

**UNITED NATIONS ENVIRONMENT PROGRAMME
GLOBAL ENVIRONMENT FACILITY (GEF)**

PROJECT DOCUMENT

SECTION 1 – PROJECT IDENTIFICATION

1.1 Title of Sub-Programme:	Latin America and Caribbean Region	
1.2 Title of Project:	Generation and Delivery of Renewable Energy Based Modern Energy Service; the Case of Isla de la Juventud	
1.3 Project Number:	PMS: 5024 IMIS: GFL-2328-2721-	
1.4 Geographical Scope:	Cuba – Isla de la Juventud	
1.5 Implementation:	External: UNIDO	
1.6 Duration of the Project:	6 years	
	Commencing:	March 2005
	Completion:	December 2010
1.7 Total Cost:	US\$ (million)	
GEF financing:	Full Project	US \$ 5.337 ¹
Co-financing	Government of Cuba	US \$ 1.624
	Private Sector Investors	US \$ 8.660
	UNIDO	US \$ 0.170
	UNEP	US \$ 0.050
	ADEME ²	US \$ 0.200
	Subtotal Co-Financing	US \$ 10.704
Total Cost of Full Size Project	US\$ 16. 041³	

1.8 Project Summary

The overall 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 addresses 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 promotes business models for

¹ GEF financing for PDF-B was US\$ 325,000 provided directly to UNIDO by GEF. Total GEF financing for the project including the PDF-B is US \$ 5.662 million.

² ADEME (French Agency for the Environment and Energy Management) has confirmed to collaborate and co-finance the project activities to the tune of about \$ 200,000, especially concerning with feasibility studies and operationalization of the financial mechanisms proposed in the project.

³ Total project cost including GEF financing for the PDF-B is US\$ 16.366 million

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 presents a priority opportunity for a GEF intervention to support renewable energy technologies.

The project would adopt 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 help in creating 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 – the Centre for Management of Priority Programmes and Projects (GEPROP) 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.

The project will 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 will 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.

SIGNATURES:

For: UNIDO

For: UNEP, Nairobi

.....
Mr. Abel J.J. Rwendeire
Managing Director
Programme Development and Technical
Cooperation Division

.....
Mr. S. Kurdjukov
Officer-in Charge,
Budget and Financial Management Service

Date:

Date:

SECTION 2 - BACKGROUND AND PROJECT IMPLEMENTATION
UNITED NATIONS ENVIRONMENT PROGRAMME
GLOBAL ENVIRONMENT FACILITY

PROPOSAL FOR FULL PROJECT GRANT

Region / Countries: Cuba
Project Title: Generation and Delivery of Renewable Energy Based Modern Energy Services in Cuba; the Case of Isla de la Juventud
Focal Area: Climate Change
Implementing Agency: UNEP
Executing Agency: UNIDO
National Counterparts: GEPROP⁴
Total Project Cost: US \$ 16.366 million (GEF grant US \$ 5.337 million, PDF B Grant US \$ 0.325 million, and US \$ 10.704 million co-financing)
Brief Description:

Financial, institutional, technical, information and human resource barriers hamper the increased use of renewable energy sources in isolated areas in Cuba. Currently in Isla de la Juventud, the second largest island outside the main island of Cuba as with many islands and developing countries, diesel based power and heat generation is common. Isla de la Juventud has used Independent Power Producers (IPPs) since 1998 to increase diesel power generation capacity. The main objective of the project is to reduce energy-related CO₂ emissions through barrier removal and promotion of environmentally sound renewable energy technologies for power generation and process heat. Establishment of commercial business models will be undertaken to deploy renewable technologies for providing modern energy services on the Island and their replication in the region under like conditions.

The project will address barriers to the development of renewable energy based power and heat generation through technical assistance and softening of finance in order to achieve attractive initial conditions for wind power and biomass gasification technology markets. Replications of the RET IPP concept in Cuba will be directly supported through a shared risk project development fund and replication in other appropriate countries through dissemination activities. Without these barrier removal activities, diesel will certainly retain the largest market share and even with this project, a major threat to broad market expansion will be the absence of environmental costs (local and global) in fossil fuel pricing.

The Isla de la Juventud – as a remote supply area in Cuba – presents a relatively high avoided cost of fossil fuel opportunity and one that already has used independent power producer arrangements for diesel power generation. The PDF-B phase identified, evaluated and designed activities to reduce/remove barriers and demonstrate business models encouraging investment and incentive based management within the local institutions and physical conditions. The island represents a more cost effective opportunity or niche market to introduce the RET IPP arrangement, wind farm and biomass technologies, and would have a favourable influence on other projects in Cuba and the region.

Removal of barriers constraining the wide spread use of renewable energy technologies (Biomass and Wind) would be achieved through demonstration of business models on Isla de la Juventud. The wind farm demonstration would join a growing pool of (>1MW) experience in the region (Guadeloupe on line, Dominican Republic in development) with the issue of grid stability in small island networks being of key interest. The Biomass gasifier technology is considered an emerging technology with the largest commercially operated plant in India at 750 kW. The potential for replication is partly constrained by the ability to sustainably produce suitable biomass at low cost. Integrated management of the biomass resource and ecosystem would be used, and can result in carbon sequestration benefits.

⁴ GEPROP - The Centre for Management of Priority Programmes and Projects coordinates research and development efforts in international projects in Cuba.

Since local forests will provide biomass needed for the business model on power generation, the project will introduce mandatory certification standards for sustainable forestry management on the Isla de la Juventud. The local employment benefits and the ability to provide dispatchable power at Kw to Mw scale become very attractive especially if the cost to produce electricity drops below 7 cents per kwh.

The adoption of the risk sharing mechanism by Cuba and other bilateral donors 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 mainland in 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 is most effectively addressed by the risk sharing mechanism, but dissemination efforts within institutions and to private sector actors in the market will be important as well. The economics are more difficult on the main island generally, and hence would require policy and targeted incentives support from the Government. The sugar bagasse as fuel with sugar refinery and ethanol production processes, as cogeneration uses are more viable opportunities but experiencing difficulty in the current fluctuating sugar markets. In the region/Small Island States, a broad general information dissemination strategy will be used to ensure that the information becomes available to those interested. A replication and information strategy to promote renewable energy technologies in the region will include caribbean islands where woody biomass harvest or agriculture residues are of interest, and would include Central America as well. Afforestation may be possible in some cases but the technology would not be promoted to islands without a woody biomass resource potential. Cuba, Belise and Guyana are part of the CARICOM project and the dissemination effort will also reach out to Central America where biomass technology and wind energy are of significant interest.

Wind energy and small island electrical infrastructure is a commonality that can be pursued for replication. Integration of intermittent wind energy to smaller weaker electric grid structures is an issue attracting significant attention. Regional wind energy dissemination will be effected through various activities and events. The UNEP/GEF SWERA project has received new additional Dutch Partnership funding to expand and enhance the effort. Dominican Republic and Belize have been identified already. UNIDO is initiating RET promotion efforts in the Lesser Antilles with UN Foundation support. Guadeloupe has geothermal, wind and waste incineration power and the French regional council has an interest in promoting cleaner technologies in the region. Dissemination is the mechanism for reinforcement of replication, and would seek or generate regional events to target the largest audience. Two conferences/meetings are proposed – Cuba and Guadeloupe or Guatemala. Central America has been identified as a good replication potential and some activities will be directed there.

For the GEF, UNEP is the Implementing Agency, which will oversee the successful achievement of the project objectives, while UNIDO will execute the project activities. The national counterpart agency will be the Centre for Management of Priority Programmes and Projects (GEPROP) under the Ministry of Science, Technology and Environment, Government of Cuba. Compañía Fiduciaria⁵ – a national level financial and banking company will play an important role in managing the innovative funding mechanism (RRMF) in the project. Initial discussions with bilateral partners indicated that the funding as well as technical support from them is likely come into play as well. Ongoing consultations with bilateral agencies to join hands in strengthening new and innovative financial mechanisms have started yielding results. ADEME (French Agency for the Environment and Energy Management) has now confirmed to collaborate and co-finance the project activities to the tune of about \$ 200,000, especially concerning the operationalization of the financial mechanisms including capacity building proposed in the project. New funding so received will be used to undertake feasibility studies, and to expand the investment volume for large-scale replication.

