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United Nations Environment Programme

**TERMINAL EVALUATION REPORT
"GENERATION AND DELIVERY OF RENEWABLE
ENERGY BASED MODERN ENERGY SERVICES IN
CUBA: THE CASE OF ISLA DE LA JUVENTUD"**

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**Evaluation Office
April 2015**

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Table 1. Project General Information

Project Title:	Generation and Delivery of Renewable Energy Based Modern Energy Services; the Case of Isla de la Juventud
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Executing Agency:	UNIDO
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Project partners:	MINCEX, Ministry of Energy and Mines (MINEM), MINAGRI, CITMA, CUBAENERGIA, UNE, CF
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Geographical Scope:	Cuba
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Participating Countries:	Cuba
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GEF project ID:	1361	IMIS number*¹:	GFL-2328-2721-4837
Focal Area(s):	Climate Change	GEF OP #:	OP 6
GEF Strategic Priority/Objective:	CC 3	GEF approval date*:	23 March 2005
UNEP approval date:	23 June 2005	Date of first disbursement*:	July 2005
Actual start date²:	5 September 2005	Planned duration:	109 months
Intended completion date*:	October 2014	Actual or Expected completion date:	October 2014 (approved by the PSC meeting of 02/10/2013)
Project Type:	FSP	GEF Allocation*:	\$5,337,000.00
PPG GEF cost*:	\$325,000.00	PPG co-financing*:	-
Expected MSP/FSP Co-financing*:	\$10,704,000.00	Total Cost*:	\$16,366,000
Mid-term review (planned date):	-	Terminal Evaluation (actual date):	October 2014

¹ Fields with an * sign (in yellow) should be filled by the Fund Management Officer

²Only if different from first disbursement date, e.g., in cases were a long time elapsed between first disbursement and recruitment of project manager.

Midterm review (actual date):	May-June 2010	No. of revisions*:	5
Date of last Steering Committee meeting:	11 June 2014	Date of last Revision*:	January 2014
Disbursement as of 30 June 2014*:	5,247,327.00	Date of financial closure*:	2015
Date of Completion^{3*}:	N/A	Actual expenditures reported as of 30 June 2013⁴:	4,423,618.17
Total co-financing realized as of 30 June 2014⁵:	\$7,230,793.49	Actual expenditures entered in IMIS as of 30 June 2014*:	3,429,054.17
Leverage financing⁶:	\$7,230,793.49		

³ If there was a "Completion Revision" please use the date of the revision.

⁴ Information to be provided by Executing Agency/Project Manager

⁵ Projects, which completed mid-term reviews/evaluations or terminal evaluations during FY11, should attach the completed co-financing table as per GEF format. See Annex 1

⁶ See above note on co-financing.

LIST OF ACRONYMS

AENTA	Agency of Nuclear Energy and Advanced Technologies	Agencia de Energia Nuclear y Tecnologias de Avanzada
ALASTOR	Company dealing with installation and operation of boilers	
BMs	Business Models	
BSP	Bali Strategic Plan	
BOT	Build Operate Transfer	
CF		Compania Fiduciaria
CICMA		Centro de Investigaciones de Mecanizacion Agricultura
CITMA	Ministry of Science, Technology and Environment	Ministerio de Ciencia, Tecnología y Medio Ambiente
CMIJ		Centro Meteorologico Isla de la Juventud
DGEF	Division of GEF Coordination	
EA	Executing Agency	
EOU	Guidelines... Evaluation Office...	
EO	Evaluation Office	
EFI	local forestry company	Empresa Forestal Integral de la Isla de la Juventud
ER	Evaluation Report	
FRR		
GEAM	national forestry organization	Grupo Empresarial de Agricultura de Montana
GEB	Global Environmental Benefits	
GEPROP	Centre for Management of Priority Programmes and Projects	Ecosol Solar and the Institute for Meteorology Cuba
GIS	Geographical Information System	
IA	Implementing Agency	
IIF		Instituto de Investigaciones Forestales
IJ		Isla de la Juventud
INEL	National electricity institute	Instituto Nacional de Electricidad
MEP	Ministry of Economy and Planning	
M&E	Monitoring and Evaluation	
MINAG		Ministerio de la Agricultura
MINAL	Ministry of food industry	Ministerio de la Industria Alimenticia
MINBAS	Ministry of Basic Technology	Ministerio de Industria Básica
MINCEX	Ministry of International Cooperation	Ministerio del Comercio Exterior y la Inversion Extranjera
MTE	Mid-term Evaluation	
MTR	Mid-term review	
MTS	Medium Term Strategy	
NES	National Electric System	
OBE	Local Electricity Utility	Organización Básica de la Isla de la Juventud
PDF/B		
PFC	Power finance corporation	
PIR	Project Implementation Review	
POW	Programme of Work	
PSC	Project Steering Committee	

RC	Institution dealing with mechanical engineering	
ROtI	Review of Outcomes to Impacts	
RRMF	Risk and Replication Management Fund	
RT	Reference Terms	
SIME	Ministry of Mechanical Industry	Ministerio de la Sideromecánica
SLM		
SWERA	Project of UNEP/GEF	
TE	Terminal Evaluation	
TOC	Theory of Change	
Toe	Tons of Oil Equivalent	
TT	Technology Transfer	
UNICAR	Institution in Havana dealing with meat	
UNILAC	Institution in Havana dealing with milk	
UNE	National Electricity Utility	Unión Nacional Eléctrica
UNEP	United Nations Environment Programme	
UNIDO	United Nations Industrial Development Organization	

A. Executive Summary

In Isla de la Juventud there are plenty of renewable energy resources, especially biomass, and the electricity generation and industrial activities heavily depend on imported liquid fuels, but up to now no systematic efforts had been directed towards the use of renewable domestic resources, therefore from the viewpoint of its design, the general purpose and initial objectives of the project were adequate. Moreover, the realization of the project objectives will clearly pave the way for a wider use of renewable energy resources in other parts of the country.

It is true that there were delays in the project development due to the effects of the hurricanes which reached Isla de la Juventud in 2008, but the initial design of the project underestimated the effects of the bureaucracy of the Cuban system and this resulted in long delays; after almost ten years (the project officially started in March 2005, but project activities were initiated in September-October 2005) not all the activities have been finished, despite of a reduction in performance targets agreed in 2010. Bidding procedures for acquisition of equipment have been time consuming and difficult to carry out, and in some cases have completely failed to attract bidders, due to mistrust and perception of high risks of business in Cuba (not only due to internal causes) from the side of potential bidders. In fact, it was not possible to attract foreign investments for the renewable energy business in Cuba, as initially contemplated in the Project; as a result all the project funding has come either from the donor or from the Cuban counterparts (the Government of Cuba has invested much more effort than initially expected in the project design).

The initial selection of final beneficiaries for the demonstration activities took into consideration their relevance to the project objectives, the real needs of the community of Isla de la Juventud, as well as the likelihood of potential replicability; dairy and meat industries cover basic necessities, marabou (*Dichrostachys cinerea*) is a real problem, replacement of liquid fuels for generation of electricity is an urgent issue, etc. Unfortunately, from the viewpoint of the practical realization of the project outputs, as indicated above, the project experienced considerable delays, for several reasons. Some of these reasons can be considered as “force majeure”; the hurricanes caused very serious damage to the island infrastructure, and a vast reconstruction effort was necessary. The economic crisis also had a negative impact. The Cuban government had to devote large amounts of money to reconstruction purposes, and asked for a reduction in the performance targets; the project Steering Committee took a reasonable attitude and decided to accept the suggested revisions.

A high number of Cuban Ministries and organizations have been involved in the project activities, and this has been another serious barrier for the implementation of the project activities, although the present administrative system in Cuba does make it

particularly difficult to design a more simple organizational project structure. Moreover, the Government of Cuba has embarked, in the last months, on a reorganization which has added still more difficulties: some institutions have disappeared, other have been created, and many officials already familiar with the project have been replaced by others who have no knowledge of it; this has resulted in further delays for the project activities. Although the reorganization is devoted to the simplification of procedures, it remains to be seen whether the reorganization will result in real simplification for future projects and activities. The many changes that occurred in key project positions were also negative, although this has improved since the time of the Mid –Term Evaluation (June 2010). On the other side, the involvement of two UN agencies (UNIDO and UNEP), rather than one, has not simplified matters.

The project document specified the technology to be used for each activity; there does not seem to have been a process of selection of the most suitable technologies. Only a few of those activities specified in the revised Project Document have been finished at the time of the Final Evaluation (creation of the Revolving Fund, evaluation of wind resources in Isla de La Juventud, creation of the forestry unit (using mainly *Acacia*, since *Eucalyptus* has been considered dangerous for the long term stability of the biomass – cultivated soils), etc.). An important effort towards training and information dissemination has been made, with more than fifty specialists receiving training in the new technologies already defined in the project document, but the training still has some gaps; the Meat Factory personnel have shown an acute lack of knowledge about the technology to be implemented; this was previously detected at the time of the Mid Term Evaluation and unfortunately the situation has not improved.

Construction of La Melvis plant has been finished, but the commissioning process cannot be considered complete since the plant has run for only a few hours at partial loads. The rated power output (500 kW) has never been reached, the influence of the different types of biomass has not been analyzed, and some problems still need to be solved (one of them: inadequate size wood pieces supplied to the gasifier, was only reported to the supplier of the chipping machine three months after its appearance). The installation in the Meat Factory has not yet been started (nor even the corresponding civil works), and the project has faced incremental costs; the project was late in signing the contract with the supplier (February 2014). The contract gave a six month period for initiation of activities, and this term has been exceeded. As for the gasifier of the Dairy Plant, it had to be abandoned due to excessive delays in the process (the old existing boiler had to be urgently replaced, and there was no time to wait for the gasifier contemplated in the project to be commissioned).

The manufacturing of small wind generators has not yet started; the necessary fabrication schemes and layouts have not yet been finished. The Cocodrilo plant was installed and ran 9 hours per day in 2013, but then suffered malfunctions and has been

out of service since April 2014, allegedly due to human mistakes (the present operators did not receive sufficient training). Moreover, it has been discovered that at least some parts of the gasifier were not new at the time of installation; they had been previously used.

The solution to the problem of collection and cutting of marabou remains unsolved; the prototype prepared under project auspices (although not directly financed by it) has proved inadequate in the field tests, and a new prototype has to be prepared, taking advantage of the experience gained from the first one.

Nevertheless, it has to be emphasized that all the Cuban counterparts have agreed to complete all pending activities, and a written commitment for completion has been adopted.

The Risk and Replication Management Fund (RRMF) was created by Compania Fiduciaria and is in charge of funding the three project Business Models (La Melvis, the forestry activities and the meat industry); contract loans were signed, and a part of the funding has already been repaid. The RRMF approach seems to be working properly, but up to now no more projects are being financed by the RRMF, although some entities have shown interest. The RRMF is now under the responsibility of the Cuban government, and will try to get new funding through international collaboration schemes (and private funding whenever possible). A mechanism for raising of funds has yet to be agreed upon.

In general the project activities have been seen by the final beneficiaries as a potential source of income (prior to the start of the project the biomass obtained from forest cleaning was considered as waste), as a means of reducing fossil fuel consumption (and corresponding reduction of GHG emissions and import expenditures), and as an opportunity for job creation. Due to the structure of the Cuban state, institutions are strongly interrelated to enterprises and companies, and hence the institutions are very closely following the impacts of the project activities. A general atmosphere of support for renewable activities has been created, both at national and local level, and a high degree of interest in all the technologies contemplated in the project has been created in national and local authorities (including universities) and other involved stakeholders, and this is a basic requisite for future activities. There is potential for future replication, and this would not be possible without the dissemination and demonstration efforts contemplated and carried out under this project.

The reduction of project activities has resulted in some funding still being available for future activities; GEF has agreed the use of these funds for renewable energy-related purposes. An extension of the La Melvis power plant has been proposed, but at present sufficient funding is not available and it would be prudent to wait until the

current problems faced by the first La Melvis unit have been solved and sufficient supply of biomass can be fully guaranteed.

In June 2014 the Cuban Council of Ministers adopted a policy that encourages the development of and support for the use of renewable energy sources in Cuba. The project portfolio has not yet been officially made public, but it seems to contemplate a wide range of projects. The approval of this policy has undoubtedly been influenced by the project activities (the high number of involved Cuban agencies and organizations has resulted in many key officials becoming familiar with the project activities and objectives) and it is clearly very positive from the viewpoint of future replication of project activities and new projects.

In summary, the project has not been successful from the viewpoint of achieving all of its activities, but it has played a positive role in the raising of awareness of the role to be played by renewable energy sources and the benefits derived from their use. It has contributed to creating a situation where catalytic effects are likely to be realised.

B. Introduction

1. According to the original Project Document, the main objective of the project was to reduce the Greenhouse Gas Emissions (GHGs) in Cuba by promoting environmentally sound renewable energy technologies for power generation as well as providing modern energy services on a commercial basis on the Isla de la Juventud. The project has tried to address the key barriers that constrain the use of renewable energy technologies (biomass and wind) for power and heat generation on the Isla de la Juventud, and to promote business models for sustainable harnessing of renewable energy resources in Cuba. The generation of electricity in Isla de la Juventud was totally dependent on expensive imported liquid fossil fuels, but the potential for use of renewable energy sources was high; given the high cost of generating electricity on the island and the demonstrated engagement of private sector investments in fossil fuel based power generation, Isla de la Juventud presented a priority opportunity for a GEF intervention to support renewable energy technologies.
2. The project has adopted a holistic approach to demonstrating the technical, economic and financial viability of sustainable renewable energy production through business models on the Isla de la Juventud, and has helped to create an enabling environment – in terms of institutional, financial and policy mechanisms – for their replication throughout the country and the region. Both, the national counterpart UNE (since January 2010) and Compañía Fiduciaria – a national level trust fund financial and banking company - are designated agencies for the introduction of business models to support sustainable development in Cuba.
3. The project aimed to introduce new and innovative financial and institutional structures to encourage future private investments, support economically viable markets, promote environmentally sustainable forestry management, develop mandatory certification standards and enhance local manufacturing capacity for renewable energy technologies in Cuba. The adoption of the risk-sharing mechanism by Cuba would signal the effectiveness of the financial instruments in bringing forward investment opportunities and environmental technologies. The financial mechanism will encourage private sector investment in new renewable energy projects on Cuba mainland. Broader and long-term outcomes in Cuba should be observable in the form of project proposals and ultimately investments on a long-term basis. Replication of business models for generation of power and processing heat from renewable

energy sources (biomass and wind) in Cuba is most effectively addressed by the risk-sharing mechanism, but dissemination efforts within institutions and to private sector actors in the market are important as well.

4. The main long-term result of this project targeted the creation of a robust market and strong institutional and financial capacity at the national level for supporting renewable energy investment projects and markets that would make Cuba's economy less reliant on imported fossil fuels to meet its growing energy needs, and in the process, help in reducing overall GHGs emissions through wide-spread use of renewable energy technologies in the country as well as in the Caribbean region.

C. The Evaluation

5. As established in the Evaluation ToR, the main purpose of the Terminal Evaluation is to assess project performance in terms of relevance, effectiveness and efficiency, and determine outcomes and impacts (real and potential) stemming from the project, paying special attention to their sustainability. In general, evaluations have two primary purposes: to provide evidence of results and to promote learning, feedback and knowledge sharing through results and (mainly) lessons learned; beneficiaries of this are UNEP, GEF and the executing project partners (both executing agencies and general national partners and stakeholders).
6. The key points on which the Evaluation Team has focused its activities are:
 - Involvement of the local authorities and direct local beneficiaries during the formulation and implementation of the project
 - Participation of stakeholders and public awareness
 - Effectiveness of decision-making processes in Cuba, taking into consideration both local and national bureaucracy
 - Effectiveness of the financial mechanism established by Compania Fiduciaria
 - Willingness and capacity of the Government to financially commit to co-funding and investment
 - Capacity of the project to achieve the reduced project performance targets approved by the Steering Committee in January 2010
 - Likelihood of and potential for replication of the project activities. This is an especially important point
 - Degree of satisfaction of authorities and stakeholders with the general objectives of the project and its general approach
7. The field phase of the Terminal Evaluation took place from 5th to 19th October 2014 in Havana and Isla de la Juventud (from 7th to 9th and from 14th to 16th October) and was carried out by the authors of the present report (see front page). A list of persons contacted during the evaluation is included in Annex 4: Evaluation program below.
8. The applied methodology to perform the project evaluation has followed the guidelines contained in the evaluation ToR and consisted of:

- Detailed analysis of the project documentation, supplied by UNEP and UNIDO before the field trip to Cuba.
 - Phone conference with UNEP – UNIDO officials to clarify details of the evaluation and its schedule.
 - Participation of the Evaluation Team Leader in the international workshop “Renewable Energy for Sustainable Development: the case of biomass Gasification” in Havana and Isla de la Juventud. This workshop was one of the dissemination activities planned under the Project and, apart from Cuban institutions, was attended by representatives from Mexico, Dominican Republic, Uruguay and Argentina.
 - Participation of the Evaluation Team Leader as an observer in the final meeting of the project Steering Committee.
 - During the workshop, just upon arrival to Havana, a first set of interviews of the TL with the Project Director and representatives of some relevant stakeholders.
 - A second three day trip to Isla de la Juventud by both evaluators, including visits to the sites corresponding to the different project activities and meetings with all the relevant local stakeholders and local institutions and authorities.
 - A second set of interviews with the rest of the relevant stakeholders (including UNIDO), as well with national authorities and institutions in Havana.
 - Revision of project documentation facilitated by the Cuban counterparts.
 - Final discussions with the Project Director and other relevant stakeholders.
 - Preparation of the Draft Report, after the end of the stay in Havana.
9. The evaluation has faced some difficulties due to time constraints (just nine working days, of which four were devoted to the International Workshop). This made careful preparation of each meeting necessary with prior selection of questions to be asked to each stakeholder (a complete set of the selected questions is included in Annex 7: List of questions). Under this approach it was possible to hold meetings with all the main project stakeholders and authorities (local and national) involved and acquire the necessary information about the status of the project activities, opinions about the nature and realization of the project, impact, possibilities for replication, etc.
10. The Final Terminal Evaluation Report will be prepared after receipt of comments from stakeholders (which will be summarized in I Annex 1:

Responses to stakeholders comments received), as stipulated in the Evaluation ToR.

I. The Project

11. In this section the general project objectives and outputs are described, as defined in the corresponding Project Document.
12. The project started in March 2005 and has faced considerable delays due, among other causes, to the effects of the hurricanes that reached Isla de la Juventud in September 2008. These had a serious impact on the island's infrastructure and forced the introduction of changes in the priorities of the Government of Cuba. The ongoing economic crisis has also had a negative influence on both the situation of the Cuban economy and project execution. Moreover, as a result of the hurricanes, the Government of Cuba had to devote a large financial effort to reconstruction of the damaged infrastructure and could not guarantee the investments needed for the co-financing of the four Business Models initially contemplated in the project design.
13. The project was scheduled to reach operational completion by December 2010, but it has experienced several revisions due to the indicated delays (see Sub – chapter D – III below); for the same reasons, the Project Steering Committee decided in January 2010 to establish new sets of updated performance targets, budget and milestones for the project, as described in Changes in design during implementation(Sub - chapter D-VII) below.

II. Objectives and components

14. The general objective of the project, as stated in the Project Document, is the reduction of energy – related CO₂ emissions through removal of barriers and promotion of environmentally sound renewable energy technologies for generation of electrical power and process heat.
15. More concrete objectives of the project were to remove key barriers to development of renewable energy technologies for power generation and process heat on commercial basis at the Isla de la Juventud, to reduce the island vulnerability and environmental stress, and to promote business models for sustainable harnessing of renewable energy resources in Cuba.
16. The table included in Annex II below shows the project activities, outputs and sub-activities, as defined in the Project Document.

17. Moreover, the Project Planning Matrix indicates a number of project outcomes (this Matrix was made available to the Evaluators after the field visits), as follows:
- a. Strengthened enabling policy environment for the promotion of renewable energy technologies in Cuba and the region.
 - b. Established national capacities to utilize the commercial potential of renewable energy technologies
 - c. Development of an IPP sector.
 - d. Recognize options for innovative financial mechanisms to encourage private sector investment in renewable energy projects in Cuba.
 - e. To remove the key barriers that constrain widespread use of renewable energy technologies (biomass and wind) through 4 business models on Isla de la Juventud and the rest of the country.
 - f. To develop a replication and information strategy to promote renewable energy technologies in the region
18. In the same Matrix, the following project outputs were contemplated (it seems more logical to consider these so-called “outputs” 1 to 4 as project outcomes):
- Output 1: A policy and regulatory framework to provide enabling environment for the development of renewable energy technologies (biomass and wind).
 - Output 2: Local and national capacity built to utilize the commercial potential of renewable energy technologies.
 - Output 3: Setting up innovative financial mechanisms and structures to encourage private sector investment in renewable energy projects.
 - Output 4: Implementation of business models to demonstrate commercial feasibility of renewable energy technologies for power generation and productive use on Isla de la Juventud.
 - Output 5: Establishment of project management and coordination structures.
19. It is worth noting that the project activities described in the project document already indicate the biomass technology to be used: gasification of wood, whereas direct combustion of biomass is not contemplated, in spite of the fact that use of biomass for generation of process heat in the food industry is contemplated. The selection of technology to be used was made during the preparatory phase of the project, before the Project Document was drafted; this seems to indicate the willingness from the side of Cuban stakeholders to develop and learn about gasification technologies (mentioned during the Evaluation).

III. Target Areas/Groups

20. The project focuses mainly on use of biomass gasifiers for generation of electrical power and process heat in Isla de la Juventud, including plantations of trees for use as biomass fuel for the gasifiers (which is a reasonable approach, since the quality of a large part of the soil in Isla de la Juventud makes it inadequate for agricultural purposes). Elimination of the invasive tree species (marabou - *Dichrostachys cinerea*, among others) is also contemplated.
21. It also considers wind energy, including evaluation of wind potential in the island, installation of wind farms and design of small wind generators for fabrication in Cuba.
22. Use of biomass for generation of electrical power is contemplated both for off-grid and grid-connected plants; in the first case a remote area is electrified through a dual-fuel engine (using gas from a biomass gasifier and diesel oil as fuels), whereas the grid-connected plant uses internal combustion engines fuelled exclusively by gas from a biomass gasifier.
23. Therefore the targeted areas contemplated were:
 - Electrification of isolated, rural areas
 - Supply of electricity to the network from biomass gasification plants
 - Supply of electricity to the network from wind generators
 - Supply of process heat for the food industry (initially meat, dairy, ceramic and fish industries were contemplated, but the installations corresponding to the fish and ceramic industries were eliminated, and the dairy industry was later dropped (see Sub – chapter D-VII Changes in design during implementation below)).
 - Harvesting and use as a biomass fuel of an invasive plant (marabou), which has invaded a large surface of agricultural land in Isla de la Juventud (and also in Cuba)
24. As for the groups of beneficiaries involved:
 - Inhabitants of an isolated area, which will get a supply of electricity for domestic and some public activities (school, bakery...). Trainees for operation of a small biomass power plant
 - General users of the electrical system in Isla de la Juventud
 - Food industry (see paragraph 23 above)

- As complementary (but very important) activities, training of specialists on the above technologies, as well as dissemination efforts on use of renewable energy sources and technologies.

IV. Milestones/key dates in project design and implementation

25. The project officially started in March 2005 and has experienced significant delays and modifications due to the reasons described above.
26. In view of the difficulties experienced and subsequent delays, a revised Project Document was prepared in December 2009, reducing the project activities. The new Project Document was approved by the Project Steering Committee in its meeting held on 29th January 2010. The modifications are summarized in Changes in design during implementation (Sub – chapter D – VII below).
27. Apart from the above, the Project has been extended four times:
- 1st extension: Approved by the Steering Committee on 29/01/2010, from June 2011 (initial schedule) to December 2011
 - 2nd extension: Approved on 11/04/2011, until June 2012
 - 3rd extension: Approved on 05/06/2012, until December 2013
 - 4th extension: Approved on 13/01/2014, until October 2014
28. Moreover, the project budget has been revised another four times:
- Budget revision 1: Request date November 2010
 - Budget revision 2: Approved on 11/04/2011
 - Budget revision 3: Approved on 07/09/2012
 - Budget revision 4: Approved on 13/01/2013
29. A Mid - Term Evaluation was carried out in June 2010, through which a general perspective of the project was given, and a set of recommendations prepared. In the following Sub – chapter an analysis of the adoption and implementation of these recommendations is made.

V. Implementation arrangements

30. As stipulated in the initial Project Document, a Project Team was selected and the management structure was agreed with the Cuban counterparts. In fact, the Project Team was composed of Cuban officials paid directly by Cuba, hence this was a part of the Cuban contribution to the Project.
31. The Steering Committee was formed, including representatives of the Government of Cuba, UNEP, UNIDO and the main project stakeholders.

32. In general, it can be said that all the project implementation arrangements were carried out as indicated in the Project Document.

33. The Mid Term Evaluation Report contained a number of recommendations for improved realization of the project’s intended results. Some of them were general recommendations intended to accelerate the completion of some concrete but delayed activities, but others contained more specific measures. Table 3 below gives a general overview of the main MTE recommendations and their acceptance or rejection.

Table 2. Status of recommendations from the MTEvaluation

Recommendation	Measures adopted
To maintain more fluid and frequent communications between UNIDO and the Cuban team	Monthly meetings were adopted, alongside ad hoc tele-conferences and field missions. ADOPTED
To prepare an Action Plan, including milestones	The Work Plan was prepared. ADOPTED
To unblock the situation in Compania Fiduciaria, updating the agreement with UNIDO	The contracts between CF and UNIDO were signed and implemented, as well as agreements between CF and the Beneficiaries. ADOPTED
To keep UNIDO as a member of the RRMF Steering Committee after the project end	This is not possible, according to the Cuban legislation. Moreover, according to UN legislation, UNIDO cannot remain in the Committee after the end of the project. NOT ADOPTED
To increase the frequency of the Progress Reports (quarterly)	A bi-monthly Working Progress Report established. ADOPTED
To develop a replication and dissemination strategy plan, including preparation of a website	The website is not accessible from abroad. The Evaluation Team was unable to access the website at the time of the field visit. NOT ADOPTED An international conference on RETs experience in the Isla de la Juventud took

	place in early October 2014.
To provide external expertise/support to the project team in the field of biomass gasification	A specific in-depth training on gasification technologies was organized and conducted by a group of international Experts on 2013 (Gasification Technology Transfer activity of the actualized Work Plan), but no expert was hired. NOT ADOPTED
To prepare a Monitoring & Evaluation plan for the Cocodrilo plant	Monitoring Plan prepared. ADOPTED
To create a bonus system for plant operators	The bonus system was created. ADOPTED
Forestry management. To prepare a plan for all the different types of biomass to be supplied	Plan created. ADOPTED
To prepare a business plan to supply the whole Isla de la Juventud with sufficient biomass for future replications	The business plan was created and a contract between CF and GEAM was signed. ADOPTED
La Melvis plant. To use dual fuel engines	NOT ADOPTED
La Melvis plant. To avoid a new bidding process, using a gasification technology similar to that of Cocodrilo	NOT ADOPTED
To consider retrofitting existing diesel gensets for future plants (other than La Melvis)	Taken into consideration by the Project Team. ADOPTED
To reduce the demo project Compact Plant to the Technology Transfer component only	The Compact Plant and the Radar Punta del Este activities were cancelled altogether and relevant funds were allocated to the Gasification Technology Transfer activity. ADOPTED

VI. Project financing

34. The initial design of the project financing was in general adequate. The attempt to look for private (foreign) external finance was appropriate given the political context at the time, although it failed to materialize due to the perceived risk (by the potential investors) associated with the country (among which are the consequences stemming from the present embargo). Nevertheless, all the project stakeholders reacted positively to fill the gap created by the lack of private investment.
35. Table 3 below shows the latest available project financing information supplied to the Evaluation Team, and approved by UNIDO in April 2014.

Table 3. Project Financing

OP/UNIDO BLs	Description (proposed)	Allocations x 2005-2012	Allocations x 2013	Allocations x 2014	Approved Budget Rev5 2005-2014
		1	2	3	4=1+2+3
01	Implemented 103084 (GPCUB05001)				
11-00	International Experts	118.813,38	0,00	0,00	118.813,38
15-00	Project Travels	44.889,35	0,00	0,00	44.889,35
16-00	Unido Staff Travels	49.297,88	0,00	0,00	49.297,88
17-00	National Experts	7.687,45	0,00	0,00	7.687,45
21-00	Sub –Contracts	2.389.601,00	0,00	0,00	2.389.601,00
30-00	Study Tours/Meetings/Workshops	67.061,53	0,00	0,00	67.061,53
45-00	Equipment	514.955,84	840,50	0,00	515.796,34
51-00	Operation and Maintenance of Equip.	11.859,92	668,38	0	12.528,30
Total		3.204.166,35	1.508,88	0,00	3.205.675,23
03	Capacity Building				
15-00	Project Travels	829,20	0,00	0,00	829,20
17-00	National Consultants/Staff	0,00	0,00	8.000,00	8.000,00
21-00	Sub-Contracts	113.199,00	0,00	0,00	113.199,00
30-00	Study Tours/Meetings/Workshops	0,00	0,00	42.000,05	42.000,05
51-00	Operation and Maintenance of Equip.	0,00	0,00	0,00	0,00
51-00	Brochures/Pamphlets/news letters	0,00	0,00	49.665,51	49.665,51
Total		114.028,20	0,00	99.665,56	213.693,76
04	Financial Mechanism				
11-00	International Experts	0,00	0	20.000,00	20.000,00
21-00	Sub-Contracts	720.000,00	-10,69	550.010,69	1.270.000,00
45-00	Equipment	0	0	0	0,00
Total		720.000,00	-10,69	570.010,69	1.290.000,00
05	Demostrative Components				
11-00	International Experts	0,00	0,00	0,00	0,00
15-00	Project Travels	4.760,80	0,00	0,00	4.760,80
21-00	Sub-Contracts	0,00	0,00	0,00	0,00
45-00	Equipment	42.413,20	24.405,44	54.673,08	121.491,72
51-00	Operation and Maintenance of Equip.	2.719,20	0,00	0,00	2.719,20
Total		49.893,20	24.405,44	54.673,08	128.971,72
06-01	Project Management and Monitoring				
11-00	International Experts	16.699,90	12.034,16	17.965,79	46.699,85
15-00	Project Travels	0	12.033,73	30.702,69	42.736,42

16-00	Unido Staff Travels	6.892,82	5.526,41	32.439,85	44.859,08
17-00	National Experts	1.354,75	6.358,87	12.241,13	19.954,75
43-00	Project Permises	0,00	81,00	0,00	81,00
45-00	Equipment	0,00	0,00	0,00	0,00
51-00	Operation and Maintenance of Equip.	540,00	-28,95	0,00	511,05
93-00	UNIDO s Supporting Cost (5%)	205.678,64	0,00	48.464,46	254.143,10
Total		231.166,11	36.005,22	141.813,92	408.985,25
GRAND TOTAL		4.319.253,86	61.908,85	866.163,25	5.247.325,96

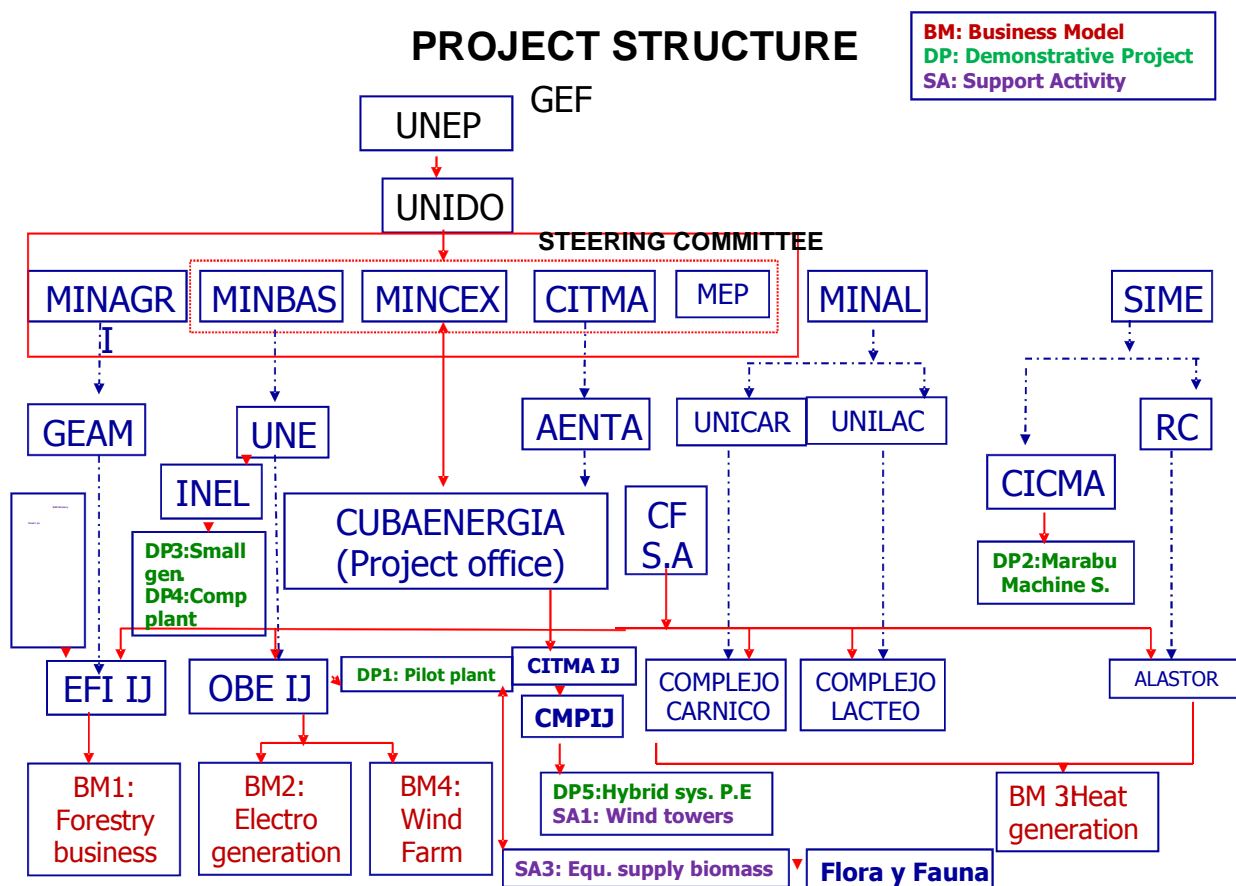
36. The Evaluation Team was informed, that at the time of writing, (November 2014) 65.000 US\$ remains unspent (to be deducted from the Grand Total of column 4 of Table 3 above). All the remaining indicated amounts were spent as indicated in the same Table.

VII. Project partners

37. The Initial project structure contemplated a high number of ministries, institutions and companies involved in the project. This created many bureaucratic complications (already mentioned in the Mid Term Evaluation Report) which resulted in delays and lack of agility, at the time, to adopt decisions.

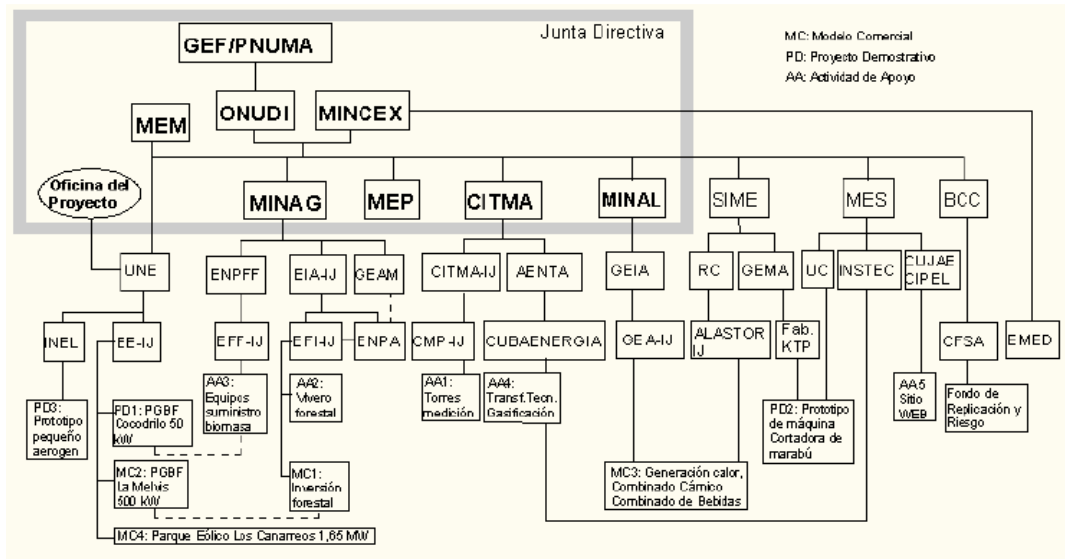
38. Table 4 below shows the initial project structure:

Table 4. Initial project structure



39. The Government of Cuba decided to carry out a restructuring which took place after the Mid Term Evaluation; the general purpose of the restructuring was to improve and increase the operational flexibility of the Cuban system. The resulting new project structure is summarized in Table 5 below:

Table 5. Final project structure



40. The table above indicates that three International Organizations, nine Ministries, five Groups of Enterprises, twelve single enterprises and five Universities/Research Institutes have been involved in the project during the last phases of project execution. As a result of this, responsible persons of institutions, enterprises, ministries, etc. which were already familiar with the project were replaced by incumbents which had had no previous exposure to or interactions with the project until then. Of course these changes were external to the Project, but, not surprisingly, it took a long time and effort to make all these people and new institutions familiar with the project activities.

41. The process of Ministerial reorganization is not yet completely finished

VIII. Changes in design during implementation

42. As indicated in Sub – Chapter D – III above, a major change in project design was approved by the project Steering Committee in January 2010. Table 6 below summarizes the modifications adopted (it is to be noted that the word “completed” was added to the table at the time of submission to the Steering Committee in January 2010 and does not imply any approval from the present Evaluation Team; the Table was a submission to the Steering Committee exactly as it is shown below):

Table 6.Modifications January 2010

(A) As per Original Project Document (June 2005)		(B) As per Modifications Requested by the Gov. of Cuba	
Activities	Outputs	Modifications/Reasons/Budget (\$)	Outputs
<p>1. Establishment of a policy and regulatory framework x enabling environment x RETs.</p> <p>(\$0.2 Mn)</p>	<p>1.1 Policy and regulatory framework established and operational;</p> <p>1.2 National quality assurance standards on RETs performance and evaluation benchmarks set up;</p> <p>1.3 Guidelines on environment impact assessment, voluntary certification and carrying capacity formulated.</p>	<p>1. Establishment of assurance standards and guidelines x RETs, on the basis of the policy and regulatory framework formulated by the Government.</p> <p>Reasons:The policy has been established by the Government. The defined in this project technical standards and guidelines will be developed on the basis of the established policy.</p> <p>Budget: \$ 10,000.0</p> <p>Expenditure: \$ 0.0</p>	<p>1.1 National quality assurance standards x the biomass and wind energy resources (within the framework of the project), established</p> <p>1.2 Guidelines on environment impact assessment for biomass and wind technologies, formulated.</p>
<p>2. Building local/national capacity to utilize the commercial potential of RETs.</p> <p>(\$2.216 Mn)</p>	<p>2.1 Key stakeholders trained on technology evaluation and benchmarking of RESs;</p> <p>2.2 Key stakeholders trained on management of RE based power plants and process heat generation systems;</p> <p>2.3 Experts and planners trained to manage technical and financial services x the project, information and dissemination and implement replication strategy;</p> <p>2.4 National manufacturing capacities strengthened to</p>	<p>2. Capacity building and training of key stakeholders (U and Nationals)</p> <p>Reasons: Rationalization of the “capacity building activities” within the framework of the project.</p> <p>Budget: \$ 62,510.5</p> <p>Expenditure: \$ 62,510.5</p>	<p>2.1 Key stakeholders trained on technology and benchmarking of RETs. (COMPLETED)</p> <p>2.2 Key stakeholders trained on management of RETs based power plant and process heat generation systems; (COMPLETED)</p> <p>2.3 Experts and planners trained to manage technical and financial</p>

	manufacture, assemble and maintain biomass gasifier systems and wind farms.	Activity completed.	services x the project. (COMPLETED)
3. Setting up of new and innovative financial mechanisms x private investments in RETs. (\$2.296 Mn)	3.1 Innovative funding mechanism to attract investment, set up; 3.2 Capacity of national banks and financial institutions to evaluate and analyse RETs based power plants, built.	3. Setting up of new and innovative financial mechanisms x investment management in RETs. Reasons: It has requested change of use and size of the Fund. The change of output 3.1 reflects the new situation. Budget: \$ 216,956.0 Expenditure: US\$ 216,956.0 The amount to be allocated to the RRMF fund is considered within point B4 below.	3.1 Innovative funding mechanism to manage investment, set up; 3.2 Capacity of national banks and financial institutions to evaluate and analyse RETs based power plants, built.
4. Implementation of 4 Business Models to demonstrate commercial feasibility of RETs x power generation and heating process. (\$10.679 Mn)	4.1 Installation and start up of 4 business models (biomass gasification x power generation based and process heat + wing energy + forestry business); 4.2 Training on operational and management of business models, conducted; 4.3 Supervision of performance of business units conducted; 4.4 Pilot mini-grid based on biomass gasifier technology set up at Cocodrilo.	4. Implementation of 4 Business Models to demonstrate commercial feasibility of RETs x power generation and heating process. Reasons: Due to the lack of external and internal availability of investments, it has been requested by the Gov. to redirect the remaining fund of the GEF grant component to finance reduced project objectives in the area of electro/heat biomass generation. Budget: \$ 7,420,000.0 Expenditure: \$ 5,500,000.0 (out of which \$ 1,000,000.0 from the RRMF to finance BMs 1; 2; and 3; and \$ 4,500,000.0 invested by the Gov. x the Wind Farm of Los Canarreos -1.65 MW).	4.1 BM1 – Forestry Management for biomass fuel supply (36,423 tonnes/year at regimen). 4.2 BM2: Electro generation from biomass (La Melvis plant) 0.5 MW 4.3 BM3: Heat generation from biomass (x Milk and Meat industries) 3.8 MWth. 4.4 BM4: Wind Farm 1.65 MW. (Completed; fully funded by the Gov.)

<p>5. Establishment of project management structures for implementation, coordination and monitoring of the project activities and dissemination of results.</p> <p>(\$0.650 Mn)</p>	<p>5.1 Project team selected and management structure in place;</p> <p>5.2 Capacity building and training of key stakeholders, achieved;</p> <p>5.3 Close monitoring and evaluation of project activities, performed;</p> <p>5.4 Effective information dissemination programmes, developed and implemented;</p> <p>5.5 Lessons learned and results disseminated and regional network created.</p>	<p>5. Establishment of project management structures for implementation, coordination and monitoring of the project activities and dissemination of results.</p> <p>Reasons: same sub-activities (no changes)</p> <p>Budget: \$ 383,467.6</p> <p>Expenditure: \$ 283,467.6</p>	<p>5.1 Project team selected and management structure in place;(COMPLETED)</p> <p>5.2 Capacity building and training of Project Team, achieved;(COMPLETED)</p> <p>5.3 Close monitoring and evaluation of project activities, performed;</p> <p>5.4 Effective information dissemination programmes, developed and implemented;</p> <p>5.5 Lessons learned and results disseminated and regional network created.</p>
	<p>-----</p>	<p>6. Implementation of the DemonstrativeComponent to strengthen national manufacturing capacities to manufacture, assemble and maintain biomass gasifier systems and wind farms.</p> <p>Reasons: To better reflect the activities 2 and 4 (column A), and to make a clear division: business models (activity 4 (B)), demonstrative projects (activity 6 (B)), and activities to support business models and demonstrative projects (activity 7 (B)).</p> <p>Budget: \$ 949,601.0</p>	<p>1. Cocodrilo electro-biomass pilot plant. (Please refer to point A- 4.4 of this table)</p> <p>2. Marabou plantation cutting machines system (please refer to point A-2.4 and Project Doc.)</p> <p>3. Small aero-generators/wind turbines, up to 5 KW. (Please refer to point A- 2.4)</p> <p>4. Local manufacturing of Compact biomass gasification power plant(s) for isolated communities. (please</p>

		Expenditure: \$ 99,601.0)	refer to point A- 2.4) 5. Hybrid system for the meteorological radar of Punta del Este, based on the Compact biomass gasifier. (please refer to point A-2.4).
		7. Support activities to the Commercial and Demonstrative Components: Reason: To better reflect the activities 2 and 4 (column A), and to make a clear division: business models (activity 4 (B)), demonstrative projects (activity 6 (B)), and activities to support business models and demonstrative projects (activity 7 (B)). Budget: \$ 540,321.9 Expenditure: \$ 105,465.0 (4 Wind Towers)	1. Installation of 4 Wind measurement towers. (Point A-2.4) 2. Nursery forest plantation and small equipmentfor Forestry development and research. (Point A-2.4) 3. Equipment for supply of biomass to the Cocodrilo plant. (Point A-2.4)
		8. UNIDO overhead cost (5%) Budget: \$ 254,143.0 Expenditure: \$ 88,399.9	
		Total Operational Budget (including UNIDO overhead cost):	\$ 9,837,000.0
		Government contribution: \$ 1,624,000.0	

	Additional contributions: \$ 420,000.0 (UNIDO (\$ 170,000; UNEP (\$ 50,000); and ADEME (\$ 200,000))	
Total Budget: US\$ 16.041 Mn	TOTAL BUDGET: \$ 11,881,000.0	

43. Apart from the modifications indicated in the table above, some others were added to the project outputs and activities:

- The gasifier to be installed in the Dairy Factory was dropped altogether. The reason for this was that the existing boiler was in a bad working condition and required immediate replacement in 2011. It was considered that it was not possible to wait until the gasifier proposed in the project document became available without putting the factory activities in jeopardy, hence the old boiler was replaced by a new (conventional) one. This has been one of the negative consequences of the delays in the procedures to obtain authorization, bidding procedures, etc.
- Compact gasification plant. Activity whose elimination was recommended by the Mid – Term Evaluation Team. It was dropped in 2010, shortly before the Mid –Term Evaluation Report was submitted.
- Radar Punta del Este. Same as above.

