

## **FINAL PROJECT EVALUATION MISSION**

**PROJECT CUB/00/G35 : PRODUCING ENERGY EFFICIENT  
REFRIGERATORS WITHOUT MAKING USE OF OZONE DEPLETING  
SUBSTANCES**



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## **Glossary of Terms**

APR	Annual Project Report
CITMA	Cuban Ministry of Science, Technology and Environment
CO <sub>2</sub>	Carbon Dioxide
dm <sup>3</sup>	decimeter-cube (1 dm <sup>3</sup> = 1liter)
GEF	Global Environment Facility
GWh	Giga Watt Hour ( $10^9$ Watt Hour)
INPUD	Industria Nacional de Productos y Ustensilios Domesticos
KWh	Kilo Watt Hour
MINBAS	Ministry of Basic Industries
MINCEX	Ministry of Foreign Trade
MINVEC	Ministry of Foreign Investment and Economic Cooperation
ODS	Ozone Depleting Substance(s)
PAEC	Cuban Energy Saving Programme
PIR	Project Implementation Report
SIME	Ministry of Steel and Mechanics Industry and Electronics
TOR	Terms of Reference
TWh	Tera Watt Hour ( $10^{12}$ Watt Hour)
UNDP	United Nations Development Programme
UNDP CO	UNDP Country Office
US	United States

## 1. Executive Summary

An evaluation mission, comprising Nicholas Livingston and Benoit Lebot ("the Mission"), visited Cuba between 6 and 10 July 2003 in order to undertake a Final Evaluation of

- **Project CUB/00/G35 : Producing energy efficient refrigerators without making use of Ozone Depleting Substances (ODS) - (the "Project")**

basing their activities on the Terms of Reference (TORs) previously provided by the UNDP Country Office (UNDP CO), which are included at Appendix B. See also an extract of the relevant TORs in Sections 2 and 3 below.

After a morning of briefings with members of the UNDP CO and MINVEC, the Mission drove to Santa Clara, Province of Villa Clara, in the afternoon of 7 July, where they spent 2 full days at the INPUD plant before returning on the morning of 10 July to Havana, where a preliminary presentation of this Report was made to representatives of UNDP CO, MINVEC, CITMA, INPUD and others (see Section 6 below).

The Mission was able to establish the following results for the Project :

- Three new energy efficiency refrigerators have been developed with the relevant hydrocarbon technologies.
- Three prototypes have been successfully built and tested.
- All three INPUD Antillano refrigerators have been measured, verified and certified. They all meet the European energy efficiency class "B".
- A manufacturing line for 30,000 energy efficient home refrigerators is fully in place.
- Equipment required for the manufacturing process has been purchased and installed and all the elements of the manufacturing process are in place.
- The following steps in cold appliance manufacturing are in place: shaping, thermoshaping, isolation, preinstallation, installation, vacuuming and filling with the natural refrigerant and final control.
- The capacity to work with the new manufacturing equipment has been verified.
- Efforts to provide the service in the warranty shops throughout the country are being made.
- Although foreseen by the PRODOC, INPUD has not acquired a patent nor a license, having signed a technical agreement to produce new refrigerators based on a initial design from the Italian company SILTAL.



- INPUD has successfully installed a laboratory for testing refrigerators and freezers in accordance with the most recent international certification procedures. On 28 April 2002, the INPUD laboratory received the international accreditation ISO 17025 from the National Norms Authorities in Cuba. The laboratory is now in a position to test and certify refrigerators and freezers according to the following international norms:
  - ISO 7371 for testing refrigerators
  - ISO 8187 for testing combined refrigerator/freezers
  - ISO 8561 for testing no frost refrigerators
  - ISO 5155 for testing freezers
- As compared with a PRODOC target of 1,520,239 tonnes of carbon emission reductions, at the current rate of production, it is unlikely that more than 340,000 refrigerators will be produced before 2015. The cumulative reduction in CO<sub>2</sub> emissions is estimated to reach 1.7 million tons in 2015 (this equals 0.46 million tons of carbon).
- Lessons from the Project are currently being learned and analyzed. Some dissemination of the findings has already been undertaken at specific international meetings and fora by Dr. Ramiro Ramiro Valledor Trista, Laboratory Test Manager at INPUD, who has also made a number of visits to other countries in the region.

Issues relating to the Project's disbursement and project management have been examined and are addressed in Sections 9 and 10.

The underlying industrial / commercial project, which directly determined the Project's performance in terms of its contribution to CER generation, is considered as the prime reason for the Project's inability to meet its climate change targets. Overall, the Mission considers that the project management process, whilst dedicated and broadly satisfactory at the administrative level, failed to draw the effective conclusions regarding the interaction between the industrial project and the GEF Project itself. This was evidenced by a generally critical approach to the Project's slow disbursement over the period under review. It is the view of the Mission that this was a "false problem", and that the final disbursement profile of the Project was much more in line with the industrial / investment realities of a project of this kind.

The very significant working capital problems affecting the underlying industrial / commercial project, leading to intermittent plant closure and low production, now appear to have been addressed via a cooperation agreement between INPUD and the Daewoo group.

Suggestions regarding the maximization of the Project's impact include the following :-

- INPUD should be more directly associated with the marketing of the refrigerators it produces.
- Now that INPUD is able to bring to the Cuban market energy efficient refrigerators and freezers, its activity and business could greatly be enhanced by a multiyear national strategy to promote energy efficient appliances. Such strategies could comprise a combination of the following measures:
  - mandatory energy consumption labels at the point of sale;
  - mandatory minimum energy performance standards for any appliances placed on the Cuban market.
  - An early replacement scheme to accelerate the elimination of inefficient appliances from the current stock of appliances, as well as to enhance the

penetration of energy efficient models. Such a scheme could possibly be organised with international financial partners who could receive international credits from the associated reduction of carbon, for instance through the Clean Development Mechanism.

- The above mentioned energy efficient programmes should not only address cold appliances. They could also address several other types of end-use equipment. The programme could also be designed in partnership with other economic partners, targeting at least the Caribbean market. INPUD's testing facilities could be used as a regional centre for cold appliance certification.
- The dynamics of appliance markets subject to energy efficiency regulation is such that, for instance in Europe, the cold appliance market is now dominated by Class "A" refrigerator-freezers. The present project can be considered as a first step to move the market of cold appliances in Cuba in the same direction. It is suggested that special efforts be made to maintain and expand INPUD's research and development activities in order to prepare a second round of energy efficient improvement in the next decade and bring the cold appliances made in Cuba to the Class "A" level. The dialogue between appliance technical experts in Cuba with international professional networks in the field may prove particularly relevant.<sup>1</sup>

As outlined in Section 13, the Mission considers that one of the major benefits of the Project lies in its direct link to a local manufacturing capacity able to produce energy efficient domestic refrigerators, potentially in quantity. Rather than providing regulatory stimuli to cause manufacturers to adapt production, the GEF project's focus has been optimally placed on directly helping the sole manufacturer of white goods in Cuba.

The Mission concluded that allocating money to INPUD in this way has proven more efficient and useful than, for instance, an investment in new electrical power supply. Cuba is now able to produce cold appliances that are more energy efficient than most appliances marketed in the region or imported into Cuba and the INPUD plant is in a position to become a major participant in national efforts to save energy and reduce associated CO<sub>2</sub> emissions on a large scale.

The Mission therefore recommends the systematic approach be developed in Cuba in order to generate demand for energy efficient equipment based on a combination of mandatory labelling, minimum energy efficiency standards and an early retirement programme. Such programmes are well established in many economies throughout the world and are considered as key best practice in energy efficiency policy.

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<sup>1</sup> In this connection, the Mission noted that next 1-3 October 2003, the third International Conference "Energy Efficiency in Domestic Appliances & Lighting" is to be organized in Torino, Italy, see <http://energyefficiency.jrc.cec.eu.int/events/eedal2003.htm>. This meeting will bring together key international experts working on appliance energy efficiency programmes. This group would certainly welcome a communication on the GEF CUB/00/G35 project.

## **2. Objective of the Mission**

The following is an extract from the Terms of Reference prepared for the Mission.

*“The objective of this mission is to assess the performance, impact and sustainability of the Project implementation. Appraising the Project’s fulfillment of its stated objectives will do this.*

*The team of experts will assist the Regional Bureau for Latin America and the Caribbean in providing an in-depth evaluation of the Project CUB/00/G35Producing Energy Efficient Refrigerators without Making Use of Ozone Depleting Substances.*

*These experts will work closely together in collaboration with staff from UNDP Country Office, MINVEC and the project team, to assess the project execution. Based on these assessments, the evaluation team will also recommend strategies and actions aiming at improving the project results, sustainability and follow up.”*

### 3. Scope of the evaluation

The following is an extract from the Terms of Reference prepared for the Mission.