⁵ Compañía Fiduciaria – a national level financial company has been created under the restructuring programme to manage innovative funding mechanisms in Cuba.

LIST OF ACRONYMS/ABBREVIATIONS

ADEME	French Agency for the Environment and Energy Management
ALASTOR	The Cuban national company dealing with installation and operation of boilers
BOT	Build Operate Transfer
CARICOM	Caribbean Community
COMECON	The Council for Mutual Economic Cooperation.
CITMA	Ministerio de Ciencia, Tecnología y Medio Ambiente
EFI	Empresa Forestal Integral de la Isla de la Juventud, local forestry company
GEAM	Grupo Empresarial de Agricultura de Montaña, national forestry organization
GEF	Global Environment Facility
GEPROP	The Centre for Management of Priority Programmes and Projects
GHG	Greenhouse Gas
GoC	Government of Cuba
IIF	Instituto de Investigaciones Forestales
INEL	Instituto Nacional de Electricidad
MEP	Ministry for Economic and Planning, Cuba
MINBAS	Ministerio de Industria Básica
MINVEC	Ministerio de Inversiones Extranjeras y Colaboración
MW	Megawatt
OBE	Organización Básica de la Isla de la Juventud, Local Electricity Utility
O & M	Operations and Maintenance
PDA	Project Development Agreement
PFC	Power Finance Corporation
PIR	Project Implementation Review
PPA	Power Purchase Agreement
RRM Fund	Risk and Replication Management Fund
SIME	Ministerio de la Sideromecánica
UNEP	United Nations Environment Programme
UNDP	United Nations Development Programme
UNE	Unión Nacional Eléctrica, national electricity utility
UNFCCC	United Nations Framework Convention on Climate Change
UNIDO	United Nations Industrial Development Organization
WASP	Risoe Wind Atlas Assessment and Analysis Programme

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G2: Additional Biomass Assessment Info
H: Cocodrilo
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J: Monitoring and Evaluation Structure
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A: Terms of Reference Project Coordinator and Technical Expert
B: Terms of Reference for the Project Steering Committee

ANNEX 10

1. BACKGROUND AND CONTEXT

1.1 *Country Context*

1. 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.

2. 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 percent of Cuba's electricity generation capacity was oil-fired. Currently, Cuba produces 50 percent 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 tariff for the household sector and agriculture is highly subsidized by the Government while export earning industries face full cost tariffs.

3. 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.

4. 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 tonnes annually (with an additional national production of nearly 3 million tonnes)⁶.

5. 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.

6. The critical importance of fossil fuels for Cuban electricity sector can be appreciated in details given at Table 1.

Table 1
Installed Capacity and Generation in the National Electric System (NES) of Cuba, 2001

Source	Installed capacity, MW	Generation, GWh	Percentage of Total Generation
Fuel-oil	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%

Source: CITMA, Ministerio de Ciencia, Tecnologia y Medio Ambiente, 2002.

⁶ David Perez, Cuba Energia, CITMA, Ministerio de Ciencia, Tecnologia y Medio Ambiente, 2002.

National Energy Policy and Institutions

7. The national energy agenda in Cuba is spread over several ministries and institutions. The Ministry for Economic and Planning (MEP) is overall in-charge of evaluating short, medium and long-term energy demand for the country and to allocate the economic resources needed to guarantee energy supply. The MEP also identifies opportunities and potential actions to improve the efficiency of energy use in the country. The Minister for Economy and Planning heads the energy advisory body at the national level (National Energy Council) that oversees national policy planning for energy sector in Cuba.

8. The Ministry of Basic Industry (MINBAS) is in charge of the power and petroleum companies, and manages the national programmes for electricity and fuel saving. MINBAS also oversees the working of Union Eléctrica (UNE), the national utility responsible for the electricity grid that covers 95% of the country. UNE is the main institution for the production, transmission and distribution of electricity in Cuba, and has been entrusted with the responsibility of signing the power purchase agreements with private power generating units and supporting innovative schemes that would promote self-sufficiency in energy sector and reduce dependence on oil imports. Organización Básica Eléctrica de la Isla de la Juventud (OBE) is the organisation under Union Eléctrica, which has the mission to provide for generation and distribution of electricity at the Isla de la Juventud.

9. The Ministry for Science Technology and Environment (CITMA) is the GEF focal point ministry, and also looks after renewable energy development in Cuba. CITMA also manages the national R&D programme to support the sustainable energy programmes for the country, and oversees working of the Centre for Management of Priority Programmes and Projects (GEPROP) which coordinates research and development efforts in international projects, and works with various multi/bi-lateral agencies to support business models in sustainable development for renewable energy technologies, agriculture and other industries in Cuba.

10. The development of specific renewable energy sources is decentralized to several Agencies and Ministries: for instance, hydropower technologies are dealt by the National Institute of Water Resources, wind and solar technologies are coordinated by the Ministry for Informatics and Communication, the use of sugar cane residues for power generation is dealt by the Ministry of Sugar Industry, and the development of forestry resources is looked after by the Agriculture Ministry. Instituto de Investigaciones Forestales (IIF) is an organisation belonging to the Ministry of Agriculture, which has the mandate to develop and preserve forest resources of the country. ALASTOR, a company under the Ministry of the Heavy Industry, specialises in thermal energy technologies. It also looks after the design, construction and maintenance of thermal facilities throughout Cuba.

11. Given the general shortage of fossil fuels in the country, exploring alternative sources of energy has been accorded high priority by the Government. In 1993, the National Parliament approved the National Energy Sources Development Programme where the efficient use of the country's natural resources (biomass, wind, solar, hydro) for the production of energy has been accorded a priority in terms of development efforts. In October 2002, the Government of Cuba decided to create a Commission for the Development of Renewable Energy which is an inter-ministerial body coordinated by the Ministry for Science, Technology and Environment (CITMA/GEPROP). The main mission of this apex body is to coordinate national efforts to increase the share of the renewable energy sources in the national energy balance.

12. The Cuban Government is promoting foreign investment in the electric power generation sector where capital and technological innovations are most needed. Various forms of economic associations and entities, such as joint ventures, have been set up for this purpose.

13. The legal conditions for foreign investment have been spelled out under Law 77 on Foreign Investment published in September 1995. Furthermore, Article 23 of the Constitutional Reform Law approved in July 1992 stipulates that the Government will respect the property of the joint ventures and other economic associations set up under the law.

14. GENPOWER⁷ is the first private independent power producer which has been allowed by the Government of Cuba to produce power based on fuel-oil on the Isla de la Juventud under a power purchase agreement (BOT arrangements), and supply the same to OBE for distribution.

15. Although at present the overall environment is conducive for foreign investment in the fossil-fuel based power sector, national policies to promote power generation based on renewable energy technologies by private sector are still evolving. There is an urgent need to strengthen policy, institutional and market linkages, and to build capacity of local/national institutions to finance, operate and maintain renewable energy systems for successful implementation of future renewable energy based power generation programmes.

Linkage to Ongoing Projects and Programmes

16. Currently, in Cuba as well as in the Caribbean region, a number of renewable energy based projects and activities funded by GEF and other agencies are under implementation. The proposed RE IJ (Renewable Energy on Isla de la Juventud) project has been designed to complement activities of other ongoing projects/programmes, and to build synergies with them. Lessons learned from other important climate change projects will be taken into account while implementing the project activities to avoid duplication, and also to establish close linkages with the ongoing initiatives to make full use of their results, complement their activities and to develop synergies to maximize the impact.

17. A brief description of the important energy projects, which are ongoing in Cuba as well as in the region, and have relevance to the proposed project, is as follows:

18. **UNDP/GEF Enabling Activity Project - National Communications to the UNFCCC:** Government of Cuba under a UNDP/GEF Enabling Activity project is preparing national communications to UNFCCC. This project, which was approved in 1998, is assisting the Government of Cuba to comply with the provisions of the UNFCCC.