IX. Reconstructed Theory of Change of the project

44. Diagram 7 below shows the project theory of change which was used for the field mission, specifying project outputs, outcomes, assumptions, impact drivers and intermediate stated considered. The following paragraphs show the degree of realization of the project outputs and outcomes, as well as the progress towards the Project Objective and Goal.

- Outputs of Component 1 have been reached; a policy for renewable energy has been adopted by the Cuban government and standards for the considered technologies are being or have been adopted (through adaptation of foreign standards), as well as guidelines for evaluation of renewable projects. Assumption 1 has proved correct (and political will has increased as a consequence of the project activities), and Outcome 1 has been reached (the Cuban government has approved an energy plan with concrete objectives for development of renewable energy sources). Given the attitude of the Government and the degree of preparation of investment plans for use of renewable energy sources, it is clear that the intermediate state of utilization of the policy and regulatory framework will also be reached.
- Outputs of Component 2 have been only partially reached; not all the main stakeholders have been adequately trained (the Meat Factory), and the national manufacturing capacities have not been much improved (manufacturing of small wind generators has not started, and the gasifiers and main parts of the plants have been manufactured abroad). Impact Driver 1 is in place, but this is not the case of Impact Driver 2, (demonstrations of RE installations to schools/universities) since the plants have not yet been fully commissioned (except the wind farm and Cocodrilo, which is

located in a remote area). But Outcome 2 has partially been reached: local capacity has been built but only for forestry cultivation of biomass (a forest nursery has been created, a program of plantation of trees for biomass purposes has been established ...). Impact Driver 3 is also in place; communication with other projects has been established, and interest has been detected for the use of the RRMF.

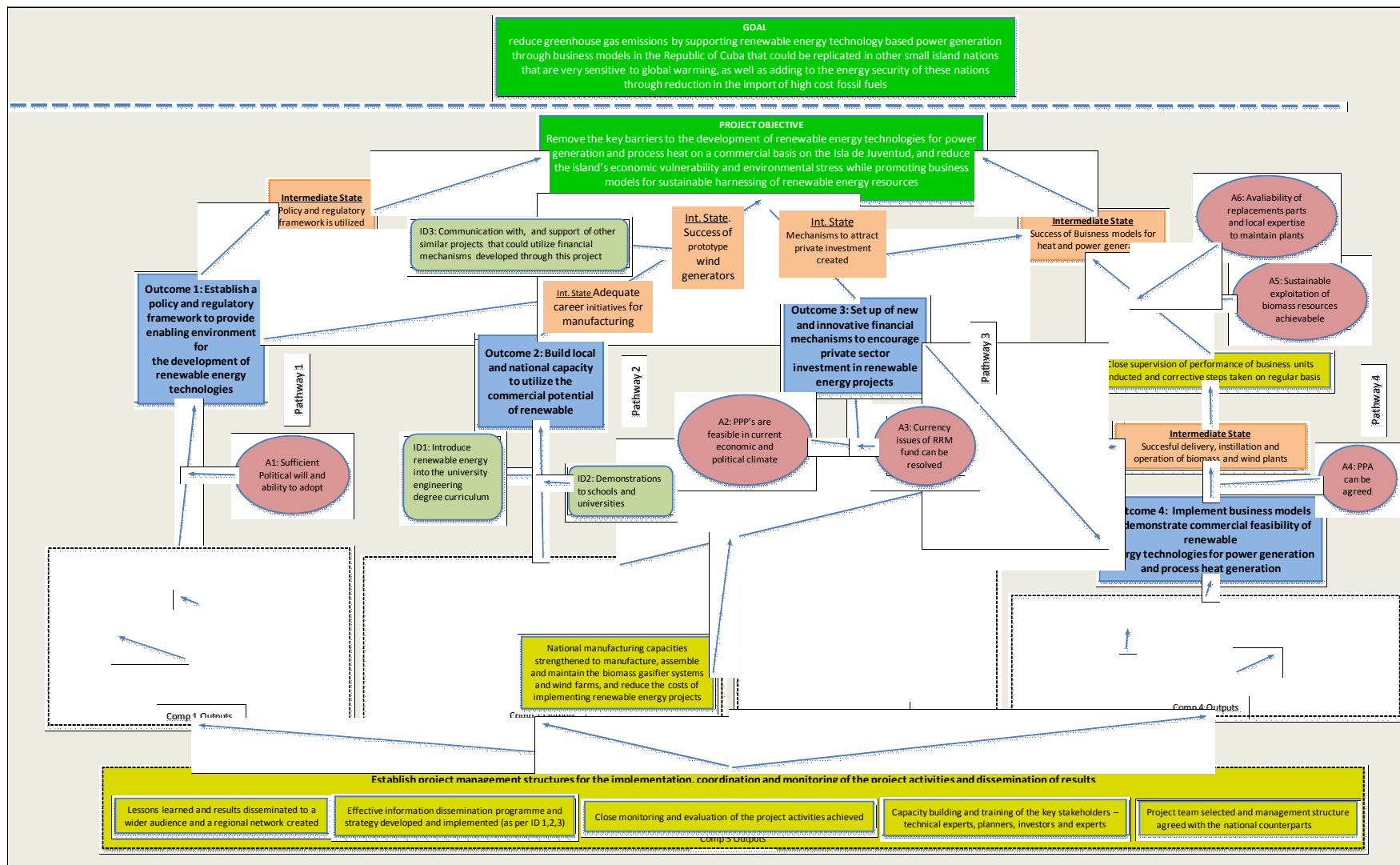
- Both outputs corresponding to Component 3 have been reached. Assumption 3 has proved correct (the RRMF has been created and is adequately managed), but this is not the case for Assumption 2; whilst the outlook at project design appeared favourable PPP's are not feasible under the present situation in Cuba, although it has to be said that the intentions of the Cuban Government seem again to be encouraging PPP's. Outcome 3 seems to be reachable, given the attitude of the Cuban authorities towards renewable energy sources, although participation of the private sector is still a delicate issue.
- Component 4: Of three business models, only one can be considered to have started: the forestry. La Melvis plant has not yet been commissioned, and the gasifier of the Meat Factory has not been installed (and the Meat Factory workers have received no training). Neither Outcome 4 nor any of the two Intermediate States have been reached. Assumption 5 that sustainable exploitation of biomass resources is achievable seems to be realistic, but Assumption 6 has proved erroneous: the lack of equipment and spare parts has proved to be a serious problem in Cocodrilo.
- As for Component 5, everything has been reached and the corresponding activities have been successfully carried out. Outcome 5 (establishment of project management structures) has been reached, and some dissemination efforts (Intermediate State) have been carried out, although a project website is not accessible from abroad; this is a serious inconvenience for the dissemination of project results. Moreover, the prevailing idea at the time of the field visits was to maintain the website only for one year after project termination (clearly too short a term).
- In general, activities devoted to disseminate project objectives and results have been very scarce; the website is not available, and only one international workshop has taken place (in October 2014, attended by the team leader of the evaluation team).

45. After the field visits and further discussions with project officials and stakeholders, the Evaluation Team considers that new Intermediate States should be considered and added to Diagram 7 below:

- For Outcome 2: Success of first prototypes of Cuban-manufactured wind generators

- For Outcome 2: Adequate training and career initiatives to develop abilities to manufacture gasifiers and auxiliary equipment in Cuba
- For Outcome 3: Government successful in creation of mechanisms to attract investments from the private sector

Table 7. Project Theory of Change



D. Evaluation Findings

46. The following paragraphs reflect the main findings of the evaluation, after the field visit and detailed analysis of the documents received. In general, the Evaluation Team considers that the visions given in some of the project Progress Reports have been, in some cases, too optimistic when compared with the actual situation.
47. According to the stipulations contained in the evaluation ToR, the different items are rated according to a six-point scale (HS to HU).

I. Strategic relevance

48. The project objectives were realistic at the time of project definition and clearly responded to the most relevant environmental necessity in Isla de la Juventud: to reduce emissions from combustion of liquid fossil fuels; the implementation strategy was also reasonable taking into consideration the organizational structure of the Cuban state.
49. Both project objectives and strategies were consistent with the environmental issues and needs of the area; an important part of the soil in Isla de la Juventud is inadequate for agricultural usage, and it is hence reasonable to use it for biomass forestry purposes. Objectives and strategies are also consistent with the UNEP Medium Term Strategy, especially with three of the six areas contemplated: Climate Change (the main objective of the project is to reduce emissions of GHGs), Ecosystem Management (supply of biomass to the Cocodrilo plant has resulted in a more adequate management of the surrounding ecosystem - a National Park with delicate environment), and the creation of a forest nursery to supply biomass to La Melvis plant and the Meat Factory will also have a very positive impact on the management of the environment on the island). Objectives and strategies are also consistent with GEF policies and Focal Area Priorities. The project was funded under the Climate Change Focal Area Operational Programme 6 -Promoting the adoption of RE by removing barriers and reducing implementation costs a part of Strategic Priority CC 3 Power Sector Policy Frameworks for RET & EE.

Rating of Strategic Relevance: **Satisfactory (S)**

II. Achievement of outputs

50. As indicated above, the Project Steering Committee decided, in 2010, to modify the project objectives and milestones, hence the following paragraphs refer to the outputs approved in that meeting (summarized in Table 6 above).

51. The activities consisting of the creation of the project team and of institutional reinforcement and training of the main stakeholders were adequately carried out; the project team was created, and the stakeholders have been adequately trained and informed about the project objectives and tasks. Nevertheless some remarks have to be made:

- There have been four different Project Directors during the project lifetime up until now; these changes have resulted in delays and have affected the coordination amongst the different activities and bodies involved. It has, nevertheless, to be said that the Mid - Term Evaluation recommended in June 2010 that no more changes in key positions should be made, and this recommendation was followed.
- The Mid Term Evaluation Team also recommended to hire some personnel to give direct support to the Project Director. The recommendation was followed, but the hired personnel did not remain in their posts for long (they later found better paid jobs).
- The delays in implementation of demonstration activities and business models has resulted in the fact that in some cases, persons already trained on the physical realization of the corresponding activities have either moved elsewhere or not been given any “on the spot practical” training; this is especially relevant in the case of the Meat Factory. Clearly specific training will be necessary before the installations are commissioned.

52. Demo 1 (Cocodrilo 50 kW Biomass Power Plant). The installation was completed, the necessary arrangements for a regular supply of biomass were made, and a monitoring and evaluation plan was prepared (this is important for possible replication of similar projects).

53. The plant ran intermittently during 2011 and 2012, and satisfactorily during the year 2013 (saving 18 metric tonnes of liquid fuel), but it has suffered a number of malfunctions; the compressor of the gas chiller unit had to be replaced (it was then discovered that the original one was not new at the time

of plant commissioning). Apparently due to human error, the new chiller ceased to work in April 2014, and the plant has been out of service ever since (a new unit has to be imported, and this process takes a long time). The possibility exists that the biomass dryer will have to be replaced due to corrosion (the plant is located near the sea). Moreover, the initial well-trained operators moved elsewhere to other jobs, and were replaced by insufficiently trained new personnel; this resulted in the referred to malfunctions. A better understanding of training of personnel is necessary to avoid repetition of this situation in the future.

54. Demo 2 (Radar Punta del Este). Activity dropped.
55. Demo 3 (Marabou Cutter and Biomass Processing). The first prototype was completed in December 2012 and went through field testing until March 2013. The prototype, designed on the basis of a sugar cane cutting machine, proved unsuccessful. Taking advantage of the experiences gained with this first prototype, a new one will have to be prepared, but this will involve a cost of about one hundred thousand US dollars. The project Steering Committee decided in June 2014 that this activity should be continued by the local industry and financed by the Ministry of Industry, without any co-financing from the project. The Evaluation Team learnt that some other cutting machines (manufactured abroad) have also been unsuccessfully tested (marabou wood is exceptionally hard).
56. Demo 4 (Small Wind Turbines). All components of two small generators 1,5 kw each and another two of 3,0 kw were purchased in the last months of 2012. Detailed schemes for the manufacture of the prototypes have not yet been finished, hence the fabrication has not started. The Cuban electric utility UNE has committed itself to acquire fifty units for assembling and installation in remote areas.
57. Demo 5 (Biomass Gasification Compact Plants – Local Manufacturing). The agreement for transfer of technology was replaced by a workshop on Technology with technical assistance hired by UNIDO, with the objective to supply training to Cuban personnel in the fields of design, engineering and manufacturing of biomass gasifiers.
58. Business Model 4. Wind farm. The Los Canarreos wind farm (five units with a total installed capacity of 1,65 MW, already commissioned) was a direct contribution by the Cuban government to the project (according to the initial Project Document, a 1,5 MW wind farm should be constructed in Playa de la

Bibijagua; this has been replaced by Los Canarreos wind farm, fully funded by the Government of Cuba).

59. Investment 1 (Biomass Boiler Meat Processing Plant in Nueva Gerona). The supply contract has been signed with a supplier from Uruguay (Berkes), after a bidding process with only two participants (Berkes and Ankur, from India, the supplier of La Melvis gasifier (see paragraph 611 below)). The contract had an initial validity of six months, which had been surpassed at the time of writing, hence a price increase is currently being discussed. Civil works have not yet started, allegedly due to the financial situation of the company and to lack of necessary information to be supplied by Berkes. Additionally, the meat plant personnel have received no training.

60. Investment 2 (Biomass Boiler Dairy Industry in Nueva Gerona. As indicated elsewhere in this report, this activity has been dropped.)

61. Investment 3 (La Melvis Biomass Gasifier and Power Plant). The construction of the plant is finished, but it has not yet been commissioned; it has faced several problems during the start-up process (inadequate size of biomass chips supplied to the gasifier, clogged hopper). The 500 kW unit has been online only at partial loads, and for a very small number of hours; the amount of synthesis gas produced was not sufficient to run the two engines at full load. At the time of the visit, the plant was offline and the problem of the size of the chips had not been solved: three months after the first appearance of the problem, assistance of the chipper manufacturer was required. No systematic tests with different types of biomass have been carried out.

62. Investment 4 (Biomass Processing – Empresa Forestal). This is probably the most important Business Plan, since it is in charge of supplying biomass to all others. The objective is to reach a biomass production and supply of 36,400 tons per year, and the field results have revealed that the usable biomass resource can reach 48,200 t/y available on sustainable basis, from *Acacia*, pine and *Casuarina*. The rotation length for the newly established forest is seven years.

63. In spite of reduction of both electricity and heat generation (capacity of La Melvis plant reduced from 3,5 to 0,5 MW, gasifiers in business's other than the Meat Factory dropped), it was decided to maintain the biomass production capacity at the 36,400 t/y level, to cater for future growth of biomass demand on the island. The activity was completed in April 2013 and all the necessary contracts signed.

64. A Forestry Development Program has been prepared and approved by the Ministry of Agriculture for Isla de la Juventud. The program was published in December 2011.
65. Others 1 (Compañía Fiduciaria). The Risk and Replication Management Fund (RRMF) was created (and is under the responsibility of Compañía Fiduciaria) and is in charge of funding the three project Business Models (La Melvis, the forestry activities and the meat industry); contract loans were signed, and a part of the funding has already been repaid. Operational Guidelines for the RRMF have been prepared, defining the conditions to be fulfilled by entities wishing to ask for loans. No interest rates are being charged to the three present projects, (except in case of delays in return payments), but an interest rate will be charged to future projects. Up to now no more projects are being financed by the RRMF, but some entities have shown interest. The RRMF is under the responsibility of the Cuban government, and will try to get new funding through international collaboration schemes (and private funding whenever possible). The recommendation of the Mid Term Evaluation to integrate UNEP-UNIDO in the Technical Committee after the end of the project has been rejected, due to lack of compatibility with Cuban law.
66. Others 2 (Meteo Towers). The 4 towers were installed and a campaign of evaluation of wind resources was successfully carried out.
67. Others 3. In June 2014 the Cuban Council of Ministers adopted a policy encouraged to develop and support the use of renewable energy sources in Cuba. The project portfolio has not yet been officially made public, but it seems to contemplate a wide range of projects covering 2200 MW (750 GWh/year) relative to wind, hydro, photovoltaic and bio-plants. The energy supplied to the network will be compulsorily bought by the electric utility Union Electrica, and the target date for preparation of the corresponding Regulatory Framework for renewable energy use is March 2015; the corresponding investment contracts are to be agreed by December 2015 (which seems to be optimistic, given the slowness of the procedures in Cuba and the difficulties to attract foreign investment). The approval of this policy has undoubtedly been influenced by the project activities and it is clearly very positive from the viewpoint of future replication of project activities and new projects.
68. Others 4. National Standards for generation of electricity or heat through use of biomass and wind. This activity started in mid-2010 and was completed in

December 2011 with the issuance of a set of National Technical Standards for Biomass electricity & heat generation and Wind electricity generation.

Rating of Achievement of Outputs: **Unsatisfactory (U)**

III. Effectiveness: Attainment of project objectives and results

69. The following paragraphs contain an overview of the quality and achievement of outputs that contributed to the project outcomes defined in the Project Document. Theory of Change (ToC) analysis is included, as well as information about evaluation of outcomes.

70. A first analysis of the reconstructed Theory of Change of the project has been given in paragraph 0 above. It is to be noted that new Intermediate States have been defined.

a. Direct outcomes from reconstructed ToC

71. As indicated in Table 6 above, the considered project outcomes are:

- Outcome 1. To establish a policy and regulatory framework to provide enabling environment for the development of renewable energy technologies.
- Outcome 2. To build local and national capacity to utilize the commercial potential of renewable energy sources.
- Outcome 3. To set up of new and innovative mechanisms to encourage private sector investment in renewable energy projects.
- Outcome 4. To implement the business models to demonstrate commercial feasibility of renewable energy technologies for power generation and process heat generation.
- Outcome 5. To establish project management structures for the implementation, coordination and monitoring of the project activities

72. For Outcome 1, the most relevant output is the creation of a policy to provide enabling environment for the development of renewable energy projects (biomass and wind).

73. For Outcome 2, the most important output is the strengthening of national manufacturing capacities.

74. For Outcome 3, the creation of the funding mechanism is the most relevant output.

75. For Outcome 4, the installation and start-up of the business models is of exceptional importance.
76. And for Outcome 5, capacity building and training of key stakeholders is the most important output.
77. Project Outcome 1 has a very general and ambiguous nature and it is therefore difficult to evaluate its degree of realization; it can be said that it has been partially reached during the project lifetime, since a favourable enabling environment for renewable energy has been created both in Isla de la Juventud and among Cuban authorities, resulting in the adoption by the Cuban government of a general plan for development of renewable energy sources, with quantified objectives for each energy source.
78. From the viewpoint of training, Project Outcome 2 has been successfully reached (with the exception of the Meat Factory), but it cannot be said that national manufacturing capacities or local universities/research groups have been strengthened. Moreover, although initial maintenance staff for Cocodrilo were well trained, they found later better paid jobs elsewhere, and the persons who replaced them were not adequately trained; this resulted in plant failures.
79. A mechanism for funding has been created (RRMF) under Outcome 3 and is working adequately. And the government is going to create another mechanism, based on the avoided costs of imported fuel, to remunerate investment in renewable energy plants.
80. Of the business plants contemplated under Outcome 4, only one is already running: the forestry / biomass production. The commercial feasibility of renewable energy technologies cannot be considered to be fully demonstrated.
81. Outcome 5 is not an outcome of the intervention; it covers activities needed for the creation of management structures to carry out the project intervention.

Rating of Achievement of Direct Outcomes: **Unsatisfactory (U)**

b. Likelihood of impact using RoTI and based on reconstructed ToC

82. Table 8 on the next page shows in a self – explanatory way the likelihood of project impact, through the analysis, based on the reconstructed ToC, as described above.

Table 8. Analysis of Likelihood of Project Impact

Results Rating of the Isla de la Juventud project							
OUTPUT	OUTCOME	Rating A-D	INTERMEDIATE STATES	Rating A-D	IMPACT	Rating (+)	OVERALL
Creation of a policy to provide enabling environment for the development of renewable energy projects (biomass and wind)	1. To establish a policy and regulatory framework to provide enabling environment for the development of renewable energy technologies.	B	Utilization of the policy and regulatory framework	C	The new policy will result in a number of renewable energy plants commissioned in Cuba, and hence in a reduction of both emissions of GHGs and imports of fossil fuels	BC	ML
Strengthening of national manufacturing capacities.	2- To build local and national capacity to utilize the commercial potential of renewable energy sources.	D	Success of first prototypes of Cuban-manufactured wind generators Adequate training and career initiatives to develop abilities to manufacture gasifiers and auxiliary equipment in Cuba	-		--	--
Creation of a funding mechanism	3- To set up of new and innovative mechanisms to encourage private sector investment in renewable energy projects.	A	Government successful in creation of mechanisms to attract investments from the private sector	C	Increase of available funding will result in further reduction of GHGs and fuel imports	AC	ML

installation and start up of the three business models	4- To implement business models to demonstrate commercial feasibility of renewable energy technologies for power generation and process heat generation.	B	Success of business models for power and heat generation	B	Good incentive for creation of new business and activities based on use of renewable energy sources	BB	L
Capacity building and training of key stakeholders	5- To establish project management structures for the implementation, coordination and monitoring of the project activities	A	Successful dissemination of results	C	.Reduction of GHGs and imports of fossil fuels in other countries in the area.	AC	ML
	<p>Rating Justification</p> <p>The project has had a relevant role towards the creation of a policy for development of renewable energy sources in Cuba. Important dissemination efforts among Cuban officials and stakeholders.</p> <p>Outcome 2 not reached.</p> <p>The RRMF was created, and specific responsibilities after project funding were specified.</p> <p>Only two business models created. Commercial feasibility not demonstrated.</p> <p>Project management structures created. Satisfactory project management</p>	B	<p>Rating Justification</p> <p>The government policy for development of renewable energy sources in Cuba has been just implemented; there has been no time for practical application of policy.</p> <p>Outcome 2 not reached, but process for manufacturing wind generators is in its early stages.</p> <p>A first funding mechanism created (RRMF). Government policy contemplates a mechanism for funding renewable energy projects based in avoided costs of</p>	C	<p>Rating Justification</p> <p>The Cuban government has taken a clear position to support use of renewable energy sources. Project business models not finished due to long delays, but (with one exception) installations are terminated and close to commissioning. Important training and dissemination effort carried out among stakeholders and Cuban authorities</p>	BC	ML

			<p>imported fossil fuels.</p> <p>Forestry management designed and running. La Melvis plant finished.</p> <p>International workshop celebrated. Webpage not available.</p>				
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Rating of Likelihood of Impact: **Moderately Likely (ML)**

c. Achievement of project goal and planned objectives

83. The Project Goal (“to reduce GHG s emissions by supporting renewable energy technology based power generation through business models in the Republic of Cuba that could be replicated in other small islands nations that are very sensitive to global warming, as well as adding to the energy security of these nations through reduction in the import of high cost fossil fuels”) has, according to the Project Planning Matrix, an indicator: the amount of fossils fuels displaced by renewable energy technologies. The Cocodrilo plant has saved approximately 18 tons of diesel fuel, whereas the Los Canarreos wind farm (which is not a result of project activities, but a contribution from the Government of Cuba) has avoided the consumption of approximately 1,630 toe (Tons of Oil Equivalent) between 2007 and 2013. Both plants have reduced the emission CO₂ by 6.500 tons up until June 2014; the end-of-project target being 390.000 tons of direct emissions of CO₂ avoided, (plus 1.000.000 tons indirect), according to PIR 2014 (covering the period until June 2014).
84. These results are clearly unsatisfactory. The main causes are the long delays experienced by the project (whose causes have already been mentioned in this report).
85. As for the Project Objective (“to remove the key barriers to the development of renewable energy technologies for power generation and process heat on a commercial basis on the Isla de la Juventud, and reduce the island’s economic vulnerability and environmental stress while promoting business models for sustainable harnessing of renewable energy resources”), it has to be said that, although the term “key barriers” is rather imprecise, the creation in Cuba of a policy to support renewable energy sources is a very important achievement.
86. The realization of the project outputs and outcomes can be seen described in detail in paragraphs 71 to 82 above.

Rating of Achievement of project goal and planned objectives: **Unsatisfactory (U)**

Global Rating for Efficiency: Unsatisfactory (U)

IV. Sustainability and replication

87. A fact to be emphasized is that the project is not just devoted to developing a number of activities with different types of renewable sources to serve as good examples and set the precedent for future projects and activities; the general principle on which the project is

based is to create a mechanism to carry out in a sustainable manner the development of renewable energy sources in Cuba. Clearly, the concept of sustainability was a matter of first concern at the time of the project design, and in fact this is specifically reflected in the Project Document

a. Socio – political sustainability

88. The Evaluation Team has detected no risks of a socio-political nature during the evaluation process. Consciousness about the convenience of use of renewable energy resources is very high among the stakeholders, authorities and general public, and has reached the Cuban government authorities to the extent of creating a policy aimed at encouraging the use of renewable energy resources. Scarcity of domestic fossil fuel resources and high prices of imported fuel put an important pressure on increasing future impacts of this type of projects.

Rating of Achievement of Socio – political sustainability: **Highly Likely (HL)**

b. Financial resources

89. From the viewpoint of sustainability, the creation of the RRMF plays a major role. It has been created and seems to be functioning adequately, although it is necessary to find more sources of financing, aside from repayments of the three present business models.

90. There is a risk the future development of the Fund could face, and this is based on the foreseeable future monetary situation of the country. Up to now, a relevant characteristic of the Cuban economy is that it is based on the use of two currencies: the Peso (also called Moneda Nacional) and the Peso Convertible (CUC). The Cuban authorities have indicated their intention to move towards a single currency, but this change could create tensions in the economic situation of the country, which could impact adversely on the development of renewable energy.

91. Clearly, a complete and detailed description of the present Cuban economic and monetary system is beyond the scope of this report, but the creation of a single Cuban currency (hence the criteria to be applied to exchange CUCs into the new currency) is uncertain. Given that the RRMF administered by Compañía Fiduciaria is composed of CUCs, this represents a future risk which at present is very difficult to quantify.

92. Nevertheless, the very existence of the RRMF is an important step towards sustainability of activities in the fields of renewable energy resources. Apart from the role played by the funds directly supplied by the Project, it guarantees the continuous existence of funds for funding of future projects and it constitutes a nucleus for future financing from other possible external donors. Given the scope of the project, a good degree of financial sustainability has been reached; the RRMF has only financed the three initial model businesses (La Melvis, the Meat Factory and the forest nursery), and approximately 290,000 US\$ of the initial loans have already been repaid.

Rating of Achievement of Financial sustainability: **Likely (L)**

c. Institutional framework

93. Like in many other countries around the world, the general energy policy of the Cuban authorities is directed towards reduction of oil imports and use of domestic energy resources, and the repeatedly mentioned recent creation of a policy for use of renewable energy resources indicates that this policy is now stronger than before.
94. Unfortunately, the necessary know-how is at present not in place; Cuba has some technical resources to manufacture biomass gasifiers and other types of components for installations that use renewable energy resources, but a transfer of technology is still necessary to take advantage of these capabilities. In this sense, the signature of agreements for further transfer of technologies with the foreign institutions already contacted during the development of the project is very important; the case of the components for small wind generators is a good example.

Rating of Achievement of Institutional sustainability: **Moderately Likely (ML)**

d. Environmental sustainability

95. Given the organization of exploitation of biomass resources defined by the project, no risks are derived from the project activities from the viewpoint of protection of the environment. The use of wind resources is certainly not harmful, and consumption of biomass is contemplated under a scientific approach (biomass cultivated exclusively for its use as an energy resource, use of forest waste proceeding from cleaning, etc.). In fact, cleaning of forests was already being carried out, but now an economic profit is to be obtained from the residues; this is considered a very relevant issue. The only possible risk is that a delay in the implementation of the scientific approach mentioned above results in an excessive use of forest wood other than residues during the first 6-7 years after the project end (due to the unavailability of the nursery).

Rating of Achievement of Environmental sustainability: **Highly Likely (HL)**

e. Catalytic Role and replication

96. As indicated in paragraph 87 above, a guiding idea of the initial project was to create a catalyst for future activities; in fact the idea behind the creation of a Risk and Replication Management Fund is to develop a mechanism to support the development of future projects, since experience has repeatedly shown in practically every country that one of the most important barriers to implementation of projects based on renewable energy sources is the difficulty of finding adequate funding. The project contains activities of the foundational type (establishment of a policy and regulatory framework enabling development of renewable energy technologies), as well as demonstration activities

(biomass gasifiers for use in power plants and in industrial installations, wind generators, etc) and investment activities (implementation of business models). This chain of activities seems to be well designed to create a basic infrastructure to allow for replication and sustainable activities in the field of renewable energy.

Catalyzed behavioural changes

97. The program prepared by the Cuban government to develop renewable sources of energy contemplates a five-fold increase in penetration of renewable energy from 2014 to 2020. Although this objective is probably too optimistic, it clearly indicates a clear support for renewable energy. The Program includes, among other things, a total installed capacity of 27 MW for electric plants using forest biomass and thirteen new wind farms with a total installed capacity of 633 MW. The Program also contemplates additional incentives to those included under Law 118 on Foreign Investments (This Law, passed in April 2014, establishes a legal framework for foreign investments in Cuba, defining guarantees, repatriation of benefits, etc). The Program considers both joint ventures and independent companies.
98. Given that forest biomass for grid-connected generation of electricity has been introduced in Cuba through the project (La Melvis), the influence of the project at the time of definition of Cuban renewable energy policy is clearly visible. This influence will hopefully result in a catalytic role when La Melvis reaches its full commercial availability.
99. No catalytic effect has been detected by the evaluation team in the fields of assessment, monitoring and management systems (except the possible role played by the forest nursery at the time of creation of new ones elsewhere in Cuba).

Incentives

100. As indicated in the Mid Term Evaluation Report, cleaning of forests was previously an activity that was carried out in Isla de la Juventud only because it is necessary to guarantee an adequate maintenance of forests, to prevent fires, etc., and the biomass obtained was treated as a residue. The project is creating the possibility to see this activity from a completely new viewpoint: now this “residue” has a commercial value, defined by the value of the fossil fuel savings that are obtained through use of biomass for generation of electricity and heat. Beside this, the new land area to be reforested for generation of more biomass results in creation of jobs and an increased consciousness about the importance of forest related activities
101. The project has also played a role in facing other biomass-related problems on the island: marabou has invaded a large area of land (not only in Isla de la Juventud, but also in the main island), and it is seen as a serious problem; unfortunately the marabou-cutting machine designed under project’s auspices has proved inadequate in design (it was made on the basis of a sugar cane cutting machine, but marabou is much harder than sugar cane). In the long-term, when this harvesting problem is solved, the removal of the invasive Maribu tree has the potential to yield environmental benefits in addition to fossil fuel savings from the use of the biomass.

102.Reduction in the use of fossil fuels is a strong incentive towards use of renewable energy sources. Oil imports are a heavy burden on the Cuban economy, and every mechanism to reduce it is welcome by stakeholders, mainly by those responsible for industrial activities. In summary, the project activities have acted as an incentive towards new and positive attitudes from stakeholders on the use of renewable energy sources.

Institutional changes

103.A general atmosphere of support for renewable activities has been created, both at national and local level. The project activities are seen as a source of income, reduction of fossil fuel consumption, and of creation of jobs. The Cuban institutions have closely followed the development of the project activities (see paragraph 97 above).

Policy changes

104.At the time of the project start, no renewable energy policy as such existed in Cuba; only references were given in some pieces of legislation. Now a program for renewable energy has been prepared (paragraph 97 above). The Cuban authorities did not contemplate financial support for renewables beyond the scope of this project (just the possibility to obtain soft loans); now a financing mechanism for support of renewables has been prepared, based on the avoided costs of imported fuels.

Catalytic financing

105.The creation of the Risk and Replication Management Fund has been an important step for the future, since it is a very appropriate tool to channel future development activities involving renewable energy. The Fund can receive funds from donors other than this project, and future donors will be happy to have at their disposal a proven mechanism to select and finance new activities. It can be reasonably expected that RRMF will play a relevant role in the future development of activities in Cuba in the field of renewable energy.

Project champions

106.CubaEnergia, the Cuban counterpart of the project, has strongly championed the project activities, as well as UNE, the electric utility, and the Isla de la Juventud local authorities.

Replication

107.Speaking in general terms, the project is clearly suitable for replication. Distinction has nevertheless to be made between the replicability of the project as a whole and of its different activities. The Los Canarreos wind farm is working, wind resources have been evaluated, the Cocodrilo plant has run satisfactorily for long periods, and can be replicated, but the same cannot be said for La Melvis; it has run at partial loads for a very short time and its technical and commercial feasibility remains to be demonstrated (the case of the Meat Industry is still more doubtful, since construction of the plant has not been initiated).

108.As a whole, it could be replicated in other areas, especially in those with geographical and environmental characteristics similar to those of Cuba (large biomass resources, scarce

development of activities in the field of renewables, absence of structures for funding of renewable energy projects, etc.), but the concrete biomass technologies to be used in each future project should be evaluated and compared before a decision to implement a certain technology is reached. Of course the entire project cannot be replicated in Cuba (it would be useless to have two sets of guidelines for development of renewable, two RRMFs, etc.).

109. The creation of a RRMF in other parts of the world can be useful (financing has proven to be a strong barrier for development of renewable energy projects practically everywhere). It is worth noting that the Cuban currency system makes it especially difficult to arrange for investments from foreign countries, so the creation of a RRMF should in principle be easier elsewhere.

110. The demonstration and creation of business activities can be replicated inside Cuba, and in fact the Evaluation Team was informed of several plans to do so (to generate electricity from residues in sawmills, to electrify isolated areas through forest biomass and/or wind energy, to develop plants of the “La Melvis” type in other parts of the main island, etc.). However, replication will only happen if the RRMF is successfully implemented and La Melvis performs adequately. The Cocodrilo plant could be replicated, since it has performed satisfactorily for long periods; the problems encountered (breakdown of the chiller) are not uncommon, and the delays in obtention of spare parts are due to the specific conditions of the Cuban economy, not to the technology itself.

Rating of Achievement of Catalytic Role and Replication: **Satisfactory (S)**

Global rate for Sustainability and Replication: Likely (L)

V. Efficiency

111. From the viewpoint of cost, the project was initially well defined and has been efficiently managed; with the only exception of La Melvis (initially intended to have a capacity of 3,5 MW, for which the budget was insufficient, according to the project management) all the other activities were adequately budgeted and their costs have had no significant differences with the corresponding budget lines.

112. As for the timeliness, the project has experienced major delays. The hurricanes of 2008 had certainly a very negative impact on the project activities and time schedule, but this has not been the only cause; it can be said that the main causes have been the bureaucratic complications of procedures in Cuba and the high number of institutions involved, as well as the (relatively) recent restructuring of the Cuban government.

113. The reduction of the project performance targets and time schedule agreed in January 2010 has had no positive effects on elimination or reduction of delays; milestones to be reached in June and December 2010 (described in the Mid Term Evaluation Report) were not reached in due time, and at the time of the project’s formal operational completion many activities remain unfinished (although the involved stakeholders have agreed to finish them).

114. The Evaluation Team has detected no concrete time-saving measures taken along the project timeline, except the dedication and insistence of the Project Director and his team. Clearly the consequences of the high number of Cuban institutions involved (at several levels) and the slowness of procedures and authorization processes in Cuba were underestimated at the time of project design; more attention should have been paid during the design phase and detailed discussions held with the Cuban counterparts on the project structure (see Tables 3 and 4 above) with the aim of a simpler solution.

115. Communication problems among the involved institutions (including UNEP and UNIDO) were also detected at the time of the Mid Term Evaluation; the situation seems to have improved, since reporting was made more frequently, but the communication problems were not eliminated.

Rating for Efficiency: **Unsatisfactory (U)**

VI. Factors affecting project performance

116. The following paragraphs consider issues related to the project development, from its initial design to the present, analysing both the difficulties arising and the measures taken to solve them.

a. Preparation and readiness

117. At the time of the project definition the Cuban energy outlook was characterized by a heavy dependence on imported fossil fuels and a low degree of use of renewable energy sources. This situation was especially acute in Isla de la Juventud, where dependence on imported (and heavily pollutant) liquid fuels was practically absolute. The Project Document adopted a logical approach at the time of definition of project objectives and activities, considering the available renewable energy resources in Isla de la Juventud: large biomass resources, large amounts of land, inadequate for food-related agricultural activities, unknown wind energy potential, etc., but the project was focused on biomass gasification and did not consider a process of selection of the most adequate biomass technology for each activity.

118. The initial project budget was adequate for the project objectives, with the exception of La Melvis power plant (whose initial capacity was reduced to 0.5 MW). On the other hand, and considering the institutional context of Cuba, the initial time allocated to the project was too optimistic; the initial term was approximately five years, but almost ten have proved to be insufficient to finish all the planned activities, in spite of the reductions effected by the Steering Committee in January 2010 (to cater, among other things, for the effects of the hurricanes of 2008). Bureaucratic conditions (two UN agencies and a large number of Cuban authorities and institutions were involved) were also clearly underestimated, as well as the effects of the specific characteristics of the institutional context in Cuba. Moreover, further delays have been experienced since the project

modifications and revised time schedule defined by the Steering Committee in January 2010.

119. It was a well known fact that Cuban procedures are slow and time-consuming and that many different authorities and bodies would have to be involved, and those considerations were obviously taken into account when the time length of the project was defined; the project objectives were clear and practicable, but, as indicated in the previous paragraph, the proposed project duration was too short, regardless of *force majeure* events (such as the hurricanes of 2008). The commissioning, in a five year period, of a gasification plant for electricity generation in a country with no experience in that technology, no organized biomass supply infrastructure and very lengthy and bureaucratic procedures was an overly optimistic objective; it is worth noting that even after a four year extension (from 2010 to 2014, with no hurricanes) the plant commissioning process is not yet complete.
120. As indicated elsewhere in this report, no previous selection of the most adequate biomass technology is mentioned in the Project Document; the use of gasification was directly included in the Project Document without giving any reason. Clearly Isla de la Juventud had (and has) a very high biomass potential, but analyzing a selection of possible technologies would have been advisable (perhaps based on outputs from other projects).
121. Selection of the executing agency was adequate, and all the counterparts in Cuba were chosen according to reasonable criteria, taking into consideration the organization of the Cuban state and the project tasks and objectives. The number of institutions involved was very large, but this was probably difficult to avoid due to the nature of the tasks and objectives, the structure of the Cuban state and the limited degree of development of renewable energy resources in Cuba.
122. The Project Document makes clear that due consideration was given to past experiences and data obtained from several relevant projects and related activities (UNEP/GEF SWERA, UNEP/GEF Project on Cogeneration using sugar cane and trash, CREDP-UNDP-CARICOM).
123. The Project Steering Committee decided to make an important reduction of the project performance targets in 2010, due to the effects of the two hurricanes of 2008 and to the consequent reduction of available funds from the side of the Cuban government. This decision seems reasonable given the prevailing situation and circumstances.
124. At the time of project implementation, the roles to be played by the different institutions involved seem to have been clearly defined and agreed, but in fact there were many different bodies involved in each activity, and, as indicated above, the coordination of all of them has proved difficult in practice. Counterpart resources were adequate at the time of the project start-up, and an adequate (if complicated) project management structure was defined. Later, the project faced difficulties derived from excessive changes in the project staff (the Project Director was replaced three times) and slowness in the process of project management.

c. Project implementation and management

125. The project implementation arrangements were, in general adequately designed at the time of project definition. The project organization, objectives, M&E mechanisms, etc. were properly described.

Project implementation mechanisms

126. The implementation mechanisms defined in the Project Document for its implementation were clear and concise, and adequately defined the roles and responsibilities of the different entities and organizations involved.

127. The reaction of the Steering Committee to the changing environment derived from the effects of hurricanes, which changed the priorities of the Cuban authorities and required a large amount of money to rebuild the infrastructure of Isla de la Juventud, was clearly adequate. It was necessary to reduce the scope of the project, eliminate certain activities, and re-distribute the project budget.

128. At the time of the project's inception, seven Ministries, ten Havana – based Agencies and seven other agencies, companies and institutions based in Isla de la Juventud were involved in the project. Co-ordination of so many stakeholders has been very complicated, and has resulted in significant delays to the project activities. Worse still, the project structure was changed (see paragraph 38 above). It has to be recognized that, given the structure of the Cuban public administration, it is difficult to avoid the involvement of so many institutions, but this situation makes the role of project co-ordination especially important.

129. The project has had four different Project Directors in the first five years, and all of these changes resulted in delays. Certainly, the situation improved later in project execution; following the recommendations of the Mid Term Evaluation no more changes have taken place.

130. It can be said that a common cause of delay has been that each stakeholder has been waiting for the other to act and, in spite of the Project Management efforts, this has resulted in a lack of initiatives to unblock the different processes and to try to make some progress independent of the attitude adopted by other stakeholders

Effectiveness, efficiency and adaptability of project management

131. As repeatedly indicated elsewhere in this report, the Steering Committee reacted adequately to a changing environment due to the impact of hurricanes in 2008. The policy adopted to establish concrete milestones to be reached at certain times was positive and helped to clearly define priorities and adequately indicate responsibilities. But in general the defined milestones were not reached in due time.

132. It can be said that in general the Cuban executing agencies have shown support for the project. Especially important is the case of Compañía Fiduciaria, which plays the very important role of administration of the RRMF. However, the co-ordination among them has not been optimal.

133. The Project Direction Team has made many efforts to coordinate the many institutions involved.

Administrative, operational and/or technical problems and constraints

134. In addition to the problems noted above, the restructuring recently carried out by the Cuban government, has resulted in further delays.

Rating for Project Implementation and Management: **Satisfactory (S)**

c. Stakeholder participation and public awareness

135. The Evaluation Team detected a high degree of commitment to the project objectives from the local authorities in Isla de la Juventud. In spite of the delays, this commitment is likely to be maintained for the completion of all the pending project activities. The dissemination efforts carried out by the project team have clearly been successful.

136. It has to be said that the current procedures for authorization of projects and installations not only involve the local authorities, but also Ministries and other organizations based in Havana, hence the delays in authorization procedures are not the direct responsibility of the local authorities.

137. The direct beneficiaries of the project have been adequately informed about the nature and purpose of the project and shown a clear interest in the success of its activities. This is especially important for technologies implemented in Isla de la Juventud for the very first time. When the ToR for the bidding process of La Melvis and the meat factory were prepared, the main stakeholders (the electric utility and key personnel of the meat factory) were consulted.

138. It was noted, however, that the implications of use of biomass gas for steam generation has not been adequately explained to the only remaining stakeholder (the meat factory, since the dairy plant had to abandon the project due to the urgently needed replacement of the existing conventional oil-fuelled boiler). This issue was also noted by the Mid Term evaluation team, and unfortunately the situation has not changed.

139. In general, public awareness is satisfactory and the effectiveness of collaboration and interaction between the project partners can be considered adequate, but the supply of information and training to the meat factory is urgently required.

Rating for Stakeholder participation and Public Awareness: **Satisfactory (S)**

d. Country ownership and driven-ness

140. Cuba has experienced, since the early 1990s, a serious economic crisis, including shortage of energy supplies, due to the collapse of commercial relations with the former COMECON, and further worsened by the trade embargo the country is facing. The Cuban Government initiated in 2005 the so-called “Revolución Energética” (Energy Revolution), which contemplated different measures to reduce the country’s dependency on imported fuels (including use of domestic resources and renewables), and to encourage efficient use of energy.
141. In 2010, the most relevant piece of law in relation to the activities included in the project was the National Program for Development of Local Energy Sources, which, among other things, considered development of renewable energy sources. Now a policy of support for renewable energy sources has been approved (see paragraph 67 above), and all the authorities contacted by the Evaluation Team at both national and local level expressed firm support for the use of renewable energy resources and to the reduction of consumption of liquid fossil fuels.
142. The Cuban counterparts have collaborated adequately with the project activities, taking into consideration the organization and procedures of the Cuban state, which are complicated and slow.
143. Contributions from the Cuban counterparts (most of them in kind) have been adequate and congruent with the project requirements, before and after the modifications agreed in 2010.
144. It can be said that the project goal, objectives and activities clearly reflect the priorities of the Cuban government in the field of energy. But in general the main concern of industrial stakeholders is to reduce consumption of liquid fuels, and not reduction of emissions of greenhouse gases; reduction of emissions of GHGS is certainly a consequence of reduction of liquid fuels consumption, but not an objective in itself. Anyway, the Cuban energy authorities have emphasized their commitment to the reduction of GHG emissions.

Rating for Country Ownership and Driven-ness: **Satisfactory (S)**

e. Financial planning and management

145. The fact that UNEP and UNIDO have used different formats for budgets has been a source of difficulties for monitoring the financial development of the project. The initial project budget (in UNEP format) was well structured and in general contained adequate funding for each of its lines (one exception to this is the budget line for mid-term evaluation, which was too low).

146. The initial budget by project activity contemplated 8.660 MUS\$ in private investments (more than a half of the total budget of 16.041 MUS\$), estimated through some letters of interest from private investors, but all these private investments failed to materialize.
147. Moreover, two hurricanes reached Isla de la Juventud in 2008, with disastrous effects, and the Cuban government had to devote significant financial resources to reconstruction purposes. This situation made it necessary to modify and reduce the project performance targets, and the Steering Committee, quite realistically, approved the necessary changes and subsequent budget reduction.
148. Before the Mid Term Evaluation the project budget had been modified twice, and another four times since: November 2010, April 2011, September 2012 and January 2013, to cater for the abandonment of several project activities, as indicated elsewhere in this report. At present (the project's operational completion) there is a surplus of more than 200.000 US\$; it has been decided to use this for an extension of the La Melvis project (to add another 500 kW), but, as indicated elsewhere in this report, the Evaluation Team considers that this should not be done until the present La Melvis plant has been adequately tested and proved technically and commercially successful.