- a. *Review of all materials related to the project: the UNDP/GEF Project Document, Annual Project Reports/Project Implementation Report, Tripartite Review Reports, as well as other reports or information provided by government or UNDP.*
- b. *Interviews, consultations and meetings, as appropriate, with staff from the UNDP Country Office, MINVEC and INPUD Villa Clara.*
- c. *Analysis of the project results and their relation to the project's general development objective.*
- d. *Analysis of the technical capacities associated with the project and their role in project development, management and achievements, including the results of training activities.*
- e. *Analyze and assess the effectiveness of project management structure on fulfillment the project objectives.*
- f. *Analyze the success criteria and verifiable indicators of the project development goal, project purpose and outputs.*
- g. *Elaboration of a summary of lessons learned from project experience which would be relevant to the sustainability of project's results, future resource mobilization, importance of spreading results and experiences to other countries in this region.*
- h. *Major issues and problems affecting the implementation of the project.*
- i. *Produce suggestions on:*
  - o *INPUD's cash flow regarding the refrigerator production*
  - o *Solutions and action plans to revert the situation presented during the last two years so INPUD will be able to reach the 30,000 refrigerators annual target production.*
  - o *Elaboration of a detailed evaluation report, containing the above analysis and findings, together with sections on lessons learned and recommendations.*

## **4. Introduction & Project History**

Any evaluation of the Project's performance must take full account both of the historic context into which the Project was inserted, as also the industrial and commercial context in which it has evolved. A brief history of refrigerator manufacturing at INPUD is therefore fundamental to any understanding of the current situation and of the Project.

### **History**

- 1964 – 1989

The factory at INPUD began production of domestic refrigerators in 1964. A license agreement was signed with CALEX, an appliance manufacturer based in Czechoslovakia. A single model was produced: a one-door 200-liter capacity with a freezer section of 20 liters. The compressor was purchased from the East-German company DKK (Foron) and was selected for its robustness vis-a-vis power voltage fluctuation in Cuban electricity delivery. The refrigerant used was CFC-12 (also called Freon or R-12) and glass wool was used as the material for insulating the walls of the refrigerator. Annual production was recalled to be in the order of 45,000 units/year, with a peak production of 60,000 units/year. INPUD was the sole manufacturer of cold appliances in Cuba and the INPUD refrigerator was the only model available on the Cuban market between 1964 and 1989. The design and features of the model were not modified since the start of production. A total of two hundred people worked in the factory.

In 1989, with the impact of the disappearance of the Soviet Union and of the US embargo on the Cuban economy, the production of domestic refrigerators at INPUD was stopped. The production of the one door, 200 liters unit has never been re-launched since that year. No refrigerators were produced at INPUD in Cuba between 1989 and 1999.

- 1990 – 1997

Cuba undertook the first imports of foreign-built domestic refrigerators in 1991. The appliances began to be imported from Venezuela, Mexico and South Korea. In 1998, the custom authorities in Cuba assessed that 25,000 units of cold appliance were imported annually.

In 1994, INPUD sought to establish an international partnership to start a new production line of domestic refrigerators. An international bid was issued and a total of 10 foreign appliance industries responded. In 1996, 2 foreign companies were selected: SILTAL from Italy and Liebherr from Germany.

- 1998

In 1998 SILTAL won the final competition and became INPUD's partner for the full upgrade of the fridge factory. In the selection process and during the dialogue between INPUD staff and their foreign counterpart, the concern also to address the energy efficiency of the fridge was raised by Liebherr. The German company proposed a partnership to produce refrigerators with a very high energy efficiency performance, namely the rating "A" on the European energy efficiency labeling scale.

SILTAL from Italy proposed a model rated "C" on the European energy efficiency rating. INPUD selected SILTAL as a partner on a cost basis, but imposed that the energy performance of the model to be produced should be upgraded to the "B" level.

A long and thorough analysis was performed in order to select the most relevant refrigerant gas-liquid and foaming agent. Zero ozone depleting substances were required. Isobutane was finally preferred to R-134 as the refrigeration fluid and Cyclopentane (R600) was selected as the foaming chemical for the foam insulation.

- 1999

#### **INPUD's new production line**

INPUD installed an entire new production line located in the same building where it used to produce the first generation of refrigerators during the period 1964 to 1989. The factory employs 110 staff. All raw materials are purchased from SILTAL in Italy. The handling of the refrigerators on the assembly line is heavily manual.

A special series of small size Daewoo refrigerators were assembled at the factory during 2002. This was part of an agreement with the Korean manufacturer.

In the course of 2002 under the budget of Project CUB/00/G35, INPUD solicited the contribution of 2 German consulting companies, specialized in refrigeration engineering. ILK Dresden performed a detailed investigation of model Antillano FG 34VIP. The unit was sent and tested in Germany. The other German consultant, Legatis located in the city of Kelkheim, investigated the technical handling and engineering of the isobutane (R600a) and ciclopentane in INPUD assembly lines. This work concluded with a series of concrete technical recommendation to improve the quality of the manufacturing.

#### **INPUD produces two models of combined refrigerator and freezer under the brand name of Antillano**

The first Antillano refrigerators manufactured at INPUD came off the production line in 1999. Two models are currently being manufactured:

- FG 28 VIP a 237 liter refrigerator-freezer with 52 liter of freezer capacity;
- FG 34 VIP a 298 liter refrigerator-freezer with 75 liter of freezer capacity;

A prototype of a third model, FG 31 VIP, a one door 251 liter with a 26 liter frozen food compartment, was designed and evaluated as initially planned in the Project CUB/00/G35. This third model refrigerator has not entered full production, since it is considered that the Cuban market is no longer interested in a one-door unit. The model is therefore not currently being produced. However INPUD is in position, at any moment, to start producing model FG 31 VIP, and short runs of this model were made in 1999 and 2001.

All models are fully tested under the International Test Procedure ISO 8187 (equivalent to EN 153 in Europe) in the INPUD test laboratory, which received the international certification ISO 17025 on 28 April 2002.

The following table presents a summary of the technical characteristics of the INPUD combined refrigerators and freezers.

Characteristics	Model FG 28VIP	Model 31 VIP	Model 34 VIP
Dimension	60x139x60	60x139x60	60x168x60
Insulation Thickness (mm)	70/45	45	70/45
Frozen Food Capacity (dm3)	52	26	75
Fresh Food Capacity (dm3)	185	225	223
Energy Consumption (kWh/24 h)	0.97	0.75	1.10
Energy Efficiency Index *	0.66	0.67	0.67
European Energy Efficiency Rating	B	B	B

\*The Energy Efficiency Index is calculated according to European Commission Directive 94/2/EC of 21 January 1994

All three models are manual defrost and correspond to climate class N (Normal). The choice of the normal climate class may be surprising in the light of Cuba's ambient sub-tropical climate in most of its territory. However, the experience of INPUD engineers taught them that the class N refrigerator is perfectly suitable for the temperature range found in Cuban kitchens.

In 2001, a total of 11,400 units were produced. In 2002, total production did not exceed 2,500 units. In 2003, 7,600 units are expected to be produced : it should be noted that production of the Antillano models at the plant was halted from January until mid-May 2003. When the Mission visited the factory, the rate of production was 10 units per hour. Assuming 8 hours of production per day, 20 working days per month, the current production rate corresponds to 19,200 units per year.

The average retail cost of model FG 28 VIP and FG 34 VIP is respectively US\$ 450 and US\$ 490 : these prices have been maintained since the start of production in 1999. The production cost of these models is less than US\$ 200 for both models.

Both Antillano refrigerator-freezers present an attractive design and are similar in format, shape and display to many modern cold appliances found on the European market.

The prices of INPUD refrigerator-freezers are below the ones of their competitors on the Cuban market.

#### A fully compliant Test Laboratory for products at INPUD

INPUD has successfully installed a laboratory for testing refrigerators and freezers according to the most recent international certification procedure. On 28 April 2002, the INPUD laboratory received the international accreditation ISO 17025 from the National Norms Authorities in Cuba. The laboratory is now in position to test and certify refrigerators and freezers according to the following international norms:

- ISO 7371 for testing refrigerators
- ISO 8187 for testing combined refrigerator/freezers
- ISO 8561 for testing no frost refrigerators
- ISO 5155 for testing freezers

The test laboratory at INPUD has been set up as an independent entity within the INPUD factory. The laboratory reports to INPUD's General Director. The test laboratory is in position to serve any other party interested in testing cold appliances. Retailers, consumer bodies, independent manufacturers, foreign manufacturers can now send products to be tested under the international certification.

The test facility is a clear asset for INPUD's future technical development but also for contributing to Cuba's efforts to promote energy efficient products.