19. As highlighted in the First National Communication Report for Cuba, starting from the projections on the economic evolution for the coming years (increase of the gross domestic product in 4-6 % annually), it has been estimated that, if the carbon intensity levels and GDP are considered to be similar to those of 1990 and mitigation measures are not adopted, the gross emissions level would ascend to about 81.3 MMt for the year 2020. An emission scenario for Cuba for the year 2020, taking into consideration the reduction of the energy intensity reached in these years and without including mitigation actions, presumes a gross emissions level in the order of 70.8 MMt of carbon (a reduction in 10.5 MMt with regard to the previous projection). Therefore, it can be affirmed that the measures adopted in the 1990's, although they were not aimed at the mitigation of climate change, presuppose an important contribution to the reduction of emissions. The mitigation study carried out during 1999 and the outlook in the progression of economy, allow to estimating that the levels of gross emissions in the year 1990 will be reached and surpassed approximately between 2005 and 2010. The onset of 26 mitigation options designed and evaluated in this stage represents a mitigation potential of about 230 MMt of carbon in the period comprised between 1999

⁷ Gen Power is a fully private incorporated company registered in Panama, which set up a new modern power plant (3 units of 3.5 MW MAN modern generators each that use light fuel oil as fuel with a specific consumption of 220 g/kWh) to meet the growing electricity needs of the Isla de la Juventud. The contract for the investment in power sector was signed under the BOT arrangements in 1998-99 that made it the first 100% foreign private investment in the power sector in Cuba. Contract obligations have since been successfully met by both parties, and the contract will be renegotiated in 2004.

and 2030. This figure constitutes only a part of the total mitigation potential, which could be higher in Cuba. A first approach to the economic evaluation demonstrates that parts of the measures are those known as “no regret” options. However, they confront important limitations for their implementation from the financing point of view and due to the insufficient knowledge, experience and mastering of financing mechanisms and sources.

20. The proposed RE IJ project has benefited from the information already made available under the first national communication report, especially from the details given on GHGs emission sources and abatement options, and would strive to achieve synergies by exchanging information on the project activities on regular basis.

21. UNDP/GEF project – Co-generation of Electricity and Steam Using Sugarcane Bagasse and Trash: This project aims at reducing Cuba’s energy-related CO₂-emissions by removing barriers to the substitution of fuel oil in power and steam co-generation by using sugarcane bagasse and trash on the main island. This will be achieved by demonstrating the technical, economic and financial viability to establish companies in the vicinity of sugar mills to co-generate steam and power by using biomass-fired high-pressure condensing-extraction steam turbine technology. In the medium-term, it is estimated that some 3,000 GWh/yr of additional biomass-based power can be supplied to the grid thus reducing annual carbon emissions by over 600,000 tonnes. The large amount of co-financing required for the project is being sought.

22. By comparison, the proposed RE IJ project will focus on a smaller island - Isla de la Juventud, and would address barriers to the commercial sustainability of renewable energy technologies such as biomass gasifiers and wind farm in this nearer term commercially viable market niche.

23. UNEP/GEF SWERA Project: The Solar and Wind Energy Resource Assessment: SWERA is a global UNEP/GEF project. The project has been designed to compile solar and wind energy resource data in 13 developing countries, and to facilitate investments in solar and wind energy projects. Through a network of international and national agencies collecting and analysing data on solar and wind energy resources, SWERA is creating a global archive of this information as well as a technical review service that can help developing countries to assess their own national resources. Cuba is one of the SWERA partner countries.

24. The proposed RE IJ project has benefited from the SWERA project by way of compilation and validation of field data on wind resources on Isla de la Juventud. The SWERA wind assessment training component provided technical support through Risoe Laboratory, Denmark to the proposed RE IJ project during the PDF phase activities. US NREL, State University of New York and INPE Brazil are continuing to support the solar and wind energy planning components of SWERA for Cuba. As a partial outcome of the SWERA activities, UNEP wishes to ensure the success of the RE IJ project, and with co-financing from the Netherlands dedicated to enhancement and expansion of SWERA will also pursue regional dissemination activities.

25. CREDP: Caribbean Renewable Energy Development project, UNDP-CARICOM: This PDF project aims at developing a regional project to remove barriers to renewable energy utilisation in the Caribbean region. Through specific actions related to policy, finance, capacity and awareness barriers, it is estimated that the contribution of renewable energy sources to the region’s energy balances will be significantly increased. A wide- range of renewable energy activities have been proposed by the many countries involved in this project.

26. In comparison, the proposed RE IJ project would aim at demonstrating the commercial viability of business models based on biomass and wind for power and process heat generation for the local industries on one island.

27. Forum for Co-operation in Renewable Energy (Europe-Caribbean) INSULA – UNESCO: The forum aims at the development of commercial technological solutions for the use of renewable

energies and to improve the energy efficiency to mitigate global climate change not only in island states, but also in isolated regions of the developing world.

28. The proposed RE IJ project would link up with the activities of the Forum for Co-operation in Renewable Energy (Europe-Caribbean) INSULA – UNESCO, and would strive to achieve synergies by exchanging information on the project activities on regular basis.

29. **AOSIS: Alliance of Small Island States:** The Alliance of Small Island States (AOSIS) is a coalition of small islands that share similar development challenges and concerns about the environment, especially their vulnerability to the adverse effects of global climate change. It functions primarily as an ad hoc lobby and negotiating voice for Small Island Developing States (SIDS) within the United Nations system. AOSIS has a membership of 43 States and observers, drawn from all oceans and regions of the world. Together, SIDS communities constitute some five percent of the global population.

30. One of main objectives of the proposed RE IJ project is to replicate renewable energy technologies based business models on the mainland in Cuba as well as in the region/small island states. To achieve wide spread replication, the project team will remain in touch with the office of AOSIS, and share information and lessons learned for achieving synergies and reaching out to a wider audience.

UNIDO

31. Over the past two decades, UNIDO has had multiple consultations with the Cuban national counterparts and key stakeholders on the sustainable industrial development and policy issues, and has implemented a number of projects and programmes to enhance productivity and investment in the industrial sector in Cuba. UNIDO has a field office in Havana. Since 1999, UNIDO has also been implementing an Integrated Programme (IP) in Cuba covering a range of industrial development issues, and among others, it also looked at the possibility of introducing energy efficient and renewable energy technologies in Cuba. Given the national priorities in the power sector, to begin with, it was agreed to focus on Isla de la Juventud, and explore the possibility of harnessing renewable energy sources for power generation and productive use activities.

32. In 2000, UNIDO commissioned a field study to assess the potential of renewable energy resources for the provision of modern energy services at the Isla de la Juventud. The field study focused its attention not only on assessing renewable energy resources, but also evaluated likely potential of new and renewable energy technologies that could be applied for both - power generation and productive use activities such as process heat for industrial applications and water pumping for enhancing agriculture and horticultural production on the Isla de la Juventud. The outcome resulting from the UNIDO led field study served as the basis for a PDF B project, which was funded by GEF. The PDF phase activities have resulted into the proposed full project – RE IJ project - to promote renewable energy based power generation on the Isla de la Juventud.

Past Experience in Renewable Energy Technologies

33. In Cuba, over the last two decades, a number of renewable energy technologies and systems have been introduced on pilot basis through funding provided by various donor agencies with strategic support given by the Government and public sector institutions, private agencies and NGOs.

Solar Energy

34. To date, about 7000 solar PV systems have been installed in Cuba, with a total capacity close to about 1.1 MW. Most of these solar systems have been used to electrify isolated rural schools and other social facilities. At national level, an NGO Cuba solar has been actively involved in utilizing solar PV systems for powering rural medical posts. According to a recent estimate, about 2000

schools, 400 medical posts, 5 hospitals, close to 1600 TV Halls and many other isolated facilities receive their electricity from small independent PV systems, and the interest in using solar photovoltaic has expanded to other commercial sectors as tourism, navigation and telecommunication.

Wind Energy

35. Wind energy has been used extensively on a smaller scale, with more than 6,500 windmills for mechanical water pumping currently operating along with many small wind turbines (less than 1 kW) for electricity generation usually as hybrid wind solar systems. Prior to the expansion of the national grid starting in the 1960s, several hundreds wind battery chargers operated in remote sites, mainly on the northern coast of the eastern provinces. The grid expansion, combined with the availability of diesel generators, reduced the use of wind power for electrical generation and water pumping. However, there is renewed interest now in Cuba to harness wind energy due to recent technological advances in efficient wind energy systems, and relatively high prices of fossil fuels.