Assessment of financial controls

149. Quarterly financial reports were to be prepared and submitted, according to the Project Document. A financial report model was included in the Project Document, and it was adequately designed and structured to give a clear idea of the financial situation of the project at any time.
150. The scheduled budget lines have been surpassed on very few occasions; this indicates that adequate financial controls have been properly carried out and the Project Management has always been in a good position to make informed decisions regarding budget and flow of funds.
151. It goes without saying that the project delays have resulted in expenditures well behind schedule on many occasions but, at project completion, the only budget disequilibrium (surplus) is due to the dropped activities.

Co - financing

152. The initial project budget contemplated 8.660 MMUS\$ of private investments, which have failed to materialize. This has been one of the main causes of reduction of project size and objectives, together with the effects of the hurricanes in 2008. For these reasons and due to the economic crisis, the Cuban government had to change its priorities for investments; this resulted in budget modifications, approved by the Steering Committee. Nevertheless, all Business Models and Demonstration Projects have secured co – financing in local currency from Cuban Ministries, duly expressed in the corresponding National Economy Plans. GEF funds have been mainly used for imports in hard currencies.

Diligence

153. Funds have been adequately managed, and only small deviations from the budget have been detected. The Evaluation Team has not detected any complaints from project stakeholders.

154. No reports of financial audits have been made available to the Evaluation Team.

Actual costs and co - financing

155. As indicated elsewhere in this report, the Government of Cuba has supplied more funding (mainly in kind) than originally foreseen in the Project Document. Table 8 below shows the final co-financing report, supplied by UNIDO.


Table 9. Final project co-financing report

ANNEX 1C
UNEP/GEF REPORT ON PLANNED PROJECT COFINANCE AND ACTUAL COFINANCE RECEIVED (until June 2014)

Title of Project: Generation and Delivery of Renewable Energy based Modern Energy Service: the Case of the Isla de la Juventud							
Project Number:		PMS.GF/4040-05-10		IMIS.GFL-2328-2721-4837			
Name of Executing Agency: UNIDO							
Project Duration: From: 05/9/2005 31/10/2014							
Reporting Period: September 2005 to June 2014							
Source of Cofinance	Cash Contributions			In-kind Contributions			Comments
	Budget original	Budget latest revision	Received to date	Budget original	Budget latest revision	Received to date	
Gov. of Cuba	1,594,000	1,594,000	7,200,793	30,000	30,000	30,000	Gov. of Cuba has financed the full construction of the Wind Farm (1.65 MW) Los Canarreos (\$4.6 Mn) and all civil works/infrastructures of the La Melvis biomass plant (0.5 MW) + civil works of all Demonstrative component + the salary of the Project Team
Private sector investors	8,660,000	8,660,000	0	0	0	0	
UNIDO	0	0	0	170,000	170,000	170,000	
UNEP	0	0	0	50,000	50,000	50,000	
ADEME	200,000	200,000	0	0	0	0	
Additional Cofinance:-							
Total	10,454,000	10,454,000	7,200,793	250,000	250,000	250,000	

All amounts in US dollars

Name: Diego Masera
Position: Project Manager
Date: Septiembre 2014



156. As for leveraged resources, it proved impossible to obtain funding from private investors. But, in spite of serious financial difficulties due to the effects of the hurricanes on Isla de la Juventud in 2008, the Cuban government reacted positively by asking for Los Canarreos wind farm to be considered as contributions to the project, and this was approved by the Steering Committee. In fact, many contributions from the Cuban side were in kind.

Rating for Financial Planning and Management: **Satisfactory (S)**

f. UNEP supervision and backstopping

g. The project monitoring plans were adequately defined at the time of project design, taking due consideration of the special characteristics of the project, its duration and

the low degree of use of renewable energy sources in Cuba at the time of project start up. In the same way, the design of the project implementation review reports (PIR's) is adequate to give a clear and detailed outlook of the situation of the project at a certain time. These PIR's were to be prepared on a yearly basis (the last one covers the period from 1/7/2013 to 30/6/2014).

- h. It is worth noting that the situation reflected in the last available PIR (mentioned in the previous paragraph) is better than the actual situation observed by the Evaluation Team.
- i. In other PIRs, it has been detected that the Task Manager ratings seem to be more severe than those of the Project Manager.
- j. The Mid Term Evaluation recommended that the progress reports (initially to be prepared every six months) were prepared more frequently, and that these reports (as well as the PIRs) should be prepared in due time, without delay. These recommendations were followed.
- k. Both UNEP and UNIDO officers have visited Cuba and the project sites in Isla de la Juventud several times and made a follow up of the project development. Nevertheless the Evaluation Team has detected complaints from UN officers, indicating that they did not know the real situation of some project activities. The Evaluation Team wonders why this situation has not been detected during the almost ten years of project development.
- l. The Evaluation Team considers that the initial mechanism adopted by UNEP to supervise the project was in general well designed. A different issue is that the reports have been prepared with delays in several cases.
- m. Last but not least, it has to be said that, after the hurricanes, UNEP took a realistic approach to adapt the project to the new circumstances, reducing its performance targets and creating sets of milestones to try to have a clearer control of the project achievements. UNEP backstopping can be considered adequate.

Rating of UNEP Supervision and Backstopping: **Satisfactory (S)**

g. Monitoring and evaluation

1. M&E design

- n. As indicated in the Mid Term Evaluation report, the project monitoring and evaluation indicators and means of verification contemplated in the Project Document were in general well designed and seemed adequate to give clear and concise information about the project outputs and outcomes. The responsibilities of the project management entities regarding monitoring and reporting were clearly defined.
- o. The log frame matrix of the project had specific indicators for all the project objectives. The indicators were clear and relevant to each of them, and the Evaluation Team considers that they are sufficient to give clear references for the monitoring, evaluation and quantification of results.
- p. The baseline information is sufficient for a project which has as its immediate objectives to replace liquid fuel for generation of electricity, but the consumption of fossil fuels in industries for heat (steam) is not mentioned as a reference for the activities related to dairy and meat industries. Otherwise, specific targets were defined

for all the project outputs, and the desired level of achievement was clearly specified in the Project Document.

- q. The project design of M&E fulfils the minimum requirements of GEF projects:
- Although some of them are of a general nature, it can be said that the indicators for project implementation cover the SMART requirements (Specific, Measurable, Achievable, Relevant & Realistic and Time-bound & Timely & Trackable & Targeted). There are sufficient relevant indicators for each of the project outcomes. Not all of them are quantifiable, but this is a logical consequence of the very nature of some of the project outcomes.
 - The same can be said of indicators for outputs.
 - The project baseline is described in the Project Document, and clearly defines the problems to be addressed, and establishes indicator data (amount of liquid fuels replaced by renewable energy sources).
 - The Project Document contains an M&E plan which identifies the reviews and evaluations to be undertaken.
 - Evaluations are at present adequately budgeted (mid – term and terminal evaluations), but there is no specific budget line for monitoring (see paragraph t below).
 - Responsibilities for M&E have been adequately defined.
 - The time frame for M&E was designed, but it has experienced some delays (the Mid-Term evaluation was postponed several times, and certainly the Final Evaluation has taken place much later than initially scheduled).
 - No specific targets were defined for the time of evaluations (in fact, the Mid Term Evaluation has been carried out after almost five of the initial six years of project duration).
 - The external factors (both assumptions and risks) indicated in the Project Document covered all the reasonable possibilities at the time of project initiation. Some assumptions have proved erroneous:
 - a. It was assumed that a *policy and regulatory framework is in place that is fully supportive of renewable energy technologies based power projects in Cuba*. It is true that Cuban authorities had shown their support to technologies based on renewable energy sources, but no policy as such existed; the approval of the policy plan for renewables is very recent at the time of the Final Evaluation (four years after the initially scheduled project end).
 - b. *International financing remains committed to investments in renewable energy sector in Cuba*. This assumption has proved completely erroneous; it has not been possible to find foreign investments, and this has been one of the reasons for some of the changes in the project approved by the Steering Committee. A successful final commissioning and positive experiences from the remaining three Business Models could have a positive impact on possible new investors. In fact, the plan mentioned in the previous paragraph is a new attempt by the Cuban authorities to attract foreign investments.
 - c. Last but not least, the influence of the situation and structure of the Cuban economic system was heavily underestimated.

Rating for M&E design: **Satisfactory (S)**

2. Budgeting and funding for M&E activities

- r. The project budget only contains lines for Mid-Term and Final Evaluations, but there is no specific budget line for monitoring; these activities are supposed to be embedded in other budget lines.
- s. The initial project budget, included as Annex 1A to the Project Document, did not contain any budget line for monitoring and evaluation, but Line 550 was added later to contemplate mid – term and terminal evaluations (but not project monitoring).
- t. The budget for Mid Term Evaluation was very low, and had to be increased later. This has resulted in a negative balance for the Evaluation budget line (5500).

Rating for budgeting and funding for M&E activities: **Moderately Unsatisfactory (MU)**

3. M&E plan implementation

- u. The M&E system included in the Project Document was followed with some modifications during the project implementation. The responsibilities were been clearly defined.
- v. The time frame has suffered important modifications due to the delays experienced by the project activities.
- w. Although not in the previously scheduled dates, the ToR's for both the Mid Term and the present Final Evaluation were prepared containing concise and detailed aspects to be considered by the Evaluation Team. Some mistakes were detected, probably due to copying and pasting parts of the ToR corresponding to other projects.
- x. The Final Evaluation ToR corresponding to the Team Leader did not mention the technical evaluation to be made by the other team member as a part of the contents of the Evaluation Final Report; this resulted in some misunderstandings at the time of drafting the report.
- y. The general structure of the project reports was adequately defined and sufficient to give a clear idea of the status of the project activities. Some of the PIR's were prepared and submitted with substantial delays.
- z. The Evaluation Team has detected during the evaluation process that information about project developments and incidences were not adequately reported. Probably UNIDO/UNEP officials did not make sufficient visits to the project sites.
- aa. The Mid Term Evaluation report recommended increasing the frequency of reporting, in order to improve communications between the project management and UNO agencies. This recommendation was followed, but the information submitted in some of the reports gave a too optimistic view when compared to the actual situation.

Rating for M&E plan implementation: **Moderately Unsatisfactory (MU)**

Global Rating for Monitoring and Evaluation: Moderately Unsatisfactory (MU)

Global Rating for Factors Affecting Project Performance: Satisfactory (S)

GLOBAL PROJECT RATING: UNSATISFACTORY (U)

- bb. The global rating above reflects the fact that, after almost ten years, commercial viability of biomass – based technologies has not been proved. This is (among other factors) largely due to the complicated procedures of the Cuban system (repeatedly mentioned elsewhere in this report), and not to lack of effort and dedication from the project management team.

VII. Complementarity with UNEP strategies and programmes

- cc. The UNEP Medium Term Strategy considers six thematic focal areas (Climate Change, Disasters and Conflicts, Ecosystem Management, Environmental Governance, Harmful Substances and Hazardous Waste and Resource Efficiency – Sustainable Consumption and Production). Although the project was designed before this Strategy was launched and therefore cannot be considered a part of it, it can make a tangible contribution to some of the expected accomplishments of the UNEP Strategy. In the following paragraphs (which are an update of the analysis carried out during the Mid Term Evaluation) the potential contribution of the project activities to the six areas is analyzed (since the project realizations are not finished, the following analysis is only indicative of the complementarities with UNEP Medium Term Strategy which can be reasonably expected):

Climate change

- dd. The main objective of the project is to reduce GHGs in Cuba by promoting environmentally sound renewable energy technologies. It is obvious that there is a clear relationship between the project objective and this thematic area, especially in terms of two of the expected accomplishments:
- Project activities, especially dissemination efforts, have resulted in a high degree of consciousness among stakeholders of the advantages of use of renewable energy sources. Cuban authorities have prepared a policy plan for use of renewable energy source which has been influenced by the project dissemination efforts.
 - When successfully commissioned, the biomass – related project activities will imply improvements in land use and reduced land degradation

Disasters and conflicts

Not applicable

Ecosystem management

- ee. The supply of biomass fuel to the Cocodrilo plant has resulted in a more adequate management of the surrounding ecosystem which is a National Park with a delicate environment. Beside this, marabou biomass is also supplied to Cocodrilo, which implies a certain contribution to adequate ecosystem management elsewhere in Isla de la Juventud. Removal of the invasive species marabou is also complementary with ecosystem management objectives.

- ff. In the same way, the creation of a new forest nursery to supply biomass fuel to La Melvis electric plant and to the meat industry is also having a positive impact on the management of ecosystems in Isla de la Juventud. Besides this, the potential for replication of these types of activities is high, not just in Isla de la Juventud, but also on the main island and in other countries in the area, and this will result in increasing integration of ecosystem management approaches into development and planning processes.

Environmental governance

- gg. Cuban stakeholders have had access to sound technical and policy advice for decision-making through the different project activities. Apart from the diffusion activities, sound technical advice has been given on the types of control equipment to be used in the plants using biomass gas as fuel.

Harmful substances and hazardous waste

Not applicable

Resource efficiency – sustainable consumption and production

- hh. The realization of the project activities will result (has already resulted in the case of Cocardillo) in a more efficient use of resources and a reduction of pollution both over plant life cycles (due to the use of renewable energy sources) and supply chains (due to the subsequent reduction of use of liquid fuels).
- ii. From the viewpoint of increases of investments in efficient, clean and safe industrial production methods through public policies and private sector action, it is necessary to distinguish between public policies and private sector actions:
- From the viewpoint of public policies, the project is clearly already having a positive impact; the attitude of both national and local public authorities in Cuba is in favour of use of renewable energy sources and clearly committed to the project objectives; possibilities for replication of some activities in other parts of the country is being considered.
 - As for private sector actions, it must be considered that in Cuba no industrial private sector exists, apart from foreign companies. The project has failed in attracting foreign investments on renewable energy projects in Cuba, but on the other hand, the Cuban government has decided to develop a plan for renewable energy sources which contains new incentives for private investments, apart from those already existing. The role to be played by the RRMF is therefore crucial.

E. Conclusions and Recommendations

I. Conclusions

- jj. The project has been successful in creating a good atmosphere for development of renewable energy sources in the Isla de la Juventud. Local authorities now quite

enthusiastically support renewable energy, and this is largely due to the dissemination efforts carried out by the project team.

- kk. In more concrete terms, a very positive aspect is the fact that up to now biomass waste was seen as just waste, but now it is seen as a product from which economical (and environmental) benefits can be obtained, and jobs created. It can be said that the role played by the project to generate these feelings has been decisive.
- ll. The situation is also favourable among the national authorities in Havana. The high number of ministries, entities and organizations involved (before and after the restructuring process decided by the Cuban government) has resulted in bureaucratic complications and delays, but it has had the positive effect of extending the knowledge and consciousness of project activities and objectives to a wide audience of relevant officials.
- mm. The creation of RRMF has been a notable project achievement; experience has shown everywhere that funding is an essential issue at the time of developing new renewable energy projects. Although limited in resources, the RRMF represents at least an embryo source of funds for new projects. The election of an adequate institution (Compania Fiduciaria), with sufficient experience in management of financing issues, for the creation and management of the fund has had a positive impact on the development of the project activities (and on future possible replications of project activities).
- nn. Nevertheless the high number of institutions has had more negative than positive effects. More efforts should have been done to simplify the project structure, both at the time of process design and later. Beside this, the Evaluation Team has not detected any decrease in the number and “quality” of bureaucratic complications in the project development after the restructuring carried out by the Cuban government.
- oo. As repeatedly indicated elsewhere in this report, delays have been significant and have resulted in an extension of the project length (which has proved insufficient to terminate all the project activities). This indicates that at the time of the project design the implications of Cuban economic and political organization and bureaucracy were underestimated.
- pp. The project has been unsuccessful at present in demonstrating commercial viability of businesses based on use of renewable energy sources; needless to say, the issue of showing viability is of the utmost importance.
- qq. Table 10 below summarizes the project evaluation ratings

Table 10. Summary of project evaluation

Criterion	Summary Assessment	Rating
A. Strategic relevance. Page 39	Project objectives consistent with the island energy resources and environment. Budget adequate	S
B. Achievement of outputs. Page 40	Many outputs not reached, in spite of project extensions and reduction of activities	U
C. Effectiveness: Attainment of project objectives and results. Page 44	Insufficient results after almost ten years	U
1. Achievement of project outcomes. Page 44	Several relevant outcomes not reached	U
2. Likelihood of impact. Page 46	Good atmosphere created for renewable energy	ML
3. Achievement of project goal and planned objectives. Page 50	Very small reduction of emissions of GHGs and consumption of fossil fuels after ten years	U
D. Sustainability and replication. Page 50	Two basic elements for replication created: RRMF and forest nursery.	L
1. Financial. Page 51	RRMF created and functioning: partial repayments of loans made.	L
2. Socio-political. Page 51	High degree of support for use of renewable energy sources detected	HL
3. Institutional. Page 52	Although there is insufficient technical capacity for manufacturing of biomass plants components, the willingness of the authorities plays in favour of institutional sustainability and replication	ML
4. Environmental. Page 52	Biomass production contemplated under a scientific approach.	HL
5. Catalytic role and replication. Page 52	Chain of activities adequate to result in replication. Wind and biomass considered in the Plan for use of renewable resources prepared by the Cuban government	S
E. Efficiency. Page 55	Long delays. Complicated project	U

Criterion	Summary Assessment	Rating
	structure (many institutions)	
F.Factors affecting project performance. Page 56	In general, project performance has been adequate, and the response from the local counterparts satisfactory.	S
1. Preparation and readiness. Page 56	Project adequately prepared. Roles well defined. Adequate SC reaction to new conditions	S
2. Project implementation and management. Page 58	Taking into account the many difficulties derived from the Cuban system, the project was well managed, especially during the last years	S
3. Stakeholder participation and public awareness. 59	Stakeholders committed with the project. Public authorities well informed and support the project	S
4. Country ownership and drive- ness. Page 60	Cuban partners have adequately collaborated with the project activities	S
5. Financial planning and management. Page 60	The financial management has been clear, transparent, and concise, and the financing resources have been spent adequately.	S
6. UNEP supervision and backstopping. Page 62	UNEP supervision has been adequate. Progress reports were clear and complete.	S
7. Monitoring and evaluation. Page 63	M&E design well prepared. Insufficient visits to project sites. Information contained in some reports not adequately reflecting the real situation.	MU
a) M&E design. Page 63	M&E procedures clear; indicators adequate. GEF requirements fulfilled	S
b) Budgeting and funding for M&E activities. Page 65	Initial budget did not contain lines for M&E. Budget for Evaluations low.	MU
c) M&E plan implementation. Page 65	M&E activities well adapted to variations in the project. Insufficient visits to project sites. Improvements in frequency of monitoring reports. Real situation of the project activities not adequately reflected in some reports	MU

Criterion	Summary Assessment	Rating
OVERALL PROJECT RATING	Disappointing degree of realization of demonstration activities after almost ten years. Due to the efforts of the project management team, a good atmosphere for renewable energy sources seems to have been created, but final proof of viability of commercial technologies based on biomass has not been given.	U

II. Lessons learned

- rr. A success of the project design was to select an area (Isla de la Juventud) with plenty of biomass resources, an almost absolute dependence of liquid fossil fuels and a low degree of economic development. The **first lesson** to be learned is the adequacy of selecting an area of manageable size whose renewable resources can, after development, make a considerable impact on the energy supply of the area and result in a relatively important number of jobs created.
- ss. A **second lesson** to be learned is the convenience of having only one UN agency involved; two UN agencies (UNEP and UNIDO) have been involved in the project. This was due to organizational reasons at the time of project design, and has resulted in a number of difficulties (for instance, the two agencies used different accounting systems, transmission of information about project development implied more steps than strictly necessary, etc).
- tt. Another project success has been to partner with an organization (CubaEnergía) with a reasonable knowledge and a deep interest in renewable energy issues and with good contacts in the considered area. Hence the **third lesson** is the convenience of involving in the project an institution with good knowledge, influence and contacts in the considered sectors of industry (including of course the electricity supply industry).
- uu. A **fourth lesson** is to give due consideration to the political and economic organization of the country and to the bureaucratic difficulties arising as a result of it (process of taking decisions, legal outlook for imports of equipment and purchase of spare parts, bidding procedures, etc.). Experience has shown that underestimating these circumstances can result in long delays and difficulties. It is important to reduce the number of involved institutions and agencies as much as possible as well as give careful consideration to the scope of the project objectives when working in such an environment.
- vv. A relevant **fifth lesson** for future projects is to try to simplify the project organization table as much as possible before project start, defining responsible persons from each institution involved and establishing the obligation to communicate promptly any changes. Whenever possible, the new projects should be linked to only one Ministry.
- ww. Financing issues are very relevant for any project, but they are especially relevant when future replication of project activities is envisaged. It is of the utmost importance

to attain collaboration with agencies or institutions who have a deep knowledge of economic and financing issues in the corresponding country (Compania Fiduciaria in the case of Cuba). This is the **sixth lesson**.

- xx. The project has been extended several times, reaching a total duration of almost ten years. These extensions have not been accompanied by increases in the total budget, but some budget lines were re-adjusted, those dedicated to monitoring activities among them (according to information supplied by the Project Task Manager). This has resulted in an inadequate degree of knowledge about the real situation (which, surprisingly enough, has not been detected until the project end). Hence the **seventh lesson** is to pay the necessary attention, budget and effort to monitorization of the development of project activities through visits to the project sites.
- yy. Problems found with the chipping machine in La Melvis have indicated that the contract with the supplier did not contain explicit stipulations for guarantee of the adequate size of the wooden chips, and that the plant operators were not adequately trained about how to modify this size; this is important since several types of biomass are to be used. Clearly more attention should have been paid to the equipment supply contracts & the technical specifications. This is the **eighth lesson**.
- zz. Last but not least, the dissemination efforts (including an adequate and frequently updated project website) and the initiatives taken to improve technical abilities of manpower will have a positive and durable effect over both the maintenance of project activities and the replication. Therefore, the **ninth lesson** for future projects is the need to pay adequate attention to improve abilities of working personnel, to create qualified manpower, and to supply enough incentives for this manpower to remain in their posts. In fact, potential for replication of projects can only be guaranteed when adequately qualified manpower exists.

III. Recommendations

- aaa. **Recommendation 1.** The first recommendation is of course to follow up the future developments of installations and plants already commissioned or just finished. The Executing Agency should carry out this task, in collaboration with UNEP/UNIDO and the local electric utility; this recommendation should be followed immediately after project end, and UNIDO is in a better position to take care of it since it already has an office in Cuba. UNIDO should continue monitoring the commissioning of La Melvis, and performance of Cocodrilo, paying attention to the operation and maintenance of the plants. Whenever possible, for example periodical reports (quarterly?) should be prepared by the Executing Agency indicating the project developments, problems encountered, solutions adopted, etc., and made available to UNIDO (and UNEP). Given the level of contacts between the Executing Agency and the referred stakeholders, this task should not imply major difficulties.
- bbb. **Recommendation 2.** The Executing Agency should follow up with the development of plants whose construction has been decided but not yet commenced (Meat Factory); in this case a careful follow up is especially important during construction (periodical reports indicating the development of construction and commissioning). Still more important is the training of personnel in charge of the future, guaranteeing

technical assistance until that personnel is perfectly able to run the plant according to the necessities and demand of steam of the Meat Factory. In this way, UNIDO (and UNEP) will be in a position to follow up the longterm impact of the project (this remark applies to all Recommendations). This Recommendation should also be followed immediately after project termination and UNIDO should be in charge through its office in Cuba.

- ccc. **Recommendation 3.** No replication of La Melvis plant should be initiated before a careful and detailed analysis of the performance of the present unit, using all the different types of biomass available.
- ddd. **Recommendation 4.** In the same way, no replication of the Meat Factory gasifier should even be considered (neither for Meat nor for any other type of industry) before successful operation and careful characterization of the unit currently contemplated in the project.
- eee. **Recommendation 5.** For future projects, only one UN agency should be involved. As indicated in the previous section, involvement of two agencies has resulted in difficulties related to coordination, accounting, adequate monitoring, etc.
- fff. **Recommendation 6.** For future projects of a similar nature, it is strongly recommended that an analysis of the most suitable biomass technologies for each type of application should be carried out before selection and implementation. This analysis can be either one of the project activities or be based on results from previous projects or experiences. This approach should be followed by all UN agencies.
- ggg. **Recommendation 7.** If the purpose of any future project is the development of technologies, which are not entirely commercially available or are not well known in the countries/areas where they are to be installed, it is recommended to engage universities and /or laboratories where analysis and testing procedures can be adequately carried out. This recommendation should also be applied by all UN agencies.
- hhh. **Recommendation 8.** Attention should be paid to dissemination efforts (including creation, maintenance and frequent updates of project websites) and assistance to any future plant of the same or similar type to be built-up either elsewhere in Cuba or in any countries in the area. This help to designers/operators of new plants is a good way to take advantage of the experiences and learning from this project. This task could be coordinated by the Executing Agency, since its existence goes beyond the project termination.

F. Annexes

I Annex 1: Responses to stakeholders comments received

A general comment to the Draft Report indicates that the project has successfully carried out a number of activities and has resulted in the creation of an Energy Policy for renewable energy sources in Cuba.

The creation of such Energy Policy is undoubtedly a positive fact, and certainly the project activities and dissemination efforts have influenced the Cuban authorities at the time of taking the decision to create this Policy. But it cannot be considered a direct result of the project activities; extensive use of renewable energy sources has been a matter of discussion and a key issue around the world for many years, and many countries have created energy programs and policies devoted to encourage a wider use of renewable energy sources. This global tendency has undoubtedly made a strong influence on the Cuban authorities to create a renewable energy policy, to be added to the high prices of imported energy carriers, global tendencies, scarcity of domestic resources, etc.

The comments received also repeatedly mention the effect of the two hurricanes which hit Isla dela Juventud in 1998 as one cause of the delays experienced by the project activities. It is clear that the hurricanes had a very negative impact in the project activities, and this is recognized in the Evaluation Report above, but these negative effects were duly taken into consideration by the project Steering Committee, which defined updated objectives for the project in January 2010. These new objectives have also experienced considerable delays, and in fact many project activities have not yet been completed at the time of the Terminal Evaluation. And the commercial viability of biomass gasification for industrial use and grid – connected electricity generation purposes still remain to be demonstrated in Isla dela Juventud at the time of the project closing.

The two tables in the following pages contain answers to all the concrete comments received from the Project stakeholders.

The first table corresponds to comments received from Mr. Peerke de Bakker, whereas the second table contains responses to comments received from other stakeholders. The main text of the Draft Report has been accordingly modified as indicated in the tables, and the final text is shown in Chapters A to F above.

Table 1. Responses to comments from Mr. Peerke de Bakker

Paragraph	Comment no.	Stakeholder comments	EO comments	EO recommendations	COMMENTS FROM THE EVALUATION TEAM
Exec Summary, p.7	1	??????????????????	I think this refers to the use of the word 'cession'	Please elaborate in the report on the meaning in this context	Report wording modified. The Team was informed that some parts of the gasifier were (chiller included) just transported from India and installed, and not specifically designed for Cocodrilo. In general, the requirements submitted to the suppliers of gasifiers just indicated "wood" as the type of biomass to be used. This is insufficient; each system must be designed for the specific biomass to be used.
Exec Summary, p.7	2	This is entirely new for me. I had heard that indeed the chiller that was supplied was secondhand, or at least the compressor was. From this I now understand that the entire gasifier unit was second hand? Come on! For comments of UNIDO.	To be addressed by UNIDO	-	
Exec Summary, p.10	3	acquisition	grammar	Perhaps a more fitting noun	Funds raising. Report wording modified.

Exec Summary, p.12	4	<p>Not only the fuel, the feedstock, needs to be secured. I had expected to hear from the evaluation team also about the technical maturity of both big and small gasifier units. The professor (Faaij) invited to the workshop had strong doubts about the appropriateness fo larger scale gasifiers for grid connected (island) grids. And neither does a 50 kW gasifier with 17 people on the payroll seem to make much sense in terms of sustainability. So far both small and big gasifier have failed and based on current status should not be replicated...Fully guaranteed fuel supply is not sufficient.</p>	<p>I agree it would be useful to assess the appropriateness of gasification technology in this context</p>	<p>I suggest Suani addresses this comment</p>	<p>The Evaluation Team was in doubt about the scope of the evaluation; either to evaluate a project for which the biomass technology to be used was already defined in the Project Document, or to give its views about the appropriateness of the selected technology. The reason to select a 500 kW gasifier is unclear, since this size is not widely commercially available. The option of a biomass-fired Rankine system fired with the biomass should have been evaluated either through another project or at the very beginning of the present one, and the two options compared. The Evaluation Team was said that the reason for the general choice of biomass gasification for all installations was "to learn" about biomass gasification. But the capacity building on a new technology would be easier if laboratories or universities are involved in the project, and advantage taken of the already existing small scale biomass gasification systems in Cuba. Considering that the La Melvis gasifier is already in place, it is strongly recommended (before any further investment or replication) that: 1. tests with each one of the different types of biomass available should be performed, even considering the problems with the cutting machine 2. results of the tests should be analyzed to determine the most adequate type(s) of biomass to be fed; 3. measurements should be made of the composition and low heating value of the syngas; energy balances and efficiency should be evaluated for each biomass type, as well as atmospheric emissions measured 4. Plant efficiency and economic characteristics should be compared to Rankine cycle-based commercially available units 5. Finally, a decision should be taken about replication of use of other technology. The Cocodrilo plant (50 kW) has eight workers, and La Melvis (500 kW) seventeen.</p>
Exec Summary, p.13	5	<p>With so many outright failures it is more that notwithstanding the project Renewables Energy Technologies are being considered in the future power mix of Cuba. This project only included the well performing 1.65 MW Wind turbines...</p>	<p>This would be an interesting assesment if in fact the lack of succes with gasification technology led to the refocusing of Cuban renewable energy policy on other technologies</p>	<p>No action necessary</p>	
Table 2	6	<p>Yeah, great it was adopted but it (again) also failed to meet objectives, milestones... Fantastic that plans were always so easily adopted but never were realized. I do not see that back in the evaluation of the project management at all.</p>	<p>This addresses a larger issue that needs to be addressed in the project management section.</p>	<p>No action necessary</p>	

Table 2	7	Yes, the UNEP taks manager regularly did receive these bi monthly progress reports. In hind sight it can now be ascertained that this bi monthly reports were just void of any relevant information. Issues re. gasifier in Cocodrillo or at a later stage in La Melvis were simply never brought to the attention of UNEP. Was UNIDO aware? I wonder. But the Cuban counterparts have most intentionally degraded this bi monthly reporting into a meaningless exercise.	This is an important issue to clarify. If indeed the bi monthly reports were not accurately reporting the state of the project what was the reasoning behind this? Was UNIDO aware of this or was this a deliberate omission on the part of UNE in Cuba?	Please check the bi monthly reports with the actual facts. Pls also assess at what level this communication break down was taking place and if it was deliberate	The Evaluation Team has just evaluated facts at the time of the Terminal Evaluation and cannot ascertain whether the information contained in each bi-monthly report was accurate. Not all the reports were made available to the Team. But the TM comment indicates that the monitoring of the project has not been entirely adequate. The Evaluation Team wonders why these imperfections have been detected by the TM just now and not during the project execution (almost ten years). Monitoring and Evaluation rating modified.
Table 2	8	Never seen anything	Referring to the monitoring plan. Is there evidence of a monitoring plan?	Please investigate	Yes. A monitoring plan was prepared and followed. Copies of the monitoring reports for the year 2013 were made available to the Evaluation Team
Table 2	9	Yes, at least that worked!		No action necessary	
Table 2	10	duel	Spelling	please correct	Done

Table 6	11	<p>How about the drama that happened in Cocodrillo because of a lack of sufficiently trained staff. Completed but insufficient, or?</p>	<p>Peerke raises a good point here. The operators of Cocodrillo should have received sufficient training from the project for the activity to be 'completed'. If training was completed but the staff then left then this should have been a risk identified in project planning, since high staff turnover has been an issue throughout the project. If the training was insufficient for the needs of the project then it is again a planning issue and should have been identified early on and increased as necessary.</p>	<p>You briefly address this in the reconstructed TOC section but it should be discussed in more detail in the effectiveness section and preparation and readiness section</p>	<p>Please note that Table 6 is just a copy of the Table submitted to the Steering Committee in January 2010 at the time of project modification and added to the Minutes of the SC meeting. The term "complete" was included in the Table at that time and has nothing to do with the present Evaluation. A paragraph has been added to the Draft Report to emphasize this. Effectiveness and P & R sections to be modified.</p>
Table 6	12	<p>Local activities of wind mill manufacturing so far? Manufacturing of a local produced Marabou cutter? What is actually locally produced successfully? What does COMPLETED than really mean?</p>	<p>How exactly were national manufacturing capacities strengthened? What did the training for financial and technical services consist of?</p>	<p>Please elaborate on this point on the effectiveness section</p>	<p>See comment above Moreover, it does not seem possible to have local production of marabou cutter machines in the short term since local operator/other technical people were not even able to regulate the La Melvis chipping machine. Also both the machine and the gasifiers were purchased without informing the manufacturer about the type of wood to be used (it was mentioned only wood, according to the information received). And this is an important information to be provided to the gasifier/cutter manufacturers.</p>

		La Melvis failed (at least so far! Cocodrillo failed, Heat in Dairy industry failed and in the meat industry so far nothing was achieved. The wind farm was actually later introduced as Cuban Cofiancing in this project.	Since the activity only refers to the start up and implementation of the projects the actual succes or not of the project has no relevance in this section	-	See comment above
Table 6	13				
Table 6	14	Completed but not operational?	see comment above,	-	See comment above
Table 6	15	If the evaluator spells out "completed" in bold letters, maybe also "not completed" should be presented in the same way... This one is not completed	As mentioned in the original feedback on the zero draft this table is not clear on what has and has not been completed	Please instert 'not completed' next to those outputs that have not been completed	See comment above. The Evaluators have not spelled anything in this Table
Table 7	16	Or is this referring only to the wind farm?	See comment above, a little confusion here	see comment above	See comment above
Table 6	17	Considering the meager project achievements it is hard to think in positive terms about capacity building, structures in place etc. On paper possibly yes, but an adequate project management is something that is able to achieve much more.	Is it to be assumed the activity of establishing project management structures must by its very nature be sufficient in order for the task to have been completed?	I think this probably was completed regardless of whether it was capable of executing the project.	See comments above . Again, Table 6 does not try to reflect the present situation, but that in January 2010.

Table 6	18	<p>While on field trip to IdIJ inspecting the non working Melvis gasifier, the UNE project director told me that me, as Task Manager UNEP for this project saw the project totally wrong: This phase was actually only to install the gasifier and not to operate it, that would be part of a next phase! And this was told after the gasifier should have been operating already for a few years as O&M were supposed to be part and parcel of this one project! Sad that no performance data for gasifiers were ever included in any reporting as the technology and its appropriateness for island/grid electrification have remained unclear. is still not very</p>	<p>Given the lack of correct information given in the bi monthly reports, if this is in fact the case, the monitoring of the project does not seem to have been sufficient</p>	<p>I am not sure whether from the table this has been completed or not? A little ambiguous and might be useful to clarify</p>	<p>See comments above</p>
p.43	19	<p>That the boiler in the dairy plant needed to be replaced because of old age was already known before the Mid term Evaluation. Yet, no timely arrangements were undertaken to start the process of retrofitting. And then when the boiler broke down it was suddenly too late. To the TM this is above all a sign of poor project management and, admittedly as per observation of the evaluator, also a negative impact of the complex bureaucratic processes.</p>	<p>There seems to be some confusion about the immediacy of the problem. If this issue was known about prior to the mid-term and no action was taken then this would seem to indicate either an issue with project management or an issue with bureaucracy or both</p>	<p>You probably have a better idea on where the issue lay so pls inform accordingly</p>	<p>The problem was not mentioned to the Evaluation Team at the time of the Mid-Term Evaluation (hence is not mentioned in the Mid-Term Evaluation Report). As indicated in the Final Evaluation Report, the delay (and also that of the Meat Factory) is due to the very lengthy bureaucratic processes in Cuba, changes of key officials, industry restructuring, etc.</p>
p.44	20	<p>As per information of the evaluator himself, also the trained staff of Cocodrillo disappeared and the replacement staff was insufficiently trained which led to a complete break down of the system.</p>			<p>The Evaluation Team was informed that the trained people had to be replaced because they found more attractive jobs elsewhere. The same experience happened to other projects in remote areas in other countries; it seems it is a regular behaviour in regions where most people are not skilled</p>

p.55	21	During the workshop I heard that engineers were complaining that because of the economic embargo against Cuba, high quality steel that would be necessary for the cutting blades is simply not available in Cuba?	Was the issue of ability to import the necessary equipment addressed in the project document/planning phase? If not why not?	Please investigate	Difficulties derived from the embargo are constant and affect to many different imports, not only metals. These difficulties were not mentioned in the Project Document; reasons for this are unknown to the Evaluation Team.
p.65	22	The real danger is now that under given lack of supervision, CF might be tempted to engage in the financing of a second gasifier of La Melvis, even though the first unit of 0.5 Mw has not yet shown whether it is appropriate and cost effective in IdJ.	Is this a likely scenario?	Suani's opinion on the suitability of the technology would be useful here also	It is clearly stated in the Draft Report that an extension of La Melvis should not be considered until proper functioning of the present plant is guaranteed. The Evaluation Team considers that: 1, Cocodrillo has performed well despite some initial mistakes (the current problems are the compressor waiting to be replaced and the biomass drier to be replaced due to corrosion problems in a near future) and can indeed be replicated; a deeper capacity building at UNE is suggested to guarantee an adequate O&M (only training of operators cannot be enough considering replication; local people at university could also be trained); 2. La Melvis must be carefully revised and adequate tests with each type of biomass/syngas must be performed to allow technical information, also including the solution of the cutting machine problems (it must be verified if operational problems faced by the gasifier, not producing enough syngas for the engines is due to the size of biomass or any other difficulty). After that the activities mentioned above must be developed and then to discuss the possible replication. Anyway, risks for La Melvis replication are high considering the large size of the gasifier. 3. Meat industry: this one presents a higher risk for replication (in fact, it does not make sense to think about replications of a non existing plant!); a deep technical analysis considering energy balance, O&M issues and economic feasibility must be performed, comparing the updraft-biomass-gasifier-boiler system with a conventional biomass-boiler (also the option of using biogas from sewage treatment), before deciding for replication.
p.85	23	That would be an achievement. The word milestone in this project was used for other purposes	Agree	Pls replace with 'achievement'	OK, done

p107	24	<p>This is where I completely disagree with the evaluator. This statement needs to be qualified and detailed substantially. Given the current status of the operations in Cocodrillo and La Melvis the gasifier concept appears to be very far away from any replication prospect! For this specific reason alone the gasifier/biomass expert Suani was included in the evaluation team. Nothing less is expected than a clear description of the prospects for replication of gasifiers and for what (niche) markets. In addition please consult the mission report of the Task Manager, and the discussion with Prof Faaij who also appeared more than skeptical on the appropriateness of the technology for island/grid connected electrification. This is seriously insufficient, more input expected from the evaluators..</p>	<p>I agree. There needs to be clearer distinction between replication of the gasification technology/project in Cuba and suitability for other similar countries</p>	<p>Pls ask Suani to give a detailed opinion of the suitability of the technology and the scope for replication around Cuba in this section</p>	<p>See other comments above. Cocodrillo can possibly be replicated, but for the moment not the two others (La Melvis and the Meat Industry) in details, Cocodrillo as a small size gasifier can be replicated but the other two plants (La Melvis and Meat Industry) currently present a high risk.</p>
p.110	25	<p>See comments db24 Compania Fiduciaria should be prevented from putting money into gasifier projects as long as the performance has not been properly assessed.</p>	<p>see comment above</p>	<p>see comment above</p>	<p>See response to comment 24.</p>
p.111	26	<p>At early stages of the project (as well as in the ProDoc) much larger gasifiers were actually proposed. TM has been extremely reluctant to endorse such large gasifier systems of 1 MW and above as no reference projects (outside India could be presented at that time. Given the performance of this 0.5 MW unit in IdIJ it would be quite questionable if much larger gasifiers are properly operating, not only in India – again a question for Suani to be addressed.</p>	<p>see comment above</p>		<p>Please see comment above. Nowadays only one large scale biomass gasifier power plant (to produce electricity) is in operation worldwide (Gussing, Austria) and all other large scale plants were shut down due to technical problems. Therefore risk of replication must be carefully evaluated and only after concrete positive results from LA Melvis, as mentioned above.</p>

p.115	27	<p>During Mid Term it was agreed to improve and intensify communications and in addition to Year end reports and mid year PIRs the stakeholder agree to bi monthly reporting. These have not been received every two months but there was indeed some regular reporting...Upon arrival in Cuba in October 2014, TM was extremely keen on visiting Cocodrillo which was supposed to be now in operation for quite some time. Upon learning in the program of the IdJ trip that Cocodrillo was not part of the itinerary. A request was made to visit Cocodrillo instead of some more touristical sites (beach, a town etc). Request was not honoured as it would "require a military permit to go there"... After making sure that at least the Terminal Evaluator would be able to go there, TM was able to read about the actual dismal situation in Cocodrillo. It should be noted that these issues with Cocodrillo were never shared with UNEP through the bi monthly reports or latest PIR 2014 and it became obvious why no trip to Cocodrillo was going to be arranged. This serious lack of proper information should be shared in the TE. And included in the overall rating. TM is now wondering if UNIDO has been misinformed on a same level as well.</p>	This should be investigated as previously mentioned	Please investigate	<p>As indicated above, the Evaluation Team has given an overview of the present situation, in Cocodrillo and elsewhere. The Evaluation Team did visit Cocodrillo and was informed that eight persons are working there, not seventeen (this figure corresponds to La Melvis). The Evaluation Team is not in a position to determine whether information provided in the past was accurate or not. It is indicated in the Draft Report that the last available PIR gives a too optimistic view. But the TM report has indicated to the Evaluation Team the necessity to revise some of its initial opinions about project monitoring.</p>
p.116	28	<p>Point 116 should be removed entirely: this is never the case. GEF projects of this nature are never executed by UNEP/UNIDO hired staff.</p>	agree	Please remove	<p>OK, but it has to be noted that the Evaluation Team is just indicating that the contact between the project personnel and UNEP/UNIDO would have been more intense should this personnel have been directly hired by UNEP/UNIDO.</p>
p.121	29	See db26	-	-	

p.127	30	<p>Possibly the decision making culture in socialist Cuba needs to be mentioned here: Nobody will ever make firm decisions by him/herself and certainly not the project director. All decisions are basically reached by consensus and it may take a while to reach consensus as outside of Steering Committee meetings all stake holders did not convene for the sake of the project. Even when there were no hurricanes, the project did not meet deadlines, milestones . Preparation and Readiness for a GEF project like this is therefore not very satisfactory in the TM's opinion.</p>	<p>Agree, there seem to have been some major oversights in the preparation and readiness as mentioned previously</p>	<p>You might review the rating here</p>	<p>According to paragraph 63 of the Evaluation ToR, Preparation and Readiness are referred to the quality of project design and preparation, not to the project developments. From this viewpoint, only the project time span and the complications derived from the decision-making culture in Cuba were underestimated. The remaining items specified in Paragraph 63 were adequately considered. The Evaluation Team has considered that both project term and bureaucratic complications were difficult to evaluate at that time.</p>
p.129	31	<p>With a project falling systematically short of the expectations, I am wondering how the evaluation team can possibly assess that the implementation mechanism was adequate. It was clearly not adequate, and - as the evaluator already observed – it was unnecessarily complex and inefficient. And this had absolutely nothing to do with hurricanes!</p>	<p>I agree the implementation mechanisms were clearly not satisfactory regardless of the hurricane</p>	<p>You address this diplomatically in this section but I am not sure the rating should be as high as it is</p>	<p>The implementation mechanism considered the necessity to have many institutions involved; this was a consequence of the very particular decision-making culture in Cuba (the general economic system in Cuba is inefficient (as experience in other countries of the former Eastern Block has repeatedly shown)). One thing is to evaluate the quality of the initial implementation mechanism and a different one is to evaluate the real performance of the mechanism. The initial design has been considered adequate (was it possible to define a better mechanism in a country like Cuba? The mechanism is certainly very complex, but not "unnecessarily complex" (the term "unnecessarily" would have been adequate for a country different from Cuba); the project performance has been clearly unsatisfactory.</p>

p.137	32	<p>Considering comments db 30 and 31, plus all of the observations of the Evaluation Team itself, it is hard to justify a satisfactory rating here. 4 extensions and still not achieving all the the expected results? Poor local project management is most certainly one of the main reasons for the overall negative project rating?</p>	see comment above	see comment above	<p>The Project Management cannot be blamed for complications derived from restructuring, changes of key officials, etc. The adequacy of reactions to these changes is that has been rated</p>
p.142	33	<p>How can it be satisfactory? Obviously the only stakeholder that was adequately "serviced" was UNE the utility as the project director was an UNE employee himself! Neither the dairy industry nor the meat industry were facilitated properly. The gasifiers in Cocodrillo and la Melvis were UNE projects. Should be rated negative.</p>	<p>How well informed were the direct beneficiaries? There do seem to be some glaring omissions</p>	<p>Perhaps you could elaborate on this issue</p>	<p>The Evaluation Team has expressed concern about lack of training in the meat industry (the dairy industry has unfortunately been dropped). Public awareness in IdJ is very satisfactory, and everyone supports use of renewable energy sources. The rating has taken into consideration both aspects (participation and public awareness). in Cocodrillo village the Evaluation Team could verify local public awareness specifically in the case of the small scale biomass gasifier. The technical coordinator of Cocodrillo plant is also a kind of mayor in the village with strong local support (it seems). On another hand, for the Meat Industry there was no concrete facilitation or capacity building. Also at the Meat Industry it was not discussed or informed that there was the possibility of using the biogas from the sewage treatment plant as an energy source and the biogas is now released to the atmosphere and not used.</p>

p.166	34	The Evaluators may rate UNEP supervision as satisfactory given budgetary constraints. Extensions were granted in order for the project to achieve much more of the originally formulated results (including all Business Models), but such extensions were all budget neutral, also for the Implementing Agency (UNEP) and the Executing Agency (UNIDO) and hence UNEPmissions were restricted to attendance of the Steering Committee Meetings only. Considering the final results of the project one may question if that was sufficient.	I imagine the TM and PM are in the best position to evaluate this	It would be worth asking the opinions of UNIDO and UNE whether they think this is the case	Yes, I agree.
p.170	35	The Mid Term was intentionally moved to a later date as at the moment of the actual midterm there was absolutely nothing to show for. The Terminal Evaluation happened in the last month of actual project execution after it was agreed with UNIDO not to extend the project for yet another year.	why was the mid-term delayed?	Perhaps clarify why the mid-term was delayed	It was logical to delay the MTE, given the project status at that time.
p.178	36	In hindsight the TM thinks a project of this nature and in this country would have needed more active involvement of the Executing Agency (UNIDO), more missions...	The question is whether further visits would have made a difference	It would be worth asking the opinions of UNIDO and UNE whether they think this is the case	I agree
p.179	37	After reading the draft Terminal Evaluation it appears that information (e.g. Cocodrillo gasifier) was kept away from the Implementing Agency.. and possibly also from UNIDO..	As mentioned previously this needs to be investigated	-	

p.179	38	??????	I think this refers to the rating	Please see if further enquiries effect your opinion of the rating	From the viewpoin of both Evaluations, things have been carried out in a satisfactory manner. But the Evaluation Team is now realizing that the differences between the situation described in the PIRs and other reports and the actual one were not adequately detected. A change in rating is being considered.
p.180	39	TM agrees with the overall rating, certainly when all the extra comments of the TM are taken into consideration db21 – db38	-	-	
p.182	40	In a sustainable manner that can be replicated? TM wonders...	In the report it states 'when successfully commissioned' there will be improvements in land use and reduced land degradation. Given the minimal biomass usage and technology issues is this is a valid assumption or likely scenario ?	Please comment	At present, consumption of biomass has been very low, but infrastructure for continuous supply of large amounts of biomass from forestry has been created and will result and large surfaces of forests. Special attention has been devoted to select adequate species (eucalyptus has been discarded). this development (if biomass plants are successfully commissioned) will result in improvements in land use; according to the information received there will be a replacement of degraded land by wood plantations. Also the replacement of diesel oil by sustainable biomass will reduce carbon emissions and contribute to mitigate climate change. And the same will happen if biomass-fired plants using steam systems are used instead of large scale gasifiers.
Disasters and conflicts	41	Should the issue of the damaged rotor blades during the hurricanes not be mentioned here? Apparently the lowering of the wid turbine towers still led to serious damage to 2 of the windpropellors...	I agree.	Given the impact of natural disasters on the project it would be prudent to assess the risks	The Evaluation Team could not visit the wind farm, allegedly due to bad roads and lack of an adequate vehicle. The Team was verbally informed that all the towers can be lowered now in case of Hurricane without any risk.

p.203	42	I wonder if UNIDO (the executing agency) would have budgets to stay engaged in the Cuba project. UNEP certainly does not have.	Since UNEP/UNIDO will be directly responsible for implementing the recommendations, if accepted, there need to be clearly stated activities that UNEP will be able to execute.	Please be clearer with recommendations and responsibilities (What?Why?When?How?)	UNIDO in a meeting with the Evaluation Team proposed to use some additional funds still available to engage some other experts to help solving the problems at La Melvis, using experiences and experts from some other (Ankur) biomass gasification plants existing in Cuba. Such funds could also be used for important tests needed (such as measurement of syngas heating value and syngas composition, never performed and strongly recommended by the Evaluation Team during the meetings). Recommendations modified
p.203	43	The lessons learned and recommendations are according to the TM the weakest part of this evaluation. Certainly more is expected of the Biomass expert in terms of projects of these gasifiers to (sustainably) contribute to island/grid electrification (La Melvis) or not grid connected village electrification (Cocodrilo) but also recommendation for future (biomass based) projects in the industry (e.g. meat industry, dairy industry but also other such as ceramics that was originally mentioned in the ProDoc. These lessons/recommendations shall be of utmost relevance in the formulation of future projects in Cuba but also in other (GEF) countries. Based on the experiences in this projects the entire gasifier technology could hardly be recommended for replication in Cuba or beyond.	I agree	I would like Suani and yourself to give a little more thought to this section given the unsatisfactory rating of the project. I feel there are more recommendations that could probably be made.	In brief biomass gasification technology can only be recommended for isolated systems and small scale systems, below 200 kW. For installed power above 200 kW there is no need for such technology and have higher risks; steam systems (commercially available and with no risk) are recommended (please see another experience in Brazilian Amazon with steam systems of 200 kW using wood residues. On another hand such small scale biomass gasifiers are important in remote villages since they use wood or biomass residues and can provide enough power for productive uses. Other recommendations to be given.