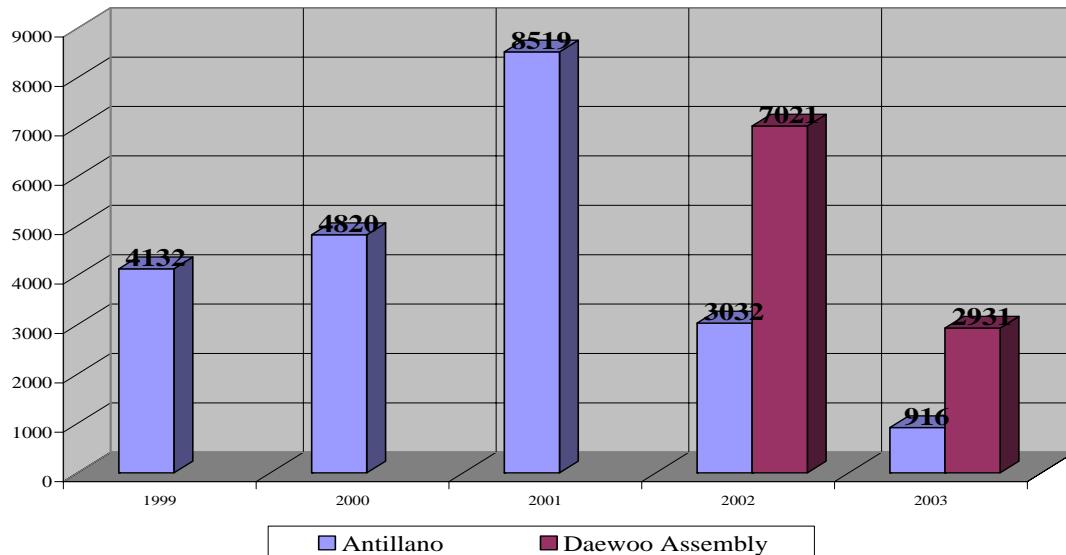
### Sales of Refrigerators and Assembly Operations

The volume of units produced / sold has been a critical factor in the realization of the targeted environmental objectives of the Project. The breakdown of these sales, as provided by the Director of Sales of INPUD on 9 July is presented below. It should be noted that, during periods when working capital problems severely constrained production of the INPUD Antillano models, spare line capacity was devoted to the assembly of Daewoo imports (Daewoo and Daytron)

	<i>FG -28</i>	<i>FG-34</i>	<i>FG -31</i>	<i>Daewoo</i>	<i>Daytron</i>	
				<i>2701</i>	<i>251</i>	<i>Daytron2701</i>
1999	776	3177	179			
2000	1678	3142	0			
2001	4044	4453	22			
2002	1391	1641	0	3724	1979	1318
2003	254	662	0	885	1023	1023

The evolution of annual sales on a totalised basis is presented below, as divided between the Antillano models (FG 28 and FG 34, with a short run of 179 FG 31 units in 1999) :-

**Total Annual Sales (1999 - June 2003)**



The most recent (July 2003) projection of sales provided by INPUD to the Evaluation Team is presented on the following Chart. This indicates a total production of an additional GEF CUB/00/G35 : Cuba INPUD refrigerator project : Final Evaluation Report (draft 31/7/2003)

117,383 units for the period 2003 – 2008, which, when combined with the 20,503 produced between 1999 and end - 2002, indicates a total production over the 10 year period of 137,886 units in the FG 28 and FG 34 range. The FG 31 was only produced for a total of 199 units over the period.



It should of course be noted that these projections are predicated on the complete solution of the working capital and raw material supply problems which have bedeviled the company in recent years (see Section 11 below on the recent collaboration agreement with Neneka).

## **5. Review of materials and information supplied**

A list of documents available to the Evaluation Team, both in advance of and in the course of the mission, is presented below :-

- PRODOC signed on 17 May 2000
- UNDP / GEF PIR of 2001 (draft version only – undated)
- UNDP / GEF PIR of 2002 (21 June 2002)
- Tripartite Meeting Report of 19 July 2001
- Tripartite Meeting Report of 195 August 2002
- Ministerio de Auditoria y Control internal audit # 2 of 19 April 2002 \*
- UNDP's internal files (2)
- *"Influencia Energética Del Estado Tecnico de los Refrigeradores Electrodomésticos"* by Dr. Ramiro Valledor Tristà, INPUD Laboratory Test Manager Reclien 98, Ciudad de la Habana. Julio de 1998.
- *"Application of Isobutane technology in the manufacturing of household refrigerator/fridge"* by Dr. Ramiro Valledor Tristà, INPUD Laboratory Test Manager. Paper presented at the International Conference “Zero Leakage Minimum Charge”, International Institute of Refrigeration, Stockholm, Sweden August 26-28, 2002

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\* Audit # 1 to which reference is made in Audit # 2 was not provided.

## **6. List of meetings**

The following meetings were held during the course of the Evaluation Mission :

7 July 03      Havana (initial briefing meeting)

UNDP :           Chisa MIKAMI, Programme Officer  
                  Tony PERERA, Programme Officer  
MINVEC         Ramiro LEON Torras, Specialist

8 – 9 July 03    INPUD Industrial Complex, Santa Clara, Province of Villa Clara

INPUD           Ing. Fidel ALONSO Garcia, Director General, INPUD plant  
                  Dr. Ramiro VALLEDOR, Laboratory Test Manager  
                  Ms. Blanca Margarita CRUZ, Project Administrator  
                  Jorge DIAZ DE VILLEGAS Pascual, Finance / Accounts  
                  Director  
                  Ing. Jose PEREZ Rodriguez, Sales Manager  
                  Ing. Ricardo CARDENAS, Manager, Refrigerator Plant  
                  Party representative: Mr. Augusto Bravo Puñales  
                  Workers representative: Mr. Pedro Mendoza Pérez

10 July 03      Havana (presentation of preliminary draft of Final Evaluation)

UNDP :           Chisa MIKAMI, Programme Officer  
                  Tony PERERA, Programme Officer  
                  Arnaud Peral, Programme Officer  
MINVEC         Pedro Morales, Director of Economic and International  
                  Organizations  
                  Ramiro LEON Torras, Specialist  
CITMA           Gricel Acosta, Specialist, International Cooperation Division  
                  (DCI)  
                  Nouraida González, Specialist, DCI  
                  Miriam Montes, Specialist, Empresa Ejecutora de Donativos  
                  (national procurement agency)  
INPUD           Blanca Margarita CRUZ

## 7. Analysis of the Project results

- a. **Analysis of the Project results and their relation to the Project's general development objective.**

The overall objective of the Project was defined in the PRODOC as follows :-

**By aiming to overcome the mainly technical barriers, the proposed initiative is consistent with GEF short-term project. GEF support is required to strengthen local capacity for the design and production of a prototype and to assist with the design, establishment and exploitation of a manufacturing line for 30,000 energy efficient home refrigerators annually.**

Detailed results which the Project should generate were defined in the PRODOC as follows (***bold type***) : comments of the Evaluation Team are appended on an item by item basis.

### **Expected situation at the end of the Project**

**When the Project is completed, INPUD will have a manufacturing plant for the annual production of 30,000 energy efficient home refrigerators using hydrocarbon technology as foaming and cooling agents. The proposed initiative will be one of the first crosscutting climate change/ozone layer depletion projects and as such it will have a considerable demonstration effect for the region and beyond. After three years it is expected that the initiative will have produced the following outcomes:**

- Three new energy efficient home refrigerators have been designed, including their refrigeration systems using hydrocarbon technologies**

This objective has been clearly met. Three new energy efficiency refrigerators have been developed with the relevant hydrocarbon technologies.

### **• Three prototypes have been built, tested and modified if necessary:**

Three prototypes have been successfully built and tested. Their main characteristics are summarized in the following table:

Characteristics	Model FG 28VIP	Model FG 31 VIP	Model FG 34 VIP
Dimension	60x139x60	60x139x60	60x168x60
Insulation Thickness (mm)	70/45	45	70/45
Frozen Food Capacity (dm3)	52	26	75
Fresh Food Capacity (dm3)	185	225	223
Energy Consumption (kWh/24 h)	0.97	0.75	1.10
Energy Efficiency Index *	0.66	0.67	0.67
European Energy Efficiency Rating	B	B	B

\*The Energy Efficiency Index is calculated according to European Commission Directive 94/2/EC of 21 January 1994

Model FR 34 VIP received special attention as a prototype was sent to Germany and its technical performance thoroughly analysed. As a result, the foam density of the insulation was modified in order to increase its performance. This resulted in a reduction of 20% of the total consumption of the model, allowing it to reach the European energy rating B.

- Energy savings of the prototypes have been measured, verified and certified, thereby meeting international requirements for class B electric power devices;**

All three INPUD Antallino refrigerators have been measured, verified and certified. They all meet the European energy efficiency class B, as presented in the previous table. As the testing of the energy efficiency of a refrigerator lasts a minimum of 3 days, the Mission was not able to perform or participate in a full testing.

- A manufacturing line for 30,000 energy efficient home refrigerators will have been designed;**

A manufacturing line is fully in place. When the Mission visited it, the production rate was about 10 models per hour. Not all manufacturing tasks were busy. This translates into an annual production of 19,200 units per year. It is therefore estimated that the line can indeed reach an annual production of 30,000 units when the market develops.

