participated in seminars organized with resources from Project BRA/12/G77. The evaluation of these participants was that the experience was highly positive.

**Date: September 27, 2017**

**Place: Office/UNDP**

**Interviewed: Rosenely Diegues, Program Officer/UNDP**

What is your assessment of Project BRA/12/G77 and finalizing the Project, what recommendations would you raise?

Rose explained about Project BRA/09/G31 that gave rise to the Integrated Management of the Chiller Sector. This one that had financial resources of the IDB and the GEF had as objective to look for an improvement of the energetic efficiency in buildings and was denominated Project of Market Transformation for Energy Efficiency.

As was widely verified by the final evaluation process, the EE theme involved other energy consuming elements such as lighting, water consumption among others and this proposal took time to raise resources.

Thus, the BRA/12/G77 that was approved in 2005 had to wait for this survey until 2009 when it reached the amount of US\$ 25 million. This project was composed of six results and Outcome 3 was related to the activities proposed and financed by the MLF.

However, the Fund itself verified that the amount of the Project's resources of US\$ 1 million would not be sufficient for the exchange of Chillers and proposed that it be dismantled from the GEF/IDB project and focused on capacity building activities.

According to Rose, the process of retro-commissioning that presented subsidies for the elaboration of the BRA/12/G77 Project products was highly important to awaken to the problem. But, the Project with its financial resources could not provide conditions for the replacement of equipment, as recommended by the retro-commissioning process. Even with the support of Project BRA/09/G31 that focuses on the EE, it is not possible to implement, mainly, those public buildings.

Still, according to the interviewee, Law 8,666 is too rigid to work with biddings to implement retro-commissioning processes and other public buildings and replacements of necessary equipment. These would have to look for other alternatives such as PPPs and RDS or R&D/ANEEL resources so that the proposal could be feasible. Increasing EE is a major challenge because the public sector has cost containment but the reduction in energy expenditure may not necessarily be reversed for improvement in the refrigeration sector.

In short, implementing the recommendations of the retro-commissioning process is a major challenge, since financing for the improvement of the EE alone is not an object of change, but other elements that could constitute a cost reduction project through technologies.

The interviewer was closed and the recommendations incorporated into the Final Evaluation Report.

#### **5.4 Lista de documentos avaliados**

Leitura e análise de documentos relacionados ao Projeto BRA 12/G77:

- Documento de Projeto (PRODOC)
- Termos de Referência
- Relatórios de Avaliação
- Relatório Anual de Progresso
- Política Nacional de Resíduos Sólidos
- Relatórios de Atividades do Projeto
- Boletins e Folders
- Relatórios de Implementação 2016-2017
- “Handbook on Planning, Monitoring and Evaluating for Development Results”
- Outros documentos afins.

#### **5.5 Questionário Utilizado**

##### **Avaliação de Meio Termo do Projeto BRA/12/G77**

#### **QUESTÕES**

1. Quais são as principais dificuldades para o desenvolvimento do Projeto BRA/14/G72?
2. Na sua opinião, quais foram os principais achados ou descobertas que emergiram do processo de redação de documentos?



3. Que recomendações você elevaria para uma Revisão Substantiva do Projeto?
4. Quais são as ligações estabelecidas entre o desenvolvimento do Projeto com outros projetos e programas?
5. Qual é a relevância dos resultados do Projeto BRA/14/G72? Considera relevante e como se relaciona com os principais objetivos do Protocolo de Montreal?
6. Quanto à eficácia, se alcançada e resultados que se relacionam com o propósito do Projeto?
7. Sustentabilidade – consider que os resultados do Projeto como base para a implementação de políticas, projetos e programas em Mudança do Clima?

## 5.6 Formulário de Acordo do Consultor de Avaliação

### Evaluation Consultant Agreement Form 30

Agreement to abide by the Code of Conduct for Evaluation in the UN System

Name of Consultant: Mary Dayse Kinzo

Name of Consultancy Organization (where relevant): \_\_\_\_\_

I confirm that I have received and understood and will abide by the United Nations Code of Conduct for Evaluation.

Signed at (place) on date

Signature: Mary Dayse Kinzo September/2016

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