Table 2. Responses to comments from other stakeholders

Comment no.	Stakeholder comments	EO comments	EO recommendations	COMMENTS FROM THE EVALUATION TEAM
1	Ministerio del Comercio Exterior y la Inversion Extranjera		Please correct	OK, corrected
2	To be deleted		Please delete	OK, deleted
3	Project activities effectively started in September-Octobre 2005	The point is to emphasize the long duration of the project. Start of activites is rarely reflective of project start date	Pls check project start date info	Official starting date of the project is March 2005, according to the documentation received. The Report has been modified to emphasize this
4	Around 2 years delay; re-direction of human and financial resources; change in Gov, priorities.	Further detail could be added but not a necessity	For ET to decide	The impact of the hurricanes is repeatedly emphasized in the Report; no analysis giving reasons to estimate the delay in two years has been made available to the Evaluation Team
5	Many other project activities have been completed: Cocodrilo plant, Marabou cutting machine (even though with negative field tests results), Wind farm; Forest Management; etc.	Wind farm and Forest management are mentioned in the previous line. Marabou cutting machine and Cocodrillo are, in the opinion of the consultant, not completed.	ET to comment	A successful marabou cutting machine has not been developed. Cocodrilo has run satisfactorily for several months, but has faced large shutdowns due to lack of spare parts
6	According to NPD, the construction of the 1 st prototype has already started since end of 2013.		ET to check	Manufacturing has not started. To prepare an initial prototype is a different thing.
7	????? They should have arrived directly from India.	I believe the parts may have been previously used in India and were thus second hand by the time they arrived in Cuba	ET to comment	The Evaluation Team was informed during the field visits that some parts had been already used before installation in Cocodrilo
8	It was not within the set of project objectives	Although it was not within the set of project objectives it is fundamental to the sustainability and replicability of the project.	ET to comment	The report is just indicating that a mechanism needs to be agreed upon, not that it is a project requirement.

9	The main reason for the GEF funded project was the total dependence of electrical power generation of the Island from fossil fuel imported from the main-land (via ferry boat). The island electrical grid is not interconnected with the main-island grid. An additional reason, was the presence of a constant and strong wind, together with the abundance of local biomass and land for the creation of a specific forest to support the electro and heat biomass generation.		Can be added by ET if deemed pertinent	Text modified
10	More than the creation of a robust market, the main long-term objective was to create the conditions for the development of a market in renewable energy (long-term objective) through the establishment of an innovative financial mechanism to support relevant national/foreign private investments (short-term objective).		ET to comment	The term "robust" just refers to the necessary sustainability of the market
11	The project performance assessment has to be conducted with respect to: A) The reduced quantitatively and qualitatively project objectives as approved by the SC of 2010 and not with respect to the original project objectives planned under a very different national and international contexts; and, B) The actual economic/financial national and international contexts during which the project activities have been implemented (which changed dramatically especially during the last years of the project life)	It is normal for the context to change during the life of the project although the impact was more severe in this case. The evaluation takes into account these unusual circumstances and therefore bases its assessment both on the original objectives, upon which it must, as well as the 2010 revised objectives.	ET to comment	The changes introduced by the Steering Committee were devoted, among other things, to take into consideration the effects of the hurricanes, and this is duly reflected in the Report. The evaluation has considered all the objectives
12	As already noted the effective project activities started in September/October 2005 (1 st payment made on July).	As above	As above	See response to Comment 3 above
13	The 2 hurricanes caused an approximate 2 years delay.	The delays are stated as 'considerable'	Can be added by ET if deemed pertinent	The Evaluation Team certainly considers that the effect of the hurricanes was important: see response to Comment 4 above
14	Through 4 demonstrative Business Models		Can be added by ET if deemed pertinent	Text modified. But the Los Canarreos wind farm was a contribution from Cuba; its construction was not a project activity.
15	4 business models		As above	As above
16	The selection of the gasification technology was made during the preparatory phase and the technical discussions with counterparts for the formulation of the the final project document.		No response necessary	
17	Also a ceramic and a fish industries were contemplated (4 industrial subsectors were initially contemplated).		Can be added by ET if deemed pertinent	Text modified

18	We assume that we talk about Cocodrilo plant)		ET to comment	Yes
19	Electrical supply for the bakery was not foreseen. The project targets were only houses and school.		Please correct	Information obtained during the visit to Cocodrilo. The Evaluation Team has considered that, since the bakery is connected to the Cocodrilo local network (and it is the main consumer), it should be mentioned.
20	All type of industry present in the Island, not only the food industry (La Melvis biomass plant is linked to the island electrical grid).		ET to comment	Text modified
21	The project activities started in September/Octobre 2005)	As above		See response to Comment 3 above
22	tele		Suggest ET add	Text modified
23	once the project is closed, also according to the UN legislation we can not stay in the RRMF Steering Committee.		Suggest ET add	Added
24	The recommendation has been adopted, but the website has not yet been completed	I believe this table is taken directly from the MTE recommendations report and has not been amended/updated by the ET	ET to comment	The Report just indicates that the website is non-existent at the time of the Final Evaluation
25	Concretely speaking, this recommendation has been adopted. External Experts came for the in-depth training course on 2013, providing expertise for biomass gasification to many local Technicians.	As above		The Comment reflects what it is said in the Report!
26	It could not be adopted due to the UN rules and regulations that impose new independent international open bidding and does not allow direct contracts.	As above		
27	UNEP and UNIDO were part of the Steering Committee from the beginning of the project life. Heat generation is BM3 and not 2	This Table was I believe taken from the Pro doc, hence the title: 'Initial project structure'. It will be difficult to correct without the original diagram.	ET to comment	The Table was taken from the Project Document (and it is not denied that UNEP and UNIDO were part of the Steering Committee)
28	It is almost impossible for a project to interfere with Minsitries/Institution concerning the movement of human resources from the project elsewhere.	I believe the ET is just stating the facts. Perhaps the likelihood of this scenario should have been identified as in issue during project planning and a strategy put in place to mitigate effects?	ET to comment	The ET is just indicating that the influence of the Cuban structure was not duly taken into consideration at the time of the project planning
29	Compact, not Local		ET to comment	Modified

30	According to NPD the manufacturing of the 1 st prototype started since end of 2013/beginning 2014.		ET to check	See response to Comment 6 above
31	Also the Wind Farm is in place and functioning.	The wind farm was not initially part of the project and was it not already operating by the time it was included in the project? If so it may be difficult to use as an example.	ET to comment	Los Canarreos plant was added later and considered as a contribution from the Cuban government to the project
32	Local capacity has been built not only for the Forestry cultivation, but also for the Wind and also for Biomass Gasification (through the training activities and the GTT course in 2012.	I believe capacity building is discussed in more detail later in the report	ET to comment	Capacity building has been created, but it still lacks of sufficient experience (La Melvis not yet operational, meat factory plant not installed ...). This is discussed in other parts of the Report.
33	The Business Models are 4 (Wind Farm is included). In any case, even though the La Melvis has not yet been commissioned, the plant is there and has already started the planned initial running tests phase. The problems raised during this phase will be solved soon.	For Wind Farm See comment 31. This comment verifies the ET's assesment.	ET to comment	See response to Comment 14 above. The Evalaution Team hopes that the problems in La Melvis will be solved soon, but the very fact is that the plant had not yet reached its nominal capacity at the time of the Evaluation.
34	BM1 completed; BM4 completed; BM2 completed but still to be commissioned; BM3 not yet started (practically 3 out of 4 BMs have been completed)!!!	Only 2 out of 4 business models have been completed and even of these 2 the commercial feasibility seems to be questionable.	ET to comment	The ET agrees with the EO response. Moreover, see response to Comment 14 above
35	For the spare parts it is true, but for what it concerns "local expertise to maintain plants" has been developed (more then 50 technicians have been trained).	Capacity building is discussed later in the report		Information received during the visits show the opposite. La Melvis operational problems and local operators do not know how to solve
36	According to NPD the manufacturing of the 1st prototype started since end of 2013/2014.		ET to check and comment	See response to Comment 6 above
37	The Biomass Compact Plants activity has been replaced by the Gasification Technolgy Transfer course in 2012.		Can be added by ET if deemed pertinent	This fact is indicated in the Report
38	BM3		Suggest ET add for clarification	OK
39	BM2		Suggest ET add for clarification	OK
40	BM1		Suggest ET add for clarification	OK

41	3.5 MW and not 3		ET to correct	Corrected
42	Dairy factory was dropped and not the Meat factory	This is what the ET is stating	No response necessary	
43	Compania Fiduciaria has always been under the Gov. responsibility.		ET please clarify	Text modified.
44	4 wind measutrement towers		Can be added by ET if deemed pertinent	OK
45	Why "U" when the majority of the project objectives have been achieved???	Given the failure of the project to meet many of its outputs and outcomes the Unsatisfactory rating is valid	ET to comment	Many of the project outputs and outcomes not reached, as detailed in the Report
46	4		As above	As above
47	Running, maintenance and manufacturing capacities; not only manufacturing		ET to comment	According to the corresponding Table, the outcome refers to manufacturing.
48	4 Business models		As above	The Business Models are described one by one elsewhere in the Report. See response to Comment 31 above
49	This outcome has been fully reached "in accordance to the prevailing national economic/financial context".		ET to justify why it has been only partially reached	As indicated in the Report, the project activities have had a relevant influence in the (very recent) creation of a renewable energy policy in Cuba, but it cannot be said that this is only due to the project activities. Moreover, the Policy is still not completely defined.
50	They are 4 business models and not 3		As above	As above
51	2 are full working (BM1 Forest management, and BM4 Wind Farm) and BM2 La Melvis plant is erected but not yet commissioned (initial operational running tests phase has already started)	See comment 34	ET to comment	As stated in the Report (paragraph 80) the commercial viability of renewable energy is not fully demonstrated; this does not necessarily imply that it will not be demonstrated in the future, but the Report indicates the situation at the time of the Final Evaluation

52	Again, rate "U" is not correct; the majority of outcomes have been reached!!!	From the report it is clear that outcomes 3 & 4 have not been achieved. With only 50% of outcomes achieved the rating would seem valid	ET to comment	Same as EO comment
53	Should be A	A is the highest rating. Has a clear policy and regulatory framework been provided to enable an environment for the development of renewable energy technologies? From the report this does not seem to be the case?	ET to comment	The renewable energy policy of Cuba is being created just now and is still incomplete. See answer to Comment 52 above
54	???? More then 50 technicians have been trained through the project	Clear arguments for this rating are provided later in the report	ET to comment	Same as EO comment.
55	It should be B	From the report it is clear that no private investment was attracted can it therefore be seen as a succesful mechanism? Are funds being returned to the RRMF from the succesful operation of the buiness models? and if so at a level of return that would attract private investment?	ET to comment	At present, no private investment has been obtained at all
56	It could be "L"	Ratings are based on the qualitive opinions of the ET	ET to comment	Availability of private funding is essential to guarantee impact; the present situation seems to be moderately promising
57	This was the original target for a period of 15 years. The original target was of 26,000 tonnes of GGHG reduction per year (para 213 of Pro. Doc.) with La Melvis at 3.5 MW generation power and the full scale Heat generation 6 MWth in place!!! Nevertheless, the above target of GHG reduction has to be updated with the reduction of the La Melvis (from 3.5 to 0.5 MW) and of Heat generation (from 6 to 3.8 MWth and still less, due to the drop-down of the dairy industry project).	Have these target been updated on in any formal documentation? If not then the original target must be used as the benchmark	ET to comment	Please note that the data are extracted from the project PIR 2014

58	In light of above comments, this rate has to be re-considered	Even if the benchmark was recalculated to better reflect the reduced objectives of the project in 2010 the project will still have significantly underachieved given the further delays and issues	ET to comment	Same as EO comment. See response to Comment 57 above
59	Again, in light of the above comments, this evaluation has to be changed in MS			
60	As previous comment.			
61	3.5 MW		As above	OK, modified
62	nominal project life has been 9 years; effective duration around 7 years; effective delay less than 50% (2 years out of 5 initially foreseen)	A 5 year project has spanned 9.5 years. I would say that could be described as 'enormous'	ET could change to 'major' if suitable	It is just a matter of terminology. Replaced by "major"
63	2 activities: BM3 Meat industry; SWGs. Plus the commissioning of BM2 La Melvis plant.		Can be clarified by ET if deemed pertinent	The ET considers that the wording adequately describes the situation at the time of the Terminal Evaluation
64	and of Project Manager as well as through monthly tele-conferences with NPD and Ministerial Officials, and regular field visits.		ET to comment	Please note that the paragraph refers to "concrete time-saving measures"
65	As said above in this report, this could not be implemented due to the actual State organization.	The question here is whether this issue could have been addressed and mitigated through planning/procedures at the design stage or whether the structure of state organization and the necessity of their involvement was such that nothing could be done.	ET to assess	The ET considers that these issues should have received more consideration at the time of the project design. Although very slowly, the project has been able to carry out some activities; a more adequate understanding of the difficulties derived from the structure of the Cuban state would have resulted in better project developments.
66	Considering the content of the statements and above comments, the rate should be MS	I do not think that any stakeholders can be under the illusion that this project was carried out efficiently given the information provided in the report	ET to comment	Reasons for the project rating are clearly stated in the Report

67	The selection of the most suitable biomass gasification technology has been discussed and agreed upon during the preparatory phase of the project.	I think the report clearly indicates that an in depth process of selection was not carried out and thus did not lead to the selection of the most suitable technology	ET to comment	The Project Document directly defines the technologies to be used, and the Evaluation Team was informed that the Cuban counterpart wished to learn about biomass gasification. No evidence was supplied of any analysis of the most adequate technologies carried out at the time of project design.
68	No, only Los Canarreos has been requested to be considered as Gov. contribution to the project and not Holguin.		ET to check and correct if necessary	Corrected. Apparently the information received during the field visit was misunderstood.
69	UN Habana office officials????		ET to comment	No
70	Taking into consideration the evaluation of the many sub-chapters and the comments made until now, we consider that the project evaluation rate cannot be "U" but should be "MS" at least.	I believe given the information presented the Rating is valid	ET to comment	Reasons for the project rating are clearly stated in the different Chapters of the Report
71	TE Report: Additional Comments A. As recognised in the report, many very important project objectives have been achieved; in particular we must highlight the following: 1. The establishment of a Government policy to support the development and use of renewable energy sources in Cuba has been undoubtedly influenced by the project activities; 2. The project has been very decisive and successful in creating a high level of awareness for the use of renewable energy technologies both at local (Isla de la Juventud) and national levels. Actually the project activities in this area (including the use of biomass waste to generate energy) are seen as source of income, reduction of fossil fuel consumption (reduction from imported fossil fuel, particularly important for the Isla de 3. The establishment of a Risk and Replication Management Fund (RRMF) has been a very important result of the project. In practice the RRMF, managed by a national very well experienced financial institution like the Compania Fiduciaria, constitutes an essential mechanism (especially in the Cuban context, but not only) to promote and facilitate the development of RE projects in Cuba and elsewhere. 4. Through this project, more than 50 officials/technicians have been trained in RE Technologies and a high level training course on RETs (Gasification Technologies Transfer- GTT) has been conducted in Cuba. The project cannot be considered responsible if, after an initial active involvement within the project activities, some of	1 & 2. The report refers to the influence of project activities on Govt. policy and its success in raising public awareness. 3. It is difficult to make an objective judgement on the success of the RRMF. The success of it as a financing structure will depend on its ability to finance commercial renewable energy projects in the future and attract private investment. At present this is yet to be achieved. 4. The training and retention of the technical staff is an essential part of the project and the loss of skills due to high personnel turnover should have been considered and addressed. 5. At present there is no verifiable example of successful project replication. As has been shown by this project planning and purchasing of	ET to comment	1 & 2. The report refers to the influence of project activities on Govt. policy and its success in raising public awareness. 3. The report duly emphasizes the importance of the RRMF, but it remains to be seen whether it manages to attract external funding for future projects. 4. Importance of training is recognized in the Report, but clearly it failed to foresee possible necessary replacements for personnel leaving the project activities. 5 No verifiable example of successful replication does exist, and the Evaluation Team wonders why the Government has already ordered 50 Small Wind Generators whose manufacturing has not started (no prototype is available for testing)

the trained technicians have found alternative jobs (outside the project itself).
5. There is high potential for the future replication of similar RETs projects in the Country and in other islands of the Region. This could not be possible without the dissemination and practical demonstration efforts implemented in this project. The Government has already ordered 50 Small Wind Generators on the basis of the project activity related to the construction of 4 different types (as far as generated power and construction models) of such SWGs units.

equipment does not always convert into succesful operation and commercially sustainable ventures.

B. Concerning the 3 negative evaluations included in the report (outputs; results and reduction of GHGs emissions), we would like to underline the following issues:

1. Concerning the “no achievement of some outputs and outcomes” we have out of the 4 Business Models included in the Project Document (BMs: 1. Forest Management; 2. La Melvis electro-generation plant; 3. Heat generation – meat industry; and 4. Wind Farm 1.65 MW), 3 of them have been practically completed: BMs: 1; 2; and 4 (in spite the fact that La Melvis electro plant has not yet been commissioned, in reality the plant is there and is working even though with some technical problems under solution). If the Wind Farm (BM4) is not considered as part of the project achievements, the evaluation has to take into consideration the achievement of 2 BMs (1; and 2) out of 3. All equipments needed for the assembling of the 4 Small Wind Generators (SWGs) have been supplied to the local factory and the first prototype is under construction. SWGs units, on the basis of the effective field tests results of the project prototypes (this must be considered as a very strong achievement of the project).

2. The effective quantitative reduction of GHGs emissions has to be compared with the actual approved (by the Steering Committee meeting of 2010) new reduced project objectives (in particular the electro-power generation from 3.5 to 0.5 MW and heat generation from 5.7 to 3.8 MWth) and not with respect to the initial quantitative objective as stated in the original Project Document (based on too optimistic, but understandable at that time, national and international economic/financial considerations/contexts).

3. Due to the 2 very destructive hurricanes that hit the Isla de la Juventud in 2008, the project suffered of around 2 years delays: change of priorities and re-direction of human and financial resources. The effective duration of the project has been of around 7 years and not 9 years.

4. As highlighted in the report, there has been a very high level of bureaucracy involved in the decision as well implementation processes along all project life. But as also underlined in the report, this level of national bureaucracy could not be “reduced” due to: a) the complexity of the project, that involved many ministries and institutions; and b) the actual government/state organization proper of the Country and the specific relationships between with the different enterprises beneficiary and local suppliers involved in the project implementation .

1. The reasoning for the ratings and the current status of these projects is discussed thoroughly in the report. 2. Please see comments above. 3. This is referred to and discussed in the report. 4. As discussed in comment 65 what must be analysed is the ability of the project planners to foresee and address this issue prior to project implementation.

ET to comment

1. The wind farm is an "in kind" contribution of Cuba to the project, but it has not been built up as a part of the Project. The La Melvis plant has not been commissioned at at the time of the evaluation had not yet reached its nominal capacity of 500 kW (maybe if will reach it in the future, but this fact remains to be seen). Construction of the Meat Industry plant has not yet started. As for the SWGs, see response above. 2. Please see responses above. 3. All this is adequately mentioned and discussed in the Report 4. Please see response to Comment 65 above

72	Some evaluation rates should be changed according to the comments made in previous chapters of the report.		ET to comment	Reasons for the ratings are discussed and duly analyzed in the Report. The Evaluation Team considers that they clearly reflect the project achievements at the time of the Terminal Evaluation.
73	It should be MS		ET to comment	See the indicated pages of the Report and the corresponding responses above
74	It should be MS		ET to comment	Same as above
75	It should be MS		ET to comment	Same as above
76	It should be MS		ET to comment	Same as above
77	It should be MS		ET to comment	Same as above
78	It should be MS		ET to comment	Same as above

II. Annex 2: Project outputs and activities

Project Activities	Outputs	Sub - activities
<p>1 - Establishment of a policy and regulatory framework to provide enabling environment to the development of renewable energy technologies</p>	<p>1.1 A policy and regulatory framework to provide enabling environment to the development of renewable energy is established and made operational</p>	<p>1.1.1 Evaluation of present policies and legislation on the development of renewable energy at local and national level: All the existing policies, legislation and regulations dealing with the power generation and the development of renewable energy technologies will be examined and gaps identified. New policy provisions and regulatory framework will be suggested that would support and provide a level playing field for the development of renewable energy technologies on the Island and rest of the country. The project will facilitate preparation of a national renewable energy development policy by the Ministry for Science Technology and Environment (CITMA), as an integral part of the overall energy policy of the country.</p>
		<p>1.1.2 Establishment of power purchase agreement (PPAs) and legal matter agreements: Institutional, legal and regulatory framework will be established. Model PPAs on power generation and distribution of process heat will be drawn by the project</p>

		team and agreed with investors, and a model guideline for harnessing renewable energy technologies will be widely circulated
		1.1.3 Incentive schemes, tax waivers and a risk fund for attracting renewable energy investors and service providers will be developed and suggested to the policy makers to give a boost to the development of renewable energy technologies in Cuba
	1.2 National quality assurance standards on renewable technology performance and evaluation benchmarks set up and widely disseminated	1.2.1 The Ministry for Science, Technology and Environment (CITMA) and GEPROP will facilitate preparation of national quality standards and norms on renewable technology performance and evaluation benchmarks. This would help in ensuring the quality and standards of renewable energy technologies to be introduced in the country, and would assist in quality assurance in national manufacturing facilities and markets for renewable energy technologies, especially biomass and wind equipment
		1.2.2 Workshops and seminars will be held to widely disseminate information on the policies, standards, norms and quality issues to the public and private sector, consumers and other key stakeholders like service and maintenance providers.

	<p>1.3 Guidelines on environment impact assessment, mandatory certification and carrying capacity are formulated to evaluate new and renewable energy investment projects, especially where biomass resources and wind technologies are to be used, and to ensure sustainability of the projects.</p>	<p>1.3.1 Assistance will be provided to the Ministry for Science, Technology and Environment (CITMA), Ministry of Forestry and local administration to formulate guidelines to evaluate new renewable energy projects, especially where biomass resources and wind technologies will be used for power generation and process heat. This would ensure sustainability of the biomass resource utilization for power generation, and setting up of wind energy farms in fragile ecosystems of island states.</p>
		<p>1.3.2 The Ministry for Science, Technology and Environment (CITMA) and Ministry of Forestry will facilitate the development of environment management plans to support renewable (biomass/wind) energy based business models on the Island.</p>
		<p>1.3.3 A mandatory certification programme to verify sustainable forest management practices will be put in place, to begin with, on the Isla de la Juventud, and will be replicated in the rest of the country wherever found feasible</p>
<p>2. Building local and national capacity to utilize the commercial potential of renewable energy technologies.</p>	<p>2.1 Key stakeholders are trained on technology evaluation and benchmarking of renewable energy systems</p>	<p>2.1.1 Capacity building of the key stakeholders, planners, professional and experts will be undertaken through the training workshops and study trips with the main focus on technological evaluation, benchmarking and validation</p>

		of standards of emerging renewable energy technologies and systems, documenting such standards and disseminate lessons learned.
		2.1.2 Training on evaluation of the techno-commercial status of relevant renewable technology – biomass gasifier and wind systems in terms of specifications, inputs and outputs, capital and operating costs, minimum viable project sizes and ranges of economic viability indicators will be imparted. The benchmarks for performance and evaluation for each type of technology will also be developed and documented for wider dissemination through workshops.
	2.2 Key stakeholders are trained on management aspects of renewable energy based power plants and process heat generation systems	2.2.1 Identification of specific capacity building needs on general aspects of operational management of renewable energy based power plants and process heat generation (biomass and wind projects) will be undertaken, and training imparted on key issues such as: a) sustainable supply of biomass through energy plantations; b) technical back-up and management and c) financial and administrative operations
		2.2.2 Training will be imparted on using national and international databases on all aspects of biomass and wind resources, technologies, projects, markets, opportunities, and

		stakeholders
		2.2.3 Training will be imparted on grid synchronization and taking systems approach for power generation based on renewable energy systems
		2.2.4 Training will be provided on developing certification standards as advocated by the Forest Stewardship Council (FSC) to provide the basis for putting in place a mandatory forest certification mechanism to ensure sustainable forestry management on the Isla de la Juventud
	2.3 Experts and planners are trained to manage the technical and financial services for the project, information dissemination and implement the replication strategy	2.3.1 Training courses and seminars will be organized for the project team, experts and planners to manage the technical and financial service unit, disseminate information on the project activities to a wider audience and implement the replication strategy
		2.3.2 Training workshops will be carried out for UNE, OBE, ECOSOL, ALASTOR and GEAM (Forestry Company), and private enterprises that use fuel-oil for heating such as ceramic, meat and fish processing factories, on the effective use of renewable energy systems as a part of replication strategy
		2.3.3 Women experts and consumer groups will be included under the various training programmes to ensure their close involvement in the project

		activities as well as in the replication strategy
	2.4 National manufacturing capacities strengthened to manufacture, assemble and maintain the biomass gasifier systems and wind farms, and reduction in costs of implementing renewable energy projects achieved	2.4.1 Capacity of national/local technical institutions and manufacturing units involved in the manufacturing and servicing of renewable energy equipments will be built and strengthened through technology selection, field visits, training workshops and seminars. The focused efforts in the identified biomass and wind sectors will yield visible growth to ensure their large-scale development and adoption in the future.
		2.4.2 Local capacity to assemble and build biomass gasifier and hybrid wind energy systems will be enhanced through training of skilled manpower. The prospective for mitigation scenarios for energy development in Cuba alone would include, for the next ten years, up to 200 MW power capacity of biomass power plants, 3600 energy efficient boilers for heat production and 30MW of wind power
3. Setting up of new and innovative financial mechanisms and structures to encourage private sector investment in renewable energy projects.	3.1 An innovative funding mechanism is set up to attract investment in renewable energy development on Isla de la Juventud, and replication in the rest of the country	3.1.1 A Risk and Replication Management Fund (RRM Fund) will be set up to cover a part of the investment costs as well as for developing a pipeline of new renewable energy projects in Cuba. The fund will essentially be an interest free loan to cover a small percentage of the private investment component that

		<p>will be taken as GEF risk sharing contribution to the private investors upfront. Once the demonstration period is over and the agreed grace period expires, the private investor will have to pay back the interest free loan as a part of their contribution to the risk and replication management fund (RRMF). The replenished fund will act as a revolving fund for the replication and development of renewable energy investment projects throughout the country. In addition, on completion of the project, RRM fund will also meet the costs on the pre-feasibility studies on a cost-sharing basis with private developers for the new investment projects in Cuba.</p>
		<p>3.1.2 Financial rules/procedures will be developed with the Compañía Fiduciaria – a national level trust fund financial and banking company and National Bank of Cuba to set up RRM Fund targeted at promoting renewable energy projects in the county. Consultations and meetings held with the Compañía Fiduciaria and National Bank of Cuba have revealed a high degree of ownership and willingness to participate in the project, and to support new funding mechanisms. The Compañía Fiduciaria and the National Bank of Cuba will play key roles in managing the RRM</p>

		<p>fund during the demonstration period. This experience will facilitate creating an enabling environment and building local capacities for setting up and management of a national level revolving fund to support renewable energy development at a later stage.</p>
		<p>3.1.3 Financial rules/procedures will be developed with the Compañía Fiduciaria – a national level trust fund financial and banking company and National Bank of Cuba to set up RRM Fund targeted at promoting renewable energy projects in the county. Consultations and meetings held with the Compañía Fiduciaria and National Bank of Cuba have revealed a high degree of ownership and willingness to participate in the project, and to support new funding mechanisms. The Compañía Fiduciaria and the National Bank of Cuba will play key roles in managing the RRM fund during the demonstration period. This experience will facilitate creating an enabling environment and building local capacities for setting up and management of a national level revolving fund to support renewable energy development at a later stage.</p>
	<p>3.2 Capacity of national banks and financial institutions is built to</p>	<p>3.2.1 Study trips, training workshops and seminars will be organized for officials of</p>

	<p>evaluate and analyse renewable energy technology based power projects</p>	<p>the Compañía Fiduciaria and other financial and public utility institutions to appraise, evaluate and analyse renewable energy based investment projects. Sensitization of finance and technical officers of various agencies on appraisal and evaluation of renewable energy based investment projects will greatly assist in creating an environment where new renewable projects will be analysed more professionally, and power purchase agreements, financial guarantees etc., will get finalized within a reasonable time limit.</p>
		<p>3.2.2 Regular consultations between finance officials and technical officials and experts from ECOSOL and OBE will help in simplifying procedures to attract new investments in renewable sector. Best practices world wide on financial evaluation, and investment processes will be compiled and shared with the key financial institutions and banks as well as prospective investors.</p>
		<p>3.2.3 Focused training programmes to impart information on business, finance and technical skills for bankers, renewable energy entrepreneurs and personnel in the selected renewable energy technologies will be undertaken. Training will include the provision of business tools, training on</p>

		financial mechanisms to financial intermediaries, and additional training to major stakeholders inside or outside the project in biomass and wind energy technology
4. Implementation of business models to demonstrate commercial feasibility of renewable energy technologies for power generation and process heat generation	4.1 Installation and start-up of four business models – investment projects (3.5 MW power generation based on the biomass gasification, 6 MWTh based on the biomass gasification for process heat, 1.5 MW based on wind energy and a forestry business model to produce 36,400 tonnes of wood chips).	4.1.1 Technical and financial designing of four business models – investment projects based on the biomass gasification and wind energy technologies will be completed. Technical specifications will be drawn up for each of the renewable equipments to be procured. Although feasibility studies carried out during the PDF phase have resulted in detailed information, technical design and financial packaging will be finalized in consultation with the public utility officials, local enterprises, private investors and financial institutions taking a consortium approach.
		4.1.2 Procurement of technical equipment and services will be undertaken for each business unit as per the technology design finalized through an open bidding process and contractual arrangements
		4.1.3 Discussions with the Cuban authorities and investors during the PDF phase revealed that best options for the implementation of business models would be public private partnership – either under BOT arrangements (already tried on the Isla de

		la Juventud) or taking a joint venture approach. In both cases, UNIDO will facilitate tendering and bidding process. Suppliers will be short-listed and local institutions will be involved to build their capacity to procure renewable technology equipment through global bidding processes
		4.1.4 Installation of biomass gasifiers and wind energy systems will be undertaken on the sites – at Nueva Gerona and Playa de la Bibijagua, and a systems approach will be taken to complete the implementation. Selected local companies, which could be involved in replication strategy, will be taken on board for experience and technical tie up with international companies supplying the equipment.
		4.1.5 Power purchase agreements, legal issues and fund flow arrangements will be facilitated and operational issues finalized for smooth operations of business models
	4.2 Training imparted on the operational and management issues to business models and their linkages with productive use activities	4.2.1 Technical assistance will be provided to the business models i.e. the local forestry company and private power producers on the best management strategies as it will be the key to the success of biomass gasification plants and wind farms for the power generation and process heat for the local

		industries. Environmental benefits of biomass gasifiers and wind farms for electricity generation and process heat will be demonstrated to entrepreneurs and decision-makers in Cuba.
		4.2.2 Training will be imparted to the key stakeholders – business model personnel on the operational and management issues, risks associated with injecting an intermittent energy source by wind farm into a weak mini-grid, and the opportunities available for productive use activities.
	4.3 Close supervision of performance of business units conducted and corrective steps taken on regular basis.	4.3.1 Supervision and interim evaluation of performance of business units will be undertaken to standardize the operations and providing technical assistance, wherever needed
		4.3.2 Based on feedback monitoring of the performance of business units, corrective steps taken by providing technical and institutional support to the investors to optimise the outputs
	4.4 A pilot mini-grid based on biomass gasifier technology set up at Cocodrilo to demonstrate the potential of biomass gasifier technology for isolated mini grids.	4.4.1 A pilot mini-grid based on a 25 kW generator with 50 kg/hr biomass supply (fuel to be used - mainly woody biomass) will be installed at Cocodrilo as this location is only place on the island which is not connected to grid.
		4.4.2 Technicians/Experts

		from the local power utility will be trained to operate and maintain the biomass gasifier systems. Experts from the local power agency - OBE and IPP will also be trained and introduced to the biomass gasification technology
		4.4.3 Local community and women groups will be sensitised and closely involved in the implementation of the proposed biomass gasifier based demonstration unit at Cocodrilo
		4.4.4 Since this will be first of its kind experience in Cuba to set up a mini-grid on biomass energy technologies, as suggested by national counterparts, focused replication strategy would use public private partnership approach involving local communities as key stakeholders in the decision-making processes including biomass production, distribution of power and productive use activities.
5. Establishment of project management structures for the implementation, coordination and monitoring of the project activities and dissemination of results.	5.1 Project team selected and management structure agreed with the national counterparts.	5.1.1 Project team's terms of reference (TORs) will be finalized, and the team selected with background in management, technical and financial areas. The team will prepare work plan and TORs for all experts – national and international experts to be recruited under the project. The team will create a dynamic and sustainable institutional framework for effective implementation of

		the project activities
		5.1.2 Public-private partnerships and joint venture mechanisms will be explored and established by bringing together public and private entities for the implementation of the business models, and by establishing the innovative financial mechanism. Compañía Fiduciaria and National Bank of Cuba would coordinate setting up of the proposed risk and replication management fund.
	5.2 Capacity building and training of the key stakeholders – technical experts, planners, investors and experts achieved	5.2.1 All key stakeholders including technicians, experts, possible investors and planners will be trained in the management of renewable energy systems – business models, and a comprehensive manual prepared to ensure the use of the technical equipment and application of maintenance procedures
		5.2.2 An updated national and international database on all aspects of biomass and wind resources, technologies, projects, markets, opportunities, and stakeholders would be created and shared with the national partners and key stakeholders
		5.2.3 A Technical and Financial Service Unit will be set up and trained whose responsibilities would include, among others, implementation of the replication strategy

	<p>5.3 Close monitoring and evaluation of the project activities achieved</p>	<p>5.3.1 Project activities will be closely monitored and evaluated through a management information system which would also help in taking corrective steps where required. Best practices and lessons learned will be documented and disseminated</p>
		<p>5.3.2 The project will be monitored and evaluated according to GEF, UNEP and UNIDO standard rules and procedures. For each of the activities, a monitoring plan will be put in effect with the detailed set of indicators shown in the Logical Framework Annex B. In addition, record-keeping will also be strengthened to enable adequate attention to information about electricity generation and sales, as well as renewable energy generation. Information about the quantity of energy provided by renewable sources vs. fossil fuel will be an important measure of the project success. This aspect will assume special significance for information sharing between the archipelago and the mainland</p>
	<p>5.4 An effective information dissemination programme and strategy developed and implemented.</p>	<p>5.4.1 Information dissemination activities will include creation of up-to-date information, database on biomass and wind power projects, technology update, newsletter on biomass power, development of data bank on biomass and wind power technologies, preparation of biomass and</p>

		wind power directory hand-book, developing mandatory forest certification standards, preparation of model pre-feasibility, techno-economic feasibility and detailed project reports; model energy purchase agreements and MoUs, project development agreements, fuel supply agreement, package of bid documents
		5.4.2 Model appraisal guidelines for different types of biomass and wind power projects will also be prepared and disseminated
		5.4.3 A website will be created, which will act as a clearing-house for providing detailed information on selected renewable energy resources and technologies. This website will be updated from time to time and maintained after the project by the same agency
	5.5 Lessons learned and results disseminated to a wider audience and a regional network created.	5.5.1 As a part of replication strategy, lessons learned and experience gained under the project will be documented and disseminated by UNEP to a wider audience through brochures, workshops, press, electronic media and Internet.
		5.5.2 A regional network of agencies and institutions involved in the development of the renewable energy technologies will be created to share lessons learned and experiences. UNEP, UNIDO and CARICOM regional initiatives on renewable

		<p>energy will be used to disseminate results and exchange of information. A network of institutions will be created to exchange information with Small Island States</p>
		<p>5.5.3 A network of investors, utilities, NGOs and financial institutions working in the field of renewable energy technologies in the region will be created to provide a common front to mobilize resources for renewable projects</p>

III. Annex 3: Evaluation Terms of Reference

TERMS OF REFERENCE⁷

Terminal Evaluation of the UNEP/GEF project “Generation and Delivery of Renewable Energy Based Modern Energy Services; the Case of Isla de la Juventud”

PROJECT BACKGROUND AND OVERVIEW

Project General Information

Project Title:	Generation and Delivery of Renewable Energy Based Modern Energy Services; the Case of Isla de la Juventud
Executing Agency:	UNIDO
Project partners:	MINCEX, Ministry of Energy and Mines, MINAGRI, CITMA, CUBAENERGIA, UNE, CF
Geographical Scope:	Cuba
Participating Country:	Cuba

Table 1. Project summary

GEF project ID:	1361	IMIS number*⁸:	GFL-2328-2721-4837
Focal Area(s):	Climate Change	GEF OP #:	OP 6
GEF Strategic Priority/Objective:	CC 3	GEF approval date*:	23 March 2005
UNEP approval date:	23 June 2005	Date of first disbursement*:	July 2005
Actual start date⁹:	5 September 2005	Planned duration:	86 months
Intended completion date*:	December 2013	Actual or Expected completion date:	December 2013 (approved by the SC meeting of April 2012)
Project Type:	FSP	GEF Allocation*:	\$5,337,000.00
PPG GEF cost*:	\$325,000.00	PPG co-financing*:	-
Expected MSP/FSP Co-financing*:	\$10,704,000.00	Total Cost*:	\$16,366,000
Mid-term review	-	Terminal Evaluation (actual)	NA

⁷ TOR version of 15 July 2014

⁸ Fields with an * sign (in yellow) should be filled by the Fund Management Officer

⁹ Only if different from first disbursement date, e.g., in cases where a long time elapsed between first disbursement and recruitment of project manager.

(planned date):		date):	
Midterm review (actual date):	May-June 2010	No. of revisions*:	4
Date of last Steering Committee meeting:	18 April 2012	Date of last Revision*:	18 th September 2012
Disbursement as of 30 June 2013*:	5,293,903	Date of financial closure*:	NA
Date of Completion¹⁰*:	N/A	Actual expenditures reported as of 30 June 2013¹¹:	4.359.316,58
Total co-financing realized as of 30 June 2013¹²:	\$ 6,300,000.00	Actual expenditures entered in IMIS as of 30 June 2013*:	3,429,054.17
Leverage financing¹³:	\$ 6,300,000.00		

2. Project rationale

In 2005 UNEP implemented a 6 year GEF-funded project with the main objective being to reduce the Greenhouse Gas Emissions (GHGs) in Cuba by promoting environmentally sound renewable energy technologies for power and heat generation as well as for providing modern energy services on a commercial basis in the Isla de la Juventud. The project addressed the key barriers that constrained the use of renewable energy technologies (biomass and wind) for power and heat generation on the Isla de la Juventud, and aimed to promote business models for sustainable harnessing of renewable energy resources in Cuba. Given the high cost of generating electricity on the island and the demonstrated engagement of private sector investments in fossil fuel based power generation, Isla de la Juventud presented a priority opportunity for a GEF intervention to support renewable energy technologies.

The project adopted a holistic approach for demonstrating the technical, economic and financial viability of sustainable renewable energy production through business models on the Isla de la Juventud, and aimed to help create an enabling environment – in terms of institutional, financial and policy mechanisms – for their replication through-out the country and the region. Both, the national counterpart agency UNE (since January 2010) and Compañía Fiduciaria (CF) – a national level trust fund financial and banking company - were designated agencies for the introduction of business models to support sustainable development in Cuba.

The project aimed to introduce new and innovative financial and institutional structures to encourage private investments, support economically viable markets, promote environmentally sustainable forestry management, develop mandatory certification standards and enhance local manufacturing capacity for renewable energy technologies in Cuba. As a result, a robust market and strong institutional and financial capacity at the national level for supporting renewable energy investment projects and markets would emerge that would make Cuba's economy less reliant on imported fossil fuels to meet its growing energy needs, and in the process, also help in reducing overall GHGs emissions through wide-spread use of renewable energy technologies in the country as well as in the Caribbean region.

¹⁰ If there was a "Completion Revision" please use the date of the revision.

¹¹ Information to be provided by Executing Agency/Project Manager

¹² Projects, which completed mid-term reviews/evaluations or terminal evaluations during FY11, should attach the completed co-financing table as per GEF format. See Annex 1

¹³ See above note on co-financing.

The adoption of the risk sharing mechanism by Cuba aimed to show the effectiveness of the financial instruments in bringing forward investment opportunities and environmental technologies. The financial mechanism aimed to encourage private sector investment in new renewable energy projects on mainland Cuba. Broader outcomes in Cuba should be observable in the form of project proposals and ultimately investments on a long-term basis. Replication of business models for generation of power and process heat from renewable energy sources (biomass and wind) in Cuba should be most effectively addressed by the risk sharing mechanism, but dissemination efforts within institutions and to private sector actors in the market should be important as well.

The project started in July 2005 and was supposed to be completed by end of June 2011 (a number of extensions were granted, see 4b.Implementation issues). The Executing Agency of this project was UNIDO and the National operational counterpart in Cuba was CUBAENERGIA, under the Ministry of Science, Technology and Environment (CITMA).

3. Country context.

Cuba is an island country with an area of 110,860 sq. km and a long coastline of 3735 km. It has a population of about 11 million with terrain mostly flat to rolling plains, with rugged hills and mountains in the southeast on the main island. The country is composed of several islands, Isla de la Juventud being the second largest island outside the main island, with tourism potential as well as agricultural prospects.