- Equipment required for the manufacturing process will have been purchased and installed;**

The Mission have been able to see all the elements of manufacturing process in place.

- The following productive activities will have been completed at INPUD in the context of setting up the manufacturing line: shaping, thermoshaping, isolation, preinstallation, installation, vacuuming and filling with the natural refrigerant and final control;**

The Mission confirm that the following steps in cold appliance manufacturing are in place: shaping, thermoshaping, isolation, preinstallation, installation, vacuuming and filling with the natural refrigerant and final control.

- The capacity to work with the new manufacturing equipment, as well as to provide the service in the warranty shops throughout the country will have been sufficiently strengthened. Forty-two Cuban technicians and specialists will have been trained in the various sections of the refrigerator production line;**

The capacity to work with the new manufacturing equipment has been verified. Efforts to provide the service in the warranty shops throughout the country are being made. INPUD owns 15 warranty shops across the country, one per province. Each warranty shop employs 4 technicians. The total of 60 technicians regularly attend training sessions in Santa Clara. For the introduction of the new Antillano line, the training session of technicians lasts 4 days. A manual “Technical guide for the Warranty Service of the Antillano refrigerators” has been produced and distributed to the

appliance retailers across the country. Feedback sheets are included in the manual to allow retailers to report on appliance failures. The information is centralized at INPUD by the marketing department. It should however be noted that the Mission was not able to visit any of the distribution shops in the time.

**• Patents, licenses and other necessary documentation of the new manufacturing equipment and processes will have been acquired;**

For the Project, INPUD has not acquired a patent nor a license. As outlined in the previous Section 4 describing the history of the Project, INPUD signed a technical agreement to produce new refrigerators based on a initial design from the Italian company SILTAL. SILTAL provided the engineering support to build the production line, the technical consultation for designing 3 new refrigerators meeting the desired specification and now provides the raw material for manufacturing the appliances.

**• An assay laboratory, including the required equipment and trained personnel, will have been set up and exploited to work on meeting the ISO 9000 standards;**

INPUD has successfully installed a laboratory for testing refrigerators and freezers in accordance with the most recent international certification procedures. On 28 April 2002, the INPUD laboratory received the international accreditation ISO 17025 from the National Norms Authorities in Cuba. The laboratory is now in a position to test and certify refrigerators and freezers according to the following international norms:

- ISO 7371 for testing refrigerators
- ISO 8187 for testing combined refrigerator/freezers
- ISO 8561 for testing no frost refrigerators
- ISO 5155 for testing freezers

See photograph of Certificate at Appendix.

The test laboratory at INPUD has been set up as an independent body within the INPUD factory. The laboratory reports to INPUD's General Director. The test laboratory is in a position to serve any other interested party by testing cold appliances. Retailers, consumer associations, independent manufacturers, foreign manufacturers can now send products to be tested under the international certification.

The test facility is a clear asset for INPUD's future technical development but also for contributing to Cuba's efforts to promote energy efficient products.

**• An amount of 1,520,239 tonnes of carbon emissions will have been reduced as a direct result of the production and sales of 430,000 home refrigerators during 15 years of production (see Annex);**

At the current rate of production, it is unlikely that more than 340,000 refrigerators will be produced before 2015 as reported in Table 1 in Section 4 : Sales of Refrigerators. The cumulative reduction in CO<sub>2</sub> emissions is estimated to reach 1.7 million tons in 2015 (this equals 0.46 million tons of carbon). It should also be noted that it is not clear what happens to the old models replaced by the Antillano range, as regards their destruction or possible transfer on to new ownership.

A further issue which has not been addressed fully is that of technological change over the life of the Project. The arrival of new technologies onto the world market might well impact upon the production and especially sales of this production model.

- *Lessons from the Cuban energy efficient home refrigerators using hydrocarbon technology as foaming and cooling agents have been collected, drawn up and shared with other nations in the Latin American and/or Caribbean Region (and elsewhere as appropriate) during the implementation of the 3-year project.*

Lessons from the Project are currently being learned and analyzed. Some dissemination of the findings have already been promoted at specific international meetings and fora by Dr. Ramiro Valledor Trista, Laboratory Test Manager at INPUD<sup>2</sup>. Regarding dissemination to Latin America and the Caribbean region, Dr. Valledor already visited potential new industrial partners in Mexico, Jamaica and Santo Domingo. In September 2003, Dr. Valledor is invited to share the findings of the Project in Germany to professional partners by Danfoss, the Danish compressor manufacturer.

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<sup>2</sup> Dr. Ramiro Valledor Trista, Laboratory Test Manager, INPUD. “Application of Isobutane technology in the manufacturing of household refrigerator/freezer” Presented at the International Conference “Zero Leakage Minimum Charge”, organized by the International Institute of Refrigeration, Stockholm, Sweden, August 2002.

## 8. Analysis of technical capacities

### a) How much electricity does a new Antillano model save?

In his excellent research work, Dr. Ramiro Valledor Trista, INPUD Laboratory Test Manager, has been able to assess the energy consumed by the current stock of refrigerators in Cuban households. The energy consumption of a total of 1,537 refrigerators have been monitored in a panel of Cuban households. This evaluation of the existing stock of cold appliances provides a unique and realistic insight into the situation. The stock is largely dominated by energy inefficient refrigerators. On average the energy consumption of a refrigerator in a Cuban household is 3.0 kWh/day. The average age of the models is 18 years. A large portion of the existing appliances has been refurbished or modified (replacement of door seal, of compressor...). A paper describing this remarkable piece of work is available<sup>3</sup>.

New INPUD models (RG 28 and RG 34) consume on average 1.04 kWh/day assuming that each model comprises half of the sales. Hence each new INPUD model replacing a model from the stock in Cuba will save 1.96 kWh/day or 717 kWh/year. Assuming an average lifetime of 15 years, the cumulative energy saved is 10,700 kWh.

According to the PRODOC, each kWh not consumed avoids 1.05 kg of CO<sub>2</sub>. Over its lifetime, each new INPUD refrigerator will contribute to reduce by 11.3 tons the emission of CO<sub>2</sub>. If the lifetime is expanded to 18 years, the reduction of CO<sub>2</sub> will reach 13.5 tons of CO<sub>2</sub>.

By using the time series for yearly production (and assuming that all units produced are sold), it is possible to estimate the total amount of energy saved and CO<sub>2</sub> reductions for a given year.

Year	Production in Number of Units	New Stock: Unit in use	Annual Energy Savings GWh/year	CO <sub>2</sub> reduction Ktons CO <sub>2</sub>
2001	10530	10530	8	8
2002	3032	13562	10	10
2003	7610	21172	15	16
2004	17280	38452	28	29
2005	19353	57805	41	44
2006	21675	79480	57	60
2007	24276	103756	74	78
2008	27189	130945	94	99
2009	30000	160945	115	121
2010	30000	190945	137	144
2011	30000	220945	158	166
2012	30000	250945	180	189
2013	30000	280945	201	212
2014	30000	310945	223	234
2015	30000	340945	244	257
Total Over 15 years :			1,586	1,666

<sup>3</sup> Dr. Ramiro Valledor Tristà, INPUD Laboratory Test Manager “Influencia Energética Del Estado Técnico de los Refrigeradores Electrodomésticos” Reclien 98, Ciudad de la Habana. Julio de 1998.

In year 2010, the programme will have saved 137 GWh/year of electricity and reduced the CO<sub>2</sub> emission by 144,000 Tons. In year 2015, the programme will have saved 244 GWh/year of electricity and reduced the CO<sub>2</sub> emission by 257,000Tons.

In 2003, the current price for international trading of CO<sub>2</sub> is at minimum \$US 3 /ton CO<sub>2</sub>. For 2010, the CO<sub>2</sub> reduction envisaged have a value of at least \$US 430,000/year.

Cumulated over the next 15 years, the programme will save a total 1.6 TWh of electricity and abate CO<sub>2</sub> emissions by 1.7 Million tons based on the assumptions for production and sales of refrigerators listed above.

In terms of reductions in power demand, annual savings of 717 kWh translate into an average reduction of 82 Watt. In 2010, the Project will contribute to the reduction of 190 945 X 82 W = 16 MW of electrical power.

Assuming that the marginal cost to produce electricity in Cuba is around \$US 0.05/kWh, the electricity saved in 2010 will generate a cost saving of \$US 6.8 Millions/p.a. to the Cuban economy.

#### **b) Domestic Refrigerators account for at least 12 % of national electricity use in Cuba**

There are 2.1 million households in Cuba and 1.7 million refrigerators in use. If one assumes that each refrigerator of the stock consumes 3 kWh/day (Valledor, 1998), the overall stock of refrigerators consumes 1.9 TWh/year. This is 12% of national electricity consumption, estimated at 15 TWh/year in 2000 (source: <http://www.cubaenergia.cu>, according to the statistics of the International Energy Agency the total electricity consumption in Cuba is 13 TWh/year in 2000).