36. In the early 1990's, the Cuban wind resource was not considered adequate to support large wind turbines or wind farms. However, studies of wind energy potential conducted by the Cuban specialists in the northern coastal areas of the central and eastern regions have revealed that large wind turbines of rated power higher than 500 kW could achieve capacity factors higher than 28%. Since 1991 the research activities for assessing the wind potential have been strengthened in the country, and several demonstration projects have been/are being implemented in Cuba. A brief account of the key wind projects being implemented in Cuba is as follows:

- A 0.45 MW Demonstration Wind Farm has been set up on the Turiguanó Island, with two 225 kW stall regulated wind turbines. The wind farm was installed by UNE and the Wind Power Group of Ecosol Solar, and supported by European agencies.
- A nationally designed, partially locally manufactured 10 kW grid connected wind turbine was installed at Cabo Cruz. The wind system was installed by CETER at the Technical University and SIME, with financial support received from the Folkecenter, Denmark.
- A small hybrid wind-diesel system has been installed at Cayo Romano by the EcoSol Solar.

Biomass Energy

37. Energy derived from biomass constitutes an important potential renewable resource for Cuba, with forests and sugar cane providing the most of the renewable bio-sources. Forestry sector provides fuel wood that partially meets the primary energy needs of the rural areas. The large share of Cuban sugar in the global economy and the use of bagasse for cogeneration are the key reasons for the high proportion of biomass fuel in the national energy balance. The energy production from bagasse traditionally takes place at low efficiency, and in terms of electrical generation, its transformation represents just 28-29 kilowatt hours per tonne (kWh/tonne) of ground sugar cane, as a national average. In the medium term, it is estimated that some 3000 GWh/yr of additional bagasse based power can be supplied to the grid⁸.

38. In Cuba, there are about 100 biogas plants in operation presently. The main organic matter being used for the production of biogas include cachaza (filter mud from the sugar process), vinasse (residue from alcohol production), residue from the production of Torula yeast, residual wastes from pigs and cattle and the municipal solid waste. The main use of biogas is for cooking, and in some cases, when purified, it is being used for metal cutting in some installations. Further, there is a huge potential on the main land of Cuba in the form of forestry wood (where ever it is feasible to harvest forests sustainably), crop residues and from energy plantations on the degraded lands by planting

⁸ UNDP/GEF project focusing on cogeneration of electricity and steam using sugarcane bagasse and trash aims at harnessing large potential of bagasse for power generation in the main island of Cuba.

indigenous fast growing species. A conservative estimate puts electricity potential from the forestry, weeds and crop residues on the mainland at 200 MW.

1.2 *Energy Scenario on Isla de la Juventud*

39. 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.

Problem statement

40. The Isla de la Juventud has a population of about 85,000, with almost 92 percent of this population living in urban areas and 8 percent living in rural areas. The island's installed electricity generation capacity at present is 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 beginning to emerge. These new activities however, will also lead to increased demand for energy. Even at present, availability of energy services at economic price acts 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.

41. Although the present demand for electricity on the Isla de la Juventud is currently 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 are 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 is causing many socio-economic and environmental problems. The negative economic effect due to non-availability of adequate modern energy services at affordable prices is manifested in limited employment opportunities and lack of income generation activities on the island.

42. The key issues impacting upon the energy scenario on the Island are: 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 operate 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, is by ships from the main island, hence transshipment remains unreliable, especially during the hurricane season; d) energy conservation and efficiency measures can play a significant role in enhancing industrial competitiveness⁹; and e) excessive emissions from fossil fuels continue to degrade the local environment.

43. The expansion in tourism activities and related services on the island, along with the necessity of more reliable and efficient power generation is drawing the attention of planners to the need of substituting old diesel engines by new efficient ones, and pursuing the introduction of renewable energy based technologies based power generation on the island.

⁹ INEL, Comportamiento Actual y Perspective del Consumo y la Demanda de Energia Electrica en la Isla de la Juventud, Grupo Desarrollo Perspective del SEN, Julio 2002

44. Resource assessment conducted under the UNEP/GEF SWERA project and the UNIDO PDF/B have identified more than enough wind and biomass resources for a sustainable commercial market in competition with diesel based IPPs and aging state facilities.

Energy demand and supply on Isla de la Juventud

45. 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 2
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

Source: CITMA, Ministerio de Ciencia, Tecnología y Medio Ambiente, 2002

46. The use of electricity on the island can be broken down into four main sectors: residential (households), commercial, agriculture and industrial.

47. Electricity generation accounts 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, supply the main electrical grid, which covers 99 percent of the island's population with only the village of Cocodrilo not being connected to the main grid. The residents of Cocodrilo are supplied with electricity (peak demand 25 kW) for 12 hours every day produced from two 37 kW diesel generators.

47. 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.

48. According to the Planning Authority of the Island, two commercial activities - tourism and industries - account for increased demand for electricity. The tourism industry will 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 is a growth scenario that should be planned for.

49. The development of the tourist industry will also increase the consumption of electricity by the industrial, commercial and agriculture sectors. In addition, the industrial sector has the potential for food processing and ceramics industries to work at full capacity. The agricultural sector has further potential for developing small- scale industries based on the tobacco and citrus crops.

50. Under these conditions the Isla de la Juventud represents a ripe opportunity to accelerate private sector engagement in sustainable development.

Renewable Energy Resources on the Isla de la Juventud

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

Wind

52. As part of field studies undertaken during the PDF phase and UNEP/GEF supported SWERA project, a wind map has 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 is continuing with wind mapping of all potential locations in Cuba.

Solar

53. SWERA project has 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 is underway by GEPROP, Ecosol Solar and the Institute for Meteorology Cuba.

Biomass

54. A large part of the island is covered in thick forests (more than 100,000 ha.), and the field studies have 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 heat¹⁰. Biomass has been identified as most important renewable energy resource available locally that has 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 has been 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 producer 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 tonnes available annually on sustainable basis from the following tree species: *Pinus* sp., *Eucalyptus* sp., *Casuarina* sp., *Albizia* sp., and Marabu¹¹. Hence, it is 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 is in addition to the planned sustainable forest harvest. The Marabú biomass resource potential would be tested by this project providing both a safety option and a potential new opportunity.

55. 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.

56. 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 have large potential to meet energy needs of the island for power generation and 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.

2. BARRIERS TO RENEWABLE ENERGY DEVELOPMENT ON THE ISLA DE LA JUVENTUD

57. Despite Cuba's unique history of socio-economic development, generic barriers to renewable energy development are dominant. The engagement of independent power production using fossil

¹⁰ Instituto Forestal, Disponibilidad de biomasa forestal aprovechable, Septiembre 2002

¹¹ Instituto Forestal, Disponibilidad de biomasa forestal aprovechable, Septiembre 2002

fuel based generation with reliable power purchase arrangement on the Isla de la Juventud and the barriers being faced by Cuba are not unlike many other developing countries especially regarding remote locations and mini-grids. In general, the deployment of renewable energy technologies has been slow in Cuba due to a variety of factors, some of which act as key barriers not only on the Isla de la Juventud but also at the national level. A few small capacity solar and wind projects have been supported by donor agencies, public utilities and NGOs in the last two decades, but a general commercialisation thrust is needed.

58. PDF B phase studies identified a number of barriers that constrain the development of renewable energy sources for power generation and productive use activities. These barriers are inter-related, and would need an integrated approach to overcome through active participation of key stakeholders such as planners, public and private sector enterprises, public utilities, technology and service providers.

2.1 Financial Barriers

59. The financial barriers have been identified as the key obstacles to the public and private sector investments in renewable energy based power generation on the Isla de la Juventud. Some of the significant financial barriers identified during the PDF phase are as follows:

- The high capital cost of renewable energy technologies acts as the main barrier to the increased use of renewable energy sources for the provision of modern energy services on the Isla de la Juventud;
- No dedicated financing for supporting renewable energy technologies exists within national financial institutions in Cuba and it is also true for Isla de la Juventud;
- Local capacity within financial institutions and power utilities to appraise renewable energy proposals is also limited or non-existent; and
- Cuba's isolation from some global international financing institutions poses an additional risk for investors for arranging finances for renewable energy technologies based investment projects in Cuba.