Provision of reliable electricity at affordable prices to all households, services and industries is an integral component of the national development plan of the Government of Cuba. In 2001, over 90% of Cuba’s electricity generation capacity was based on fossil fuel. Currently, Cuba produces 50% of oil for its domestic consumption while rest is imported. The national grid has covered about 95% of total population at present while 5% of the population located in far and remote places, mainly in the eastern province, is yet to be provided with reliable electricity services. Electricity tariffs for the household sector and agriculture are highly subsidized by the Government while export earning industries face full cost tariffs.

The National Program for Development of Local Energy Sources in Cuba places a high priority on the development of indigenous and environmentally benign renewable resources/options for rural/urban areas. These options, among others, include biomass, wind, solar, and small hydro technologies in order to meet growing demand for electricity, reducing oil imports and preserving the environment.

Since the beginning of the 1990s, Cuba has been in a critical period of development caused by the sudden collapse of commercial and financial relations with the former COMECON economies along with the reinforcement of the economic, financial and trade embargo that the country is facing. In addition, the Cuban industrial and energy sectors are historically over-dependent on imported fuels. Despite an enduring fall in Gross Domestic Product and the lack of hard currency, fuel imports are maintained at about 6 million tones’ annually (with an additional national production of nearly 3 million tones).

Like most Caribbean island states, high priced oil imports, while minimized through conservation strategies, are constraining the ability of Cubans to develop sustainable livelihoods. The private sector (national as well as international) independent power producers are an opportunity being pursued to fill this gap.

The critical importance of fossil fuels for Cuban electricity sector can be appreciated in details given at Table 2:

Table 2. Installed Capacity and Generation in the National Electric System (NES) of Cuba, 2001

Source	Installed capacity, MW	Generation, GWh	Percentage of Total
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			Generation
Fossil Fuel	3,505	14,372	85.5%
Hydroelectric	57	75	0.5%
Natural Gas	145	1,258	8%
Biomass	704	929	6%
TOTAL	4,411	16,634	100%

4. Background

1. The Isla de la Juventud, an island located southwest of the main island, is the second island in the extension of the Cuban archipelago. Although 350 islands make up the Archipiélago de los Canarreos, Isla de la Juventud is by far the biggest of them, and is administered from the island's capital, Nueva Gerona. Much of the island is flat and a part of it - the Ciénaga de Lanier - is Cuba's second-largest swamp. The island is also the least populated region of Cuba, with most people living in the north of the island. The local economy and employment opportunities of the island mainly depend upon small and medium scale industries. To reduce over-dependence on fossil fuels to meet its growing energy needs, renewable sources of energy offer a viable alternative to enterprises and households on the Isla de la Juventud to achieve their potential.
2. The Isla de la Juventud has a population of about 85,000, with almost 92% of this population living in urban areas and 8% living in rural areas. The island's installed electricity generation capacity at the time of project inception was totally fuel-oil and diesel-based. The main economic activities in Isla de la Juventud are fishing, agriculture, in particular citrus plantations, and dairy, meat and ceramics industries. Tourism is increasing on the island and a number of new economic opportunities for the local population are emerging. These new activities however, will also lead to increased demand for energy. At the start of the project availability of energy services at economic price acted as a constraint for the industrial sector (power for the household sector is subsidized by the Government) on the island. The island possesses abundant natural and renewable resources that could be commercially harnessed to meet the growing needs for energy. These resources, among others, include biomass residues from the forest products and agricultural crops, and wind power located along the coastal areas.
3. Although demand for electricity on the Isla de la Juventud was being met by the mixed quality fuel-oil generators (diesel generators are also being used for peak production or as back up), most of the enterprises were operating below capacity for the want of electricity and fossil fuels for process heat at affordable prices. Further, the increasing use of high sulphur fuel oil and diesel as the main energy fuels on the island was causing many socio-economic and environmental problems. The negative economic effect due to non-availability of adequate modern energy services at affordable prices was manifesting in limited employment opportunities and lack of income generation activities on the island.
4. The key issues impacting upon the energy scenario on the Island were:
 - a) fossil fuels meet primary energy supply for power generation on the island, and the fuel wood partially meets industrial and domestic demand for fuel;
 - b) most of the enterprises were operating at sub-optimal level because of their inability to meet costs on fuel-oil and diesel at commercial rates in foreign exchange (obsolete technologies and lack of market linkages further compound their problems);
 - c) supply of both, fuel-oil and diesel, was by ships from the main island, hence transshipment remained unreliable, especially during the hurricane season;

d) energy conservation and efficiency measures played a significant role in enhancing industrial competitiveness¹⁴

e) excessive emissions from fossil fuels was continuing to degrade the local environment.

5. The expansion in tourism activities and related services on the island, along with the necessity of more reliable and efficient power generation drew the attention of planners to the need of substituting old diesel engines for new efficient ones, and pursuing the introduction of renewable energy based technologies based power generation on the island.
6. Resource assessment conducted under the UNEP/GEF SWERA project and the UNIDO PDF/B identified more than enough wind and biomass resources for a sustainable commercial market in competition with diesel based IPPs and aging state facilities.
7. As of 2001, the island's installed electricity generation capacity was entirely met by fuel-oil and diesel based generators. Against a peak demand for 16.1 MW, total electricity generation was 94.9 GWh.

Table 3. Power demand and supply on the Isla de la Juventud

	1999	2000	2001
Gross Power Generation, GWh	89.9	92.5	94.9
Maximum Demand, MW	15.1	15.6	16.1

8. The use of electricity on the island could be broken down into four main sectors: residential (households), commercial, agriculture and industrial. Electricity generation accounted for 54 percent of the island's primary energy use, and a majority of commercial energy imports. Three fuel oil MAN generators, 3.5 MW each, supplied the main electrical grid, which covered 99 percent of the island's population with only the village of Cocodrilo not connected to the main grid. The residents of Cocodrilo were supplied with electricity (peak demand 25 kW) for 12 hours every day produced from two 37 kW diesel generators.
9. The remaining 46 percent of total primary energy use was consumed in the following way: 23 percent by the transport sector (15 percent in the form of diesel for trucking activities and 8 percent in the form of gasoline for use in private cars); 6 percent in the form of fuel and diesel oil to fuel industrial boilers and cookers, 6 percent by the residential sector in the form of LPG for cooking, and the remaining 11 percent is consumed by other industrial and agricultural uses. The residential sector also consumed the renewable energy resources in the form of fuel wood and charcoal to partially meet their energy needs on the island.
10. According to the Planning Authority of the Island, two commercial activities - tourism and industries - accounted for increased demand for electricity. The tourism industry was forecast to show a robust growth in the next 15 years and generate an additional estimated 10-20% demand for electricity or about 4 MW, and consumption increase of 19 GWh, which was a growth scenario that needed to be planned for.
11. The development of the tourist industry would also increase the consumption of electricity by the industrial, commercial and agriculture sectors. In addition, the industrial sector had the potential for food processing and ceramics industries to work at full capacity. The agricultural sector had further potential for developing small- scale industries based on the tobacco and citrus crops.
12. Under these conditions the Isla de la Juventud should have represented a ripe opportunity to accelerate private sector engagement in sustainable development.

Renewable Energy Resources on the Isla de la Juventud

The Isla de Juventud had abundant renewable energy sources, which were yet to be harnessed. In combination, the estimated renewable energy resources available on the island were sufficient to replace fossil fuels used in electricity production and heat generation.

¹⁴ Mid Term Evaluation TOR- March 2010

Wind: As part of field studies undertaken during the PDF phase and UNEP/GEF supported SWERA project, a wind map had been drawn for the entire Isla de la Juventud. Results obtained show wind speed up to 6.5 m/s at 50 meters height, and the possibility of achieving, on systems with wind turbines of 300 to 700 kW, a Capacity Factor ranging from 20 to 30%. The consistency and reliability of the results were based on the use of the Danish Risoe Laboratory's WASP software to the specific site conditions. The SWERA project terminated its project activities in 2006.

Solar: The SWERA project had developed a high-resolution solar radiation map for the country including Isla de la Juventud. The range of global horizontal solar irradiation is 195 to 280 W/m² or 5 to 7 kWh/m² per day. Validation was underway by GEPROP, Ecosol Solar and the Institute for Meteorology Cuba.

Biomass: A large part of the island was covered in thick forests (more than 100,000 ha.), and the field studies revealed that it was possible to raise "energy plantations" as well as utilise forest residues. Biomass fuel could also be produced through sustainable harvesting of forests to feed the gasification based power generation and process heat. Biomass was identified as the most important renewable energy resource available locally that had several commercial applications in power generation and production of the process heat. As a part of the eco-spatial studies in Geographical Information System (GIS), an inventory of the forest resources of the island was prepared using aerial photographs. The Local Forestry Company on the island is responsible for management of 32,500 ha of woodland of which 22,100 ha are production forests and 10,400 ha are new plantations raised under a reforestation programme that began in 1961. In addition there are 3,300 ha of deforested land of which 2,300 ha have a prevalent woody weed - Marabú (*Dichrostachys Cynerea*). In terms of biomass resources, the field results revealed a usable biomass resource of 48,200 tones' available annually on sustainable basis from the following tree species: *Pinus* sp., *Eucalyptus* sp., *Casuarina* sp., *Albizia* sp., and Marabou. Hence, it was possible that adequate chipped and dried biomass fuel could be produced in a sustainable manner to feed biomass gasification plants that can replace or reduce use of fuel-oil for power generation and production of the process heat. While the biomass assessment study identified weed species and waste forestry production for use in the biomass gasifiers as opportunities, this resource was in addition to the planned sustainable forest harvest.

13. Unlike the mainland Cuba, absence of sugarcane and sugar mills on the island rules out use of bagasse for cogeneration or bagasse based biomass gasification plant.
14. An in-depth analysis of availability of renewable resources and corresponding productive use activities on the island as well as feedback from the key stakeholders revealed that biomass and wind energy had large potential to meet energy needs of the island for power generation and to process heat on commercial basis, while in comparison, solar energy was found to have limited commercial potential for field applications except water heating in hotels.

5. Project objectives and components

15. The **overall project goal** was to reduce greenhouse gas emissions by supporting renewable energy technology based power generation through business models in the Republic of Cuba that could be replicated in other small island nations that are very sensitive to global warming, as well as adding to the energy security of these nations through reduction in the import of high cost fossil fuels.
16. The **project objective** was to remove the key barriers to the development of renewable energy technologies for power generation and process heat on a commercial basis on the Isla de Juventud, and reduce the island's economic vulnerability and environmental stress while promoting business models for sustainable harnessing of renewable energy resources.

Table 4. – Specific Project components/outputs

Component	Specific Outputs
1. Establishment of a policy and regulatory framework enabling development of renewable energy technologies	<p>1.1 Create a policy and regulatory framework to provide enabling environment for the development of renewable energy to be established and made operational:</p> <ul style="list-style-type: none"> • <i>Evaluation of present policies and legislation on the development of renewable energy at local and national level and gaps identified</i> • <i>New policy provisions and regulatory framework to be suggested that would support and provide a level playing field for the development of renewable energy technologies on the Island and rest of the country</i> • <i>The project aims to facilitate preparation of a national renewable energy development policy by the Ministry for Science Technology and Environment (CITMA), as an integral part of the overall energy policy of the country</i> • <i>Establishment of power purchase agreements (PPAs) and legal matter agreements including Institutional, legal and regulatory frameworks</i> • <i>Establish Incentive schemes, tax waivers and a risk fund (RRMF) for attracting renewable energy investors and service providers</i>
	<p>1.2 National quality assurance standards on renewable technology performance and evaluation benchmarks to be set up and widely disseminated:</p> <ul style="list-style-type: none"> • <i>The Ministry for Science, Technology and Environment (CITMA) and GEPROP to facilitate preparation of national quality standards and norms on renewable technology performance and evaluation benchmarks</i> • <i>Workshops and seminars to be held to widely disseminate information on the policies, standards, norms and quality issues to the public and private sector, consumers and other key stakeholders</i>
	<p>1.3 Guidelines on environment impact assessment, mandatory certification and carrying capacity to be formulated to evaluate new and renewable energy investment projects:</p> <ul style="list-style-type: none"> • <i>Assistance to be provided to the Ministry for Science, Technology and Environment (CITMA), Ministry of Forestry and local administration to formulate guidelines to evaluate new renewable energy projects, especially where biomass resources and wind technologies will be used for power generation and process heat</i> • <i>The Ministry for Science, Technology and Environment (CITMA) and Ministry</i>

	<p><i>of Forestry will facilitate the development of environment management plans to support renewable (biomass/wind) energy based business models on the Island.</i></p> <ul style="list-style-type: none"> <i>• A mandatory certification programme to verify sustainable forest management practices to be put in place, to begin with, on the Isla de la Juventud, and then to be replicated in the rest of the country wherever found feasible</i>
<p>2. Building local and national capacity to utilize the commercial potential of renewable energy technologies</p>	<p>2.1 Key stakeholders are trained on technology evaluation and benchmarking of renewable energy systems:</p> <ul style="list-style-type: none"> <i>• Capacity building of the key stakeholders, planners, professional and experts to be undertaken through the training workshops and study trips with the main focus on technological evaluation, benchmarking, and validation of standards of emerging renewable energy technologies and systems, documenting such standards and disseminate lessons learned.</i> <i>• Impart training on evaluation of the techno-commercial status of relevant renewable technology – biomass gasifier and wind systems in terms of specifications, inputs and outputs, capital and operating costs, minimum viable project sizes and ranges of economic viability indicators.</i> <i>• The benchmarks for performance and evaluation for each type of technology to be developed and documented for wider dissemination through workshops.</i>
	<p>2.2 Key stakeholders are trained on management aspects of renewable energy based power plants and process heat generation systems:</p> <ul style="list-style-type: none"> <i>• Identification of specific capacity building needs on general aspects of operational management of renewable energy based power plants and process heat generation (biomass and wind projects) to be undertaken, and training imparted on key issues such as: a) sustainable supply of biomass through energy plantations; b) technical back-up and management and c) financial and administrative operations.</i> <i>• Training to be imparted on using national and international databases on all aspects of biomass and wind resources, technologies, projects, markets, opportunities, and stakeholders.</i> <i>• Training to be imparted on grid synchronization and taking systems approach for power generation based on renewable energy systems.</i> <i>• Training to be provided on developing certification standards as advocated by the Forest Stewardship Council (FSC) to provide the basis for putting in place a mandatory forest certification mechanism to ensure sustainable forestry management on the Isla de la Juventud.</i>
	<p>2.3 Experts and planners to be trained to manage the technical and financial services for the project, to disseminate information and to implement the replication strategy:</p> <ul style="list-style-type: none"> <i>• Training courses and seminars to be organized for the project team, experts</i>

	<p>and planners to manage the technical and financial service unit, disseminate information on the project activities to a wider audience and implement the replication strategy.</p> <ul style="list-style-type: none"> • Training workshops to be carried out for UNE, OBE, ECOSOL, ALASTOR and GEAM (Forestry Company), and private enterprises that use fuel-oil for heating such as ceramic, meat and fish processing factories, on the effective use of renewable energy systems as a part of replication strategy. • Women experts and consumer groups to be included under the various training programmes to ensure their close involvement in the project activities as well as in the replication strategy.
	<p>2.4 National manufacturing capacities strengthened to manufacture, assemble and maintain the biomass gasifier systems and wind farms, and reduce the costs of implementing renewable energy projects:</p> <ul style="list-style-type: none"> • <i>Capacity of national/local technical institutions and manufacturing units involved in the manufacturing and servicing of renewable energy equipments to be built and strengthened through technology selection, field visits, training workshops and seminars. The focused efforts in the identified biomass and wind sectors should yield visible growth to ensure their large-scale development and adoption in the future.</i> • <i>Local capacity to assemble and build biomass gasifier and hybrid wind energy systems to be enhanced through training of skilled manpower. The prospective for mitigation scenarios for energy development in Cuba alone would include, for the next ten years, up to 200 MW power capacity of biomass power plants, 3600 energy efficient boilers for heat production and 30MW of wind power.</i>
<p>3. Setting up of new and innovative financial mechanisms to encourage private sector investment in renewable energy projects;</p>	<p>3.1 <i>An innovative funding mechanism is set up to attract investment in renewable energy development on Isla de la Juventud, and replication in the rest of the country:</i></p> <ul style="list-style-type: none"> • <i>A Risk and Replication Management Fund (RRM Fund) to be set up to cover a part of the investment costs as well as for developing a pipeline of new renewable energy projects in Cuba. In addition, on completion of the project, the RRM fund will also meet the costs of the pre-feasibility studies on a cost-sharing basis with private developers for the new investment projects in Cuba.</i> • <i>Financial rules/procedures to be developed with the Compañía Fiduciaria (CF) – a national level trust fund, financial and banking company, and National Bank of Cuba to set up RRM Fund targeted at promoting renewable energy projects in the county.</i> • <i>The Compañía Fiduciaria, National Bank of Cuba and CITMA along with other agencies will look into, among others, critical issues like terms of interest free loans, length of demonstration period, grace period and penal clauses if the loan is not returned on time by the investors.</i> • <i>The Compañía Fiduciaria and the National Bank of Cuba to work out criteria for allocating funds for future projects on activities such as undertaking feasibility studies, size and capping of study funding for each project, developer/financier share of the feasibility study, repayment schedule of the loan component, separate schemes for power generation developers and</i>

	<p><i>process heat providers, interest of financing partners for replication and terms and conditions for setting up of a national level revolving fund to promote renewable energy technologies in Cuba.</i></p>
<p>4. Implementation of business models to demonstrate commercial feasibility of renewable energy technologies for power generation and process heat generation.</p>	<p>3.2 <i>Capacity of national banks and financial institutions is built to evaluate and analyse renewable energy technology based power projects:</i></p> <ul style="list-style-type: none"> • <i>Study trips, training workshops and seminars will be organized for officials of the Compañía Fiduciaria and other financial and public utility institutions to appraise, evaluate and analyse renewable energy based investment projects.</i> • <i>Regular consultations between finance officials and technical officials and experts from ECOSOL and OBE to be effected.</i> • <i>Best practices world wide on financial evaluation, and investment processes to be compiled and shared with the key financial institutions and banks as well as prospective investors.</i> • <i>Focused training programmes to impart information on business, finance and technical skills for bankers, renewable energy entrepreneurs and personnel in the selected renewable energy technologies to be undertaken.</i> <p>4.1 Installation and start-up of four business models – investment projects (3.5 MW power generation based on the biomass gasification, 6 MWth based on the biomass gasification for process heat, 1.5 MW based on wind energy and a forestry business model to produce 36,400 tonnes of wood chips):</p> <ul style="list-style-type: none"> • Technical and financial designing of four business models – investment projects based on the biomass gasification and wind energy technologies will be completed. Technical specifications to be drawn up for each of the renewable equipments to be procured. • Although feasibility studies carried out during the PDF phase have resulted in detailed information, technical design and financial packaging will be finalized in consultation with the public utility officials, local enterprises, private investors and financial institutions taking a consortium approach. • Procurement of technical equipment and services to be undertaken for each business unit as per the technology design finalized through an open bidding process and contractual arrangements. • UNIDO to facilitate tendering and bidding process public private partnership – either under BOT arrangements (already tried on the Isla de la Juventud) or joint venture approach. Suppliers will be short-listed and local institutions will be involved to build their capacity to procure renewable technology equipment through global bidding processes¹⁶. • Installation of biomass gasifiers and wind energy systems to be undertaken on the sites – at Nueva Gerona and Playa de la Bibijagua, and a systems approach will be taken to complete the implementation. Selected local companies, which could be involved in replication strategy, to be taken on board for experience and technical tie up with international companies supplying the equipment. • Power purchase agreements, legal issues and fund flow arrangements to be facilitated and operational issues finalized for smooth operations of business models. <p>4.2 Training imparted on the operational and management issues to business</p>

	<p>models and their linkages with productive use activities:</p> <ul style="list-style-type: none"> • Technical assistance to be provided to the business models Environmental benefits of biomass gasifiers and wind farms for electricity generation and process heat to be demonstrated to entrepreneurs and decision-makers in Cuba. • Training to be imparted to the key stakeholders – business model personnel on the operational and management issues, risks associated with injecting an intermittent energy source by wind farm into a weak mini-grid, and the opportunities available for productive use activities.
	<p>4.3 Close supervision of performance of business units conducted and corrective steps taken on regular basis:</p> <ul style="list-style-type: none"> • Supervision and interim evaluation of performance of business units to be undertaken to standardize the operations and provide technical assistance, wherever needed. • Based on feedback monitoring of the performance of business units, corrective steps to be taken by providing technical and institutional support to the investors to optimise the outputs.
	<p>4.4 A pilot mini-grid based on biomass gasifier technology set up at Cocodrilo to demonstrate the potential of biomass gasifier technology for isolated mini grids:</p> <ul style="list-style-type: none"> • A pilot mini-grid based on a 25 kW generator with 50 kg/hr biomass supply (fuel to be used - mainly woody biomass) to be installed at Cocodrilo. • Technicians/Experts from the local power utility to be trained to operate and maintain the biomass gasifier systems. Experts from the local power agency - OBE and IPP will also be trained and introduced to the biomass gasification technology. • <i>Local community and women groups to be sensitised and closely involved in the implementation of the Cocodrilo biomass gasifier.</i> • <i>A targeted dissemination strategy to facilitate replication of pilot models on the mainland at remote locations not served by the main grid.</i>
<p>5. Establishment of project management structures for the implementation, coordination and monitoring of the project activities and dissemination of results.</p>	<p>5.1 Project team selected and management structure agreed with the national counterparts:</p> <ul style="list-style-type: none"> • Project team's terms of reference (TORs) to be finalized, and the team selected with background in management, technical and financial areas. The team will prepare work plan and TORs for all experts – national and international experts to be recruited under the project. The team will create a dynamic and sustainable institutional framework for effective implementation of the project activities. • Public-private partnerships and joint venture mechanisms will be explored and established by bringing together public and private entities for the implementation of the business models, and by establishing the innovative financial mechanism. Compañía Fiduciaria and National Bank of Cuba to coordinate setting up of the proposed RRMF.
	<p>5.2 Capacity building and training of the key stakeholders – technical experts, planners, investors and experts:</p> <ul style="list-style-type: none"> • All key stakeholders including technicians, experts, possible investors and planners to be trained in the management of renewable energy systems –

	<p>business models, and a comprehensive manual prepared to ensure the use of the technical equipment and application of maintenance procedures.</p> <ul style="list-style-type: none"> • An updated national and international database on all aspects of biomass and wind resources, technologies, projects, markets, opportunities, and stakeholders to be created and shared with the national partners and key stakeholders. • A Technical and Financial Service Unit to be set up and trained
	<p>5.3 Close monitoring and evaluation of the project activities achieved:</p> <ul style="list-style-type: none"> • Project activities will be closely monitored and evaluated through a management information system. Best practices and lessons learned will be documented and disseminated. • The project will be monitored and evaluated according to GEF, UNEP and UNIDO standard rules and procedures. • Record-keeping to be strengthened to enable adequate attention to information about electricity generation and sales, as well as renewable energy generation.
	<p>5.4 An effective information dissemination programme and strategy developed and implemented:</p> <ul style="list-style-type: none"> • Information dissemination activities to include creation of up-to-date information, database on biomass and wind power projects, technology update, newsletter on biomass power, development of data bank on biomass and wind power technologies, preparation of biomass and wind power directory hand-book, developing mandatory forest certification standards, preparation of model pre-feasibility, techno-economic feasibility and detailed project reports; model energy purchase agreements and MoUs, project development agreements, fuel supply agreement, package of bid documents. • Model appraisal guidelines for different types of biomass and wind power projects to be prepared and disseminated. • A website will be created, updated and sustained, which will act as a clearing-house for providing detailed information on selected renewable energy resources and technologies.

	<p>5.5 Lessons learned and results disseminated to a wider audience and a regional network created:</p> <ul style="list-style-type: none"> • As a part of the replication strategy, lessons learned and experience gained under the project will be documented and disseminated by UNEP to a wider audience through brochures, workshops, press, electronic media and Internet. • A regional network of agencies and institutions involved in the development of the renewable energy technologies will be created to share lessons learned and experiences. UNEP, UNIDO and CARICOM regional initiatives on renewable energy will be used to disseminate results and exchange of information. A network of institutions will be created to exchange information with Small Island States. • A network of investors, utilities, NGOs and financial institutions working in the field of renewable energy technologies in the region will be created to provide a common front to mobilize resources for renewable projects.
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17. The main objective of activity 4 was to implement **four business models** (table 5) to demonstrate commercial feasibility of renewable energy technologies for power generation and process heat generation on the Isla de la Juventud. The project specifically focused on achieving sustainability and replicability of business models, and reducing their implementation costs for wide spread replication in Cuba as well as in the region.

Table 5. Business Models

1. Biomass fuel production and supply model	Design
	To meet the requirements of fuel supply for power generation and for the production of process heat, a conservative figure of biomass availability was used as a part of the project design to meet the biomass requirements of a 3.5 MW gasifier for power generation and 6 MW gasifiers for the process heat. This would require 36,400 tonnes per year of woodchips (as against the total availability of 48,200 tonnes of wood though sustainable forests harvesting practices).
	Biomass
	<i>The different sources of biomass production were identified as:</i>
	<ul style="list-style-type: none"> • Producer Forests: <i>Conforming to the forestry management plan, 27 ha of producer forests to be used for the production of 1,700 tonnes every year (at a yield of 63 tonnes per ha).</i> • Thinning Operations: <i>Conforming to the forestry management plan, 1725 ha of plantation forests per year to be thinned yielding 24,150 tonnes per year (yield assumed 14 tonnes per ha).</i> • Forests regeneration: <i>190 ha of degraded forests to be planted and added every year yielding 10,640 tonnes (at a yield of 56 tonnes per ha).</i>
	Institutional arrangements
	The Empresa Forestal Integral (EFI) of the Isla de la Juventud, a partner of the Grupo

	<p>Empresarial de Agricultura de Montaña (GEAM), was to be the Cuban institution in charge of the production, supply and sale of wood chips (with maximum humidity 30 %), as well as the forestry management needed to ensure sustainability. The project envisaged purchasing agreements between the local forestry company (EFI) and the biomass gasifier plant owners for the production of gas for electricity, and between the EFI, Investors and ALASTOR for the production of process heat.</p> <p>2014 PIR update</p> <p>All supply contracts signed and equipment had already arrived. The Nursery Forest Plantation has already provided plants for around 200 ha of land and is actually working as planned.</p>
<p>2. Biomass Gasifier Business Model for Power Generation</p>	<p>Design</p> <p><i>A biomass gasification system to be established to supply gas to a dual mode internal combustion engine based power plant of capacity 3.5 MW. Due to local technological experience and power generation infrastructure, the integration of biomass gasification and diesel/fuel oil engines was to be adopted.</i></p> <p>Institutional arrangements</p> <p>Discussions with the Cuban authorities and investors revealed that the best options for the implementation of business models would be public private partnership – either under BOT arrangements (already tried on Juventud) or a joint venture approach. Various implementation options (joint ventures, BOT approach etc.) were considered and firmed up in the first year of implementation phase keeping in view the financial and institutional issues to facilitate investments.</p> <p>2014 PIR update</p> <p>A biomass gasifier based electro-power plant of 0.5 MW was planned at La Melvis for the supply of electricity to the grid located near the main town of the island. The plant has been completed and after some mechanical problems at the filtering systems, the final stage of commissioning will take place in August 2014. The plant is connected to the main electrical grid at 13,800V; around 14 technicians are working in the plant, which is supposed to work 24/7. After an additional transitional period of few months (during which it will be very closely monitored), the Plant will be considered definitely in operation.</p>
<p>3. Biomass Gasifier Business Model for Process Heat</p>	<p>Design</p> <p>Under the proposed intervention, four gasifier units were to be fitted to adapted burners in local industries to provide process heat. All the selected industries were to have their burners retrofitted to be able to work efficiently on producer gas from biomass gasifiers installed on the sites. The biomass gasifier units would incorporate full water treatment schemes.</p> <p>Identified Industries</p> <ul style="list-style-type: none"> • Isla de la Juventud Meat Complex Enterprise. • Isla de la Juventud Milk Complex Enterprise. • Isla de la Juventud Ceramic Enterprise. • Isla de la Juventud Fishing Association

	<p>Institutional arrangements</p> <p>One of the possible options could be that the burners will be fitted by Alastor, which is a local engineering company currently maintaining and servicing the burners and furnaces. It is envisaged that Alastor will also own the gasifiers and will act as a gas ESCO.</p>
	<p>2014 PIR update</p> <p>One gasifier boiler for heat-generation (3.8MWth power) for the Meat Industry initiated (reduction and change of generated power requested by the Government and approved by the Steering Committees on 2010 and 2012). The equipment has been purchased from BERKES and will arrive in Cuba not before November 2014. The relevant civil works should start sometime between August – October 2014. The plant will be in operation not before February/March 2015.</p>
<p>4. Wind Farm Business Model at Playa Bibijagua</p>	<p>Design</p> <p><i>The most favourable site for locating the wind farm was identified as Playa Bibijagua. This site was ideal for two reasons. Firstly, it had the strongest wind intensity, and secondly, it was not far from the existing grid and grid connection could easily be facilitated.</i></p> <p>It was proposed to set up a 1.5 MW wind farm, which represented a penetration of 10% with respect to the maximum demand in 2000.</p>
	<p>2014 PIR update</p> <p>In 2007, the Government of Cuba established a 1.65 MW Wind Farm at Los Canarreos with a cost of around US\$ 4.5 Million. On 09/11/2009, the Government officially communicated to UNIDO and UNEP the decision to put the Wind Farm under the responsibility of the Project as a substitute contribution to the wind farm component of the project.</p> <p><i>In 2014 the wind farm has worked as planned; the Tower No 5 (out of 6 towers) is not working due to a block at its "mechanical/oleodynamics system". The constructor has been contacted, but the problem has not yet been solved.</i></p>

4.Executing Arrangements

18. The **Implementing Agency** for the project was the United Nations Environment Programme (UNEP). In this capacity, UNEP had overall responsibility for the implementation of the project, project oversight, technical support and co-ordination with other GEF projects.
19. The **Executing Agency** of this project is UNIDO and the National operational counterpart in Cuba is CUBAENERGIA, under the Ministry of Science, Technology and Environment (CITMA).

a. Project Cost and Financing

20. During the PDF phase four companies showed a keen interest in investing and joining the project. A brief summary of the key technical and financial parameters of the proposed business models was shared with them to seek their views, and also to explore their continued interest in the project. All the four companies agreed in principle with the technical and financial analysis carried out during the PDF phase, and sent strong letters of interest to participate and invest in the project in part (in one business model) or all business models. The GEF provided assistance equivalent to the incremental cost originated in replacing the baseline

case scenario (replacing and increasing generation capacity with fuel oil generators and producing heat by using fuel oil as fuel) by a CO2 reduction scenario (using biomass gasification plants and wind turbines)

21. A new and innovative financial modality (RRM Fund) of US \$ 1.92 million was proposed to provide interest free loans to investors to partially meet their upfront risk costs for undertaking business models. The fund aimed to cover a small part of the private investment component that would be taken as a GEF risk sharing contribution to the private investors. For the duration of the project, the project management team along with the Compañía Fiduciaria – a national level trust fund financial and banking company, was to administer the RRM Fund under the overall supervision of the national steering committee, backstopped by UNIDO.

Table 6 –Project Finances¹⁵

No	Number and Description of the Activity	Full Budget Allocation US\$ (2=3+4)	Expenditures US\$ 30/4/10 (3)	Remaining US\$ 30/4/10 (4)
1	Act.1 Establishment of a policy for RETs in Cuba.	10,000.0	0.0	10,000.0
2	Act.2: Capacity Building to utilize commercial potential of RETs	62,510.0	62,510.5	0.0
3	Act 3. Setting up new financial mechanism for investment in RETs	216,956.0	216,956.0	0.0
4	Act 4. Implementation of Business Models: Sub-Total *	2,920,000.0	1,000,000.0	1,920,000.0
	BM1. Forestry Management (36,423 tonnes/year)	0.0	0.0	0.0
	BM 2: Electro prod. (0.5 MW - La Melvis plant)	0.0	0.0	0.0
	BM 3: Heat prod. (Meat - 2.4 MWth + Dairy – 1.4 MWth)	0.0	0.0	0.0
	BM 4: Wind farm (1.6 MW) **	-----	-----	-----
	Compania Fiduciaria ***	2,920,000	1,000,000.0	1,920,000

¹⁵Source: Mid Term Evaluation Report, June 2010

	Act 5. Project Management, monitoring, dissemination: Sub-Total	411,948.7	312,053.7	99,895.0
	Act 6. Implementation of Demonst. Component: Sub-Total	899,601.0	99,601.0	800,000.0
	Cocodrilo plant	99,601.0	99,601.0	0.0
	Marabou cutting machine	180,000.0	0.0	180,000.0
	Small Aerogenerators (up to 5 KW)	120,000.0	0.0	120,000.0
	Compact biomass power plant for isolated communities.	280,000.0	0.0	280,000.0
	Hybrid system for meteorological radar of Punta del Este.	170,000.0	0.0	170,000.0
	Unforeseen Expenditure	50,000.0	0.0	50,000.0
7	Act 7. Support to BMs and Demonstrate components: Sub-Total	561,841.3	105,465.0	456,376.3
	Install. 4 Wind measurement towers	113,051.0	105,465.0	7,586.0
	Nursery forest plant.	168,000.0	0.0	168,000.0
	Equip./tools x Cocodrilo plant	75,000.0	0.0	75,000.0
	Reserve for potential increase of the power of La Melvis plant (BM 2)	205,790.3	0.0	205,790.3
8	UNIDO overhead cost (5%)	254,143.0	89,594.4	164,549
	TOTAL	5,337,000.0	1,886,180	3,450,820

* \$ 1,000,000.0 already at disposal of CF: US\$ 0.5 Mn already disbursed + US\$ 0.5 Mn obligated.

** Gov. has already erected the Wind farm at Los Canarreos (1.65 MW)

*** CF will directly fund the implementation of: BM1 - Forestry management (US\$ 1,000,000); BM2 – Electro production (US\$ 1,410,000); and BM3 – Heat production (US\$ 510,000). The contracts will be omni-comprehensive (equipments, training for local technicians and commissioning).

b. Implementation Issues

22. Several events over the lifetime of the project have had a significant impact on the implementation of the project. Three hurricanes struck Cuba (particularly the Isla de la Juventud) in 2008, which obliged the Government to change their priorities and to allocate the scarce financial resources to the reconstruction of all basic infrastructures (hospitals, schools, electrical grid; etc). In addition, the world financial crisis of 2008 severely affected the economy of the country, increasing the internal financial difficulties, and obliging the Government of Cuba to request some changes (basically a quantitative reduction) to the initial project objectives.
23. In the Steering Committee meeting of 27/5/09, and the months after, it became clear that not only were there difficulties in securing the international co-financing needed for the implementation of the 4 Business Models, but also that the Government of Cuba could not guarantee the investments needed (co-financing of the 4 BMs). Therefore it was decided to reduce significantly the level of some project objectives.
24. During the same steering Committee meeting of 27/5/09 it became evident that a lot of Ministries and Government Institutions were fully involved not only in the direct/indirect implementation of the project activities, but all of them were involved in the “decision chain” related to each one of the activities that needed to receive any specific authorization or/and endorsement or/and approval. It was recognized that: a) it was quite complex and difficult to manage to get quick decisions about project activities to be implemented according to an established schedule; b) the “project structure” was cumbersome and represented one of the major causes of the actual delay in the implementation faced by the project in the past.
25. The Steering Committee meeting held on 29/1/2010 approved important changes in the project:
 - Establishment of a new set of “Project Milestones for 2010” grouped according to 3 different time deadlines.
 - A new role for the Compania Fiduciaria CF) as full funding agency of the 3 remaining (reduced) Business Models and as Revolving Fund agency for similar initiatives in Cuba.
26. The next Project Steering Committee meeting was held in La Habana on 18/4/2012. After in-depth discussions about the actual status of the implementation of the activities and the achievement of some of the project objectives, the committee approved the following important decisions:
 - Request of extension of the project duration until the end of 2013 on the basis of the actual status of implementation of the project and the perspectives for the future.
 - Formulation of a realistic and detailed Work Plan for 2012-2013.
 - Request of a new Budget Revision for the years 2012-2013 and the transfer of remaining funds to UNIDO for the completion of the remaining project activities.

TERMS OF REFERENCE FOR THE EVALUATIONS

Objective and Scope of the Evaluation

27. In line with the UNEP Evaluation Policy¹⁶, the UNEP Evaluation Manual¹⁷ and the Guidelines for GEF Agencies in Conducting Terminal Evaluations¹⁸, the Terminal Evaluations of the Project “Generation and Delivery of Renewable Energy Based Modern Energy Services; the Case of Isla de la Juventud” will be undertaken upon completion of the project or immediately before the completion of the project to assess project performance (in terms of relevance, effectiveness and efficiency), and determine outcomes and impacts (actual and potential) stemming from the project, including their sustainability. The evaluations have two primary purposes: (i) to provide evidence of results to meet accountability requirements, and (ii) to promote

¹⁶ <http://www.unep.org/eou/StandardsPolicyandPractices/UNEPEvaluationPolicy/tabid/3050/language/en-US/Default.aspx>

¹⁷ <http://www.unep.org/eou/StandardsPolicyandPractices/UNEPEvaluationManual/tabid/2314/language/en-US/Default.aspx>

¹⁸ http://www.thegef.org/gef/sites/thegef.org/files/documents/TE_guidelines7-31.pdf

learning, feedback, and knowledge sharing through results and lessons learned among UNEP, the GEF and their executing partners – the National Executing Agencies and the national partners in particular. Therefore, the evaluation will identify lessons of operational relevance for future project formulation and implementation. It will focus on the following sets of **key points**, based on the projects' expected outcomes, which may be expanded by the consultants as deemed appropriate:

- the involvement of the local (Isla de la Juventud) Authorities and direct Beneficiaries during the formulation and implementation of the project;
- the stakeholder participation/public awareness.
- the effectiveness of the “local decision process” taking into consideration the local internal and inter-ministerial bureaucracy;
- the effectiveness of the financial mechanism established by the Compania Fiduciaria for the co-financing of the “Business Models” considered by the project including the RRMF; there are revolving funds to be used for similar initiatives in Cuba;
- the willingness and capacity of the Government in relation to the financial commitments for co-funding and investments foreseen in the original project document;
- the capacity of the project to achieve the revised/reduced project objectives as discussed and approved during by the Steering Committee of January 2010.
- The likelihood of and potential for replication of the project in other parts of the main Island

Overall Approach and Methods

28. The Terminal Evaluations of the Project “Generation and Delivery of Renewable Energy Based Modern Energy Services; the Case of Isla de la Juventud” will be conducted by an independent consultant under the overall responsibility and management of the UNEP Evaluation Office (Nairobi), in consultation with the UNEP Task Manager (Nairobi), and the UNEP Fund Management Officer at UNEP/DEPI (Nairobi).
29. They will be in-depth evaluations using a participatory approach whereby key stakeholders are kept informed and consulted throughout the evaluation process. Both quantitative and qualitative evaluation methods will be used to determine project achievements against the expected outputs, outcomes and impacts.
30. The findings of the evaluation will be based on the following:
 - (a) A **desk review** of project documents and others including, but not limited to:
 - Relevant background documentation, inter alia UNEP and GEF-3 policies, strategies and programmes pertaining to renewable energy at the time of the project’s approval;
 - Project design documents; Annual Work Plans and Budgets or equivalent, revisions to the logical framework and project financing;
 - Project reports such as progress and financial reports from the executing partners; Steering committee meeting minutes; National Committee meeting minutes; annual Project Implementation Reviews and relevant correspondence;
 - Documentation related to project outputs;
 - Relevant material published, e.g. in journals and books
 - (b) **Interviews** with:
 - UNEP Task Manager and Fund Management Officer and other relevant staff in UNEP as necessary;
 - Interviews with project management, Steering and National Committee and key partners to the extent possible;
 - Stakeholders involved with this project, including NGOs, private sector, related organizations, Financial and promotional entities, academia and research centres, national organizations and institutes, including National Competent Authorities, regional and international organizations and civil society representatives, including rural communities to the extent possible;
 - Relevant staff of GEF Secretariat and
 - Representatives of the government and other organisations (if deemed necessary by the consultant).
 - (c) **Country visit.** The evaluation consultant will schedule a visit to the country to interview relevant stakeholders and the project team. To the extent possible.

Key Evaluation principles

31. Evaluation findings and judgements should be based on **sound evidence and analysis**, clearly documented in the evaluation report. Information will be triangulated (i.e. verified from different sources) to the extent possible, and when verification was not possible, the single source will be mentioned. Analysis leading to evaluative judgements should always be clearly spelled out.
32. The evaluation will assess the project with respect to **a minimum set of evaluation criteria** grouped in six categories: (1) Strategic Relevance; (2) Attainment of objectives and planned result, which comprises the assessment of outputs achieved, effectiveness and likelihood of impact; (3) Sustainability and replication; (4) Efficiency; (5) Factors and processes affecting project performance, including preparation and readiness, implementation and management, stakeholder participation and public awareness, country ownership and driven-ness, financial planning and management, UNEP supervision and backstopping, and project monitoring and evaluation; and (6) Complementarity with the UNEP strategies and programmes. The evaluation consultants can propose other evaluation criteria as deemed appropriate.
33. **Ratings.** All evaluation criteria will be rated on a six-point scale. However, complementarity of the project with the UNEP strategies and programmes is not rated. Annex 3 provides detailed guidance on how the different criteria should be rated and how ratings should be aggregated for the different evaluation criterion categories.
34. In attempting to attribute any outcomes and impacts to the project, the evaluator should consider the difference between *what has happened with and what would have happened without the project*. This implies that there should be consideration of the baseline conditions and trends in relation to the intended project outcomes and impacts. This also means that there should be plausible evidence to attribute such outcomes and impacts to the actions of the project. Sometimes, adequate information on baseline conditions and trends is lacking. In such cases this should be clearly highlighted by the evaluators, along with any simplifying assumptions that were taken to enable the evaluator to make informed judgements about project performance.
35. As these are terminal evaluations, particular attention should be given to learning from the experience. Therefore, the “*Why?*” question should be at front of the consultant’s minds all through the evaluation exercise. This means that the consultant needs to go beyond the assessment of “*what*” the project performance was, and make a serious effort to provide a deeper understanding of “*why*” the performance was as it was, i.e. of processes affecting attainment of project results (criteria under category 3). This should provide the basis for the lessons that can be drawn from the project. In fact, the usefulness of the evaluation will be determined to a large extent by the capacity of the consultants to explain “*why things happened*” as they happened and are likely to evolve in this or that direction, which goes well beyond the mere review of “*where things stand*” today.

Evaluation criteria

Strategic relevance

36. The evaluations will assess, in retrospect, whether the projects’ objectives and implementation strategies were consistent with: i) Sub-regional environmental issues and needs; ii) the UNEP mandate and policies at the time of design and implementation; and iii) the GEF Biodiversity focal area, strategic priorities and operational programme(s).
37. The evaluations will also assess whether the projects’ objectives were realistic, given the time and budget allocated to the project, the baseline situation and the institutional context in which the project was to operate.

Achievement of Outputs

38. The evaluation will assess, for each component, the project’s success in producing the programmed results as presented in Table 3 above, both in quantity and quality, as well as their usefulness and timeliness. Briefly explain the degree of success of the projects in achieving its different outputs, cross-referencing as needed to more detailed explanations provided under Section F (which covers the processes affecting attainment of project objectives).

Effectiveness: Attainment of Objectives and Planned Results

39. The evaluations will assess the extent to which the project’s objectives were effectively achieved or are expected to be achieved.

40. The evaluations will reconstruct the Theory of Change (ToC) of the project based on a review of project documentation and stakeholder interviews. The ToC of a project depicts the causal pathways from project outputs (goods and services delivered by the project) over outcomes (changes resulting from the use made by key stakeholders of project outputs) towards impact (changes in environmental benefits and living conditions). The ToC will also depict any intermediate changes required between project outcomes and impact, called intermediate states. The ToC further defines the external factors that influence change along the pathways, whether one result can lead to the next. These external factors are either drivers (when the project has a certain level of control) or assumptions (when the project has no control).
41. The assessment of effectiveness will be structured in three sub-sections:
- (a) Evaluation of the **achievement of direct outcomes as defined in the reconstructed ToC**. These are the first-level outcomes expected to be achieved as an immediate result of project outputs.
 - (b) Assessment of the **likelihood of impact** using a *Review of Outcomes to Impacts* (ROtI) approach as summarized in Annex 8 of the TORs. Appreciate to what extent the project has to date contributed, and is likely in the future to further contribute to changes in stakeholder behaviour as a result of the project's direct outcomes, and the likelihood of those changes in turn leading to changes in the natural resource base, benefits derived from the environment and human living conditions.
 - (c) Evaluation of the **achievement of the formal project overall objective, overall purpose, goals and component outcomes** using the project's own results statements as presented in original logframe and any later versions of the logframe. This sub-section will refer back where applicable to sub-sections (a) and (b) to avoid repetition in the report. To measure achievement, the evaluation will use as much as appropriate the indicators for achievement proposed in the Logical Framework Matrix (Logframe) of the project, adding other relevant indicators as appropriate. Briefly explain what factors affected the project's success in achieving its objectives, cross-referencing as needed to more detailed explanations provided under Section F.