By progressively replacing the existing stock of inefficient refrigerators with models as efficient as the new Antillano series, within e.g. a 20 year timeframe, the savings would be a minimum 1.2 TWh/year. The related reduction of CO<sub>2</sub> would be 1.5 million tons just for year 2020. The replacement of 1.7 million fridges over 20 years implies an annual production of 85,000 units/year.

In Cuba, the residential sector consumes 41% of total electricity consumption (6.15 TWh/year). The replacement of old refrigerators could reduce the residential electricity bill by 20%. Ultimately, the electricity no longer used by domestic refrigerators could be made available to other electricity usage, such as information and communication technologies, that are likely to be generalized as the economy and consumer purchasing power grow.

Specific programmes can be envisaged to transform the market for domestic cold appliances. A combination of measures and incentives are possible :

- MINCEX could impose that a minimum energy performance standard be imposed on all new refrigerators introduced onto the Cuban market: the refrigerators should be at least at the level of energy performance of the Antillano models.
- MINBAS and PAEC could introduce mandatory energy efficiency labels to encourage the purchase of the most energy efficient model of the market.
- Special leasing programmes to encourage the gradual replacement of old refrigerators. Payment of the new models would be organized for instance through the

electricity bill. Such leasing programmes, possibly organized at regional levels in their first phase of implementation, could become candidates for an international project under the aegis the Clean Development Mechanism.

## **9. Analysis and assessment of Project management structure**

### **a) Participating entities and officers / responsibilities**

The Project's execution has involved the following main participants :-

- Implementation Agent: National Union for the Manufacturing of Domestic Utensils (INPUD), industrial complex in Santa Clara
  - SIME – Ministry of Steel and Mechanics Industry and Electronics
  - MINVEC – Ministry of Foreign Investment and Economic Cooperation (Governmental Executing Agent)
  - CITMA – Ministry of Science, Technology and Environment
- UNDP Country Office
- GEF – Global Environment Facility, through its Regional Office in Mexico City

The respective officers responsible for the Project have been as follows :-

- INPUD: Ing. Ramiro Valledor Tristá
- SIME: Mr. Ibrahim Nápoles, Vice Minister of Science and Technology
- MINVEC: Mr. Ramiro León
- UNDP CO: Tony Perera / Chisa Mikami
- UNDP/GEF: Ms. Catherine Vallee

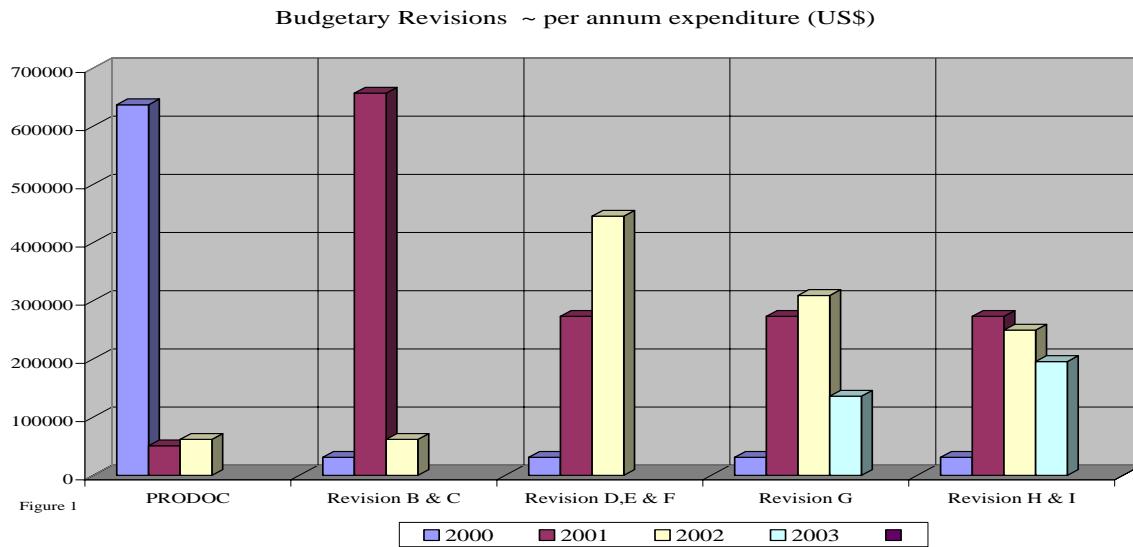
### **b) Communication between the parties**

Attention has been drawn in various reports and PIRs / APRs to the difficulties of communication between the Project and participating entities (UNDP / MINVEC etc). Appendix D contains a schematic presentation of the various meetings (project and tripartite), site visits, letters, audits and other exchanges of which records exist in the UNDP master files. It is understood that UNDP gave particular attention to this aspect of the Project, bearing in mind the geographical separation between Havana and Santa Clara (some 280 kilometres). The impression conveyed by the available documentation is generally of a high level of transparency and interchange between key participants, albeit with occasional lapses of document transmission highlighted by the Cuban internal audit body.

The issue of internet connection, providing not only access to a wider information base for the Project in Santa Clara, but also the possibility for rapid and flexible communication by electronic mail is a recurring theme in all meetings and communications. Although UNDP CO approval was given to allocating a portion of the Project resources to this as long ago as November 2000, at the time of the present evaluation Mission, no internet / e-mail connection was in place at the offices of the Project. In addition, only incoming calls could be received on the fax machine installed in the Project office at INPUD.

### c) Budgetary and Project Drawdown Considerations

The expenditure schedule has witnessed quite significant adjustment over the period under review, as illustrated by the Figure below.



This can be illustrated as follows, showing the shift in expenditure in the main budget lines over the same period, based on the evolution between the original PRODOC and the latest Revision I.

	PRODOC	2000	2001	2002	2003
10	Project Staff	12000	12000	12000	
15	Monitoring & Evaluation	1000	1000	8000	
16	Mission Costs			5000	
20	Subcontracts	217000			
30	Training	23000	38000	37000	
40	Equipment	384000			
90	Total	637000	51000	62000	
	Revision H	2000	2001	2002	2003
10	Project Staff			4107	1593
15	Monitoring & Evaluation				8000
16	Mission Costs				5000
20	Subcontracts	2860	16017	119222	109201
30	Training	19791	5499	39143	25567
40	Equipment	8464	251848	77015	46673
50	Miscellaneous			10000	
90	Total	31115	273364	249487	196034

Whilst these changes have prompted a generally critical reaction from different sources, it is the view of the Mission that a number of events can be identified as having had an impact on the execution of the Project. These are examined in greater detail in Section 11 (i) below. Bearing in mind

- the novelty of relations between the UNDP CO and an industrial complex in Cuba,
- the degree of advancement of the underlying industrial project at the time of launching the GEF project,
- issues relating to communications and administrative formalities which are examined at Section 9 (b) below,
- critical decisions affecting the application of funds to major equipment items (the R600 being replaced by a subsequent decision to purchase a range of other items)

it was to a certain extent inevitable (and therefore possibly predictable) that the investment / drawdown schedule would not have gone strictly according to plan. It is indeed arguable that the final drawdown profile realistically mirrors the evolution of events on the ground, in which a GEF project is being grafted onto an industrial project, which naturally has a life of its own beyond the control of the GEF project management.

This analysis links into the argument deployed elsewhere regarding the inseparability of the Project from its industrial and commercial context.

It is the view of the Mission that the Project has, at least at the day-to-day management level, suffered unduly from a critical interpretation of project implementation (and hence of disbursements) which took insufficient account of the difficulties which the underlying industrial project was encountering, in terms of its implementation and production.

The Mission's broadly favourable overall assessment of the value of this Project is provided in the Executive Summary and at Section 8 (a).

## **10. Summary of Lessons**

### **General Project Considerations**

#### **(i) Dual objectives of Project**

The objectives of this Project, as defined in the PRODOC, are both developmental / environmental and industrial / commercial. The overall objective makes this duality clear : "To reduce CO<sub>2</sub> emissions through the production of a home refrigerator with high efficiency and low power consumption, with the use of substances that do not deplete the ozone layer". More specifically, the Project should facilitate the installation of a production capacity of 30,000 refrigerators per annum.

The very significant cash contribution of the Cuban Government, amounting to some \$ 6,950,000 (see PRODOC), was directed to the purchase and installation of this production capacity, through the purchase of a complete production line from Italy. The original PRODOC foresaw the Project budget as contributing \$ 354,000 through the purchase of the R600 unit, but, following subsequent discussions during 2000 and 2001, it was considered preferable to allocate most of this sum to the purchase of other items not originally foreseen in the Italian supply contract, which would serve to increase Cuban industrial autonomy in such areas as plastics moulding. INPUD has now the possibility to produce the plastic shelves inside the Antillano refrigerators-freezers. A further \$ 170,000 (budget items 21.01 – 21.03) were subsequently re-allocated to activities relating to the development of the “no-frost” model.