2.2 Institutional and Policy Barriers

60. The institutional and policy barriers assume special significance as these limit the ability of renewable energy technologies based power projects to attract investment funding at Isla de la Juventud. In the absence of a level playing field in terms of policies and institutional mechanisms, renewable energy technologies can not compete effectively with conventional fossil fuel based power projects on the Island. Some of the key institutional and policy barriers identified during the PDF phase are as follows:

- UNE (the National Utility) depends on the national budget for implementation of grid activities, which creates uncertainties in allocation of project financing for renewable energy technologies;
- Production, supply and pricing of electricity, and energy fuels are state administered, and since public utilities have not been exposed to renewable energy technologies on commercial basis, there is a lack of confidence in renewable energy technologies;
- Renewable energy agenda and policies are scattered in many departments, and coordination among various institutions to support renewable energy technologies needs support;
- Underdeveloped/weak institutional and policy framework at the national, provincial and local levels to support renewable energy technologies acts as a key barrier to their speedy development;
- Lack of experience in dealing with power purchase agreements for production, distribution and sale of electricity from renewable energy technologies limits the private sector's ability to invest in renewable energy technologies; and
- Absence of commercial and service networks and market linkages for providing maintenance and logistic support to renewable energy technologies at the national as well as on the Isla de la Juventud act as a key barrier for wide-spread replication.

2.3 *Technical Barriers*

61. The technical barriers need to be addressed in order to enhance the credibility of renewable energy in industry and to build local capacity to operate, maintain, design and build new renewable energy technologies based power plant. Some of the key technical barriers identified during the PDF phase are as follows:

- Local manufacturing capacity and/or assembly of renewable energy technology components is currently lacking, although the knowledge, skills, expertise and facilities are available in Cuba;
- Limited technical capacity to design, install, operate, manage and maintain renewable energy based modern energy services, mainly as a result of lack of past commercial activities in the renewable field;
- The technical skills, including conclusive historical experience with renewable resources and technologies for fossil-fuel equivalent energy services, are limited; and
- Norms and standards in terms of renewable energy performance, manufacture, installation and maintenance are weak and/or non-existent.

2.4 *Information Barriers*

62. A number of significant information barriers to renewable energy development in Cuba were identified during the PDF phase, which are as follows:

- Availability as well as access to the existing renewable energy resource information, especially on biomass resources, is limited¹². A central information point to act as clearing house does not exist, instead information on renewable energy technologies is scattered among various sectors and ministries; e.g. public sector, development assistance, R&D centres and academia;
- Poor empirical knowledge of the costs and benefits of the range of technologies available for providing renewable energy based modern energy services, limits the decision making by the executive and policy makers;
- Lack of any comprehensive evaluation of renewable systems already installed in the country acts a serious gap in the information; and
- Low awareness level among public as well as decision makers about the potential of renewable energy sources makes it difficult for investors to decide about new projects.

2.5 *Human Resource Barriers*

63. A number of significant human resource barriers were identified during the PDF phase activities. These are as follows:

- There are few skilled professionals, technicians and experts available in Cuba who are knowledgeable, and have expertise/experience about new emerging areas such as biomass gasifier technologies.
- There are very few training facilities in Cuba in the field of renewable energy for officials, utilities, developers and service providers. Training facilities offered so far have been donor driven, and do not reflect local priorities; and
- The commercial viability of renewable energy technologies is yet to be demonstrated in Cuba (as well as on Isla de la Juventud) on a visible scale. Viable business models need to be established to improve the confidence level of investors and regulators, and to attract new investments.

¹² UNEP/GEF supported SWERA project is focusing on compiling field data on solar and wind energy resources in Cuba. However, no concerted efforts have been made so far to collect detailed information on the availability of biomass - crop residues, forests resources, agro-waste, saw mill waste etc., for power generation.

3. PROJECT OBJECTIVES AND RATIONALE

3.1 *Project Objectives*

64. The main objective of the project is to remove the key barriers to the development of renewable energy technologies for power generation on commercial basis on the Isla de Juventud, and reduce the island's economic vulnerability and environmental stress. In the process, the project will reduce Cuba's energy-related CO₂-emissions by substituting fuel-oil use in power and heat generation through renewable energy technologies. To achieve this objective, the project will focus on demonstrating the technical, economic and financial viability of a sustainable energy production based on local renewable resources by replacing a mixed fuel-oil based electricity generation and heat production on the Isla de la Juventud. The project would aim at building capacity and demonstrating commercial viability of business models based on renewable energy technologies on Isla de la Juventud. The project would specifically focus 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.

65. In line with the national priorities, this project will help Isla de la Juventud to improve its energy security, reduce environmental risks such as oil spills, and use a more sustainable approach to meet local electricity needs. Besides power generation, the project will also help increase the industrial processing capacity, and enhance employment opportunities by using renewables to meet its growing energy needs for process heat and other allied services. This project will also innovate policy, financial and institutional mechanisms to overcome the barriers preventing increased uses of renewable energy sources for productive uses, such as meeting process heat requirements in industrial sectors, activities for replication and enhancing employment opportunities on the Isla de la Juventud.

3.2 *Project Rationale*

Development of renewable energy technologies on the Isla de la Juventud

66. The PDF-B phase activities identified, evaluated and designed appropriately adapted activities to reduce/remove the financial, institutional, technical, information and human resource barriers hampering the increased use of renewable energy sources, and promote renewable energy based investment projects on the Isla de la Juventud.

67. The proposed RE IJ project would support the development of renewable energy based provision of modern energy services on Isla de la Juventud by adopting business models to produce electricity and process heat based on renewable energy technologies. Although the key project activities will focus on addressing the barriers and promoting investment projects for renewable energy based power generation on the Isla de la Juventud, replication activities will be designed for implementation on the mainland of Cuba and in other countries in the Caribbean. The project seeks to achieve a win-win situation by supporting renewable energy technologies on commercial basis, thereby ensuring reduction in implementation costs, enhancement in investments and improving sustainability for the renewable energy development in Cuba. Local communities and women groups will be involved closely during the implementation phase to ensure the sustainability and local ownership of the project.

68. Based on the availability of various renewable resources and possible economic activities on the island, biomass from the forest and wind in the coastal regions were identified as most viable renewable resources to implement business models based on biomass gasification and wind technologies. By demonstrating the technology capabilities and reducing the barriers to their large-scale replication, it is expected that a significant amount of the biomass and wind energy potential in Cuba and the region can be harnessed.

69. The Government of Cuba ratified the United Nations Framework Convention on Climate Change (UNFCCC) in January 1994. The Government, through the Cuban Programme for the Development of National Energy Sources, actively supports energy-sector investments in general and joint ventures in particular.

Relevant GEF Operational Programme

70. The proposed RE IJ project is consistent with the GEF Climate Change Operational Programme OP 6 “Promoting the adoption of renewable energy by removing barriers and reducing implementation costs.” It also constitutes a part of the Government plans and strategies to increase the share of renewable energies in the country’s energy mix with a view to improve sustainability and energy security. Furthermore, the project takes into account the suggested principles for GEF assistance for mini-Grids.

71. ***Power sector policy frameworks supportive of renewable energy and energy efficiency.*** Given the innovative features of the project, it can be classified mainly under this strategic priority (CC3). RE IJ will pave the way for grid-connected renewables in the remote areas of Cuba first and then as the renewable energy technology policy and power purchase mechanisms are recognised broader replication will be supported. The project starts from a baseline of independent power producers using fossil fuels and therefore an advanced country capacity to implement the project.

72. The other priorities of the GEF Business Plan are as follows:

73. ***Increased financing availability.*** An important element would be facilitation of foreign direct investment for renewable energy investments, enterprises and intermediaries, using leveraged private finance (with contingent loans to share early costs and risks (Risk and Replication Management Fund);

74. ***Productive uses of renewable energy in agriculture, water, education, telecommunications, and rural industry.*** RE IJ includes rural electricity for productive uses and social benefits, with applications of renewable energy in agriculture, education, water, telecommunications, and enterprise development. RE IJ project is addressing energy needs of ceramic, meat, fishing and milk processing enterprises on the island, provides power for irrigation and will lead to significant productivity improvements.

75. ***Global market aggregation and national innovation for advanced renewable energy technologies.*** While RE IJ does not seek subsidies to buy down the biomass gasification or wind technologies, some of the most interesting biomass technology applications in the GEF portfolio are anticipated to go forward to implementation.