Sustainability and replication

42. Sustainability is understood as the probability of continued long-term project-derived results and impacts after the external project funding and assistance ends. The evaluation will identify and assess the key conditions or factors that are likely to undermine or contribute to the persistence of benefits. Some of these factors might be direct results of the project while others will include contextual circumstances or developments that are not under control of the project but that may condition sustainability of benefits. The evaluation should ascertain to what extent follow-up work has been initiated and how project results will be sustained and enhanced over time. The reconstructed ToC will assist in the evaluation of sustainability.
43. Four aspects of sustainability will be addressed:
- a) *Socio-political sustainability*. Are there any social or political factors that may influence positively or negatively the sustenance of project results and progress towards impacts? Is the level of ownership by the main national and regional stakeholders sufficient to allow for the project results to be sustained? Are there sufficient government and stakeholder awareness, interests, commitment and incentives to execute, enforce and pursue the programmes, plans, agreements, monitoring systems etc. prepared and agreed upon under the project? To what extent was the project able to reach out to the stakeholders identified in the design phase (academia, private sector, civil society including rural communities etc)?
 - b) *Financial resources*. To what extent are the continuation of project results and the eventual impact of the project dependent on continued financial support? What is the likelihood that adequate financial resources¹⁹ will be or will become available to implement the programmes, plans, agreements, monitoring systems etc. prepared and agreed upon under the project? Are there any financial risks that may jeopardize sustenance of project results and onward progress towards impact?
 - c) *Institutional framework*. To what extent is the sustenance of the results and onward progress towards impact dependent on issues relating to institutional frameworks and governance? How robust are the institutional achievements such as governance structures and processes, policies, sub-regional agreements, legal and accountability frameworks etc. required to sustaining project results and to lead those to impact on human behaviour and environmental resources?
 - d) *Environmental sustainability*. Are there any environmental factors, positive or negative, that can influence the future flow of project benefits? Are there any project outputs or higher level results that are likely to affect the environment, which, in turn, might affect sustainability of project benefits? Are there any foreseeable negative environmental impacts that may occur as the project results are being up-scaled?

¹⁹ Those resources can be from multiple sources, such as the public and private sectors, income generating activities, other development projects etc.

44. **Catalytic role and replication.** The *catalytic role* of GEF-funded interventions is embodied in their approach of supporting the creation of an enabling environment and of investing in pilot activities which are innovative and showing how new approaches can work. UNEP and the GEF also aim to support activities that upscale new approaches to a national, regional or global level, with a view to achieve sustainable global environmental benefits. The evaluation will assess the catalytic role played by this project, namely to what extent the project has:
- (a) *catalyzed behavioural changes* in terms of use and application by the relevant stakeholders of: i) technologies and approaches show-cased by the demonstration projects; ii) strategic programmes and plans developed; and iii) assessment, monitoring and management systems established at national and regional level;
 - (b) provided *incentives* (social, economic, market based, competencies etc.) to contribute to catalyzing changes in stakeholder behaviour;
 - (c) contributed to *institutional changes*. An important aspect of the catalytic role of the project is its contribution to institutional uptake or mainstreaming of project-piloted approaches in the regional and national demonstration projects;
 - (d) contributed to *policy changes* (on paper and in implementation of policy);
 - (e) contributed to sustained follow-on financing (*catalytic financing*) from Governments, the GEF or other donors;
 - (f) created opportunities for particular individuals or institutions ("*champions*") to catalyze change (without which the project would not have achieved all of its results).
45. *Replication*, in the context of GEF projects, is defined as lessons and experiences coming out of the project that are replicated (experiences are repeated and lessons applied in different geographic areas) or scaled up (experiences are repeated and lessons applied in the same geographic area but on a much larger scale and funded by other sources). The evaluations will assess the approach adopted by the project to promote replication effects and appreciate to what extent actual replication has already occurred or is likely to occur in the near future. What are the factors that may influence replication and scaling up of project experiences and lessons?

Efficiency

46. The evaluations will assess the cost-effectiveness and timeliness of project execution. They will describe any cost- or time-saving measures put in place in attempting to bring the project as far as possible in achieving its results within its programmed budget and (extended) time. They will also analyse how delays have affected project execution, costs and effectiveness. Wherever possible, costs and time over results ratios of the projects will be compared with that of other similar interventions and to each other's. The evaluations will give special attention to efforts by the project teams to make use of/build upon pre-existing institutions, agreements and partnerships, data sources, synergies and complementarities with other initiatives, programmes and projects etc. to increase project efficiency, all within the context of project execution.
47. The projects suffered from moderate to significant delays. To what extent were the projects efficiently managed and what lessons can be learnt for future projects? To what extent did these challenges have an impact on the delivery of project outcomes and the achievement of the project objective?

Factors and processes affecting project performance

48. **Preparation and readiness.** This criterion focusses on the quality of project design and preparation. Were project stakeholders²⁰ adequately identified? Were the project's objectives and components clear, practicable and feasible within its timeframe? Were the capacities of executing agencies properly considered when the project was designed? Was the project document clear and realistic to enable effective and efficient implementation? Were the partnership arrangements properly identified and the roles and responsibilities negotiated prior to project implementation? Were counterpart resources (funding, staff, and facilities) and enabling legislation assured? Were adequate project management arrangements in place? Were lessons from other relevant projects properly incorporated in the project design? What factors influenced the quality-at-entry of the project design, choice of partners, allocation of financial resources etc.? Were GEF environmental and social safeguards considered when the project was designed²¹? Were sufficient components integrated into the project design to ensure the obtaining of commitment of government representatives? Were sufficient provisions integrated into project design to minimise delays in

²⁰ Stakeholders are the individuals, groups, institutions, or other bodies that have an interest or stake in the outcome of the project. The term also applies to those potentially adversely affected by the project.

²¹ <http://www.thegef.org/gef/node/4562>

implementation? Were the projects designed with the needs of the countries in mind and to what extent where they aligned to national priorities?

49. **Project implementation and management.** This includes an analysis of implementation approaches used by the project, its management framework, the project's adaptation to changing conditions (adaptive management), the performance of the implementation arrangements and partnerships, relevance of changes in project design, and overall performance of project management. The evaluation will:
- (a) Ascertain to what extent the project implementation mechanisms outlined in the project document have been followed and were effective in delivering project outputs and outcomes. Were pertinent adaptations made to the approaches originally proposed?
 - (b) Evaluate the effectiveness and efficiency of project management by the National Executing Agencies and how well the management was able to adapt to changes during the life of the project.
 - (c) Assess the role and performance of the units and committees established and the project execution arrangements at all levels.
 - (d) Assess the extent to which project management, as well as national partners, responded to direction and guidance provided by the National Coordination Committee and UNEP supervision recommendations.
 - (e) Identify operational and political / institutional problems and constraints that influenced the effective implementation of the project, and how the project partners tried to overcome these problems. How did the relationship between the project management team and the national coordinators develop?
 - (f) Assess the extent to which MTR recommendations were followed in a timely manner.
 - (g) Assess the extent to which the project implementation met GEF environmental and social safeguards requirements.
50. **Stakeholder participation and public awareness.** The term stakeholder should be considered in the broadest sense, encompassing project partners, government institutions, private interest groups, local communities etc. The TOC analysis should assist the evaluators in identifying the key stakeholders and their respective roles, capabilities and motivations in each step of the causal pathway from activities to achievement of outputs and outcomes to impact. The assessments will look at three related and often overlapping processes: (1) information dissemination between stakeholders, (2) consultation between stakeholders, and (3) active engagement of stakeholders in project decision making and activities. The evaluations will specifically assess:
- (a) the approach(es) used to identify and engage stakeholders in project design and implementation. What were the strengths and weaknesses of these approaches with respect to the project's objectives and the stakeholders' motivations and capacities? What was the achieved degree and effectiveness of collaboration and interactions between the various project partners and stakeholders during design and implementation of the project?
 - (b) the degree and effectiveness of any public awareness activities that were undertaken during the course of implementation of the project; or that are built into the assessment methods so that public awareness can be raised at the time the assessments will be conducted;
 - (c) how the results of the project (strategic programmes and plans, monitoring and management systems, sub-regional agreements etc.) promote participation of stakeholders in decision making.
51. **Country ownership and driven-ness.** The evaluation will assess the performance of national partners involved in the project, as relevant:
- (a) In how far has the national partner assumed responsibility for the project and provided adequate support to project execution, including the degree of cooperation received from the various public institutions involved in the project and the timeliness of provision of counter-part funding to project activities?
 - (b) To what extent has the national and regional political and institutional framework been conducive to project performance?
 - (c) How responsive were the national partners to the National Executing Agencies coordination and guidance, and to UNEP supervision?
52. **Financial planning and management.** Evaluation of financial planning requires assessment of the quality and effectiveness of financial planning and control of financial resources throughout the project's lifetime. The assessment will look at actual project costs by activities compared to budget (variances), financial management (including disbursement issues), and co-financing. The evaluation will:
- (a) Verify the application of proper standards (clarity, transparency, audit etc.) and timeliness of financial planning, management and reporting to ensure that sufficient and timely financial resources were available to the project and its partners;

- (b) Appreciate other administrative processes such as recruitment of staff, procurement of goods and services (including consultants), preparation and negotiation of cooperation agreements etc. to the extent that these might have influenced project performance;
 - (c) Present to what extent co-financing has materialized as expected at project approval (see Table 1, 4, 5 and 6). Report country co-financing to the project overall, and to support project activities at the national level in particular. The evaluations will provide a breakdown of final actual costs and co-financing for the different project components (see tables in Annex 4).
 - (d) Describe the resources the projects have leveraged since inception and indicate how these resources are contributing to the projects' ultimate objective. Leveraged resources are additional resources—beyond those committed to the project itself at the time of approval—that are mobilized later as a direct result of the project. Leveraged resources can be financial or in-kind and they may be from other donors, NGO's, foundations, governments, communities or the private sector.
53. Analyse the effects on project performance of irregularities (if any) in procurement, use of financial resources and human resource management, and the measures taken by the National Executing Agencies or UNEP to prevent such irregularities in the future. Appreciate whether the measures taken were adequate.
54. **UNEP supervision and backstopping.** The purpose of supervision is to verify the quality and timeliness of project execution in terms of finances, administration and achievement of outputs and outcomes, in order to identify and recommend ways to deal with problems which arise during project execution. Such problems may be related to project management but may also involve technical/institutional substantive issues in which UNEP has a major contribution to make. The evaluators should assess the effectiveness of supervision and administrative and financial support provided by UNEP including:
- (a) The adequacy of project supervision plans, inputs and processes;
 - (b) The emphasis given to outcome monitoring (results-based project management);
 - (c) The realism and candour of project reporting and ratings (i.e. are PIR ratings an accurate reflection of the project realities and risks);
 - (d) The quality of documentation of project supervision activities; and
 - (e) Financial, administrative and other fiduciary aspects of project implementation supervision.
55. **Monitoring and evaluation.** The evaluations will include an assessment of the quality, application and effectiveness of project monitoring and evaluation plans and tools, including an assessment of risk management based on the assumptions and risks identified in the project document. The evaluation will appreciate how information generated by the M&E system during project implementation was used to adapt and improve project execution, achievement of outcomes and ensuring sustainability. M&E is assessed on three levels:
- (a) *M&E Design.* Projects should have sound M&E plans to monitor results and track progress towards achieving project objectives. An M&E plan should include a baseline (including data, methodology, etc.), SMART indicators and data analysis systems, and evaluation studies at specific times to assess results. The time frame for various M&E activities and standards for outputs should have been specified. The evaluators should use the following questions to help assess the M&E design aspects:
 - Quality of the project logframe (original and possible updates) as a planning and monitoring instrument; analyse, compare and verify correspondence between the original logframe in the Project Document, possible revised logframes and the logframe used in Project Implementation Review reports to report progress towards achieving project objectives;
 - SMART-ness of indicators: Are there specific indicators in the logframe for each of the project objectives? Are the indicators measurable, attainable (realistic) and relevant to the objectives? Are the indicators time-bound?
 - Adequacy of baseline information: To what extent has baseline information on performance indicators been collected and presented in a clear manner? Was the methodology for the baseline data collection explicit and reliable?
 - Arrangements for monitoring: Have the responsibilities for M&E activities been clearly defined? Were the data sources and data collection instruments appropriate? Was the frequency of various monitoring activities specified and adequate? In how far were project users involved in monitoring?
 - Arrangements for evaluation: Have specific targets been specified for project outputs? Has the desired level of achievement been specified for all indicators of objectives and outcomes? Were there adequate provisions in the legal instruments binding project partners to fully collaborate in evaluations?
 - Budgeting and funding for M&E activities: Determine whether support for M&E was budgeted adequately and was funded in a timely fashion during implementation.

- (b) *M&E Plan Implementation.* The evaluation will verify that:

- the M&E system was operational and facilitated timely tracking of results and progress towards projects objectives throughout the project implementation period;
 - annual project reports and Progress Implementation Review (PIR) reports were complete, accurate and with well justified ratings;
 - the information provided by the M&E system was used during the project to improve project performance and to adapt to changing needs.
- (c) *Use of GEF Tracking Tools.* These are portfolio monitoring tools intended to roll up indicators from the individual project level to the portfolio level and track overall portfolio performance in focal areas. Each focal area has developed its own tracking tool²² to meet its unique needs. Agencies are requested to fill out these forms at CEO Endorsement (or CEO approval for MSPs) and submit these tools again for projects at mid-term and project completion. The evaluation will verify whether UNEP has duly completed the relevant tracking tool for this project, and whether the information provided is accurate.

Complementarities with UNEP strategies and programmes

56. UNEP aims to undertake GEF funded projects that are aligned with its own strategies. The evaluations should present a brief narrative on the following issues:
- (a) *Linkage to UNEP's Expected Accomplishments and POW 2008-2009, 2010-2011 and 2012-2013.* The UNEP MTS specifies desired results in six thematic focal areas. The desired results are termed Expected Accomplishments. Using the completed ToC/ROtI analysis, the evaluation should comment on whether the project makes a tangible contribution to any of the Expected Accomplishments specified in the UNEP MTS. The magnitude and extent of any contributions and the causal linkages should be fully described. Whilst it is recognised that UNEP GEF projects designed prior to the production of the UNEP Medium Term Strategy 2010-2013 (MTS)²³ would not necessarily be aligned with the Expected Accomplishments articulated in those documents, complementarities may still exist and it is still useful to know whether these projects remain aligned to the current MTS.
 - (b) *Alignment with the Bali Strategic Plan (BSP)*²⁴. The outcomes and achievements of the project should be briefly discussed in relation to the objectives of the UNEP BSP.
 - (c) *Gender.* Ascertain to what extent project design, implementation and monitoring have taken into consideration: (i) possible gender inequalities in access to and the control over natural resources; (ii) specific vulnerabilities of women and children to environmental degradation or disasters; and (iii) the role of women in mitigating or adapting to environmental changes and engaging in environmental protection and rehabilitation. Appreciate whether the intervention is likely to have any lasting differential impacts on gender equality and the relationship between women and the environment. To what extent do unresolved gender inequalities affect sustainability of project benefits?
 - (d) *South-South Cooperation.* This is regarded as the exchange of resources, technology, and knowledge between developing countries. Briefly describe any aspects of the project that could be considered as examples of South-South Cooperation.

The Consultants' Team

57. For this evaluation, the evaluation team will consist of two consultants, one lead and one technical expert. The consultants should have experience in project evaluation, a master's degree or higher in the area of engineering or a related field and at least 15 years' professional experience, with a preference for specific expertise in the area of renewable energy and project financing. Fluency in Spanish is necessary.
58. By undersigning the service contract with UNEP/UNON, the consultants certify that they have not been associated with the design and implementation of the project in any way which may jeopardize their independence and impartiality towards project achievements and project partner performance. In addition, they will not have any future interests (within six months after completion of the contract) with the project's executing or implementing units.

Evaluation Deliverables and Review Procedures

59. The evaluation consultant will prepare an evaluation for each country. The evaluator will start by preparing an **inception report** (see Annex 2(a) of TORs for Inception Report outline) containing a thorough review of the

²² http://www.thegef.org/gef/tracking_tools

²³ <http://www.unep.org/PDF/FinalMTSGCSS-X-8.pdf>

²⁴ <http://www.unep.org/GC/GC23/documents/GC23-6-add-1.pdf>

project context, project design quality, a draft reconstructed Theory of Change of the project, the evaluation framework and a tentative evaluation schedule.

60. The review of design quality will cover the following aspects (see Annex 9 for the detailed project design assessment matrix):
- Strategic relevance of the project
 - Preparation and readiness (see paragraph 25);
 - Financial planning (see paragraph 30);
 - M&E design (see paragraph 33(a));
 - Complementarities with UNEP strategies and programmes (see paragraph 34);
 - Sustainability considerations and measures planned to promote replication and upscaling (see paragraph 23).
61. The inception report will also present a draft, desk-based reconstructed Theory of Change of the project. It is vital to reconstruct the ToC *before* most of the data collection (review of reports, in-depth interviews, observations on the ground etc.) is done, because the ToC will define which direct outcomes, drivers and assumptions of the project need to be assessed and measured to allow adequate data collection for the evaluation of project effectiveness, likelihood of impact and sustainability.
62. The evaluation framework will present in further detail the evaluation questions under each criterion with their respective indicators and data sources. The evaluation framework should summarize the information available from project documentation against each of the main evaluation parameters. Any gaps in information should be identified and methods for additional data collection, verification and analysis should be specified.
63. The inception report will also present a tentative schedule for the overall evaluation process, including a draft programme for the country visit and tentative list of people/institutions to be interviewed.
64. The inception report will be submitted for review and approval by the Evaluation Office before the evaluation team travels to the field.
65. **The main evaluation report** should be brief (no longer than 35 pages – excluding the executive summary and annexes), to the point and written in plain English. The evaluator will deliver a high quality report in English by the end of the assignment. The team will also provide the executive summary and the conclusions, lessons learned and recommendations section in Spanish. The report will follow the annotated Table of Contents outlined in Annex 1. It must explain the purpose of the evaluation, exactly what was evaluated and the methods used (with their limitations). The report will present evidence-based and balanced findings, consequent conclusions, lessons and recommendations, which will be cross-referenced to each other. The report should be presented in a way that makes the information accessible and comprehensible. Any dissident views in response to evaluation findings will be appended in footnote or annex as appropriate. To avoid repetitions in the report, the author will use numbered paragraphs and make cross-references where possible.
66. **Review of the draft evaluation report.** The evaluation consultant will submit the zero draft report latest two weeks after conducting the field visits to the UNEP EO and revise the drafts following the comments and suggestions made by the EO. Once a draft of adequate quality has been accepted, the EO will share this first draft report with the UNEP Task Manager, who will ensure that the report does not contain any blatant factual errors. The UNEP Task Manager will then forward the first draft report to the other project stakeholders, in particular the national partners, for review and comments. Stakeholders may provide feedback on any errors of fact and may highlight the significance of such errors in any conclusions. It is also very important that stakeholders provide feedback on the proposed recommendations and lessons. Comments would be expected within two weeks after the draft report has been shared. Any comments or responses to the draft report will be sent to the UNEP EO for collation. The EO will provide the comments to the evaluation team for consideration in preparing the final draft report.
67. The evaluation consultant will submit the final draft report no later than 2 weeks after reception of stakeholder comments. The consultant will prepare a **response to comments**, listing those comments not or only partially accepted by them that could therefore not or only partially be accommodated in the final report. They will explain why those comments have not or only partially been accepted, providing evidence as required. This response to comments will be shared by the EO with the interested stakeholders to ensure full transparency.
68. Submission of the final Terminal Evaluation report. The final report shall be submitted by email to the Head of the Evaluation Office, who will share the report with the Director, UNEP/GEF Coordination Office and the UNEP/DEPI Task Manager. The Evaluation Office will also transmit the final report to the GEF Evaluation Office.

69. The final evaluation report will be published on the UNEP Evaluation Office web-site www.unep.org/eou. Subsequently, the report will be sent to the GEF Office of Evaluation for their review, appraisal and inclusion on the GEF website.
70. As per usual practice, the UNEP EO will prepare a **quality assessment** of the first draft and final draft report, which is a tool for providing structured feedback to the evaluation consultants. The quality of the report will be assessed and rated against the criteria specified in Annex 4.
71. The UNEP Evaluation Office will assess the ratings in the final evaluation report based on a careful review of the evidence collated by the evaluation consultant and the internal consistency of the report. Where there are differences of opinion between the evaluator and UNEP Evaluation Office on project ratings, both viewpoints will be clearly presented in the final report. The UNEP Evaluation Office ratings are the final ratings that will be submitted to the GEF Office of Evaluation.

I. Logistical arrangement

72. This Terminal Evaluation will be undertaken by an independent evaluation consultant contracted by the UNEP Evaluation Office. The consultant will work under the overall responsibility of the UNEP Evaluation Office and will consult with the EO on any procedural and methodological matters related to the evaluation. It is, however, the consultants' individual responsibility to arrange for their travel, visa, obtain documentary evidence, plan meetings with stakeholders, organize field visits (if any), and any other logistical matters related to the assignment. The UNEP Task Manager and local partners will, where possible, provide logistical support (introductions, meetings, transport etc.) for the country visit, allowing the consultants to conduct the evaluation as efficiently and independently as possible.

Schedule of the evaluation (tentative)

Activity	Date (s)
Start of the evaluation	10 September 2014
Inception report	15 September 2014
Comments from Evaluation Office	22 September 2014
Field visits	5 October 2014
Zero Draft report	24 November 2014
Comments from Evaluation Office	3 December 2014
First draft report	17 December 2014
Comments from stakeholders	21 January 2014
Final report	7 February 2014

73. The consultant will be hired under an individual Special Service Agreement (SSA). There are two options for contract and payment: lumpsum or "fees only".
74. **Lumpsum:** The contract covers both fees and expenses such as travel, per diem (DSA) and incidental expenses which are estimated in advance. The consultants will receive an initial payment covering estimated expenses upon signature of the contract.
75. **Fee only:** The contract stipulates consultant fees only. Air tickets will be purchased by UNEP and 75% of the DSA for each authorised travel mission will be paid up front. Local in-country travel and communication costs

will be reimbursed on the production of acceptable receipts. Terminal expenses and residual DSA entitlements (25%) will be paid after mission completion.

76. The payment schedule for the consultant will be linked to the acceptance of the key evaluation deliverables by the Evaluation Office:

- Final inception report: 20 percent of agreed total fee
- First draft main evaluation report: 40 percent of agreed total fee
- Final main evaluation report: 40 percent of agreed total fee

77. In case the consultants are not able to provide the deliverables in accordance with these TORs, in line with the expected quality standards by the UNEP Evaluation Office, payment may be withheld at the discretion of the Head of the Evaluation Office until the consultants have improved the deliverables to meet UNEP's quality standards.

78. If the consultants fail to submit a satisfactory final product to UNEP in a timely manner, i.e. within one month after the end date of their contract, the Evaluation Office reserves the right to employ additional human resources to finalize the report, and to reduce the consultants' fees by an amount equal to the additional costs borne by the Evaluation Office to bring the report up to standard.

79. Submission of the final evaluation report:

The final report shall be submitted by email to:

Mr. Michael Spilsbury, Chief

UNEP Evaluation Office

O Box 30552-00100

Nairobi, Kenya

Tel: 254 20 7625097

Email: michael.spilsbury@unep.org

The Head of Evaluation will share the report with the following persons:

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United Nations Environment Programme (UNEP)

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UNEP/ Division of Technology Industry and Economics

Diego Masera Ph.D

Chief

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The evaluation report will also be copied to the following GEF Operational Focal Points.

Jorge L. Fernandez Chamero
Director of International Cooperation
Ministry of Science Technology & Environment (CITMA)
Havana, Cuba
Email: chamero@citma.cu

Ileana Nuñez Mordoche
Director
Economic International Organizations Division
Ministry of Foreign Trade and Investment (MINCEX)
Havana, Cuba
Email: Ileana.nunez@mincex.cu

80. The final evaluation report will be published on the UNEP Evaluation Office web-site www.unep.org/eou and may be printed in hard copy.

IV. Annex 4: Evaluation program

Evaluation Schedule

The evaluation process formally began with the signature of contracts with the members of the Evaluation Team (23 September 2014 in the case of the team leader).

The evaluation contemplated the following steps:

- Preliminary analysis of project documentation. This phase comprises analysis of a first set of documents submitted in electronic format by UNEP and UNIDO.
- Elaboration of a Draft Agenda for the evaluation in Cuba. This was prepared by the Project Director and adopted by the Evaluation Team.
- Preliminary phone discussions with UNEP and UNIDO officials. These took place before the start of the Field Mission.
- The Evaluation Inception Report was submitted by 5 October 2014.
- Field visit to Cuba: from 5 to 19 October 2014 for Mr. Blasco and from 12 to 19 for Ms. Coelho
 - Mr. Blasco attended the International Workshop and Steering Committee Meeting in Havana on 6-7 October and in Isla de La Juventud on 8-9 October, flying back to Havana on 10 October for meetings with Ministries and Agencies involved in the project on 10 – 11 October.
 - Ms. Coelho and Mr. Blasco held meetings with Ministries and Agencies in Havana on 13 October, and flew to Isla de la Juventud on 14 October for technical visits to relevant project installations and meetings with involved authorities and agencies.
 - Ms. Coelho and Mr. Blasco flew back to Havana on the evening of 16 October and held further meetings during the two following days.
 - Both of them flew back home on 19 October.
 - Analysis of further documentation was carried out at the same time as all the activities described in the four points above
- Comments from the Evaluation Office to the Draft Inception Report were submitted to the Team Leader by 12 October. Mr. Blasco immediately modified the draft accordingly and submitted the Final Inception Report.
- The Zero Draft Report is scheduled for submission by 24 November, as indicated in the Evaluation ToR. Two weeks later (by 3 December 2014), comments from the Evaluation Office will be received by the team leader of the Evaluation Team.
- A first draft Evaluation Report was prepared under the responsibility of the Team Leader and submitted by 17 December 2014.
- Due to several reasons (beyond the responsibility of the Team Leader) it was necessary to prepare a second version of the Draft Evaluation Report, submitted on 9 February 2014.

- Comments from the different project stakeholders should have been submitted to the team leader by 21 January 2015 at the latest. This milestone is delayed, as indicated in the previous paragraph.

According to the evaluation ToR, the team leader will consider the received comments and/or prepare responses as appropriate and submit the Final Report (including the responses as necessary).

Agenda for field visits

	AM	PM	Location
domingo, 05 de octubre de 2014	Consultant Manuel Blasco (MB) arrives		Havana
lunes, 06 de octubre de 2014	MB participates in the International Workshop and steering committee		Havana
martes, 07 de octubre de 2014	MB participates in the International Workshop and steering committee		Havana
miércoles, 08 de octubre de 2014	MB flies to Isla de Juventud	MB visits the projects and participating in the International Workshop	Isla de Juventud
jueves, 09 de octubre de 2014	MB visits the projects and participates in the International Workshop		Isla de Juventud
viernes, 10 de octubre de 2014	MB flies to Havana	MB meets with ministries and agencies	Havana
sábado, 11 de octubre de 2014	MB meets with ministries and agencies		Havana
domingo, 12 de octubre de 2014	MB DAY OFF	Technical expert Suani Teixeira (ST) arrives	Havana
lunes, 13 de octubre de 2014	MB & ST meet with ministries and agencies		Havana
martes, 14 de octubre de 2014	MB & ST fly to Isla de Juventud	MB & ST meeting with local authorities/project visit	Isla de Juventud
miércoles, 15 de octubre de 2014	MB & ST visit to Cocodrilo Village		Isla de Juventud
jueves, 16 de octubre de 2014	MB & ST meeting with local authorities/project visits	MB & ST fly to Havana	Havana
viernes, 17 de octubre de 2014	MB & ST meet with ministries and agencies		Havana
sábado, 18 de octubre de 2014	MB & ST meet with ministries and agencies		Havana
domingo, 19 de octubre de 2014	MB & ST leave		Havana

Persons contacted

NAME	TITLE – ORGANIZATION
Jorge Luis Isaac Pino	Project Director Senior Advisor – Unión Eléctrica (UNE) H- IJ
Alfredo Curbelo Alonso	Former Project Director- CubaEnergía H
Antonio Figueiredo	Former Responsible of Construction – La Melvis IJ
Roberto Garcia	Chief of Plant Operation – La Melvis IJ
Evelio Lavadi	Chief of Plant – Cocodrilo IJ
Irma Arzola Martínez	Gerente – Compañía Fiduciaria H
Dolores Marrero Permanyer	Commercial Policy Specialist – MINCEX H - IJ
Maria Luz B’Hamel Ramirez	Director – MINCEX H
William Diaz Menendez	Economic Policy Officer H
Andres Raul Espino	Director for Renewable Energy – INEL H
Argelia Balboa Monzón	Senior Adviser Renewable Energy – MINEM H
Rosell Guerra Campana	Director for Renewable Energy – MINEM H
Aleisly Valdes Viera	Director – MINEM H
Barbara Garcia Moreda	Dean – INSTEC H - IJ
Peerke de Bakker	(formerly) Task Manager CC Mitigation, UNEP H - IJ
Diego Masera	Chief Renewable and Rural Energy Unit – UNIDO H- IJ
Massimo Garzelli	Consultant – UNIDO H - IJ
Barbara Ivette Tortosa Ferrer	Focal Point – UNIDO Havana H -IJ
Paula Cobas	Economist – ProBIO (Uruguay) H - IJ
Damaris Marte	Director of Renewable Energy Sources – Comision Nacional de Energia (rep Dominicana) H -IJ
Celso Carpio	Development Director – MINAGRI H
Roberto Ramos Dorta	Electrical Energy Specialist – MINAGRI H

Rolando Padron Perez	Instituto Nacional de Investigaciones Agroforestales – Director of Biomass Marabou H
Roberto Ramos	Director of Integral Energy Dept. Ministry of Ag. H
Tomas Betancourt	Director – Empresa Agroindustrial IJ
Antonio J. Pernas Perez	Delegate Ministry of Agriculture IJ
Hector Prada Frometa	Director of Forest Division IJ
Rene Soto Rodriguez	Vicepresident of IJ Government IJ
Leonardo Cruz Cabrera	Dean – University Isla de la Juventud IJ
Rene Aleman	Director – UNE IJ
Monica Soria Baledon	Director of Biofuels SENER (Mexico) H - IJ
Jesus Montane Oropesa	Researcher - University of Isla de la Juventud IJ
Jesus Fonseca Reyes	Director - Meat Complex IJ
Madelvis B. Guerra	Principal Specialist – Meat Complex IJ

IJ: Isla de la Juventud

H: Havana

V. Annex 5: Bibliography

The Evaluation Team has analyzed the following documents:

2014-15-07 TOR Cuba Renenergy

Project Document

1361_2012PIR_Cuba_UNEP_Cuba

1361_2013PIR_Cuba_UNEP_Cuba

PIR CUBA FY 2014 DM-JI -- 29 july

Cuba Final MTE Report 120810

Article published in *Granma* June 2014

La Melvis Progress Report

Marabou Progress Report

Progress Report Meat

Progress Report Small wind

Progress Report Wind

Activity Guidelines Progress Report

Annex 1. Contract No 60839-12 ANKUR - EMED - La Melvis -- 16ene13

1. PROG DESARROLLO FORESTAL - MAR 2009

2. PROG DESARROLLO FORESTAL - DIC 2011

CF FGRR Report

Contingency Plan 261113

CTTO 608071-13 --- EMED-AutoKraz -- 16sep13

SUP No 1 CTTO 608071-13 --- EMED-AutoKraz -- 3mar14

SUP No 1 CTTO EMED-BERKES Meat-- 14mar14

CTTO 608166-12 --- EMED-TUSA -- 27sep12

CTTO 608295-12 -- EMED-BERKES -- Meat 14feb14

Forestry Management Progress Report

July - Dec 2013 progress report

Revisions and extensions

Standards Progress Report

Status of recommendations 200414

Summary of Project Document 151209

Papers and presentations Cuba conference October 2014

Unleashing Sustainable Development

Operational procedures of Compañía Fiduciaria March 2011

Forestry Development Programme

TOR La Melvis EN

Oferta ANKUR 2011

Modification proposals no 1 and 2 -- Layout --November 2012

Guidelines for Environmental Impact Assessment

Financial Agreement MINAL – Meat Factory

Contract No 60839-12 ANKUR - EMED - La Melvis -- January 2013

Project Inventory 2014

VI. Annex 6: Biomass Technical Report

UNEP – GEF PROJECT GP/CUB/05/001

**“GENERATION AND DELIVERY OF RENEWABLE ENERGY BASED MODERN
ENERGY SERVICES IN CUBA: THE CASE OF ISLA DE LA JUVENTUD”**

**BIOMASS GASIFICATION SYSTEMS REPORT – FINAL REPORT
(CONTRIBUTION TO THE TERMINAL EVALUATION REPORT)**

BY

SUANI TEIXEIRA COELHO

Evaluation Office

February, 2015

DISCLAIMER

While this document is believed to contain correct information, neither the participating organizations nor the financial supporters, makes any warranty, express or implicit, or assumes any legal responsibility for the accuracy or completeness of any information disclosed. All the views and opinions expressed are the sole responsibility of the authors and do not necessarily reflect those of any of the involved organizations.

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Executive Summary

This report corresponds to the technical evaluation of the biomass gasification systems in the project UNEP – GEF PROJECT GP/CUB/001 (“GENERATION AND DELIVERY OF RENEWABLE ENERGY BASED MODERN ENERGY SERVICES IN CUBA: THE CASE OF ISLA DE LA JUVENTUD”). It is based on field visits, interviews with different stakeholders (together with the Evaluation Team Coordinator, Manuel Blasco/MB), and reflects the views and conclusions from this expert (Suani Coelho/SC), as a contribution to the Terminal Evaluation Report organized under the coordination of Manuel Blasco. A first preliminary draft report on the meetings and field visits was sent to the Team Coordinator on October 2014. A Second Version was presented, revised, and included evaluator’s comments, as well as the answers to the comments received from UNEP on the Zero Draft Report from the Evaluation Team (ET). This Final Technical Report includes the comments received from UNEP, as well as the answers to all questions received.

Three technical visits were performed during SC’s mission in Cuba: Cocodrilo, La Melvis and the Meat Industry.

As discussed in detail in this report, the reason for the choice of the La Melvis 500 kW-biomass-gasifier is not clear, since it is not a fully commercially available technology. Due to the size of the plant and the complexities of gasification, the option of a biomass-fired Rankine system should have been evaluated at the beginning of the project and the two options compared before a decision was taken. The Cuban technical team stated that the main reason for the general choice of biomass gasification in all cases was "to learn" about biomass gasification. Considering Gasification may not have been the most suitable technology for all the plants built during the project, this reasoning is a little difficult to understand. Additionally, the capacity building of a new technology would be easier if the local university had been involved in the project and if the project had taken advantage of the existing small-scale biomass gasification systems in Cuba (but not visited by this evaluator since they did not belong to the project).

Considering the **large-scale 500 kW-gasifier already in place (La Melvis)**, it is **strongly recommended that no further investment or replication should be made before the actions listed below are completed:**

1. Tests with the different forms of biomass available should be performed, which should also help to solve the problems with the cutting machine;
2. Analysis of the tests to identify the most suitable biomass for the gasifiers;
3. Measurements of the low heating value of the syngas, as well as its composition; energy balances and efficiency for each biomass as well as measurements on atmospheric emissions (considering the size of the plant);
4. Technical evaluation of the plant (overall efficiency compared to the commercially available Rankine cycle);
5. Economic evaluation of the plant (also compared to the Rankine cycle);

Cocodrilo 50 kW biomass gasifier plant has been built and, as informed by different technical staffs (since the plant was not in operation during the field visit), has performed well. Some initial issues were reported to the ET but these have now been solved. Current problems include a delay in replacing the compressor and the biomass drier needing to be replaced in the near future due to corrosion problems. The evaluator’s opinion is that **the Cocodrilo has been reasonably successful and is in a position to be replicated.** However, it is strongly suggested that more capacity building is carried out by UNE specifically on O&M (training of operators may not be enough and should include local people at university).

Considering the **Meat Industry (yet to be built and lacking available technical information)** it presents a **high risk for replication which is not recommended until the following actions have been performed:**

1. Development of a detailed technical analysis
2. Evaluation of the energy balance and overall efficiency
3. Development of O&M analysis
4. Economic feasibility study, comparing the updraft-biomass-gasifier-boiler system with a conventional biomass-boiler
5. Investigation of the option of using the biogas from the already existing sewage treatment (which is not used, and releases methane emissions into the atmosphere).

It is important to understand that biomass gasification cannot be seen as the only bioenergy solution for any situation and, in each case, the best technology should be analyzed considering all technical, social, environmental and economic aspects.

Introduction

As mentioned in the Terminal Evaluation Report (developed by the Evaluation Team under the coordination of Manuel Blasco), *the main objective of the project is to reduce the Greenhouse Gas Emissions (GHGs) in Cuba by promoting environmentally sound renewable energy technologies for power generation as well as for providing modern energy services on a commercial basis at the Isla de la Juventud. The project has tried to address the key barriers that constrain the use of renewable energy technologies (biomass and wind) for power and heat generation on the Isla de la Juventud, and to promote business models for sustainable harnessing of renewable energy resources in Cuba. Given the high cost of generating electricity on the island and the demonstrated engagement of private sector investments in fossil fuel based power generation, Isla de la Juventud presented a priority opportunity for a GEF intervention to support renewable energy technologies.*

This report is divided into seven sections. First section is Executive Summary, followed by the Introduction. Third section corresponds to the consultant's Evaluation. Finally, fourth section presents Conclusions and Recommendations. All these information are included in the Final Report of the Terminal Evaluation, organized by Team Leader Manuel Blasco. Additionally, some technical references are included, as well as some photos of the field visits.

The Evaluation section includes a detailed report on the field visits (meetings and visits to the plants), including initial comments. The second part of this section presents a detailed technical evaluation of the biomass-gasification plants included in the project.

Other comments on Terminal Evaluation are included in the Terminal Evaluation Report.

The Evaluation

C.1. Desk review:

A desk review of project documents was performed, where documents were available.

Documents referring to certification for forest management have yet to be received from the project manager.

More detailed technical documents regarding the biomass gasifiers at La Melvis power plant (Ankur) and the biomass gasifier-boiler system for the Meat Industry (Berkes) have yet to be provided by the manufacturers.

On December 11, 2014, further detailed information on the 50 kW Cocodrilo plant was received, showing that the plant did operate in 2013, until an issue with the chiller compressor halted operation (this issue has yet to be resolved).

C.2. Interviews:

Interviews were performed by the ET with the following institutions both in Havana and in La Isla de La Juventud. The subjects discussed were the following ones:

C.2.1. Meetings in Havana:

- **Compania Fiduciaria** – M.Sc. Irma Arzola Martinez – Manager – Management of all financial activities. The initial idea of attracting foreign investment did not happen as a result the government of Cuba made the required investments. USD 290,000 was paid by *UNE* and *Biomasa Florestal* to the *Compania Fiduciaria*. An additional USD 100,000 is expected for the La Melvis expansion (if it takes place). The *Banco de Inversiones* has received several requests for new RE projects but the evaluator was informed that there are no funds (not even for the La Melvis expansion) since CF funds come from the projects payments. CF is looking for additional external cooperation but the evaluator was informed funding for the current project activities is guaranteed.
- **UNE – Project manager – Jorge Isaac Pinto** – general presentation of the project and the corresponding investment.
 - o **Current RE legislation in Cuba** was informed: Document “*Lineamientos de la Politica Economica y Social de la Revolucion*”, where the *Lineamiento 278* deals with RE’s. There are other five *lineamientos* related to RE’s. There is also the “*Politica para el desarrollo de las Energias Renovables*” (June 2014), which was approved by the Council of Ministers of Cuban Government but this one is considered a private document.
 - o **Main contribution of the project:** Regarding the project, the main contribution was considered (by the project manager) to be the pilot plants on biomass gasification, which allowed capacity building for this technology in the country. The evaluator was informed that the capacity building processes were undertaken both on forest biomass and biomass gasification through workshops (for 50 people) and indirectly for 100-150 people from 2005-2010. At the Cocodrilo power plant, there were visits from technical experts from the Indian Institute of Science (IISc, Bangalore, India) to Cuba and Cuban visits (three people) to the IISc in Bangalore (workshop, training, field visits). Later on 12 workers were trained (now 6 workers) by UNE. For La Melvis power plant, there were three visits from Ankur to Cuba (construction, training, start-up); also there were two visits by Cuban technical staff to Mumbai/Ankur for technical meetings and to follow the final tests of the gasifier), as well as to discuss the technology change²⁵ on

²⁵ Change on the washing system by the dry cleaning system (CaCO₃) to reduce water consumption. To be noted that the existing systems from Ankur now installed in other regions of Cuba use an open system of gas washing, with a high water consumption and the corresponding environmental impacts of the water disposal in an inadequate way.

the gas cleaning system. It is important to note (according to information received) that the tests in Bangalore and Mumbai were not performed with the same existing available biomass in Cuba. The evaluator was also informed that there is no planned component on capacity building.

- **Quality standards for biomass gasification** do not exist in Cuba and were not developed by the project. Regarding Environmental Impact Assessment/EIA, the evaluator was informed that there are already laws for EIA in Cuba.

- **UNIDO – Diego Masera (DM) and Barbara Ivette Tortosa Ferrer** (focal point in Cuba)

UNIDO was in charge of investment for technology transfer (Cocodrilo plant was funded by UNIDO) but it was understood that the technologies to be used in the project were decided before the project startup. So La Melvis, the Meat Industry and the *Biomasa Florestal* projects follow this choice for biomass gasification. A general overview of the project was presented as well as the adaptations and current difficulties that still exist. The evaluator was informed that no laboratory analysis had been performed on the biomass, the syngas composition, or the syngas low heating value (LHV). DM informed that the funds still existing could be used for the syngas analysis for La Melvis. Also these funds could be used to invite other (local?) experts on biomass gasification to collaborate on the La Melvis plant operation. The evaluator was also informed that the Government of Cuba has guaranteed that the USD 550,000 still available for the project would be used for the La Melvis expansion. Another USD 50,000 is expected from UNIDO for the laboratory analysis.

C.2.2. Visits and meetings at La Isla de la Juventud (chronological sequence):

- **Visit to La Melvis 500 kW biomass-gasifier power plant – (Antonio Figueiredo, formerly responsible for the plant construction and Roberto Garcia, chief of plant operation).**

The 500 kW (downdraft fixed bed) biomass gasification-based power plant has been installed and had its start-up but it was not possible to see the plant in operation during the field visit.

- **Operation:** The evaluator was informed that the plant has been in operation for two hours at a time but had been unable to provide enough synthesis gas to operate the two gas engines to the total installed capacity. The plant produced only enough synthesis gas to feed half of the installed capacity²⁶ and was thus unable to produce the power as expected. The evaluator was informed that this is probably due to problems with the cutting machine, which does not cut the biomass to the regular size required by the biomass gasifier. The Evaluation Team (ET) ascertained that mixed biomass is fed into the cutting machine (and then into the gasifier) and so it is difficult

This is not the case of the IISc's plant at Cocodrilo, where the water cleaning system is a closed system, as recently developed by the IISc.

²⁶ According to the information during the visit the plant operated on 22nd and 28th August and 2nd and 12th September for short periods (two hours each) and did not reach the adequate temperature. The evaluator was also informed that the gasifier operated during these hours with different types of mixed biomass (costanera, marabu, casuarina, pinus, residues from forest management); it was not possible to assess the type of biomass used for the tests by Ankur in Mumbai, India, but probably it was most likely eucalyptus.

to evaluate the different behaviors of each type of biomass in the gasifier. In addition, it was verified that the technical specification prepared for the manufacturer gave no information about the type of wood (marabou, acacia, etc) and in India most of the experience is with eucalyptus.

- **Laboratory analysis:** The evaluator was informed that no analysis has been made of the synthesis gas obtained from the biomass. This analysis is important for evaluating system operation and efficiency. This subject was discussed in the meeting with UNIDO (Diego Masera), as reported previously in this document.
- **Biomass cutting machine:** The biomass-cutting machine from Lippel Co. presented technical problems and is unable to produce the biomass fuel to the specifications required for the gasifier system. Existing technical staff is unable to adjust it and therefore technical support is required from *Biomasa Florestal* and perhaps Lippel, the manufacturer.
- **Support from Ankur:** The evaluator was informed that there were three visits from Ankur. The first one (Dec 13-Jan 14) was for the gasifier assembly, but this was not possible since the civil works were not ready yet. There was a second visit on May 2014 where it was realized that some equipment had failed and needed to be replaced (replaced by Ankur). The third visit was on September 14 for another start-up when it was discovered that the size of the biomass was not adequate (too small) and this was considered the reason for lack of synthesis gas production (only half of the installed capacity).
- **Power plant efficiency:** It was not possible to verify the plant efficiency since there is not enough technical operation data. This evaluation should take place, after the technical problems have been solved.
- **Capacity building:** During the project, 15 workers were trained (11 engineers), and workshops were developed with stakeholders from the forest sector, *Cubaenergia*, *Empresa de Proyectos*, *Industria de Ceramica* and local universities (20 people). Another workshop is expected to be held after the regular operation of the plant. The two field visits to Ankur in India with three engineers discussed the change to the gas cleaning system among other technical details. However, additional capacity building is needed to provide good support on O&M of the system and mainly for the future possible manufacture of the biomass gasifiers in Cuba since there are deficiencies in the technical information/training available.
- **Equipment manufacture in Cuba:** For this project, the following equipment was locally produced: biomass storage, biomass transportation system and metallic structure, as well as civil work and some electric equipment.
- **Energy offer:** it was verified that the 500 kW installed in the plant will be produced and supplied to the local UNE grid supplying 500 people from the local community with electricity replacing old diesel engines and giving significant environmental advantages.
- **Lessons learned:** The technical staff does not consider that the technical difficulties are due to the large size of the gasifier (a not widely used or fully commercialized

technology) and believe the problems arise mainly from issues with the cutting machine. However, the evaluator believes this may not be the only reason, as discussed later in this report. It is fundamental that tests are carried out on each type of biomass to check the gasification process. In addition it is important to have the laboratory analysis on the biomass and on the synthesis gas.