#### **(ii) Project Implementation vs. Project Results**

A recurring concern in the different PIRs, APRs and Cuban internal audits relates to the slowness of Project implementation, as evidenced by the utilization over the period under review of the \$ 750,000 total budget. The re-allocation of the R600 budget mentioned above provides one of the principal explanations for the significant delay in the schedule of Project draw-downs, as highlighted in Section 9 (c) above. See also following figure which provides the evolution of the annual budget allocations from the PRODOC to the latest revision in percentage terms.

	<b>2000</b>	<b>2001</b>	<b>2002</b>	<b>2003</b>	
	85	7	8	0	PRODOC
	4	88	8	0	Revision B & C
	4	36	59	0	Revision D,E & F
	4	36	41	18	Revision G
	4	36	33	26	Revision H & I
<b>% drawdown</b>					

Additional reasons advanced for the slow disbursement include :-

- Delays and difficulties in identifying, pre-qualifying and selecting equipment suppliers
- Delays in processing orders, leading to payment delays to suppliers

- Delays and other obstacles affecting the identification and mobilization of consultants
- Delays associated with the participation of Cuban technicians in international events
- Strategic considerations relating to the shift from “frost” to “no-frost” technology, flowing from a reassessment of market demand.

In evaluating the significance of such events and problems, it is necessary to assess their effective impact on the respective developmental / environmental and industrial / commercial objectives of the Project. As this Report demonstrates, the Project was directly and indirectly affected by events of differing kinds :-

- a. At the industrial / commercial level
  - i. Working capital constraints leading to significant interruption of raw materials supplies
  - ii. Consequent erratic production and even full plant closures for up to 6 consecutive months during the period under review
  - iii. Marketing difficulties relating to
    - Absence of any national Cuban refrigerator production for most of the 1990s, thereby rendering market re-entry much more difficult
    - Low consumer awareness in relation to issues of energy efficiency
- b. At the GEF project-specific developmental / environmental level
  - i. On-going redefinition of Project programme budgetary allocations for the reasons examined above
  - ii. Administrative delays of different kinds, some of which exacerbated the commercial situation (slow processing of invoices or contracts).

In spite of the above, and with the proviso that at the time of undertaking this Evaluation Mission an amount of approximately \$62,000 remains undisbursed relating to fridge design (\$28,000), dissemination mission (\$2,700), training (\$11,600), equipment (\$19,000) and audit (\$700), it is possible to report that the stated investment objectives of the Project and the overall programme have been met, as regards :-

- Installation of a testing laboratory, certified in conformity with ISO 17025
- Installation and commissioning of a production line with a capacity of 30,000 refrigerators per annum, with a potential to be increased to 45,000 units per annum. These refrigerators are both as energy efficient as defined by the PRODOC and manufactured without recourse to any ODS.

On the technical training and capacity building side, the Project has to date formed 60 technicians and project managers in critical areas of expertise.

The developmental / environmental / climate change objectives of the Project, in so far as they are directly linked to the production and sale of a stated number of energy efficient / non-ODS units (10,000 in year 1 and 30,000 in subsequent years), have evidently not been met to the full. Total production of the plant, which should have cumulatively attained some 55,000 units by mid-2003 (date of this Report), has in fact only attained some 21,000 units, a shortfall of some 34,000 units for the period under review (see Section 4 : GEF CUB/00/G35 : Cuba INPUD refrigerator project : Final Evaluation Report (draft 31/7/2003)

Sales of Refrigerators). Although recent arrangements involving Neneka, a subsidiary of the Daewoo Group (see Section 11 (a) below), represent a tangible improvement on the difficult financial and production situation obtaining during 2002, a number of commercial and marketing issues require attention, as examined in Section 11 (b).

### (iii) Project Assumptions and Risks

The original PRODOC identified the following risks as potentially affecting the viability of the Project, and these were monitored in the annual PIRs (2001 and 2002)

- a. Import of low-cost energy efficient refrigerators that do not make use of natural refrigerants nor has use been made of hydrocarbons as foaming agents.
- b. Linking R&D activities with manufacturing might be difficult to organize, since different institutions will be involved with their own approaches.
- c. Difficulties in the purchase of foreign equipment might delay the assembly and exploitation of the manufacturing line.
- d. Difficulties in the identification and contracting of foreign companies for technology transfer training and consultancies might interrupt the technology transfer and smooth and timely implementation of the proposed activities.
- e. High prices of raw materials and components in the available distant markets may result in purchase difficulties that may temporarily affect the expected production levels.

These were assessed in the annual PIRs as follows - probability that the assumption w hold = high (H), substantial (S), modest (M), low (L) :-

	<b>PRODOC</b>	<b>2000</b>	<b>2001</b>	<b>2002</b>
Low cost imports		H	H	
Foreign equipment purchasing difficulties		S	S	
Difficulty in identifying & contracting TT counterparties		S	S	
Raw materials high prices		S	S	
<b>2001 PIR New assumptions</b>				
Difficulty in transactions and equipment receipt		H	na	
Strictly compliment of the training programme (sic)		S	na	
Difficulties with new model subcontract		M	na	

Comment :

It should be noted that Assumption/Risk (b) (Linking R&D activities with manufacturing might be difficult to organize, since different institutions will be involved with their own approaches) either failed to materialize or was overlooked in subsequent annual PIRs. Nor was any further comment made on these new assumptions in the PIR of 2002.

The history of the Project shows that at least 2 of the risks identified did have a very significant impact on the implementation of the underlying industrial project, namely the impact of low cost imports and difficulties with the purchase of foreign equipment – albeit less the production equipment than the essential parts and raw materials for production

and assembly. It is worth noting that although these risks were annually re-evaluated (being maintained at the same level of probability), nowhere did any analysis draw the essential link between the performance of the industrial project and its impact on the viability of the GEF Project meetings its climate change targets. The value of identifying and tracking risks in any project rests entirely on the ability to recognize and mitigate them.

#### **(iv) Conclusions regarding project management support**

Section 13 evaluates the innovative and groundbreaking qualities of this Project in greater detail. From a project management viewpoint, however, there are clearly lessons to be learned, the most important being that – as in other industrial GEF projects of this kind - the Project activities, although not physically linked to or administratively contingent upon an industrial or manufacturing process, are nevertheless heavily dependent for their impact upon the success or failure of the latter. They must therefore be planned and managed in full cognizance of the industrial / commercial context in which they will have to develop and survive to attain their maximum potential.

Although the Project management team, in UNDP and at the Project and state level, appear to have been fully aware of this, consideration should be given to whether the Project might not have been reinforced through a timely, albeit minimal, deployment of complementary industrial, commercial, marketing or financial skills, benefiting the INPUD complex as a whole. The Project reports (PIR / APR / Tripartite meetings) reflect an understandable level of frustration derived from a commercial situation beyond their control.

The geographical obstacles to UNDP project management, albeit real, do not appear in the final analysis to have significantly hindered the execution of the Project. The frequency and form of information exchange during the period under review is examined in Section 9 (b).

## **11. Major issues affecting Project implementation**

### **a) Financial Considerations affecting Project**

As 2002 reports and meetings relating to the Project have shown, a major limiting factor in the production and sales of the refrigerators at certain periods since the start of production in 1999 has been the absence of working capital to ensure the payment of equipment and raw materials supplies and other production costs. This state of affairs has affected not only the Project and the INPUD refrigerator production unit in particular, but also the industrial complex as a whole. As indicated elsewhere, the entire complex was closed during the first 4 – 5 months of this year. The end-2001 Nueva Ley de Cobros y Pagos sought to improve this state of affairs, but with only partial success, bearing in mind the incidence of events following 9/11 and Hurricane Michelle.

Whilst the causes of this situation were therefore beyond the control of the Project itself, it is to be noted that, in exchanges between UNDP and the Cuban authorities, both at the time of the August 2002 Tripartite Meeting and in subsequent meetings, it was suggested that a financial consultant should be retained to examine possible solutions.

On the basis of information provided to the Mission by senior INPUD management, the Cuban side has been able unilaterally to obtain a solution to the problem through the signature in March 2003 of a production-cooperation agreement with the Daewoo Group subsidiary, Neneka. It should be noted that this agreement covers not only the refrigeration plant, but also the ventilator, stove and coffee-machine units of INPUD. Under the terms of this agreement, Neneka has repurchased the outstanding debt of INPUD relating to these operations (estimated at the time of signature at some \$ 5,7 million), as well as undertaking to take steps to ensure the supply of raw materials to the manufacturing units, and also reinforce the sales strategies. In the case of the refrigeration unit, this agreement covers the production of the FG 34 and FG 28 models and foresees a period of collaboration of up to 5 years. The parties recognize that profits of this agreement are likely to be low during the first 3 years. The agreement makes no provision for export collaboration.