3.3 Baseline

76. The Isla de la Juventud is the second island in the extension of the Cuban archipelago formed by more than 2000 islands and keys. As on 2001, the island’s installed electricity generation capacity was totally fuel-oil and diesel based. Electricity generation accounts for 54 percent of the island’s primary energy use. Three new diesel-powered generators, 3.5 MW each, and partially supported by old Russian and Czech generators, supply the mini-electrical grid, which covers 99 percent of the island’s population with only the village of Cocodrilo not being connected to the grid. The residents of Cocodrilo are supplied with electricity for 12 hours per day produced from two 37 kW diesel sets, with the main problem of shortage in diesel oil supply.

77. The cost of fossil fuel-based power is very high, making it expensive for industrial activities as power for residential use is subsidized. Even though at present, the power installed at the island is well over its necessity, but given the obsolete technology of the old engines and forecasted increase

in demand for power, the need for reducing the dependence on fossil fuels for power generation is a priority issue. The local electric utility proposes to take the current Russian engines off the generation system, and keep the Czech engines only for guaranteeing a reserve for generating power. Although the local electric utility has plans to strengthen/enhance power generation capacity based on fossil fuel, it has also started exploring the potential and opportunities being offered by renewable energy technologies to meet the growing local needs for electricity and energy services. Because the island is isolated from the major power plants of the main grid for Cuba, and the demand for agriculture is highly variable, a large margin for capacity must be maintained.

78. Fuel consumption for heat process production is also a key issue at the island energy services. Some industrial activities like fishing and ceramic production have been adversely affected because of the high fuel costs that made their production very expensive in the market. Without any external assistance, baseline energy scenario on the Island would continue to be characterised by over-dependence on fossil fuel based power generation, under-utilization of industrial capacity, low employment opportunities and higher emissions of greenhouse gases due to increasing demand for energy from fossil fuels.

3.4 *Alternative Project*

79. The Isla de la Juventud has abundant natural resources and renewable energy resources that have not been utilised optimally at present due to lack of financial resources, absence of policy, institutional and market linkages, and lack of access to appropriate technologies. The field studies undertaken during the PDF phase have confirmed that the Isla de la Juventud has adequate potential for sustainable biomass production and good wind energy resource that can be harnessed not only to replace existing diesel engines and fossil fuels in a phased manner but also can meet likely increases in the future for electricity needs and process heating.

80. The proposed project focuses on the replacement of fuel-oil and diesel generators with renewable energy based business models on the Isla de la Juventud. The proposed RE IJ project has two main components: a) Technical Assistance (TA) and b) Business Models (BM).

81. Some of the key barriers identified will be adequately addressed through TA targeted at the specific problems and issues facing the Isla de la Juventud. TA will include, among others, activities to address barriers – institutional, technical and financial, developing standardized project development agreements, power purchase agreements, support to investment projects, and the identification of selection criteria for replication projects; developing project appraisal guidelines with particular emphasis on the business models, Government support agreements, policy dialogue with the Government (Ministry for Science, Technology and Environment, in close co-operation with the Ministries for Basic Industry, for Agriculture, Metal Mechanic Industry and for Foreign Investment and Cooperation), and other national actors (UNE (National Power Utility), ALASTOR (Energy Services Company for Boilers), ECOSOL (Renewable Energy Company), and GEAM (Forestry Company), capacity building, training and information dissemination initiatives, for addressing generic barriers related to wide-spread adoption of the proposed investment models. Gender issues will be mainstreamed into the various project activities to ensure active involvement of women during the implementation phase.

82. Sustainability of the project would be ensured through active participation of the private enterprises on the Isla de la Juventud in the following business cum investment models:

- Biomass gasifier model for power generation
- Biomass gasifier model for process heat
- Biomass fuel production model
- Wind farm model

83. To fully implement the first two models in a sustainable manner, it will be necessary to support and develop sustainable forestry activities on the island. Thus the forestry management will form an integral part of the biomass fuel production model in order to support sustainable forest harvesting to produce the quantity of biomass required to feed the gasifier systems for power and heat generation. [In collaboration with the Forest Stewardship Council \(FSC\)¹³, the project will provide the basis for mandatory forest certification to ensure sustainable forestry management on the Isla de la Juventud.](#)

3.5 *Replication Strategy*

84. The success of this project will mainly depend on the demonstration of the technical and commercial viability of renewable energy technologies – biomass gasifier systems and wind energy systems to meet the electricity and process heat needs of the Isla de la Juventud, and their widespread replication in Small Island States. The project would specifically aim at setting up a sustainable financial mechanism for supporting feasibility studies for prospective investments, and would facilitate technological transfer to establish commercial renewable energy technologies based business models for power generation. The project is expected to have a wide replication potential for renewable energy systems throughout Cuba, the Caribbean region and the small island states.

- It is expected that the introduction of new renewable energy technologies on a commercial basis to feed the power grid on the Isla de la Juventud, will be an important first step towards the country and region-wide replication as this project would address the barriers and enhance the credibility of biomass gasifiers and wind farms, and the key role these technologies can play in meeting the power needs in an island scenario.
- The experience with power production with forestry biomass using advanced gasifier technology will be replicated in the mainland as well as in the Island States where small forestry plantations can be raised and managed for power generation. The generation of electricity from forestry biomass or agricultural residues could also be adopted in the biomass industry.
- The local demonstration of use of forestry biomass to replace fossil fuels in heat process would be a significant contribution to the cost reduction and production stability in the Cuban industry, and will support the development of a comprehensive forestry programme for biomass fuel production at the national and regional level.
- The biomass gasification component will be further strengthened by including additional international expertise and experience in the design of power plant based on gasification technology on the Isla de la Juventud. Experience gained and lessons learned in various parts of the world on commercial adoption of biomass gasification technologies to local conditions will be very useful for the successful implementation of pilot plant at Cocodrilo and subsequent larger investments on Isla de la Juventud as well as on the mainland.
- Previous studies have determined that the wind potential in Cuba alone is about 400MW in the longer term, and 30 MW in the short term. Hence wind energy systems have great potential to attract investments in renewable based power sector in the Island States.
- In Cuba alone there are 3600 boilers to provide process heat for the industry with capacities up to 20 ton/h. Many of them are located where biomass is an abundant resource, and hence replication of gasifier systems can easily be facilitated.
- There are many isolated communities in Cuba as well as in the Island States where grid penetration is low, and electricity is provided by diesel generators based local grids with capacities between 20-40 kW. Local communities located in the remote and inaccessible areas could easily be serviced by renewable energy technologies based local grids - small biomass gasification plants and stand-alone solar/wind systems.

¹³ [Forestry Stewardship Council \(FSC\) was founded in 1993 to promote environmentally appropriate, socially beneficial and economically viable management of forests. FSC operates through a network of regional offices and national initiatives, coordinated by an international centre based in Bonn, Germany. FSC develops international, national and local forest certification standards based on recognised principles and criteria of forest stewardship.](#)

- For grid power generation, the replication potential is also substantial for biomass and wind energy based business units, which aim at reducing Cuba's dependence on imported fossil fuels.

85. It is realistic to envision vast replication potential of this project to other Caribbean countries and Small Island nations as they have many similarities with the Cuban situation. National markets are small, technology and equipments are inefficient, and, except for Trinidad and Tobago, there is over dependence on imported fuel. Hence, local grid power systems based on renewable energy technologies could easily be replicated in these countries. Cuba is fully integrated into CARICOM - a regional Caribbean organisation that would facilitate technology transfer and information sharing in the region. Although woody island states are not common but degraded ones where plantations for highly efficient biomass gasification are viable, exist and wind potential in these islands is also good.

86. This project will help in creating a supportive and enabling environment for the entrepreneurial sector, especially for small businesses in order to fulfil the replication potential described above. Elements of such support may include developing business models for power generation through mini grids based on renewable energy technologies for Cuba and other small island countries, reduction in costs of renewable energy projects by technology transfer and augmenting local manufacturing capacities, and helping to build the demand and capacity for the servicing and maintenance of biomass and wind energy technologies.