- **Visit to Cocodrilo 50 kW biomass-gasifier power plant – Evelio Lavadi (Chief of the plant and Mayor of Cocodrilo village)** - plant in regular operation according to information received during the field visit.
 - **Operation:** During the field visit it was not possible to see the plant in operation since the compressor of the cooling system had to be replaced and the replacement needs to be imported (it is not manufactured in Cuba). This will be the third compressor to be installed, since, according to the information received, the previous two were damaged due to lack of protection in the electric system. The biomass drier is starting to suffer from significant corrosion probably due to the combination of proximity to the sea and exposure to high temperatures. The evaluator was informed that in the near future it would be replaced by a drier made from more resistant material.
 - **Fossil fuel replacement:** The evaluator was informed that around 70% of diesel oil can be replaced (as expected in this type of technology), which corresponds to a significant benefit in economic and environmental aspects. However, the detailed spreadsheets received in Dec 11, 2014 by the evaluator, with operation figures from 2013, show this replacement was not yet achieved, since more than 60% of the power was still produced from diesel oil²⁷.
 - **Biomass** – the plant is being test fed with different types of biomass and *casuarina* was found to be the most efficient. However there is no information about the LHV of *casuarina* which prevents evaluation of the plant efficiency. The evaluator was informed that there are huge amounts of *casuarina* available (10-20 years worth of supply at current estimates). The other biomass available (marabou) is apparently more homogeneous and harder, which could be an interesting option for gasification. Cocodrilo plant was initially designed for forest residue management but is now using *casuarina* (which is highly abundant and is extracted from the beach side). Currently the *Empresa Nacional de Flora y Fauna* is the institution in charge of forest management and biomass supply.
 - **Positive impacts:** the plant could supply electricity for a village of 384 inhabitants operating 18 hours per day. This would include the electricity supply for a bread manufacturer and a water pump thus replacing (imported) fossil fuel. Some additional power is expected to be installed soon since the fisheries cooperative has no cooling or freezing system for the fish, which is currently preserved using salt. The demand would be 24 kW.
 - **Capacity building:** In 2006, there was a workshop on biomass gasification for 20 people. In 2011, there was a visit from two IISC (Bangalore) engineers, but it does not seem to have provided sufficient training for the operation and maintenance,

²⁷ The expected fuel replacement with this technology (small scale biomass gasifier with dual diesel engine) is 80%, as verified in existing plants in Bangalore (visited by this consultant) and in Amazon (projects developed under the coordination of this consultant - <http://cenbio.iee.usp.br/projetos/gaseifamaz.htm>)

considering the possible technical problems, as discussed later in this report. A detailed plan for technical support from UNE to the plant should be worked out given the distance between the plant and UNE's offices in La Isla.

- **Lessons learned:** According to information received, initial mistakes were made: regarding the design of the civil work the space for the workers to feed the plant was not considered and the ceiling had to be raised to accommodate an upper level. Also, the bag filters were not cleaned in a proper way (water was used instead of compressed air). These issues must be taken into account when considering replication of the plant. In addition the same comments on the La Melvis plant regarding laboratory analysis of the biomass and the syngas apply here.
- **Visit to the Meat Industry (*Combinado Carnico*²⁸ – *Empresa Productora de Alimentos – Grupo Empresarial de la Industria Alimentaria*) – Jesus Fonseca Reyes (Director) and Madelvis B. Guerra (main specialist).**
 - **Technical information:** no specific technical information on the system to be purchased from Berkes (see below the meeting with Cubaenergia) was received, since the manufacturer will only provide it after the first payment. The evaluator was informed that this system provided by Berkes can be fuelled with larger sized biomass (up to 30- 45 cm according to rough estimates from the representatives of the Meat Industry and confirmed later on by Cubaenergia) and with biomass with higher moisture content (up to 45%). Plants from Berkes in Uruguay were visited but no detailed technical information was received (please see interview with Cubaenergia).
 - **Biomass:** the biomass is expected to be the same as the other plants but this information has yet to be relayed to Berkes according to information received (as in the case of the other biomass gasification plants). Please see below comments on the meeting at Cubaenergia.
 - **Capacity building:** A visit was performed in Uruguay to Berkes industry and to existing power plants using the technology (see meeting at Cubaenergia). According to information received from A. Curbelo, this visit was made by *Cubaenergia* and *Empresa de Calderas de Cuba Alastor*, but it seems it did not involve participants from the Meat Industry. Therefore, no capacity building has so far been developed. Berkes is expected to come to Cuba for the startup and the local training.
 - **Current difficulties:** Some location changes had to be made due to required authorization from different sectors of the Cuban Government. Civil work has yet to start since it falls under the responsibility of different Government sectors. In addition, at the time of this report the Government had not yet authorized CF to make the first installment (15%) to Berkes; during the field visit the ET was informed that the gasifier manufacturer (Berkes) had requested an increase in total payment since the period for which the offer was valid (six months) had expired. The evaluator was informed that the project decided to implement this technology only at the Meat Industry plant and not in the others as previously planned.

²⁸ In this industry is expected to be installed a biomass gasifier/boiler system to replace the old existing boiler fuelled with diesel oil (1.5 t/h of steam – 6 bar).

- **Additional comment:** According to information received during the field visit, the industry has a liquid effluents treatment system producing biogas from the anaerobic digestion system but there is no capture system for the biogas produced (the biogas is released into the atmosphere). The evaluator was informed there are future plans to design and install a system for biogas capture and its energy conversion. It was not clear why the option to use this biogas to feed a boiler in a simple commercialized technology was not considered. It was not possible to visit the biogas plant (despite the suggestion made by the ET) and no technical information was received. Considering the use of woody biomass for steam generation, it is not clear why biomass boilers were not considered for the replacement of the old diesel-boiler.
 - **Lessons learned:** it is not possible to discuss lessons learned since the whole process is at an initial phase.
- **UNE – Director René Alemán**
- **O&M for the power plants:** UNE will supervise O&M operations in the two power plants Cocodrilo and La Melvis). Spare parts shall be provided by UNE to the plants and this is an important issue since there are significant difficulties related to the supply of spare parts due to Government rules (according to UNE’s Director, the government controls the purchase of spare parts in any plant in Cuba). In addition, several spare parts are not manufactured locally and must be imported (such as the compressor for the Cocodrilo plant). The Cocodrilo plant, considering the distance and difficulties of access, must be carefully supervised to avoid risks of interruptions to the operation.
 - **Biomass supply:** regarding the biomass supply to La Melvis, UNE is contacting *Biomasa Florestal* to provide guarantees on the size and supply of biomass to feed the gasifier²⁹ before expanding La Melvis. UNE mentioned there are difficulties with La Melvis plant despite the small size due to the technology choice for biomass gasification (considered a quite small size when compared to other fuel oil plants in the Isla³⁰). The evaluator was informed that Isla de la Juventud has 240,000 ha from which 44,000 ha are forested with marabou (invasive species). UNE purchases biomass from *Biomasa Florestal* for 1.5 million USD per year (around 190-200 USD/ton).
- **Ministry of Agriculture – Biomasa Florestal – Tomas Betancourt (Director - Empresa Agroindustrial Isla de la Juventud) – Antonio J. Pernas (Delegado – Ministerio da Agricultura en Isla de la Juventud)**
- **Discussion on the existing problems of the cutting machine for La Melvis plant:**
- The evaluator was informed that there is no way to solve the problem locally as it is not possible for the workers to adjust the cutting machine themselves. The evaluator was informed that *Biomasa Florestal* will discuss the situation with the Ministry of Agriculture to rectify the problem. There is a similar machine installed in Camaguey that is working

²⁹ During the visit, the evaluator was informed that contacts with the Ministry of Agriculture would be developed to solve this problem.

³⁰ This is a common issue with electric utilities working exclusively with diesel oil engines; with thermal systems (steam cycles or gasifier systems) difficulties can be even worse due to the lack of experience. In the case of La Melvis the situation is more difficult due to the fact that it is a new technology and is on a (large) scale not yet successfully demonstrated.

well though the technical requirements are different as the biomass is used to feed a biomass boiler. The evaluator was also informed that the cutting machine from Lippel worked well with marabou during the visit from Ankur technicians to La Melvis. However, the biomass cannot be too large otherwise it will not work well (it was reported that the existing problems are with pinus but the cutting machine is being fed with mixed biomass). Therefore, it is not possible to reach a conclusion on this problem without additional information from the cutting machine manufacturer. There is also a problem related to the biomass feeding to the transportation system.

- **Discussion on the development of acacia – accomplishment of the milestones:** *Biomasa Florestal* is now supplying (native) marabou but the evaluator was told that by November 2014 they will accomplish the milestones established in the project.
- **Financial issues:** According to information received from BF, they are waiting for funds for the additional equipment forecasted to be purchased (chainsaw, trucks, etc., from Ukraine) as well as protection equipment, in charge of *Grupo de Agricultura de Montana*.
- **Biomass production for La Melvis:** For the first stage (0.5 MW), the amount of supplied biomass is expected to be 6,000 t/yr; for the 3 MW plant (after eventual expansion) 50,000 t/yr will be required.
- **Biomass for the Meat Industry (*Combinado Carnico*):** *Biomasa Florestal* will also be in charge of biomass supply to the Meat Industry; there will be no need for chipped biomass due to the Berkes gasifier characteristics (please refer to the meeting with *Cubaenergi* below).
- **Government of La Isla – Vice President**
 - **View from the local Government:** There is strong support from the local government for the RE project in La Isla, mainly due to the creation of jobs, the reduced reliance on oil imports, and the possibility of using local biomass residues.
 - **Capacity building:** According to the Vice President, there is an important process of capacity building that should include the local university (please refer to meeting at the university, later in this report).
- **Universidad de La Isla de la Juventud Jesus Montane Oropesa – Dean Leonardo Cruz Cabrera**
 - **Capacity building:** The evaluator was informed of the different courses offered by the university but currently only a small amount of students are accepted by the university due to a difficult selection process (recently introduced). The university does not carry out research on bioenergy and has no staff trained in biomass gasification; However, they do intend to develop capacity building in this (and other) areas.
 - **Laboratories:** The University has chemistry laboratories with gas chromatographs but they were not utilized for the project.

- **Comments:** It seems difficult for the local university, in the near future, to provide any technical support for the project as there is no capacity building or curriculum focused on any area of bioenergy. However, there is analysis equipment in the laboratories, and this could be used to evaluate the synthesis gas for the biomass gasifier plants, as mentioned before.

C.2.3. Additional Meetings in Havana:

- **Instituto Nacional de Investigaciones Agroflorestrales – INAF – Rolando Padron Perez (Director of Biomasa Marabu); Grupo Empresarial Agricultura de Montana Ministerio de Agricultura – Celso Carpio Camarote; Energia Integral – Ministerio de Agricultura – Roberto Ramos Dorta**
 - **Cutting machine for marabou:** A new cutting machine for marabou (to be used in the sugar mills³¹) is being imported from France through a project funded by the European Union, but it has yet to be tested on marabou. Tests will be performed only when the machine arrives in Cuba. According to the Institute, this machine could also be an option for other biomass projects in Cuba if results from the future tests are positive.
 - **Woody Biomass at la Isla:** The biomass selection and the choice for acacia was discussed. The evaluator was informed that original *pinus* forests were replaced by citrus and later on by eucalyptus and *casuarina*. *Casuarina* has proliferated well, mainly on the coast, and is now being seen as a good option. More recently, acacia has been considered due to the positive adaptation to Cuban climate. *Eucalyptus* is not considered a good option in Cuba, due to fears over the environmental impact of the species³².
 - **Biomass project:** Initially the project's main objective was the use of forest residues (*pinus*) from forest management (there are currently 13,000 ha of *pinus* and there are plans to restart *pinus* plantations, reaching 39,000 m³ to be explored). More recently marabou started to grow in the island and it was informed that there are 20,000 ha of marabou (despite official information relating only 6,500 ha). *Eucalyptus* was not considered due to environmental concerns but acacia was considered a good option (exotic). There are an estimated 700 ha of acacia and Biomasa Florestal is planning to plant a further 4,800 ha.
 - **Delays on acacia supply from plantations:** Following a question asked by the leader of evaluation team (MB), the team was informed that supply delays were due to the centralized purchasing process of field equipment for the plantation (further complicated by changes in the rules in 2012). The evaluator was also informed that equipment suppliers interested in sales to Cuba are hesitant due to the political environment, and contracting complexities.
 - **Importance of the biomass project in the country:** According to information from the project manager, the project aims to reach 30,000 ha of biomass planted in the

³¹ Unlike other sugar mills around the world, the local sugar plants do not use sugarcane bagasse as fuel (used for paper production in Cuba)..

³² Brazilian lessons learned and positive results with eucalyptus plantation were discussed but Cuban specialists did not agree with this option.

country by 2030. It must be observed that marabou is not considered planted biomass since it is a spontaneous specimen.

- **Environmental issues – land use:** Cattle farming reduced significantly with the economic crisis in the 90's due to the loss of demand from the international market but now seem to be expanding again. The evaluator was informed that there is no risk of cattle farming being expanded into native forests due to the monitoring and protection afforded by the *Instituto de Planificación Física*.
- **Comments:** Even after this conversation it was not clear why acacia was chosen as the main species of choice.

- **Cubaenergia – Alfredo J. Curbelo Alonso (former project director)**

- **Selection of the technology for the Meat Industry (*Combinado Carnico*):** The evaluator was informed (again) that the main objective of the project – and also for the Meat Industry - was to build capacity of the biomass gasification process (technology innovation). No technical-economic evaluation comparing biomass gasifier/boiler systems to biomass-boilers was carried out. The evaluator was informed that steam production for the Meat Industry is variable and for this reason the biomass-gasifier/boiler system is considered more suitable than the biomass boiler (but no technical studies were undertaken, and in fact there is additional equipment such as expansion valves to be used with steam boilers in such cases of variable flow process). Another reason given for selecting the technology is that O&M costs should be lower. There is also an apparent negative perception of biomass boilers (they are considered a step-back when compared to fossil fuel-fuelled boilers by *Alastor*, a boiler manufacturer in Cuba). The evaluator's opinion is that a technical/economic study should have been performed before the choice for biomass gasification, comparing biomass gasification and steam-cycle boilers.
- **Selection of the manufacturer (*Berkes*):** The evaluator was informed that only two suppliers presented adequate offers (Ankur and Berkes) in the bidding process. From studying the documents related to the selection process, we can conclude that Ankur was not selected mainly because they only offer the biomass gasifier and not the boiler. In comparison, Berkes offered the whole system considered to be a significant advantage due to the impossibility of manufacturing biomass boilers in Cuba.
- **Technical information from Berkes system:** During the meeting the evaluator was informed the Berkes biomass gasifier is a fixed bed updraft gasifier but no further details are available.. Several photographs of the Berkes system (of regular quality but difficult to see the details) taken during the visit to the manufacturing plant in Uruguay and from other plants (sugar refinery, paper, "malta", leather) were presented but no detailed information is available (this will only be provided after the first payment is received).

During the field visits in Uruguay, the Cuban delegation noticed that the biomass requirements for the Berkes gasifier are different from those for other gasifiers (Ankur and IISC); biomass is fed in large pieces (30-45 cm length) and has a high moisture content (more than 20%), which was considered an advantage for the Cuban project

since there would be no need for pre-treatment of biomass (cutting and/or drying). There were no field visits reports available, only reports on the technical and financial meetings to decide the supplier.

- **Biomass to be used in Berkes gasifier:**The evaluator was informed that the biomass to be used in the Berkes gasifier for the Meat Industry is expected to be *pinus* and/or acacia and/or marabou. There is no information about the biomass used in Uruguay (possibly *pinus*) and tests with marabou and acacia have yet to be performed. Berkes offer was made for *pinus*(25% moisture)³³ according to the specifications defined by Cubaenergia.
 - **Atmospheric emissions control in Cuba:** The evaluator was informed that there is no mandatory control on atmospheric emissions for stationary systems in the country³⁴.
 - **Cocodrilo plant – biomass gasifier from IISc – La Melvis plant – biomass gasifier from Ankur:** Photographs of the field visit to Bangalore and Mumbai were presented but it was not possible to get information about the biomass used in the Indian gasifier in Bangalore. No travel reports were available.
 - **Comments:** Again, it was not clear why the biomass gasification process was chosen without a previous analysis of other available biomass technologies, such as a steam Rankine cycle for La Melvis, as well as a wood (or biogas)-fired boiler in the Meat Industry.
- **Ministerio del Comercio Exterior y de la Inversion Estranjera – Maria de la Luz B´Hamel Ramirez (Director) – William Diaz Menendez (Economic policy oficial)**
- **Government view on the Project:** The project seems to be of great importance to the Cuban Government despite the delays that occurred. RE's are a priority for the Cuban Government and strongly supported. According to the Government the positive results are due to the excellent management of the project.
 - **Replication of the project:** Cuban Government considers that additional work must be performed on the project results to allow its replication (both expansion and improvement). At the moment only the activities already concluded can be discussed for replication (Cocodrilo and La Melvis). For La Melvis replication/expansion it is considered fundamental to wait for the regular operation before deciding on future action.
 - **Benefits of the project:** The Cuban Government has become more aware of the opportunities renewable energy offers, such as energy independence, and this has had a strong effect on the development of RE policy in Cuba. Regarding capacity building, it is important to realize the contribution for a *Polo Cientifico* in Cuba and the development of a R&D program funded by enterprises, such as UNE. There are other

³³This specification does not comply with the idea of using higher humidity as informed. Moreover, the information reported in the proposal for *pinus* does not follow the possible biomass to be used.

³⁴This information follows the previous one since no emissions measurements are installed in La Melvis, despite the size of the plant and possible PM and NOx emissions.

GEF projects in Cuba on biogas systems. The Cuban government is fully satisfied with the support from UNEP and UNIDO.

- **Ministerio de Energía y Minas – Rosell Guerra Campana (Director Energías Renovables) – Argelia Balboa Monzon (Senior Adviser)**
- **UNE – Union Electrica – Aleisly Valdes Viera – Director**
 - **Difficulties in the project:**
 - The different difficulties in each one of the projects were discussed.
 - Cutting machine at La Melvis: The evaluator was informed that the Ministry of Energy wrote a letter to the Ministry of Agriculture seeking a solution for the problem with the cutting machine at La Melvis plant.
 - The project initially had another coordinator (A. Curvelo), who was changed in 2010 (J. Isaac), with good results.
 - Difficulties in performing financial international agreements with Cuba were discussed.
 - **Contract with Berkes:** The evaluator was informed that Berkes has sent a new (revised) price for the system due to the expiration of the previous proposal and this will be analyzed by the Government (*Empresa de Comercio Exterior*).
 - **Project benefits:** Project objectives were:
 - To develop the biomass gasification technology in Cuba. However, according to information received during the meeting, gasification technology is considered by the Ministry as a good solution for small plants, whereas steam cycles are considered a better option for biomass-fired large plants.
 - To give support to the RE's policy in Cuba and this is considered by the Cubans to be the most important objective of the project.
 - **Guarantees of accomplishing the project:** Letters of the Cuban Government were addressed to UNEP and UNIDO with guarantees from Cuban Government that the project will be accomplished.

C.3. Project evaluation:

C.3.1. Project objectives:

The evaluator believes that in the case of the biomass project, the objectives were realistic, considering the institutional context and the budget allocated to the project.

However, considering there seems to be no clear reason for the choice of the 500-kW-gasifier at La Melvis, since it is not a fully commercially available technology. The option of a biomass-fired Rankine system fired with the biomass should have been evaluated at the very beginning of the project and the two options compared before a decision was taken.

The technical team (Project Manager and Cubaenergia Director) informed the ET that the main reason for choosing biomass gasification technology was "to learn" about biomass gasification. This 'learning' process is unclear, since a previous selection of the most adequate technologies was not carried out, and neither the local university nor any laboratories have been involved in the project, and experiences from the existing small-

scale biomass gasification systems already operating in Cuba have not been sufficiently considered to learn basic information about the technology. Even considering the context of RE projects in Cuba, there are other biomass technologies that are suitable and adequate for each case, besides biomass gasification.

In the case of the Meat Industry it is not clear why biomass gasification was chosen and other technologies such as a biomass-boiler or biogas (from the sewage treatment station) were not properly considered.

C.3.2. Achievement of outputs:

C.3.2.1. Establishment of a policy and regulatory framework

- Create a policy and regulatory framework...:

The government of Cuba established a policy for RE. The ET had access to the public document “*Lineamientos de la Política Económica y Social de la Revolución*” where *Lineamiento 278* deals with RE. However the “*Política para el desarrollo de las ER*”– approved in June 2014 by the Council of Ministers of Cuba is a private document and only the public presentation to the *Asamblea Nacional* was provided to the ET. On March 2015, a set of legislation and decrees was approved for RE. This is an important result since it affirms the existence of a program of RE in Cuba with the strong support of the government.

- National quality standards on RE technology...

According to the project manager there were no standards for biomass gasification developed by the project, since there was a lack of technical information provided by the biomass gasifier manufacturers.

- Guidelines on EIA...:

There is legislation for EIA in the country but, according to the project manager, this was not performed by the project. In the case of air emissions there are standards for stationary sources; in the case of the gasification plants, there is no equipment in place to measure air emissions from the systems. This would be important in the case of La Melvis plant where the installed power is 500 kW (mainly NO_x emissions from biomass, since NO_x is an ozone precursor) and it is located in the urban area of *Nuova Geronna*.

Cocodrilo plant is a small-scale system (50 kW) so an EIA is not necessary. The Meat Industry plant could not be evaluated since no technical information has been provided by Berkes (Uruguay).

According to the project manager, there is a mandatory certification program for sustainable forest management but this was not evident in the documents received.

C.3.2.2. Building local and national capacity

- Key stakeholders are trained on technology evaluation:

Training workshops were carried out, and study trips to India and Uruguay were undertaken.

In the case of the Meat industry, technical training has yet to begin due to lack of technical information on the specific gasifier.

More in depth capacity building activities are recommended considering the O&M requirements of the gasification systems; The evaluator was informed these activities will in the future be supervised by technically skilled personnel from UNE (*Union Electrica*).

It is strongly recommended that the local universities are involved and receive adequate capacity building and not just participation in the workshops.

A more detailed technical-economic analysis is recommended, mainly in the case of the La Melvis and the Meat Industry (but also for all biomass-based gasifier power plants when considering generation costs and overall efficiency)

Before any upscaling of the plants takes place a technical-economic analysis of the Meat Industry plant should compare the biomass gasifier-boiler system with a conventional biomass boiler.

Tests must be performed on the Berkes and La Melvis gasifiers using each type of locally available woody-biomass (there was no information available on the biomass used in the plants in operation in Uruguay and India).

In addition, tests should be performed with each type of biomass in order to analyze the conversion efficiencies of each one: these tests should evaluate the LHV (low heating value) of each type of biomass and the LHV of the synthesis gas to allow the evaluation of the real conversion efficiency as well as operation costs.

These activities are important both for starting a replication program of gasification technology in the country, and also for planning any future manufacturing of biomass-gasifiers in Cuba.

- Key stakeholders are trained on management aspects of renewable energy based power plants and process heat generation systems:

Wood production: Sustainable supply of biomass is being developed through forest management and planted forests (acacia) and the training of local stakeholders.

Power plants: The local workers have been trained to operate Cocodrilo and La Melvis plant but it is essential to have highly skilled staff to give technical support to O&M. The evaluator was informed that UNE will take charge of O&M for the two existing power plants. Although this is recommended, a more detailed plan for the participation of UNE in O&M in the two plants should be developed especially given the geographical distance of UNE headquarters from the plant.

Heat generation system: the only information available is that the system to be installed is an updraft fixed bed gasifier coupled to a boiler to produce steam according to the needs of the meat plant. There is no information on management aspects of the plant.

Data base: No evidence was provided regarding the training of personnel on the use of national and international databases on all aspects of biomass and wind resources, technologies, projects, markets, opportunities, and stakeholders

Biomass production for the power plants: Regarding the marabou cutting machine the local operator is not able to adjust the machine. In addition, a new technical problem was detected during the field visit to La Melvis related to the biomass-feeding system but the PM informed the evaluator it is being analyzed. A new cutting machine for marabou cutting (a French machine) is being purchased, but it has not been tested with marabou.

Capacity building of local stakeholders has been developed but some additional training of the local workers should be provided to develop technical skills needed to adjust the cutting machine

In the case of biomass production for the Meat Industry, no specifications are available since detailed technical information has yet to be received from Berkes manufacturer from Uruguay. A matter of concern, as in the other cases, is that manufacturers were not informed about the specific type of wood to be used. In the case of Berkes gasifier for the Meat Industry the ET was informed that there are no strict requirements on humidity (up to 45%) but the information sent to Berkes mentions 25% humidity in the wood (but no specifications on the type of wood).

The above difficulties indicate poor capacity building on biomass gasification process, which can only be solved with a more detailed and in depth training process.

Certification standards: No certification standards were developed for the project, but according to the project manager there are already standards for forest management in the country.

- Experts and planners to be trained to manage the technical and financial services for the project, to disseminate information and to implement the replication strategy

Workshops and seminars were organized for different stakeholders as mentioned during the meetings reported above; the project team carried out a workshop with international experts and technical visits were undertaken to existing plants in other countries (India and Uruguay). Information was disseminated to a wide audience. The audience for the workshops included several stakeholders such as UNE, Alastor and GEAM. According to information received some female experts was involved, mainly from ALASTOR.

However, as already discussed above in this report, the existing training is not detailed enough to allow the dissemination and the replication of the technology. Several additional actions for training, capacity building and other achievements are needed. A general study of bioenergy systems should be performed to allow the evaluation of the existing technologies and the selection of the most suitable for each situation.

- National manufacturing capacities strengthened to manufacture, assemble and maintain the biomass gasifier systems, and reduce the costs of implementing renewable energy projects:

According to information received, there are plans to install the following additional projects in the country (it is yet to be defined if they will be locally manufactured or imported):

- enlargement of La Melvis up to 3.5 MW,
- a 1 MW plant (up to 7 MW) in *Macurije* – a Pinar del Rio sawmill,
- a 0.5 MW (up to 3 MW) plant to be located at another Pinar del Rio sawmill (Pons)
- a 0.1-0.2 MW plant in *Camaguey* using marabou.

If all such plants are implemented, this will increase the total power production using biomass gasification to around 14 MW. However, the evaluator was informed that the existing funds are allocated only for La Melvis expansion at CF.

It is important that any replication of large-scale biomass projects should only be developed if the recommendations presented here are accomplished and the most suitable technologies are selected in each case.

The evaluator was informed that there is one possible local manufacturer for biomass gasifiers for power production but that there are still technical difficulties associated with manufacturing the systems locally. According to information provided, the Cuban enterprise *Empresa de Producciones Mecanicas Manuel Bravo* in Santiago de Cuba is developing a 40 kW biomass gasifier, together with the *Universidad de Oriente* but there are still major difficulties to be overcome in order to successfully manufacture a large-scale biomass gasifier such the one from Ankur at La Melvis plant. Considering the difficulties of operating large-scale gasifiers (La Melvis) and the lack of technical information available (laboratory testing for the biomass and the syngas, plant efficiency and economic analysis) it is strongly recommended the expansion and replication of La Melvis project is delayed until this technical analysis has been carried out.

For the Berkes system for the Meat Industry it was clear that there is a lack of technical information available, even after the field visits to Uruguay, since detailed technical specifications have yet to be provided by Berkes and the purchase process has not yet started (due to internal bureaucracy in the Cuban Government).

Another important point refers to spare parts: the evaluator was informed that regular spare parts for the plants already installed (Cocodrilo and La Melvis) will be provided by UNE and others must be imported such as the compressor for the cooling system in the Cocodrilo plant (the original compressor was damaged, a second unit was imported, but also damaged, and a third unit is currently being imported). The local production of spare parts must be carefully analyzed before discussing replication since the above delay highlights a major problem for efficient operation of the plants.

C.3.2.3. Implementation of business models to demonstrate commercial feasibility of renewable energy technologies for power generation and process heat generation

There is no evidence that the business models have been successful in demonstrating the commercial feasibility of biomass gasification since there is a lack of technical/financial information available. In Cocodrilo plant, a more detailed business plan is needed, factoring in all the costs and spare parts. Information received in December 2014 stated there are 8³⁵ workers in the plant (for 18³⁶ hours of operation per day). The business model for La Melvis cannot be assessed until the technical issues have been resolved.

Selection³⁷ of the equipment for the gasification plants was undertaken by two commissions: one technical and one financial; these two commissions were in charge of the final selection of the supplier for each of the two systems (La Melvis and Meat Industry), since the Cocodrilo plant was supplied directly by UNIDO.

- Training imparted on the operational and management issues to business models and their linkages with productive use activities:

Not developed

- Close supervision of performance of business units conducted and corrective steps taken on regular basis:

In the case of biomass gasifiers in Cocodrilo and La Melvis evidence was provided that there was close supervision of the plants and corrective steps were taken where needed (such as in the case of the compressor of the cooling system) but due to the Government structure execution of these solutions was slow. In the future, the supervision as well as O&M is expected to be provided by UNE. As mentioned above, it is recommended a specially trained supervisor is available to coordinate the local workers both in the case of Cocodrilo and in the case of La Melvis.

³⁵ET was informed that the trained people had to be replaced and trained again since the trained staff left. The same experience happened in remote villages in Amazon in Brazilian (USP) projects. It seems it is a regular behavior in regions where most people are not skilled.

³⁶ This is the number of hours for operation forecasted to happen but during 2013 the average was much lower (9.4 hs per day).

³⁷ There was an open bidding process facilitated by UNIDO but in some cases only a few suppliers interested in the offer, such as the case of the Meat Industry where only Ankur and Berkes presented offers.

- A pilot mini-grid based on biomass gasifier technology set up at Cocodrilo to demonstrate the potential of biomass gasifier technology for isolated mini grids:

A pilot mini-grid based on a 50 kW generator using woody biomass (in a dual fuel engine) was installed at Cocodrilo. The technicians/experts from the local power utility were trained to operate and maintain the biomass gasifier systems. Experts from the local power agency UNE were also trained and introduced to the biomass gasification technology. The Demonstration system showed quite positive results for the community. The local community and women are involved and appear to be sensitized to the project. Further expansion is expected to allow the development of further activities such as refrigeration systems for local fishermen.

Sustainability and replication

- (A) There seems to have been a lack of technical information provided to the manufacturers of the biomass gasification plants. The ET was informed in several meetings that the only specifications provided to the manufacturers were the planned size of the plant and the use of 'wood' as the biomass. These specifications were too generic since each system must be designed for the specific biomass to be used.
- (B) Considering that the large-scale gasifier (La Melvis) is already in place, it is strongly recommended (before any further investment or replication) that:
- a. tests with each one of the different biomass available should be performed, even considering the problems with the cutting machine (considering that the gasifier will be in operation, which did not happen during the visit);
 - b. results of the tests are analyzed to see the more adequate biomass to be fed;
 - c. measurements of the low heating value of the syngas, as well as its composition be taken; energy balances and efficiency be evaluated for each biomass and atmospheric emissions measured (considering the size of the plant);
 - d. technical evaluation of the plant (efficiency compared to a Rankine cycle commercially available);
 - e. economic evaluation of the plant (also compared to the Rankine cycle);
 - f. Finally the discussion on the replication or not.
- (C) There are several biomass technologies for power production. Small scale (Cocodrilo) can be replicated but other power/steam production technologies (see below) using biomass can be included in the Cuban program of RE only after the recommendations are followed.
- (D) For the operation of a biomass gasifier, even on a small scale (50 kW), it is fundamental to have a highly skilled staff member working alongside the local staff to give technical support for O&M. Since the highly skilled staff are located at UNE headquarters, quite far from the plant, regular visits should be planned³⁸.

³⁸ This problem appeared in the projects in the remote village in Amazon. In this Cuban case, conditions are better since distances are shorter and UNE is willing to give support.

- (E) Regarding the marabou-cutting machine, replication seems unlikely in the short term since local operator/other technical people are not even able to regulate the machine. In addition, attention must be paid to the fact that both the machine and the gasifiers were purchased without informing the manufacturer of the type of wood to be used. This is essential information for the gasifier/cutter manufacturers and the absence of it in the purchase order reveals a need for further technical capacity building to understand the technicalities of the gasification process.
- (F) The technology chosen for the Meat Industry is not widely produced and the manufacturer in Uruguay (Berkes) seems to be the only available manufacturer. Even in Brazil, it seems there is only one plant operating with this technology. The lack of alternative manufacturers could lead to sustainability and replication issues in the future.
- (G) From the evidences received during the field visits, we can conclude that:
- a. Cocodrilo has performed well despite some initial mistakes and is in a position to be replicated; better capacity building on O&M needed (training of operators not enough. Should include the university);
 - b. La Melvis must be carefully analyzed and adequate tests with each type of biomass/syngas must be performed before replication is considered (it must be verified if operational problems faced by the gasifier, not producing enough syngas for the engines is due to the size of biomass or any other difficulty). Risks for La Melvis replication are high considering the large size of the gasifier.
 - c. The Meat industry: a deep technical analysis considering energy balance, O&M issues and economic feasibility must be performed, comparing the updraft-biomass-gasifier-boiler system with a conventional biomass-boiler (also the option of using biogas from the sewage treatment), before deciding on replication.
- (H) In Cocodrilo village, the Evaluation Team could verify local public awareness specifically in the case of the small-scale biomass gasifier. The technical coordinator of Cocodrilo plant is also a kind of mayor in the village and there is strong local support for the project (it seems). On another hand, for the Meat Industry there was no concrete facilitation or capacity building. In addition, at the Meat Industry there was no discussion of using the biogas from the sewage treatment plant as an energy source; biogas is currently released into the atmosphere.
- (I) According to information received degraded land will be replaced by wood plantations.
- (J) UNIDO, in a meeting with the Evaluation Team, proposed to use some additional funds still available to engage experts to help solve the problems at La Melvis. In addition, it seems there are funds available for the technical tests recommended above (such as measurement of syngas heating value and syngas composition, never performed and strongly recommended by ET during the meetings).

Conclusions and Recommendations

Cocodrilo is in a position to be replicated but not La Melvis or the meat industry until further testing and analysis has been carried out. In brief, biomass gasification technology can only be recommended for isolated systems and small-scale systems, below 200 kW. Such small-scale biomass gasifiers are important in remote villages since they use wood or biomass residues and can provide enough power for productive use. For installed power above 200 kW biomass gasification

technology carries higher risks; steam systems (commercially available and with no risk) are recommended as an alternative. In addition, the use of other bioenergy sources should be considered such as biogas from anaerobic digestion (in the case of the Meat Industry and others where there is a sewage treatment system).

(E) Finally, it is important to understand that biomass gasification cannot be seen as the only bioenergy solution for any situation and, in each case, the best technology is to be analyzed considering all technical, social, environmental and economic aspects. This is probably one important recommendation for future projects.

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ENERMAD - "Implementation of a Thermal Power Plant of 200 kW using Wood Residues from a Sawmill Industry in Amazon Region". Project developed by CENBIO/IEE/USP (Brazilian Reference Center on Biomass, Institute of Energy and Environment of University of Sao Paulo). Available at http://cenbio.iee.usp.br/projetos/enermad/en_enermad.htm

Photos

1. La Melvis (Isla de la Juventud)





2. Cocodrilo (Isla De la Juventud)



3. Universidad Isla de La Juventud



4. Ministerio de Energía y Minas



VII. Annex 7: Summary of co-finance information and expenditure by activity

The following table shows present data about planned and actual project co-finance, approved and supplied by UNIDO. It has not been possible to get more disaggregated information for co-finance.

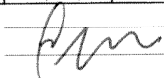
Data relative to expenditure by activity have not been made available to the Evaluation Team. Reason given for this is that UNEP and UNIDO use different accounting procedures, specifying expenditures by budget line, not by project activity. Table 3 (Project financing) of the main report (above) contains detailed information about project expenditure.

ANNEX 1C
 UNEP/GEF REPORT ON PLANNED PROJECT COFINANCE AND ACTUAL COFINANCE RECEIVED (until June 2014)

Title of Project:							Generation and Delivery of Renewable Energy based Modern Energy Service, the Case of the Isla de la Juventud						
Project Number:							PMS:GF/4040-05-10			IMIS:GFL-2328-2721-4837			
Name of Executing Agency:							UNIDO						
Project Duration:							From: 05/9/2005			31/10/2014			
Reporting Period:							September 2005 to June 2014						
Source of Cofinance	Cash Contributions			In-kind Contributions			Comments						
	Budget original	Budget latest revision	Received to date	Budget original	Budget latest revision	Received to date							
Gov. of Cuba	1,594,000	1,594,000	7,200,793	30,000	30,000	30,000	Gov. of Cuba has financed the full construction of the Wind Farm (1,65 MW) Los Canarreos (\$4,5 Mn) and all civil works/infrastructures of the La Melvis biomass plant (0.5 MW) + civil works of all Demonstrative component + the salary of the Project Team						
Private sector investors	8,660,000	8,660,000	0	0	0	0							
UNIDO	0	0	0	170,000	170,000	170,000							
UNEP	0	0	0	50,000	50,000	50,000							
ADEME	200,000	200,000	0	0	0	0							
Additional Cofinance:-													
Total													
	10,454,000	10,454,000	7,200,793	250,000	250,000	250,000							

All amounts in US dollars

Name: Diego Masera
 Position: Project Manager
 Date: Septiembre 2014



I. Annex 7: List of questions

Evaluation Criteria	Key Evaluation Questions	Indicators	Sources
Strategic Relevance			
	Have local necessities been satisfied?	Amount of electricity /heat generated. Improvements in degree of knowledge of technologies	Project documents, meetings with beneficiaries
	Have environmental issues been respected?		Analysis of environmental regulations. Meetings with stakeholders
	Was the activity realistic? Has it covered a real necessity?	Number of beneficiaries	Meetings with stakeholders
	Was the budget adequate?	Budget deficit or surplus	Meetings with project officials Meetings with stakeholders
	Is the activity compatible with the GEF Biodiversity focal area		
Achievement of Outputs			
1.1 Create a policy and Regulatory framework to provide enabling environment for the development of renewable energy to be established and made operational	Is the policy sound? PPAs established? Incentives, tax waivers, etc. defined ? Are there still any flaws missing?	Number of policy and regulatory framework pieces of law created and passed	Analysis of documents Meetings with Cuban authorities
1.2 National quality assurance standards on renewable	What has been the base for standards?	Number of standards Acts of dissemination	Meetings with stakeholders Analysis of documents

technology performance and evaluation benchmarks to be set up and widely disseminated:	Are they complete and adequate?		
1.3 Guidelines on environment impact assessment, mandatory certification and carrying capacity to be formulated to evaluate new and renewable energy investment projects	Have the guidelines been prepared? Have they been approved? Are they complete?	Number of guidelines	Meetings with Cuban authorities Analysis of documents
2.1 Key stakeholders are trained on technology evaluation and benchmarking of renewable energy systems	Have the training programs prepared? What are their contents Benchmarks for performance and evaluation of each type of technology developed?	Number of training acts Assistance Working hours per trainee	Meetings with project officials, authorities and stakeholders
2.2 Key stakeholders are trained on management aspects of renewable energy based power plants and process heat generation systems	Have the training programs prepared? What are their contents?	Number of training acts Assistance Working hours per trainee	Meetings with project officials, authorities and stakeholders
2.3 Experts and planners to be trained to manage the technical and financial services for the project, to disseminate information and to implement the replication strategy	Have the training programs prepared? What are their contents Has a replication strategy been created? Women experts and consumer groups included?	Number of training acts Assistance Working hours per trainee Contents of Replication Strategy	Meetings with project officials, authorities
2.4 National	What parts are now domestically	Number of parts manufactured as a result	Meetings with authorities

<p>manufacturing capacities strengthened to manufacture, assemble and maintain the biomass gasifier systems and wind arms, and reduce the costs of implementing renewable energy projects</p>	<p>manufactured? How many units</p>	<p>of the project activities</p>	<p>and project officials Official communications Newspapers</p>
<p>3.1 An innovative funding mechanism Is set up to attract investment in renewable energy development on Isla de la Juventud, and replication in the rest of the country</p>	<p>Has the funding mechanism created? Financial rules available? Criteria for allocation of funds defined? ¿Are his contents and regulations available? Is it supported by the Cuban authorities? How many projects have expressed interest in using the umbrella of the Mechanism? What are the future perspectives?</p>	<p>Text of the Funding Mechanism Number of projects covered</p>	<p>Discussions with Cuban authorities and project officials</p>
<p>3.2 Capacity of national banks and financial institutions is built to evaluate and analyze renewable energy technology based power projects</p>	<p>How many banks and institutions have received capacity building? How many actions have been taken? What has been their reaction?</p>	<p>Number of banks and institutions Number of training workshops organized Personnel in charge of evaluation of renewable projects</p>	<p>Meetings with project officials Direct meetings with banks and financial institutions</p>
<p>4.1 Installation and start-up of four business models – investment projects (3.5 MW power</p>	<p>Are the four models available and running? What difficulties have been found?</p>	<p>Amount of electricity/heat produced Savings of fossil fuels</p>	<p>Meetings with stakeholders Project documentation</p>

<p>generation based on the biomass gasification, 6 MWth</p> <p>based on the biomass gasification for process heat, 1.5 MW based on wind energy and a forestry business model to produce 36,400 tonnes of wood chips)</p>	<p>Delays? Why?</p> <p>How many wind generators?</p> <p>Are they generating according to the estimations of previous wind maps?</p> <p>Technical failures?</p> <p>Surface of forestry model?</p> <p>Estimated amounts of biomass to be produced?</p>	<p>Estimated environmental benefits</p> <p>Cultivated surface</p>	<p>Meetings with local authorities</p> <p>National and local press</p>
<p>4.2 Training imparted on the operational and management issues to business models and their linkages with productive use activities</p>	<p>Training programmes; contents</p> <p>Are the beneficiaries satisfied?</p>	<p>Number of training activities</p> <p>Number of trainees</p> <p>Working hours</p>	<p>Meetings with stakeholders and project officials</p>
<p>4.3 Close supervision of performance of business units conducted and corrective steps taken on regular basis</p>	<p>How many incidents took place?</p> <p>What measures were taken to carry out the supervision?</p> <p>What corrective steps were necessary?</p>	<p>Periodic performance reports</p> <p>Statistics about incidences</p>	<p>Incidence reports</p> <p>Meetings with stakeholders</p> <p>Meetings with project officials</p>
<p>4.4 A pilot mini-grid based on biomass gasifier technology set up at Cocodrilo to</p>	<p>When was commissioned?</p> <p>Was there any delay? Why?</p>	<p>Amount of electricity generated</p> <p>Fossil fuel savings</p>	<p>Meetings with local authorities</p> <p>Meetings with</p>

demonstrate the potential of biomass gasifier technology for isolated mini grids	What difficulties have been found? Corrective measures?	Environmental impact avoided	beneficiaries Plant reports
5.1 Project team selected and management structure agreed with the national counterparts	Project team ToR prepared? Public – private partnership mechanisms explored?	Number of PPP created Number of other types of joint ventures created	Meetings with project officials
5.2 Capacity building and training of the key stakeholders – technical experts, planners, investors and experts	Training programs prepared? Contents? Number of training sessions? Number of trainees?	Number of training sessions? Number of trainees?	Meetings with project officials Meetings with stakeholders
5.3 Close monitoring and evaluation of the project activities achieved	Monitoring system designed? Contents of the monitoring system? Difficulties arisen?	Monitoring reports	Meetings with project officials
5.4 An effective Information dissemination programme and strategy developed and implemented	Database of projects created? Guidelines by type of project created? Website created? Adequately maintained?	Number of guidelines Size of database	Meetings with project officials Meetings during the workshop on 5-9 October 2014 Meetings with Cuban authorities
5.5 Lessons learned and results disseminated to a wider audience and a regional network	Was a mechanism for dissemination designed and created? Regional network of agencies created? Network of investors,	Number of workshops Number of brochures	Meetings with project officials Meetings during the workshop on 5-9 October

created	utilities, networks, etc created?	Membership of agencies Activities carried out	2014
Effectiveness: Attainment of Objectives and Planning Results			
	Is the Replication Fund working properly?	Evolution and financial movements of the Fund	Meetings with Fund officials and executives Meetings with project officials
	What are the sources of financing contemplated for replication and/or future projects		Meetings with Fund officials and executives Meetings with funding institutions
	What components of windmills are domestically manufactured as a result of project activities?	Industrial statistics	Meetings with industrial stakeholders Meetings with local authorities
Sustainability and replication			
	Are there any social or political factors that may influence positively or negatively the sustenance of project results and progress towards impacts?		Meetings with all kind of project participants or stakeholders. Meetings during the workshop on 5-9 October 2014
	Is the level of ownership by the main national and regional stakeholders sufficient to allow for the project results to be sustained?		Meetings with stakeholders, especially plant owners
	Are there sufficient Government and Stakeholder awareness, interests, commitment		Meetings with government officials and stakeholders

	<p>and incentives to execute, enforce and pursue the programmes, plans, agreements, monitoring systems etc. prepared and agreed upon under the project?</p>		
	<p>To what extent was the project able to reach out to the stakeholders identified in the design phase (academia, private sector, civil society including rural Communities etc)?</p>		<p>Meetings with project officials</p> <p>Project documentation</p>
	<p><i>Financial resources.</i> To what extent are the continuation of project results and the eventual impact of the project dependent on continued financial support?</p>		<p>Meetings and analysis with owners of plants, government officials, Local authorities.</p>
	<p>What is the likelihood that adequate financial resources will be or will become available to implement the programmes, plans, agreements, monitoring systems etc. prepared and agreed upon under the project?</p>		<p>Meetings with project officials</p> <p>Meetings with financial institutions</p> <p>Project documentation</p>

	<p>Are there any financial risks that may jeopardize sustenance of project results and onward progress towards impact?</p>		<p>Meetings with project officials</p> <p>Meetings with financial institutions</p>
	<p>To what extent is the sustenance of the results and onward progress towards Impact dependent on Issues relating to Institutional frameworks and governance?</p>		<p>Meetings with project officials</p> <p>Meetings with government institutions</p>
	<p>How robust are the institutional achievements such as governance structures and processes, policies, sub--regional agreements, legal and accountability frameworks etc. required to sustaining project results and to lead those to impact on human behaviour and environmental resources?</p>		<p>Meetings with government institutions</p> <p>Meetings with local authorities</p> <p>Meetings with project officials</p>
	<p>Are there any environmental factors, positive or negative, that can influence the future flow of project benefits?</p>		<p>Analysis of project documentation</p> <p>Analysis of Cuban environmental policies</p>
	<p>Are there any project outputs or higher level</p>		<p>Discussions with forest</p>

	<p>results that are likely to affect the environment, which, in turn, might affect sustainability of project benefits?</p>		<p>authorities</p> <p>Discussion with Cocodrilo local authorities</p>
	<p>Are there any foreseeable negative environmental impacts that may occur as the project results are being up---scaled?</p>		<p>Discussions with forest authorities</p> <p>Discussion with Cocodrilo local authorities</p>
Efficiency			
	<p>Any delays?</p> <p>What are causes?</p>	<p>Comparison between the initial schedule and the present situation.</p>	<p>Analysis of project documents, especially PIRs and Final Reports.</p> <p>Meetings with representatives of factories and project officials</p> <p>Desk review.</p> <p>Conversations with project staff and representatives of companies in charge of plant/installation building works.</p>
	<p>Measures taken to recover time?</p>		<p>Conversations with project staff and representatives of companies in charge of plant/installation building works</p>
	<p>Any increment in costs?</p> <p>What are the reasons?</p>	<p>Present costs vs. estimated costs</p>	<p>Meetings with representatives of factories and project officials</p>
	<p>Is future financing guaranteed?</p>	<p>Financing analysis</p>	<p>Conversations with project staff and financing institutions</p>

	Are there financial difficulties?	Financial figures	Meetings with representatives of factories and project officials
Factors and processes affecting project performance			
Preparation and readiness	Was the project designed with the necessities of the country in mind?	Existing Cuban energy Plans at the time of project implementation	Meetings with Energy Authorities
	To what extent was the project aligned with the national priorities?	Comparison between project specifications and Cuban priorities	Meetings with Energy Authorities
Project implementation and management	Were pertinent adaptations made to the approaches originally proposed?	Changes in the project objectives and timelines.	Project documentation (PD, PIRs) Meetings with project officials
	How did the relationship between the project management team and the national coordinators develop?		Meetings with project officials Meetings with Cuban authorities
Stakeholder participation and public awareness	Were the main stakeholders adequately selected?		Meetings with project officials, Cuban authorities, financial institutions, etc.
	Did the stakeholders participate in decision-making?		Meetings with stakeholders and project officials
Country ownership and driven-ness	Have the national partners duly assumed its responsibilities?		Meetings with UNEP UNIDO officials Meetings with Cuban institutions
	How fluid have been the relationships between the national partners and UNEP?		Meetings with UNEP UNIDO officials Meetings with Cuban institutions
Financial planning and management	Are there deviations from initial project budget?	Comparison between initial budget and actual expenditure	Analysis of documents Meetings with project officials
	Has co-financing materialized as expected?	Comparison between budget figures and actual co-financing.	Analysis of documents Meetings with project officials

UNEP supervision and backstopping	Have been the project supervision plans adequately designed?		Meetings with project officials Meetings with UNEP officials
	Have they been adequately carried out		Meetings with project officials Meetings with UNEP officials
Monitoring and evaluation Note: Project Logframe has not been made available to the Evaluator	To what extent has baseline information on performance indicators been collected and presented in a clear manner? Was the methodology for the baseline data collection explicit and reliable?		Meetings with project and UNEP-UNIDO officials Analysis of project documentation
Complementarities with UNEP strategies and programmes			
	Have tender inequalities been detected?		Meetings with stakeholders Meetings with plant owners
	Have inter-exchanges of information about project results and outcomes taken place with other countries?		Meetings with project officials Meetings during the 6-10 October workshop

Annex 8: CVs of the consultants

Manuel Blasco, Evaluation Team Leader

CURRICULUM VITAE

Proposed role in the project:

Category: Senior

1. **Family name:** Blasco
2. **First names:** Manuel
3. **Date of birth:** 06/06/1950
4. **Nationality:** Spanish
5. **Place of residence:** Madrid (Spain)
6. **Education:**

Institution [Date from – Date to]	Degree(s) or Diploma(s) obtained:
Superior Technical School of Industrial Engineering, Polytechnic University of Madrid (1970-1976)	MSc Industrial Engineering

7. **Language skills:** Indicate competence on a scale of 1 to 5 (1 – excellent; 5 – basic)

Language	Reading	Speaking	Writing
Spanish	1	1	1
English	1	1	1
German	3	3	5

8. **Membership of professional bodies:** Professional Association of Industrial Engineers, Madrid, Spain

9. **Other skills:** (e.g. Computer literacy, etc.); Experience in Project Cycle Management and Logical Framework Tools, Energy Policy, Institutional knowledge and legal framework of energy regulatory agencies, Energy markets, Econometric analysis, Performance benchmarking. Microsoft Office in WINDOWS environment.