The financial arrangements under this agreement foresee the following :

INPUD and Neneka have opened a joint signature escrow account at the Banco Popular de Ahorro de Cuba. All revenues from Cuban buyers / distributors<sup>4</sup> relating to the operations of the four units covered by the agreement are paid into this account : INPUD management has the necessary information to be able to allocate revenues between the units. Under these arrangements, payments are then made in the following order of priority : 10 % to the amortization of the INPUD bank debt, then a jointly agreed order of outstanding invoices to suppliers, INPUD manufacturing costs, with the balance then being applied to a Neneka commission and finally Cuban taxes. These arrangements have made it possible for a first shipment of refrigerator inputs to be delivered from SILTAL (Italy) in May 2003, with a second shipment now signed

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<sup>4</sup> The main national buyers of the INPUD refrigerators are Cubalse, CIMEX and TRD.

GEF CUB/00/G35 : Cuba INPUD refrigerator project : Final Evaluation Report (draft 31/7/2003)

up for delivery within the next 3 months. As a result, manufacture of the refrigerators was able to resume in May.

It should be noted that this arrangement, for which the INPUD management is to be congratulated, as it has brought a much needed financial support to the complex at a critical time, coincides with a general reorganization of the plant's financial and accounting structures, whereunder it will in future be possible to break down key financial elements including cash revenues, as well as accounts receivable and payable, thereby enhancing the financial management of the plant.

**b) Market**

**• Foreign competition drives INPUD to develop No-Frost Model**

INPUD apparently has no difficulty in selling its current production on the Cuban market. However the marketing department at INPUD notes that 100% of the competition are proposing no-frost refrigerator-freezers and retailer demand is therefore for a no-frost unit. No-frost models are equipped with forced air convection combined with an electric resistance located on the evaporator, that facilitates its automatic and regular defrosting.

Under hot and humid tropical conditions as found in Cuba, the automatic defrosting system, known as the "no-frost" system, spares the consumer a frequent and laborious manual defrost.

However, since no-frost refrigerators require an extra electric resistance along with an electric fan to be added to the refrigeration system, they cost more to build and more to run.

INPUD aims to develop a "No-Frost" model that remains in the same energy efficiency category, "B". In order to meet this challenging objective, INPUD has developed a new technology partnership with Venus, an appliance manufacturer based in Mexico. So far, two prototypes are under development at Venus.

The Mission is not certain that the adaptation of the current manual defrost model enabling INPUD to propose its own no-frost refrigerator-freezer to the Cuban market will succeed. The risk is that the new technical specifications will adversely impact the energy performance of the current model. Hence, the Mission greatly encourage INPUD's engineers to maintain the energy efficiency target at level "B" for the future no-frost unit.

**c) Evaluation of the consumer market**

It has been noted elsewhere that the refrigerators sold by INPUD are denominated in US\$ and sold through the specialist distribution chain reserved for holders of that currency. The broad numbers relating to the total number of ODS refrigerators in the Cuban market cannot therefore properly form the basis for evaluating the impact of the new INPUD production line, since the percentage share of the market technically able to purchase these non-ODS models (through their holding of US\$ as opposed to Cuban pesos) cannot accurately be estimated.

Serious consideration therefore needs to be given to ways in which the Antillano range could be made available in the national currency, if the Project's full potential is to be realized.

## **12. Suggestions**

### **a) Project management procedures / information**

The Mission believes that the UNDP CO and the Cuban authorities involved in the Project will have learned valuable lessons relating to the practical management of an innovative semi-industrial project of this kind. Whilst the day-to-day running of the administrative side of the Project encountered a number of difficulties – geographic separation, bureaucratic difficulties relating to equipment imports, and others mentioned in this document – they were ultimately resolved on a pragmatic basis (with the exception of the electronic internet communications with the INPUD plant).

The files, especially the PIRs / APRs, however provide an inadequate picture of developments on the ground and have therefore, in isolation, probably led to an unfavourable appreciation of the true nature of the difficulties which the Project was encountering. Nor was this properly compensated by any visible communication between UNDP CO and technical experts from Italy, Germany, Mexico or elsewhere, brought in to work at Santa Clara at the cost of the Project.

The Mission had no difficulty in obtaining all the detailed and basic data on plant investment, production and other key factors impinging upon the INPUD plant's performance – and by extension the Project's execution, much of which appeared not to have found its way into the files of UNDP CO.

By providing \$ 750,000 of investment to the plant, UNDP / GEF can be considered to have been granted the implicit status of a “stakeholder” in the overall performance of the INPUD refrigerator plant. As a stakeholder, they would therefore be entitled to an adequate information flow on critical issues. It was the impression of the Mission that there was no reluctance of any kind on the Cuban side to answer all questions in detail and promptly.

More thought should therefore be given to the sharing of what might be termed “management information” between the parties to ensure a better understanding of the whole project's evolution on a regular (e.g. quarterly) basis.

### **b) Resolution of short-term difficulties**

Following on from the previous Section, the Mission believes that, in an innovative semi-industrial project of this type, consideration should be given, at the stage of the initial PRODOC, to ways in which the UNDP / GEF system can provide targeted collateral support in such areas as project management, management systems, financial structuring, marketing etc, where these can demonstrably impinge (directly or indirectly) on the performance of the GEF Project. The INPUD plant encountered problems in virtually all these areas, with a traceable impact on the timing of the Project's activities, yet the Project found itself with few options available to provide support to overcome them.

**c) Marketing strategy support**

- Stimulating higher demand for energy efficient appliances**

It is suggested that the Cuban national authorities create the conditions for higher demand for energy efficient domestic appliances. Labels placed on products at the point of sales show their relative and/or absolute energy performances. Numerous countries have already successfully introduced such labeling schemes as an element of their strategy to promote an energy efficient economy.

Interestingly, several importers of domestic refrigerators in Cuba are placing energy efficiency labels on the models they market. Some labels are the ones used in other countries like the USA and Mexico. At least one other label does not belong to any known national scheme: the label is deliberately placed on the model as promotion tool for the manufacturer's own benefit.

Because labels are already being used in Cuba to promote the sales of energy efficient models (on the basis of claims made unilaterally by the manufacturer), it would be advisable that the Cuban national energy efficiency authority introduce in the near future a national energy efficiency label and ban any other "exotic" label. The label would be for mandatory display on units on the point of sale.

Cuba is already complying with international standards such as the ISO and the IEC for the testing and production of domestic appliances. For the present GEF project, Cuba has already adopted the European energy efficiency rating and labeling at least for setting the energy efficiency targets. It would certainly be appropriate to adopt the European labeling scheme for the Cuban market. In Latin America alone, Brazil, Argentina and recently Colombia have already adopted an energy efficiency label under the national legislation using a format which is similar to the European label. In Jamaica, a mandatory label for promoting energy efficient domestic appliances was introduced in the late 1990s.

It is suggested that Cuba establishes appropriate partnerships with regional economic partners to develop a common energy efficiency labeling scheme. A common energy efficiency label is likely to contribute and possibly enhance regional collaboration.

As INPUD now owns a certified laboratory, Cuba should seek to become a regional certification center, e.g. for the Caribbean region.

**d) Possible areas for further UNDP / GEF support**

INPUD management, whilst making it clear that in their view the establishment of the laboratory and the development of the new models (and most recently the new "no-frost" model in collaboration with the Mexican company, Venus) would not have been possible without the support of the Project, indicated that additional support would be welcome in the following areas :-

- Support in the Cuban and regional markets to promote the use of the INPUD testing laboratory by other clients than the immediate factory
- Additional training for INPUD technicians

- Reinforce exposure of INPUD products and the laboratory via participation in international fairs and exhibitions
- Increase inward technical missions to INPUD
- Facilitate networking with international professional organizations involved in refrigeration engineering as well as energy efficiency
- Design with both INPUD and the National Energy Efficiency Authority a strategy to promote energy efficient appliances through an energy label at the point of sale.
- Set mandatory minimum energy performance standards for all the cold appliances on the market in Cuba
- Design an early retirement scheme for replacing old and inefficient appliances in Cuban kitchen with new energy efficient units
- Monitor electricity demand in the residential sector to assess the impact of the market transformation of cold appliances and identify other end-uses that can and should be targeted in future energy efficiency programmes.

### **13. An important Project outcome : direct support to enable industry to produce energy-efficient units**

The Mission considers that one of the most important benefits of the Project lie in its direct link to a capacity locally to produce energy efficient domestic refrigerators, potentially in quantity. In many cases, programmes to promote energy efficient appliances are based on stimulating the market to demand more energy efficient units through incentives, labelling, or minimum performance standards. The pressure is therefore placed on the manufacturers to improve the energy efficiency of the appliances they place on the market. In the present GEF project CUB/00/G35, the focus has been optimally placed on directly working with the sole manufacturer of white goods in Cuba.

Despite some of the difficulties that the Mission identified in the execution of the GEF project and budget disbursements, it is believed that the decision to focus on helping the national manufacturer was highly relevant, considering the situation of the national appliance market in Cuba. The Mission concluded that allocating money to INPUD in this way has proven more efficient and useful than, for instance, an investment in new electrical power supply.