87. The strategy that will be implemented to ensure replicability would comprise of a special sub-group called Technical and Financial Service Unit within the project management structure of RE II project for Cuba, with the following specific responsibilities:

- promote renewable energy based development and business model in Cuba and the region, at every stage of the implementation process Cuban, UNEP and UNIDO meetings and fora.
- develop mechanisms for effective country experience in wind and biomass power projects and ensure successful dissemination across the region Cuban representation and communication with other countries in the region including Central America.
- plan capacity building activities for the potential investors, financiers, government officials, and general public to have an increased awareness and confidence level in new biomass based and wind power technologies Two open invitation meetings are planned to attract these groups (Output 5.4 and 5.5 utilizing estimated 200k\$ from lines 5200 and 3300).
- involve local communities and women groups closely during the implementation phase to ensure the sustainability and local ownership of the project.
- implement workshops, seminars, and study tours to the successful demonstration plants for the key officials and stakeholders of other Caribbean countries, as well as project developers and potential investors.
- provide technical advisory services, including technical feasibility study, fuel supply availability, feasibility study, and technical trouble shooting service, to potential developers. This will include the use of the GIS mapping methodology developed during the Phase PDF_B of this initiative.
- provide information on financing sources and potential wind and biomass power projects to potential investors within and outside Cuba.
- provide competent advisory services to conduct financial feasibility studies, prepare agreements and contracts, and arrange project-financing package to potential investors.
- seek bilateral and multilateral financing and international IPP investment for local biomass power and facilitate a strong relationship between the financial sector and the project development sector.
- provide the basis for mandatory forest certification to ensure sustainable forestry management on the Isla de la Juventud and gradually extend it to rest of the country, and
- facilitate enactment of policies, rules and procedures that would help in attracting investments on renewable energy technologies for power generation, and ensure their commercial viability through PPAs and ESCOs.

88. The administration of the proposed financial instrument – a Risk and Replication Management Fund which would be presented to the investors as an interest free loan to promote investments in business models – would be performed by the Compañía Fiduciaria / Nueva Banca under the overall supervision of the national steering committee. A number of consultations and discussions held with the Compañía Fiduciaria brought out an urgent need to frame procedures and rules for the management of RRM Funds, disbursement of interest free loans, repayment of the loans after a grace period by the investors and penal clauses for charging interest if loans are returned on time as agreed with the investors. The Compañía Fiduciaria¹⁴ will manage the funds on the same general terms as industry standards elsewhere with typical management fees of 1 to 3 % subject to transaction costs.

89. UNEP will be the liaison point of the RE IJ project with similar projects/initiatives being implemented in the region, and will create the necessary synergy among them. The project will use these projects as a channel to communicate and co-ordinate with other Caribbean states into the replication process. By interacting with the above mentioned and future projects, the replication potential would increase enormously, and consequently, overlap and duplication of efforts will be avoided. Specific agreement will be reached with each of the ongoing projects to create appropriate channels of exchanging information and results.

90. Finally, the RE IJ project presents a unique opportunity to build a strong network and partnership among the government authorities, the private sector, the agricultural sector, local communities, entrepreneurs, equipment manufacturers and technology/service providers in Cuba. The project components have been designed to ensure that the necessary and sufficient conditions exist to make the replication projects successful. Project activities are mainly designed to put in place institutional mechanisms for long-term sustainability of business models by addressing key barriers. It is expected that the RE IJ project will lead to reduction in transaction costs and dissemination of information to different categories of potential renewable energy (i.e. biomass and wind power) investors. The project is expected to act as a catalyst to bring together various stakeholders on a common platform, and to expedite development of renewable energy technologies in Cuba.

91. The project activities will also link up with a national programme on energy efficiency “Progama de Ahorro de Electricidad en Cuba”, which was started in 1999. The national programme on energy efficiency, which also covers Isla de la Juventud, aims at introducing energy efficient technologies and measures in households, industries and government offices. The energy efficiency measures will be further augmented in the private enterprises being covered at the Isla de la Juventud under business model on process heat.

3.6 Global Objective

92. The global aim of the project will be to reduce greenhouse gas emissions by supporting renewable energy technologies based power generation through business models in Cuba and 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. The proposed RE IJ project in Isla de la Juventud will demonstrate the technical and financial viability of renewable energy based investment business models, and will aim at removing the barriers to the development and replication of the renewable energy technologies. In particular, it will demonstrate the viability of new institutional and financial practices that would enable the private enterprises/companies to become power producers and energy service providers, and link modern energy services with the productive use activities to enhance the employment opportunities in Cuba.

¹⁴ As a part of Grupo Corporativo Nueva Banca, Compañía Fiduciaria S.A., has eight years of experience dealing with fiduciary activities, and has 171 clients with effective contracts, of which more than half are foreign clients. It carries out a great volume of financial operations annually. It provides professional service through highly skilled staff, known for excellence in their services. These factors along with rich experience in dealing with similar funds make Compañía Fiduciaria S.A. a promising partner to implement and manage Replication and Risk Fund being proposed under the project.

4. PROJECT DESIGN

93. In order to achieve the overall objective of the proposed RE IJ project to remove the barriers to the development of renewable energy technologies and promote investment projects on the Isla de la Juventud in Cuba, it is proposed to implement technical assistance activities for capacity building, technology transfer, financial packaging and strengthening of institutional and policy mechanisms, and setting up initial investments as business models to demonstrate commercial viability of renewable energy technologies to provide modern energy services on the Isla de la Juventud.

94. On the basis of field data collected, resource availability, local demand for energy services and techno-economic feasibility studies including environment impact assessment study carried out during the PDF phase, biomass gasification technologies for power generation and process heat, and wind energy systems for feeding electricity to the grid have emerged as most appropriate renewable energy technologies to meet the growing energy needs on the Isla de la Juventud, and there is also strong private interest to invest in and operate renewable energy (biomass and wind) based business models.

4.1 *Selection of technologies*

95. Criteria used for the identification and selection of renewable energy technologies included potential of renewable energy resource, specific demand for energy services (power generation and process heat on the island), technical and commercial feasibility and environmental sustainability. Abundant availability of biomass and wind resources, which can be harnessed on sustainable and commercial basis, influenced the final selection of technologies on the Isla de la Juventud.

96. Biomass Gasification combined with the use of producer gas in an internal combustion engine has been identified as the most efficient way of converting bio-fuels into heat power or electricity on the island. In recent years, biomass gasification technology has matured, and is now considered a reliable and modern technology for power and heat production. This technology is therefore particularly appropriate for the Isla de la Juventud project where petroleum fuels are scarce and expensive; and biomass resources exist in abundance that can be used in a sustainable manner. This technology will be used in two ways in the RE IJ project. Firstly, a large size gasification plant (total capacity 3.5 MW – modular systems) will be installed, which will provide gas fuel to a dual gas/fuel-oil generator to supply electricity to the island's grid. Secondly, four small gasifier units will be fitted to adapted burners in small local industries to meet process heat needs of these industries.

97. The wind energy technology has also been found suitable for Isla de la Juventud because it has the necessary wind resources. Studies carried out during the PDF phase revealed that the necessary potential wind energy for exploitation on commercial basis existed on the Isla de la Juventud.

98. The business models designed for the project based on biomass gasifier and wind energy technologies are as follows:

- A biomass fuel production and supply (36,400 tonnes every year) business model that ensures a sustainable provision and supply of biomass during the entire life of the biomass gasification plants;
- A large biomass gasifier plant (3.5 MW) to produce power (electricity) for the supply of electricity to the grid of the island, near the main town of the island;
- Four gasifier applications (about 6 MW thermal) to be placed at four industrial sites for heat production (all within a reasonable distance of each other), all managed by the same company with an ESCO concept; and

- A wind farm (1.5 MW) to be located on the North coast of the island on Playa de la Bibijagua, where optimal wind conditions were found, for producing electricity to be fed into the main grid of the island.

99. Technical and financial details of these business models – technology package, investment and power purchase agreements (PPAs) – have been worked out in detail. Certifications standards will be provided for sustainable management of forests to provide biomass needed for business models.

100. In advance of the larger installations, the proposed RE IJ project will install a pilot mini-grid at Cocodrilo based on biomass gasifier technology (25 kV) as a test and for the benefit of local community, which is not connected with the island grid. The mini-grid at Cocodrilo will demonstrate the techno-economic feasibility of a pilot biomass gasifier based electricity production and provision of reliable energy services to meet the energy needs of an isolated off-grid community and promote income generation activities¹⁵.