10. **Present position:** Independent energy consultant

11. **Years within the firm:** 14 (as independent consultant)

12. **Key qualifications:** (Relevant to the project)

- Qualified senior energy expert with over 30 years experience in the energy industry and extensive knowledge of the technical and economic characteristics of energy technologies.
- Solid experience of projects financed by the European Commission (EC) and other donors: DFID, UN and International Energy Organizations like the International Energy Agency in the fields of energy, electricity, including regulatory and legal issues (preparation of pieces of law relative to electricity

supply), energy policies, energy markets, development of renewable energy sources, energy efficiency and methodologies for tariff setting.

- Specific experience in revision and drafting of transmission & distribution electric codes, licensing procedures and creation of markets for electricity.
- Experience in small electric systems in islands, including both island states (Micronesia, Palau, Marshall Islands) and other isolated and mainland-connected systems (Canary Islands, Mallorca and Menorca in Spain)
- Solid understanding of the renewable energy business and integration of renewable energy technologies in transmission and distribution electric networks, including strategies for off-grid implementation in rural and residential areas.
- Specific experience in analysis of mechanisms for mobilisation of funds for electrification in both isolated and grid-connected areas. Solid background in dissemination activities and discussion of alternatives and funding mechanisms with investors and stakeholders, including negotiations with relevant high level energy authorities in different countries (Romania, Hungary, Bulgaria, Egypt, Central America, etc. See below for further details).
- Specific background in the field of rural electrification, both off and on-grid, using renewable and conventional energy sources.
- Large experience in the field of energy efficiency in public and residential buildings, as well as in industrial installations. Definition and monitoring of implementation strategies.
- Large experience in dissemination activities, including participation in workshops, debated and round tables, as a member (and chairman in some cases) of committees and working groups, at national and international level.
- Specific experience in analysis of the energy outlook in different countries, as well as preparation of energy policies and action plans.
- Excellent and highly experienced in networking and inter – exchange and dissemination of information.
- Specific experience in the formulation and analysis of regulation and legislation of the energy sector.
- Solid background in the field of energy regulatory issues and in the creation of regulatory frameworks for the participation of the private sector in the electricity supply business.
- Solid knowledge of the EC (including EDF procedures), including good knowledge of Project Cycle Management and project identification, project formulation, developing of project Terms of Reference, preparation of project identification fiches, action fiches and methodologies for project evaluation.
- Experience in institutional knowledge and capacity building of energy regulatory agencies.
- Experience working for the Spanish Government and the Regulatory Agency in the deregulation process of the Spanish electricity sector, analyzing mechanisms applied in other European countries to create energy markets and to guarantee free private sector participation in a competitive and free market. This framework included a large number of legal dispositions, including the analysis of model supply contracts, access to transmission & distribution networks, creation of adequate grid codes, definition of methodologies to define tariffs for electricity and the treatment to be given to independent power producers using renewable energy.
- Experience in harmonization of energy legislation and regulatory framework with EU acquis, including mechanisms to encourage use of renewable energy sources for electricity generation.
- Solid understanding of and knowledge of electricity consumption markets in Europe, including deregulation processes and their effects.

13. Specific experience in the region (Latin America – Caribbean - Pacific):

Country	Date (from – to)
Guatemala, El Salvador, Honduras	March – September 2014
Philippines	January – May 2014
Cuba	June - July 2010
Republic of the Marshall Islands, Federated States of Micronesia, Republic of Palau	October 2007 – March 2008
Honduras	December 2005 - January 2006
Argentina	March 2001

The above projects were exclusively referred to the countries mentioned. Beside this, one of the main activities carried out between 1979 and 1998 (in UNESA, see Section 14 below) was to analyze the evolution of the electricity supply business in other countries; this included Chile (Chile was the first country in which the electricity supply industry was liberalized, beginning in the early eighties), Argentina, Brazil, etc. The specific characteristics of isolated systems in island areas (Canary and Balearic Islands) were compared with schemes used in other island countries.

14. Professional experience:

Date from – Date to	Location	Company & Reference Person (Name & Contact)	Position	Description
October - November 2014	Cuba	<p align="center"><u>United Nations Environmental Program (UNEP)</u></p> <p align="center">William Adams William.Adams@unep.org</p>	Team Leader	<p>Project title: Producción y distribución de servicios energéticos modernos basados en las energías renovables. Caso Isla de la Juventud</p> <p>Project features: Terminal monitoring and evaluation of a project devoted to the development of renewable energy sources (biomass, wind) for generation of electricity (grid-connected and isolated for rural electrification) and thermal energy for industrial purposes in Isla de la Juventud (Cuba). Institutional knowledge of Cuban energy system. Energy efficiency in buildings .Project financed by UNEP. Total project budget 16 M US\$.</p> <p>Team of two members.</p> <p>One field mission</p>
March – September 2014	Guatemala, El Salvador, Honduras	<p align="center"><u>Deloitte Consulting</u></p> <p align="center">Kendrick Wentzel kewentzel@deloitte.com</p>	Senior Expert	<p>Project title: Technical Assistance for Power Market Development in Central America</p> <p>Project main features: Multidisciplinary project devoted to provide regulatory advice, technical audit support (including development of monitoring and surveillance tools) and capacity building to the Comision Regional de Interconexion Electrica (CRIE). To build up the electricity regulatory agency in Honduras. Preparation of pieces of law in the field of regulation.</p> <p>Activities performed: To carry out a technical audit of the performance of the System Operator of the Central America Electric System (EOR). To design a set of market indicators for use of CRIE at the time of carrying out the supervision of the Central American Electricity Market. To assess members of the electricity regulatory agency in Honduras about common regulatory practices in</p>

				<p>other countries. Preliminary design of secondary law in the field of supply of electricity.</p> <p>Four field missions until July 2014.</p>
January – May 2014	Philippines	<p><u>INTEGRATION</u></p> <p>Bruno Wilhelm</p> <p>bwilhelm@integration.org</p>	Team Leader	<p>Project title: Technical-economic analysis of the integration of renewable energies in San Vicente, Palawan</p> <p>Project features: Perform a technical and economic assessment and compile optimization studies for the integration of renewable energy sources into the power supply of rural areas.</p> <p>Activities performed; Analyze procedures to encourage investments by private companies to participate successfully in the privatization of a missionary power supply system, combining RE with diesel gensets for backup. Preparation of a technically and economically adapted business model and strategy for investments in island electric systems using renewable energy sources. Analysis of possible public-private partnership schemes, according to the guidelines and procedures established by the energy authorities in Philippines. Analysis of mechanisms for private sector participation in other areas of Philippines.</p> <p>Team of five members</p> <p>One field mission</p>
June 2013 – February 2014	Egypt	<p><u>MWHGLOBAL</u> Luigi Vargiu</p> <p>Luigi.Vargiu@uk.mwhglobal.com</p>	Senior Expert	<p>Project title: Short term Technical Assistance to the Egyptian Electricity Regulatory Authority (EGYPTERA)</p> <p>Project features: Capacity building. Support to the Egyptian Electric Utility and Consumer Protection Regulatory Agency (EGYPTERA) and to the Egyptian Electricity Transmission Company (EETC).</p> <p>Activities performed: Review, improvement and implementation of Transmission Grid Code. Participation in three dissemination workshops. Discussions with relevant officials of the Egyptian Transmission Company, the Regulatory Agency and other involved bodies.</p>

				Two field missions
June – October 2013	Kenia, Uganda, Rwanda	<u>United Nations Environmental Programme (UNEP)</u> Tiina Piironen Tiina.Piironen@unep.org	Team leader	<p>Project title: Greening the Tea Industry in East Africa (GTIEA)</p> <p>Project features: Final evaluation of a project devoted to develop renewable energy sources (hydropower schemes) to supply electricity to the tea industry and electrification of neighbouring rural areas in East Africa.</p> <p>Activities performed: Evaluation of results impact and possible replicability. Analysis of public-private partnership schemes for rural electrification projects used in Kenya, Rwanda and Uganda. Discussion with the corresponding authorities about improvements which could be introduced as consequence of the project derived experiences.</p> <p>Team of two members.</p> <p>One field mission</p>
May 2013	Homework (Madrid)	<u>Danish Management A/S (Ltd.)</u> Anise Sacranie asa@danishmanagement.dk	Senior Expert	Preparation of tendering documents for the new EU Framework on Energy
March-April 2012	Homework (Madrid)	<u>Danish Management A/S (Ltd.)</u> Anise Sacranie asa@danishmanagement.dk	Senior Expert	Preparation of a Monitoring Manual for energy projects for EU Delegations.
August 2011 – December 2011	Bosnia - Herzegovina	European Commission-AETS Remy Naude	Team leader	<p>Project title: Review of legislation in the electricity sector in Bosnia & Herzegovina</p> <p>Project features: Detailed analysis of the legislation of BiH in the field of electricity and energy policies, and comparison with the EU acquis. Identification of gaps. Project financed by the</p>

		remy.naude@aets-europe.fr		<p>European Commission. Budget 0.2 M€.</p> <p>Activities performed: Detailed comparison, article by article, of the B&H legislation of the EU acquis, including the Third Package. Participation in two dissemination workshops. Discussions with energy authorities and officials of the transmission company.</p> <p>Team of two members.</p> <p>One field mission (four months)</p>
June 2010 – July 2010	Cuba	<p><u>United Nations Environmental Programme (UNEP)</u> Michael Spilsbury michael.spilsbury@unep.org</p>	Team Leader	<p>Project title: Producción y distribución de servicios energéticos modernos basados en las energías renovables. Caso Isla de la Juventud</p> <p>Project features: Mid-Term monitoring and evaluation of a project devoted to the development of renewable energy sources (biomass, wind) for generation of electricity (grid-connected and isolated for rural electrification) and thermal energy for industrial purposes in Isla de la Juventud (Cuba). Institutional knowledge of Cuban energy system. Energy efficiency in buildings .Project financed by UNEP. Total project budget 16 M US\$.</p> <p>Team of two members.</p> <p>One field mission</p>
August 2009 – July 2010	South Africa, Gambia, Cameroon, Ghana, Senegal, Uganda, Zambia	<p><u>European Commission-AETS</u> Magdalena Wancowicz Magdalena.wancowicz@aets-europe.fr</p>	Senior Electricity Expert	<p>Project title:Technical Assistance and Capacity Building for the African Forum for Utility Regulators (AFUR)</p> <p>Project features: Capacity building. Strengthening the capacity of the African Forum for Utility Regulators (AFUR). Cross-border trade in electricity, organization of power market structures and regional integration. Cross – border transmission issues.</p> <p>Activities performed: Training on economic fundamentals related to electricity regulation, rural electrification, mechanisms to encourage investments, public-private partnership and on regulatory aspects concerning quality of service. Encouragement of South- South cooperation. Analysis of the electricity sector in Cameroon, Ghana, Senegal, Uganda and Zambia. Provided</p>

				<p>institutional capacity building to AFUR members as well as dissemination of information among AFUR member countries through seminars and networking.</p> <p>Four field missions.</p>
May 2009 – May 2010	Bosnia - Herzegovina	European Commission - BESEL, S.A./Guillermo Lopez glopez@besel.es	Senior Expert	<p>Project title:Support to the B-H institutions in implementation of the EU Directive on promotion of Green Electricity</p> <p>Project features: Support to the BiH institutions in implementation of the EU Directive on promotion of green electricity.</p> <p>Activities performed: Design of strategies for development of renewable energy sources. Institutional knowledge of BiH energy system. Discussions with relevant B&H energy authorities.</p> <p>Two field missions.</p>
January– June 2009	Bosnia - Herzegovina	European Commission - SOGES, S.P.A./Elisabeta Pop elisabeta.pop@sogesnetwork.eu	Senior Expert	<p>Project title:Assessment of Needs in Energy and Terms of Reference Preparation</p> <p>Project features: EuropeAid Project. Definition of projects to be funded under IPA 2010 devoted to reinforcement of regulatory bodies, creation and liberalization of markets, energy efficiency and use of renewable energy sources.</p> <p>Activities performed: Project identification and design, taking into consideration the situation and necessities of the B&H electricity supply systems. Project formulation: preparation of Terms of reference, Project Identification Fiches and Action Fiches.</p> <p>One field mission (six months).</p>
Oct 2007 – March 2008	Republic of the Marshall Islands, Federated States of Micronesia, Republic of Palau	European Commission -EPU – NTUA David Moïssis Fwc-epu@epu-ntua.gr	Team Leader	<p>Project title:Identification of the 10th EDF Multi-Country Energy Programme (Pacific Region)</p> <p>Project features: Definition and identification of projects and strategies devoted to encourage use of renewable energy sources for rural electrification (solar and mini hydro) and to improvements in energy efficiency, including DSM in the residential sector in island countries.</p> <p>Analysis of mechanisms for mobilization of funds for electrification: discussions with other</p>

				<p>donors. Projects to be financed through EDF 10. Total funding 13 M€.</p> <p>Activities performed: Discussion with energy authorities and possible project beneficiaries in each island country. Analysis of most urgent necessities. Project identification. Project formulation.</p> <p>Team of two members.</p> <p>One field mission.</p>
May 2005 – Jan 2007	Bulgaria	<p><u>European Commission</u> - BESEL, S.A.</p> <p>(see above)</p>	Senior Electricity Expert	<p>Project title: Strengthening the Bulgarian energy regulator</p> <p>Project features: EuropeAid Twinning Project. Assistance to the Energy Regulatory Authority.</p> <p>Activities performed: Development of secondary legislation in the fields of electricity and gas, including methodologies for tariffs, ancillary services and policies for use of renewable energy sources. Review of technical codes for transmission and distribution of electricity. Analysis of impact on distribution grids of plants using renewable energy sources (wind and grid connected solar PV) owned by independent power producers.</p> <p>Five field missions.</p>
Oct 2005 – Jan 2009	Madrid, Spain	<p><u>Carlos III University</u> Antonio Lecuona lecuona@ing.uc3m.es</p>	Associated professor	Teaching of Energy and Environment Engineering Lay out and characteristics of renewable energy plants (wind and PV, both stand alone and grid connected). Definition of components. Evaluation of renewable energy resources. Connection to transmission or distribution grids. Solar thermal and photovoltaic technologies.
Dec 2005 – Jan 2006	Honduras	<p><u>European Commission</u> - SOFRECO</p> <p>Carlos Zamorano Carlos.zamorano@sofreco.com</p>	Team Leader	<p>Project title: Evaluación de Medio Término del Proyecto GAUREE 2 (Honduras)</p> <p>Project features: Mid - term evaluation of a multidisciplinary project devoted to rural electrification (stand - alone PV and small hydro in different areas), analysis and improvement of a distribution network. Energy efficiency measures in industrial and public buildings. Rural electrification (solar photovoltaic and small hydro). Improvement of distribution grids for electricity. Total project budget 6 M€.</p> <p>Activities performed: evaluation of activities carried out, timeliness, degree of satisfaction of</p>

				<p>beneficiaries. Discussions with stakeholders and energy authorities in Honduras</p> <p>Team of two members.</p> <p>One field mission.</p>
Sep 2003 – July 2005	Pamplona and Madrid (Spain)	<p>CENER (National Centre for Renewable Energy of Spain)</p> <p>Juan Ormazabal jormazabal@cener.com</p>	Technical Director	<p>Research, development and demonstration activities in the fields of renewable energy sources (photovoltaic, biomass and wind). Technical assistance to electricity generation units using renewable energy sources. Head of a team of 60 technicians and workers (interdisciplinary team covering technical and economic aspects of each technology). Scheduling, organising and supervision of team. Evaluation of renewable energy resources (wind, solar and biomass). Characterization of PV panels. Definition and supervision of PV projects (from 100 to 800 kW). Monitoring of existing grid-connected PV plants.</p>
June 2003 – Jan 2004	Hungary	<p>European Commission - BESEL, S.A (see above)</p>	Senior Energy Expert	<p>Europe Aid project. Assistance to the Hungarian Energy Authority related to EU legislation, regulatory issues and energy policies for use of renewable energy sources. Adequation of the Hungarian energy law to the EU acquis. Assessment in the field of connection of renewable energy plants to the grid; problems involved, voltage and frequency stability. EU-Twinning project.</p>
Nov 2001 – Aug 2003	Madrid, Spain	<p>EMVS (Empresa Municipal de la Vivienda y Suelo de Madrid)</p>	Senior Engineer	<p>Twinning project. Definition of installations for heating, cooling and warm water systems in multi-family dwellings using both conventional and renewable energy. Energy efficiency in buildings. Analysis of available renewable energy sources. Definition of back up natural gas fuelled systems to guarantee supply. Led a team composed by 6 technicians.</p>
March 2001	Mar del Plata (Argentina)	<p>DFID-EDEA (Empresa Distribuidora de Energía Atlántica)</p>	Senior External Consultant	<p>Assessment related to tariffs, power purchase agreements, supply options and DSM programs, including energy efficiency. Definition of standard contracts for purchases of power generated by independent power producers, using either conventional or renewable energy sources.</p>
April 2000 – Dec 2000	Romania	<p>European Commission - IDOM, S.A.</p>	Senior Electricity Expert	<p>Europe Aid project. Assistance to the Romanian Energy Authority. Elaboration of tariff methodologies for electricity and heat, including transmission, distribution, ancillary services, independent power producers and self-producers, end-users and splitting of costs between electricity and heat in cogeneration plants. Analysis and review of technical codes for transmission, distribution and connections for independent power producers. Preparation of</p>

				licensing procedures.
April 1999 –March 2000	Madrid, Spain	<u>Weder & Weather</u>	Technical Director	Managing and control of projects and build-up of cogeneration plants. Cogeneration plants of up to 500 kW. Leading, organising and supervision of a10 technicians team.
Feb – Dec 1979	Jülich (Germany)	<u>IEA/ KFA</u> (Forchungszentrum)	Collaborat or	MARKAL project. Impact analysis of the oil crises in the energy supply of IEA member countries. Evaluation of technical, economic and environmental characteristics of energy technologies and measures to improve energy efficiency. Project financed by the International Energy Agency.
Feb 1979 – Oct 1998	Madrid	<u>Unidad Eléctrica, S.A.</u> (UNESA)	Head of Technical Division	Analysis and definition of criteria for setting of tariffs for electricity in Spain. Analysis and continuous monitoring of the Spanish electricity supply system, including Canary and Balearic islands. Works related to the entire process of transition from the vertically integrated electric system in Spain to the creation of a liberalized market. Analysis of regulatory issues related to different types of electric markets, considering both natural monopolies (transmission and distribution) and activities subject to competition (generation and final supply to consumers). Follow up of electrical markets evolution in other IEA and Latin American countries through participation in international Working Groups and Committees. Analysis of different models of markets for electricity before the liberalization of the Spanish electric system. Analysis of regulatory issues relative to cross-border trade of electricity and high voltage transmission. Control of working groups on energy planning, new renewable technologies, refurbishment of thermal plants, role of electricity in the energy spectrum. Distribution networks.
1974 – 1978	Madrid	<u>Superior Technical School of Industrial Engineering</u>	Auxiliary Staff, Teacher	Teaching activities. Turbines, internal combustion engines and fluid mechanics. Work on performance improvement of internal combustion engines

15. Other relevant information (eg, Publications)

- Member (and co-ordinator) of several committees and working groups, both at national and international level. These committees studied various topics, such as photovoltaic energy, thermal generation, fuel cells, and competitiveness of energy technologies.

- Spanish representative in the Solar Photovoltaic Program of the International Energy Agency.
- Co-author of the MARKAL model for the International Energy Agency (IEA). This model was created to be used as a tool to mitigate the effects of the oil crises of 1973 and 1979, and its purpose was to perform econometric analysis of the most adequate ways to guarantee the energy supply of IEA member countries. The model was designed for use of different objective functions, such as minimise oil imports, minimise cost of energy supply, maximise use of renewable forms of energy, etc. as well as different combinations among them.
- Spanish representative in the IEA working team in charge of the “Energy after the Eighties” study, which analysed the future energy outlook for IEA member countries after the oil crises.
- Advisor at the IEA headquarters in Paris, collaborating in a study devoted to analyse the future evolution of the penetration rate of electricity in the global energy consumption of IEA member countries. The required analysis included an assessment on electricity final costs, covering all kinds of technologies for generation of electricity, as well as transmission and distribution costs and environmental advantages of electricity use, among other aspects.

Publications:

- Energy Technology Data Handbook. Vol. 1 (Conversion Technologies), January 1980. Jülich (Germany), Energy Technology Data Handbook. Vol. 2 (End-use Technologies), October 1980. Jülich, Energy Scenarios and Impact of New Technologies for Spain. April 1981. Jülich, Summary Report on Technology Characterizations. December 1982. Jülich, Energy After the Eighties. Elsevier, Amsterdam 1992, Environmental Impact of Energy Technologies, NOx Control Technologies. March 1993, Emissions of Trace Species by Coal-fired Power Plants in Europe. February 1997, Selective Catalytic Reduction. February 1997, Co-firing of Biomass and Waste with Coal. March 1997, The Effect of Coal Quality on NOx Emissions. April 1997, Gas Turbine Emissions. October 1997, Continuous Emission Monitoring in Power Stations and CHP Plants. October 1997, Analysis of Cost-efficient CO2 Reduction Options. Country Report for Spain. Karlsruhe, January 1991, Fuel Cells. State of the Art and Perspectives. 1993 y 1998. Spanish and English versions, Status Report on PV Power Applications in Spain. 1995 and 1997.

Suani Teixeira Coelho

1. Personal Information:

- **Brazilian, born in Rio de Janeiro, June 13, 1948.**
- **Female, divorced**
- **Son: Roberto Teixeira Coelho, 31 years old, architect and business administrator, married**
- **Daughter: Carolina Coelho Carvalho de Oliveira, 30 years old, lawyer, married. Grand son: Guilherme, 4 years old**
- **Home address: Alameda Joaquim Eugenio de Lima, 1250 ap 54 – Jardim Paulista – Sao Paulo – Capital – Brazil – Phones: +55-11-30912591 (com), +55-11-994937849 (mob), +55-11-38897439 (res); Fax +55-11-30912546**
- **E-mail: suani@iee.usp.br; suani27@hotmail.com**
- **Chemical engineer (1972) – Ph.D. on Energy (1999) – University of Sao Paulo, Brazil**

2. References:

- **Prof. Dr. Jose Goldemberg – Institute of Eletrotechnics and Energy – University of Sao Paulo – email goldemb@iee.usp.br**
- **Prof. Dr. Emilio L. La Rovere – Federal University of Rio de Janeiro – email emilio@ppe.ufrj.br**
- **Prof. Dr. Eric Larson – Princeton University – email el Larson@princeton.edu**
- **Prof. Dr. Andre Faaij – Utrecht University – email a.p.c.faaij@uu.nl**
- **Dr. Kandeh K. Yumkella – UNIDO – email k.yumkella@unido.org**
- **Dr. Lucas Assunção – UNCTAD – Geneve – email lucas.assuncao@unctad.org**

3. Current Position:

- **Professor/Lecturer at University of Sao Paulo - Energy Graduation Program of the University of Sao Paulo. Bioenergy – ENE 726 (since 2006).**

- Researcher/Thesis advisor at University of Sao Paulo - Energy Graduation Program of the University of Sao Paulo. Subjects: Bioenergy. Coordination of studies/researches on Bioenergy, Biofuels, Biofuels Sustainability. Since 2000
- Thesis Advisor at University of Sao Paulo – Doctor Degree Graduation Program on Bioenergy. Member of the Program Graduate Commission. Since 2012.

4. Academic Background:

- Ph.D. on Energy: University of São Paulo. Thesis subject: "Mechanisms for the Implementation of Biomass-origin Cogeneration. A proposal for São Paulo State". 1999. Special honor mention.
- M. Sc. on Energy: University of São Paulo. Thesis subject: "Technical and Economic Analysis of Cogeneration from Sugarcane Bagasse in Gasifier/Gas Turbine Systems". 1992. Special honor mention.
- Chemical Engineer (1972) – Special honor award.

5. Academic Activities

- Thesis (doctor and master) advisor – University of São Paulo – Brazil
- Lecturer on MBA courses at Polytechnic School – University of Sao Paulo on Renewable Energies. Subject: “Biogas, bioenergy and bio digesters”.
- Thesis advisor:
 - Doctor Degree: 3 candidate students (under development)
 - Master Degree: 4 candidate students (under development)
 - 17 students graduate since 2006

6. Former positions

Deputy Secretary - State Secretariat for the Environment of São Paulo State (2003 - 2006). Official representation of the State Secretary and of the State Governor, when required, as well as general advisory to the State Secretary. Coordination of the international agreements of the State Secretariat (cooperation with Bavaria State, Germany, on renewable energies and solid waste; cooperation with California State, US, on climate change and energy efficiency, among others). General coordination of technical commissions on policies for the sustainable development of the State of Sao Paulo.

Member of the United Nations Secretary Advisory Group on Energy and Climate Change (2008-2011)

Reviewer of World Energy Assessment - Overview to Energy and the Challenge of Sustainability, the World Energy Assessment. Published in 2000 – Overview. 2004 update. UNDP/UNDESA/WEC, 2004 ISBN: 92-1-126167-8

Reviewer of World Energy Outlook – IEA

Reviewer of IRENA – International Renewable Energy Agency

Lecturer – Engineering School – Armando Alvares Penteado Foundation – Thermodynamics (1972 – 2002)

7. Professional Activities

7.1. Activities developed for UN institutions:

- Coordinator of the Mid Term Review of the Cogen for Africa GEF/UNEP Project (2011)
- **UN Secretary General AGECC** – member of the AGECC – United Nations Secretary General Advisory Group on Energy and Climate Change - member of the Working Group on Bioenergy (2009-2011)
- **GNESD “Global Network on Energy for Sustainable Development” (co-funded by UNEP)** – www.gnesd.org. Joint coordination of Brazilian team – CENBIO/USP – CENTROCLIMA/UFRJ since 2002. Studies developed on Energy Access, Renewable Energy Technologies, Bioenergy
- **UN – Habitat - “Enhancing Access to Modern Energy Options for Poor Urban Settlements”**. Report on *Expert Group Meeting on Modern Energy Access for Poor Urban Settlements*. UN-Habitat, Nairobi, Kenya, 4-6 December, 2006
- **UNCTAD** – Elaboration of the study “Biofuels – Advantages and Trade Barriers” (2005). Presentation of the results at *UNCTAD Expert Meeting for Sectoral Trade Review of Developing Country Participation in New and Dynamic Sectors*. Session on Biofuels. UN, Geneva, Switzerland, 7-9 February, 2005

7.2. Published Books / Chapters:

- COELHO, S.T., GRISOLI, R., STRAPASSON, A., LUCON, O., FERREIRA, D., GORREN, R. "Sustentabilidade Ambiental dos Biocombustíveis" (Cap 10). In *Biocombustíveis no Brasil: fundamentos e perspectivas*. C.A. Perlingeiro (ed). ANP (Agencia Nacional de Petróleo, Gas e Biocombustíveis). 2014
- GORREN, R., COELHO, S.T., GRISOLI, R., STRAPASSON, A., LUCON, O., FERREIRA, D., "Sustentabilidade Social dos Biocombustíveis" (Cap 11). In *Biocombustíveis no Brasil: fundamentos e perspectivas*. C.A. Perlingeiro (ed). ANP (Agencia Nacional de Petróleo, Gas e Biocombustíveis). 2014
- PECORA, V. G.; COELHO, S. T.; CORTEZ, C. L. "Unidades de Produção de Biogás no Brasil e América Latina – Conversão de Biogás em Eletricidade: Projetos do CENBIO/IEE/USP". In: *Biogás – Energia Renovável e Sustentabilidade*. UFFS – Universidade Federal da Fronteira Sul. Dreger, I. & Coelho, G. C. (eds.), UFFS, Chapecó. In press.
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- GOLDEMBERG, J., COELHO, S. T., NASTARI, P.M., GUARDABASSI, P. Production and supply logistics of sugarcane as an energy feedstock. In: *Sustainable Bioenergy Production*. (Wang, ed.). Taylor & Francis Group. 2013
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- ROGNER, H.; ROY, J.; SCHOCK, R. N.; SIMS, R.;(2013) Global Energy Assessment (GEA) - Toward a Sustainable Future (Summary Booklet): Key Findings, Summary for Policymakers, Technical Summary. Cambridge: Cambridge University Press.
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 - COELHO, S. T., GUARDABASSI, P. (2013) "Brazil: Ethanol". In Sustainable Development of Biofuels in Latin America and the Caribbean. Barry Solomon, Robert Bailis (ed), Michigan Technological University. Springer. ISBN 978-1-4614-9274-0. Pg 71-101. 252 pg. UK
 - COELHO, S. T.; AGBENYEGA, O.; AGOSTINI, A.; ERB, K.; HABERL, H.; HOOGWIJK, M.; LAL, R.; LUCON, O.; MASERA, O.; MOREIRA, J. R. (2013). Land and Water. Linkages to Bioenergy. In: Global Energy Assessment (Davis, G., Goldemberg, J., orgs). International Institute for Applied Systems Analysis and Cambridge University Press. Vienna, 2013, v. 1, p. 1459-1525.
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 - COELHO, S. T. Biomassa como fonte de energia. In: PALETTA, F. C.; GOLDEMBERG, J. (orgs.). Energias renováveis. São Paulo. Ed. Blücher, 2012, v. 1, p. 23-32.
 - COELHO, S. T.; GORREN, R.; GUARDABASSI, P.; GRISOLI, R. P. S.; GOLDEMBERG, J.. Bioethanol from Sugar - The Brazilian Experience. In: MEYERS, Robert A. (Org.). Encyclopedia of Sustainability Science and Technology. Springer, 2011. Available on: <<http://www.springerreference.com>>.
 - REN 21 - Renewable Global Status Report 2010-2014. International Energy Agency. (Contributor)
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 - COELHO, S. T., GOLDEMBERG, J., BRIGHENTI, C., GUARDABASSI, P. Renewable Energy Sources and Biofuels: The Case of Ethanol in Brazil (2010). Geographische Rundschau. ISSN 1860-7098. Ed. Bildungshaus Schulbuchverlage Westermann. Braunschweig, Germany. V. 6. Series 4. Pg 22 - 27
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- ALVES SOBRINHO, E. J. M.; FELDMANN, F.; GOLDEMBERG, J.; MACEDO, L.V.; BIDERMAN, R.; COELHO, S. T.; STEINBAUM, V.; Municipal Secretariat for Health; Municipal Secretariat for Green and the Environment; Municipal Secretariat for Assistance and Social Development; UNEP. Projeto Ambientes Verdes e Saudáveis. 2009.
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- GOLDEMBERG, J.; COELHO, S. T.; PECORA, V. "Perspectivas da utilização de biogás como fonte de energia". In: Omar L. de Barros Filho; Sylvia Bojunga. (Org.). Potência Brasil: gás natural, energia limpa para um futuro sustentável. Porto Alegre: Laser Press Comunicação, 2008
- COELHO, S. T.; REI, F.; MARTINS, O. S.; LUCON, O.; GUARDABASSI, P. "National Climate-friendly Governance Proposals for Developing Countries". In: Velma I. Grover. (Org.). Global warming and climate change: ten years after Kyoto and still counting. Science Publishers, 2008, v. 1, p. 473-492.
- COELHO, S. T.; GUARDABASSI, P.; LORA, B. A.; MONTEIRO, M. B. C. A.; GORREN, R. "A sustentabilidade da expansão da cultura canavieira". In: Marcos Pimentel Bicalho; Eduardo Alcântara Vasconcellos; Laura Lucia Vieira Ceneviva. (Org.). Série Cadernos Técnicos - Transporte e meio ambiente.: ANTP / BNDES, 2007, v. 6, p. 146-152.
- KAREKESI, S.; LATA, K.; COELHO, S. T. "Traditional Biomass Energy: Improving Its Use and Moving to Modern Energy Use". In: Dirk Abmann, Ulrich Laumanns; Dieter Uh. (Org.). Renewable Energy - A Global Review of Technologies, Policies and Markets. 1 ed. London: Earthscan, 2006, p. 231-261.
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- COELHO, S. T., GOLDEMBERG, J., CORTEZ, L. A. B., MACEDO, I. C., MOREIRA, J. R., PALETTA, C. E., WALTER, A.C, BRAUNBECK, O., HOFFMANN, R., PRETZ, R. "Geração de Energia a partir da Biomassa". In: Fontes Renováveis de Energia no Brasil, Rio de Janeiro. Editora Interciência Ltda., 2003, p. 1-90.
- TURKENBURG, W., COELHO, S.T. et al., Chapter 7 - "Renewable Energy Technologies" at "World Energy Assessment – Energy and the Challenge of Sustainability", UNDP/UNDESA/World Energy Council, J. Goldemberg and T. Johansson (eds.) ISBN-92-1-126126-0. New York, 2000, p. 219-272
- COELHO, S.T. (ed.), "Medidas Mitigadoras para Gases Efeito Estufa na Geração Termelétrica no Brasil", ANEEL (The Brazilian Regulatory Agency on Electricity), Brasília, 2000.

7.3. More recent papers published in international journals:

- COELHO, S.T., GOLDEMBERG, J. Energy Access: lessons learned in Brazil and perspectives for replication in other developing countries. Energy Policy 61 (2013) 1088–1096
- CASTANHEIRA, E., COELHO, S. et al., Environmental sustainability of biodiesel in Brazil. Energy Policy (2013), Available at <http://dx.doi.org/10.1016/j.enpol.2013.09.062i>

7.4. More than 60 technical papers in scientific publications, including national and international seminars, congresses and conferences

7.5. Participation on more than 100 International Seminars/Conferences in different countries and in Brazil

7.6. Main Projects under development (Coordination):

- *"Avaliação da Sustentabilidade Ambiental de Bioenergia Através da Avaliação do Ciclo de Vida". Joint Project with Coimbra University. Funded by FCT/CAPES. 2013-2015*
- *ECOPA Project – FAPESP 2012/51466-7 – "Evolução dos padrões de consumo, convergência econômica e pegada do carbono do desenvolvimento. Uma comparação Brasil-França / Evolution des modes de consommation, convergence économique et empreinte carbone du développement. Une comparaison Brésil – France". Joint Project with CIREN, France. 2013-2016*
- *"Aplicação dos indicadores de sustentabilidade do Global Bioenergy Partnership (GBEP) em usinas de açúcar e álcool do estado de São Paulo". Funded by Forum of the Americas (Government of Italy). 2014-2015.*

7.7. Other main research areas:

- Efficient technologies for energy conversion of biogas from vinasse in ethanol mills in Brazil
- Woody biomass for sustainable pellets production in Brazil
- Efficient technologies for energy conversion of urban solid waste in Brazil for large cities and small municipalities- waste to energy/small scale gasification systems
- Energy conversion of biogas from industrial effluents and animal waste
- Energy production in small isolated communities using biomass – based system: biomass small scale gasification – in natura vegetable oils
- Sustainability of biodiesel in Brazil

7.8. Previous Projects Coordination:

- *“PROJETO 558733/2010-7. BIOACV - Comparação da ACV de Biodiesel produzido a partir de Óleo de Soja e Gordura Bovina via rota Metélica e Etélica”*. Funded by CNPq. 2011-2013 Joint Project with Coimbra University and Polytechnic School of University of São Paulo
- *“Avaliação de Ciclo de Vida (ACV) Comparativa entre Tecnologias de Aproveitamento Energético de Resíduos Sólidos”*. P&D project funded by EMAE / ANEEL N. 0393-00611. Joint Project with Coimbra University and Polytechnic School of University of São Paulo 2011-2013
- *“Possibilities of sustainable wood production increase in sustainably produced wood energy and the impact on developing and emerging countries”*. Joint project with IINAS – International Institute for Sustainability Analysis and Strategy (Germany). 2013
- *“Biofuels Assessment on Technical Opportunities and Research Needs for Latin America”*. Coordination of Brazilian participation on BIOTOP. Funded by FP-7 European Community) - www.top-biofuel.org. 2010
- *Atlas of Bioenergy*. Georeferenced evaluation of biomass potential for electricity production in municipalities in Brazil. Funded by Ministry of Mining and Energy. 2009-2012.
- *“Levantamento georreferenciado de resíduos da cana-de-açúcar em potencial no país, visando à sua utilização para produção de álcool combustível através da tecnologia de hidrólise enzimática”* (Georeferenced assessment of sugarcane residues in potential in the country, aiming at its use for ethanol fuel production through enzymatic hydrolysis technology). Funded by Petrobras. 2007-2010.
- *“BIOETANOL - Produção de Etanol via Hidrólise Enzimática da Biomassa de Cana-de-Açúcar”* (Ethanol Production via Enzymatic Hydrolysis of the Sugarcane Biomass). Funded by Studies and Projects Funding Body (FINEP – Financiadora de Estudos e Projetos – Ministério de Ciência e Tecnologia); 2005-2010.
- *“BIOGÁS DE ATERRO - Aproveitamento do Biogás Proveniente do Tratamento de Resíduos Sólidos Urbanos para Geração de Energia Elétrica e Iluminação a Gás”* (Landfill biogas - Landfill Biogas Use for

Electric Energy Generation and Lighting by Direct Burning). Funded by Ministry of Mines and Energy, 2006-2011.

- “*Fortalecimento Institucional do CENBIO II*” (CENBIO Institutional Strengthening II). Funded by Ministry of Mines and Energy, 2009-current.
- “*GASEIBRAS - Nacionalização da Tecnologia de Gaseificação de Biomassa e Formação de Recursos Humanos na Região Norte*” (Nationalization of biomass gasification technology and capacity building in Northern region). Funded by Ministry of Mines and Energy /CNPq, 2005-2006.
- “*PROVENAT - Usar o óleo de palma como um combustível alternativo aos motores diesel convencionais em comunidades isoladas da Região Amazônica*” (Use of palm oil as an alternative fuel to conventional diesel engines in isolated communities in Amazon Region). Funded by Ministry of Mines and Energy /CNPq, 2004-2006.
- “*ENERMAD - Implementação de uma central termoelétrica de até 200kW a partir do aproveitamento de resíduos de madeira sustentável, dentro de um reserva extrativista estadual localizada na Região Norte do País*” (Implementation of a 200kW thermo-power plant fuelled with sustainable wood residues, in Brazil’s Northern region). Funded by Ministry of Mines and Energy /CNPq, 2005-2006.
- “*Projeto CENP - Geração de Energia a partir de óleo de Mamona no Estado do Ceará*” (Energy generation based on castor oil in Ceará State) Funded by: CONSÓRCIO CENP (CGE - Ceará Geradora de Energia/PARANAMERIM ENERGIA S/A / CUMMINS BRASIL LTDA/ ENGEBRA - Empresa de Energia Elétrica do Brasil Ltda). 2003 / 2004
- “*PROVEGAM - Geração de eletricidade a partir de óleos vegetais na Amazônia*” (Electricity production from in natura vegetable oils in Amazon), University of São Paulo. Funded by FINEP/CT-ENERG /Ministry of Science and Technology, 2002-2004
- “*GASEIFAMAZ - Geração de eletricidade para comunidades isoladas usando sistemas de gaseificação de biomassa de pequeno porte*” (Electricity production in remote villages through small scale biomass gasifiers), University of São Paulo. Funded by FINEP/CT-ENERG / Ministry of Science and Technology, 2002-2004
- “*ENERBIOG - Geração de eletricidade a partir de biogás resultante do tratamento de esgoto*” (Electricity production using biogas from sewage treatment). University of São Paulo. Funded by FINEP / CT-ENERG/ Ministry of Science and Technology and SABESP/State Company for Water and Liquid Effluents Treatment, 2002-2004.
- “*Aperfeiçoamento nos processos de geração de eletricidade a partir da biomassa no Brasil*”. (Improvement of Electricity Generation Processes from Biomass in Brazil), University of São Paulo. Several studies. Funded by Winrock Foundation/USAID (US). 1999-2005.
- “*PUREFA - Programa de Uso Racional de Energia e Fontes Alternativas*” (Program for Efficient Energy Use and Alternative Sources), University of São Paulo. Funded by FINEP / CT-ENERG/ Ministry of Science and Technology, 2003-2004.
- “*Análise Econômico-Financeira do Potencial de Biomassa para Geração de Eletricidade em Salinas-Minas Gerais*” (Economic-financial analysis of

Biomass Potential for Electricity Production at Salinas, Minas Gerais State). Funded by CEMIG/MG (state owned utility), 2002.

- “Atlas de Biomassa” (Biomass Assessment). Funded by ANEEL (Brazilian Regulatory Agency for Electricity), 2002.
- “Projeto de Referência para a Utilização de Energias Renováveis na Amazônia” (Reference Project for Renewable Energy Use in Amazon). Funded by ANEEL, 1999/2000.
- “Identification of Opportunities for the Transfer of Biomass Technologies”, joint project Brazil, Zimbabwe e China, sponsored by Netherlands Energy Research Foundation/European Union (2000/2001)
- “Levantamento do Potencial de Absorção de Carbono nas Plantações de Palma na Amazônia” (Assessment of Potential of Carbon Absorption in Brazilian Palm Plantations). April, 2000.
- “Implementação de Projetos Conjuntos Brasil-União Européia para Geração de Eletricidade a partir de Biomassa” (Implementation of Joint Projects Brazil-European Union from Biomass), developed by CENBIO/USP jointly with CEEETA, Portugal, funded by the European Union.

6. Languages:

- English – fluency (speaking, reading, writing)
- French – fluency (speaking, reading, writing)
- Italian – fluency (speaking, reading)
- Spanish – fluency (speaking, reading)
- Portuguese – mother language

São Paulo, October 2014.