Cuba is now able to produce cold appliances that are more energy efficient than most appliances marketed in the region or imported into Cuba. INPUD is in a position to become a major participant in national efforts to save energy and reduce associated CO<sub>2</sub> emissions on a large scale.

The Mission therefore recommends the systematic approach be developed in Cuba in order to generate demand for energy efficient equipment based on a combination of mandatory labelling, minimum energy efficiency standards and an early retirement programme. Such programmes are well established in many economies throughout the world and are considered as key best practice in energy efficiency policy.

## **Appendices**

## **A. Terms of Reference of Final Evaluation Mission**

# **FINAL PROJECT EVALUATION MISSION**

## **PROJECT CUB/00/G35 PRODUCING ENERGY EFFICIENT REFRIGERATORS WITHOUT MAKING USE OF OZONE DEPLETING SUBSTANCE**

### **GENERAL TERMS OF REFERENCE**

#### **A. Background**

Cuba became a party to the United Nations Framework Convention on Climatic Change on June 1992, and on January 1994 ratified it as a Non-Party country on Annex 1 of the Convention.

Cuba signed and ratified the 1992 Vienna Convention for the protection of the ozone layer and the Montreal Protocol on Substances Depleting the Ozone Layer and actively participates in these activities.

Since 1993, Cuba has a Country Program for a gradual reduction in the use of Substances Depleting the Ozone Layer, has created a National Group for the implementation of the Montreal Protocol with the participation of the most important organizations in the country and has already prepared and is implementing the National Strategy for Substances Depleting the Ozone Layer. Refrigeration and air conditioning account for more than 80 per cent of the consumption of Ozone Depleting Substances (ODSs) in the country.

Environmental protection and sustainable development of natural resources have been lines to which the Cuban Government has given priority attention. In Article 119 of the Environmental Act reference is made to the introduction of regulations to reduce the emissions of green house effect gases and those depleting the ozone layer.

The Ministry of Science, Technology and Environment (CITMA) is the national guiding entity of scientific, technological and environmental policy. In environment, it carries out its executive functions through the Ozone Technical Office of the Environmental Agency. The Ministry of Steel and Mechanics Industry and Electronics (SIME) is the main manufacturer of durable in Cuba, including refrigerators. INPUD, an enterprise belonging to SIME, is the only manufacturer of home refrigerators in the country. The CITMA and the Ministry of Basic Industry (MINBAS) regulate the power aspects and establish and develop programs for the refrigerator manufacturing industry.

Cuba has developed and implemented its National Strategy for the Implementation of the Montreal Protocol and the Vienna Convention for the protection of the ozone layer.

Thus, it has focused its strategy in the institutional reinforcement of the Ozone Unit and in the sector of refrigeration and air conditioning, which accounts for approximately 80 per cent of ODSs in the country. The implementation of projects with this objective, as

the Refrigerant Management Plan, the Recovery and Recycling of Freon 12, the replacement of Freon 11 and 12 in commercial refrigeration and others guarantee that Cuba complies with its commitments under the Montreal Protocol.

The Cuban Government is engaged in a significant effort for the technological conversion of the INPUD home refrigerators manufacturing line. New Cuban refrigerators should be highly efficient from the point of view of power consumption and, as an additional features, should not use substances depleting the ozone layer (ODSs). The government investment, of about 7 million U.S. dollars, will allow an output of up to 30,000 refrigerators annually. The medium-seized project by the Global Environmental Fund (GEF) is being executed in order to cover the incremental costs associated with this investment, under operational program No.5 on Climate Change that foresees the elimination of obstacles for electric power conservation and efficiency. The project address design problems in the new refrigerators, the technical training of INPUD staff and complete some equipment on time, especially that in the control laboratory, associated with the implementation of the ISO 9000 standards. The project is being implemented nationally.

An additional effort includes the updating of the technical capabilities of the factory's central laboratory, including the special equipment and training of its personal.

This evaluation will provide very useful information not only to the UNDP and GEF, but also to the national authorities involved in the project.

## **B. Objective of the mission:**

The objective of this mission is to assess the performance, impact and sustainability of the project implementation. Appraising the project's fulfillment of its stated objectives will do this.

The team of experts will assist the Regional Bureau for Latin America and the Caribbean in providing an in-depth evaluation of the project CUB/00/G35Producing Energy Efficient Refrigerators without Making Use of Ozone Depleting Substances.

These experts will work closely together in collaboration with staff from UNDP Country Office, MINVEC and the project team, to assess the project execution. Based on these assessments, the evaluation team will also recommend strategies and actions aiming at improving the project results, sustainability and follow up.

## **C. Scope of the evaluation:**

1. Review of all materials related to the project: the UNDP/GEF Project Document, Annual Project Reports/Project Implementation Report, Tripartite Review Reports, as well as other reports or information provided by government or UNDP.

2. Interviews, consultations and meetings, as appropriate, with staff from the UNDP Country Office, MINVEC and INPUD Villa Clara.
3. Analysis of the project results and their relation to the project's general development objective.
4. Analysis of the technical capacities associated with the project and their role in project development, management and achievements, including the results of training activities.
5. Analyze and assess the effectiveness of project management structure on fulfillment the project objectives.
6. Analyze the success criteria and verifiable indicators of the project development goal, project purpose and outputs.
7. Elaboration of a summary of lessons learned from project experience which would be relevant to the sustainability of project's results, future resource mobilization, importance of spreading results and experiences to other countries in this region.
8. Major issues and problems affecting the implementation of the project.
9. Produce suggestions on:
  - INPUD's cash flow regarding the refrigerator production
  - Solutions and action plans to revert the situation presented during the last two years so INPUD will be able to reach the 30,000 refrigerators annual target production.
10. Elaboration of a detailed evaluation report, containing the above analysis and findings, together with sections on lessons learned and recommendations.

#### **D. Methodology and products**

In order to undertake this evaluation, there is a proposed mission composed of **3** consultants (**2** international and **1** national) chosen by common consent by the UNDP-Havana and the national authorities. The consultants must be highly qualified in disciplines relating to the topics dealt with in the projects to be evaluated. One of the international consultants will be the team head.

All official documents relating to the project (project document, substantive and budgetary reviews, progress reports, minutes on tripartite meetings and so forth) will be available to the consultants.

Likewise, the mission members will have a copy of the handbook *Result oriented monitoring and assessment*, edited by the UNDP, where the UNDP's main guidelines concerning project and program evaluations are outlined.

The actions to be undertaken by the mission will specifically concentrate on the aforementioned project and should cover the Cuban environmental sector only as a reference framework for the context and for considerations on impacts.

#### **E. Timeframe**

The mission will be **4 days** long and it is anticipated to be carried out from July **7** to **10**, 2003.

#### **F. Mission results**

The last working day, the mission will present a draft report made according to the procedures set up by the UNDP in this regard, the draft report being subject to the consideration of all concerned parties. Subsequently, preferably within the next 24 working hours, the concerned parties will officially present their comments on the consideration-submitted draft report.

Fifteen days after the mission is finalized, the consultants – through the team head – will present the definitive evaluation version.

## **B. PRODOC**

To be attached if necessary.

### **C. Photographs Appendix**

**ORGANO NACIONAL DE ACREDITACION  
REPUBLICA DE CUBA**

# **CERTIFICADO**

**que acredita a**

## **Laboratorio de Ensayos a Productos**

**Empresa Nacional Productora de Utensilios Domésticos (INPUD)  
“Primero de Mayo”**

**Por cumplir las exigencias establecidas en la NC ISO/IEC 17025  
“Requisitos Generales para la Competencia de los Laboratorios  
de Ensayo y Calibración” y demás regulaciones complementarias.**

**Este CERTIFICADO confiere a su titular las facultades legales  
para ostentar la condición de Laboratorio Acreditado.**

**Válido para el alcance descrito en el Anexo a la Resolución de otorgamiento No. 07/2002 consignada en el  
Registro de Entidades Acreditadas del Órgano Nacional de Acreditación de la República de Cuba.**

**Expedido en Ciudad de La Habana a los 17 días del mes de Abril del 2002**

**Vigente hasta: 17 de Abril del 2005**

**Reg. No. 0 67**

## D. Communications Schedule

<i>Quarter ending</i>	<i>Jun-00</i>	<i>Sep-00</i>	<i>Dec-00</i>	<i>Mar-01</i>	<i>Jun-01</i>	<i>Sep-01</i>	<i>Dec-01</i>	<i>Mar-02</i>	<i>Jun-02</i>	<i>Sep-02</i>	<i>Dec-02</i>	<i>Mar-03</i>	<i>Jun-03</i>
Project Meetings	1	2	1						1		1		
Site Visit			1		1					1			
Written Exchange			1	1			1		1	1		1	
Tripartite Meeting						1					1		
PIR / APR									1				
National report / audit						1				1			