The O & M costs of the proposed mini grid at Cocodrilo will be met through the revenue generated by productive use activities. The project will also look at adopting energy efficiency measures in industrial enterprises where producer gas will be supplied for process heat, to improve the overall performance and competitiveness of these enterprises. Although use of solar energy technologies was not found to be commercially viable when compared to biomass and wind energy technologies the end use demand will determine the selection of technologies including energy efficiency measures in heating applications, solar dryers, solar water heating in tourism industries, solar water pumping in citrus plantations, etc.

4.2 Project Activities and Expected Results

101. The project activities (TA and investment Component) that will address the key barriers to the development of renewable energy technologies on Isla de la Juventud can be broadly divided into three categories: a) strengthening institutional, financial and policy framework; b) demonstration of commercial feasibility through business models; and c) local and regional capacity building and information dissemination.

102. The key project activities and expected outputs are described as below:

Activity 1. *Establishment of a policy and regulatory framework to provide enabling environment to the development of renewable energy technologies;*

Activity 2. *Building local and national capacity to utilize the commercial potential of renewable energy technologies;*

Activity 3. *Setting up of new and innovative financial mechanisms to encourage private sector investment in renewable energy projects;*

Activity 4. *Implementation of business models to demonstrate commercial feasibility of renewable energy technologies for power generation and process heat generation; and*

Activity 5. *Establishment of project management structures for the implementation, coordination and monitoring of the project activities and dissemination of results.*

103. Each activity is composed of immediate objective, specific outputs and a number of sub-activities designed to address the key barriers that constrain development of renewable energy technologies on the Isla de la Juventud. Collectively, project activities will aim at the establishment of commercial business models for renewable energy technologies providing modern energy services on the Island and their replications in the rest of the country.

¹⁵ Experience gained and lessons learned in various parts of the world on commercial adoption of biomass gasification technologies to local conditions will be very useful for the successful implementation of pilot plant at Cocodrilo and subsequent larger investments in Cuba. For instance, a pilot biomass gasification plant based on saw mill waste for power generation is being operated successfully by XYLOWATT S.A. Bulle, Switzerland for the last one and half year. Experience gained in this gasification based power plant as well as in similar initiatives in Europe and elsewhere will be studied and integrated into the project design for the pilot plant at Cocodrilo.

104. Gender issues will be mainstreamed into various project activities to ensure active involvement of women during the implementation phase.

Activity 1. *Establishment of a policy and regulatory framework enabling development of renewable energy technologies*

105. The immediate objective of this activity is to support policies and regulatory framework that would address policy barriers and facilitate development of renewable energy based power generation and process heat, to begin with on the Isla de la Juventud and then to be replicated in the rest of the country. Although there is a completed fuel-oil based project where Build Operate Transfer (BOT) arrangements are coming to completion in early 2004, there is no past experience, policies or regulatory framework in place to support or encourage renewable energy technologies on the Isla de la Juventud or in the rest of the country. Local administration has no expertise or regulatory/institutional framework in place to evaluate any proposal from the private sector to set up a renewable based power generation plant on the Island. Lack of any incentive or tax waiver to promote renewable energy technologies further hinders investment by the private enterprises. This activity will facilitate formulation of a policy and regulatory framework at the local and national level to mainstream renewable energy into the overall development strategy and integrated energy programmes. It would also assist in providing a level playing field to renewable energy technologies to compete with conventional energy projects.

106. **Output 1.1:** A policy and regulatory framework to provide enabling environment to the development of renewable energy is established and made operational.

107. Sub-activities:

- 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.
- 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 team and agreed with investors, and a model guideline for harnessing renewable energy technologies will be widely circulated.
- 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.

108. **Output 1.2:** National quality assurance standards on renewable technology performance and evaluation benchmarks set up and widely disseminated.

109. Sub-activities:

- 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.

- 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.

110. **Output 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.

111. **Sub-activities:**

- 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.
- 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.
- 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.

Activity 2. *Building local and national capacity to utilize the commercial potential of renewable energy technologies.*

112. The immediate objective of this activity is address capacity barriers and assist in building local and national capacity to utilize the commercial potential of renewable energy technologies. Capacity building of the major stakeholders including the Government Ministries - Ministry for Science, Technology and Environment, in close co-operation with the Ministries for Basic Industry, for Agriculture, Metal Mechanic Industry and for Foreign Investment and Cooperation, the Isla de la Juventud Administration Council, headed by the President of the Municipal Assembly; UNE (National Power Utility), ALASTOR (Energy Services Company for Boilers), ECOSOL (Renewable Energy Company), and GEAM (Forestry Company), Enterprises that use fuel-oil for heating, such as ceramic, meat and fish processing factories; R&D institutions, financing institutions and banks will be undertaken to enable them to support renewable energy services on a commercial basis.

113. Capacity building and training programmes will be organized for the local and national government officials, public and private sector officials, manufacturing units, maintenance service providers, NGOs and communities to build a solid technical and planning base for the commercial utilization of renewable energy technologies.

114. **Output 2.1:** Key stakeholders are trained on technology evaluation and benchmarking of renewable energy systems.

115. **Sub-activities:**

- 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 of standards of emerging renewable energy technologies and systems, documenting such standards and disseminate lessons learned.
- 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.

116. Output 2.2: Key stakeholders are trained on management aspects of renewable energy based power plants and process heat generation systems.

117. Sub-activities:

- 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.
- Training will be imparted on using national and international databases on all aspects of biomass and wind resources, technologies, projects, markets, opportunities, and stakeholders.
- Training will be imparted on grid synchronization and taking systems approach for power generation based on renewable energy systems.
- 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.

118. Output 2.3: Experts and planners are trained to manage the technical and financial services for the project, information dissemination and implement the replication strategy.

119. Sub-activities:

- 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.
- 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.
- 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.

120. Output 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.

121. Sub-activities:

- 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.
- 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.

Activity 3. *Setting up of new and innovative financial mechanisms and structures to encourage private sector investment in renewable energy projects.*

122. Financial barriers have been identified as the key obstacles that limit the ability of the national and international institutions and companies to invest and harness the vast potential of renewable energy resources available in Cuba. The immediate objective of this activity is to set up appropriate financial mechanisms to overcome these barriers and encourage private sector investment in renewable energy projects on the Isla de la Juventud. A specific objective of this activity will be to attract investments as well as lower the implementation costs of renewable energy projects.

123. This activity would facilitate setting up of an innovative financial mechanism at the national level to support development of renewable energy technologies throughout the country. A detailed analysis of fund flow, internal rate of return, interest rate and investment needed for business models in order to succeed in the local conditions revealed that the investment financing by the private companies would require an upfront targeted financial support to make the business units viable and attractive for the private investment.

124. **Output 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.

125. Sub-activities:

- 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 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.
- 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.
- The Compañía Fiduciaria, National Bank of Cuba and CITMA along with other agencies will look into, among others, critical issues like terms of the interest free loan, length of demonstration period, grace period and penal clauses if the loan is not returned on time by the investors. The Compañía Fiduciaria and the National Bank of Cuba would also 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 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.

126. **Output 3.2:** Capacity of national banks and financial institutions is built to evaluate and analyse renewable energy technology based power projects.

127. **Sub-activities:**

- 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. 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.
- 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.
- 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 financial mechanisms to financial intermediaries, and additional training to major stakeholders inside or outside the project in biomass and wind energy technology

Activity 4. *Implementation of business models to demonstrate commercial feasibility of renewable energy technologies for power generation and process heat generation.*

128. The main objective of this activity will be to implement four business models to demonstrate commercial feasibility of renewable energy technologies for power generation and process heat generation on the Isla de la Juventud. This activity will aim at reducing the technological uncertainties/risks and transaction costs associated with technology choices as well as removal of barriers related to institutional, policy and capacity issues. The site selection for each of the business units has been done keeping in view the resource availability, logistics involved and infra-structural facilities available on the Isla de la Juventud to minimize the overheads and other avoidable costs. Technical and financial details of business models are given in section 4.3 and at Annex E.

129. Keeping in view the logistics, resource availability and infrastructure already located on the island, three business models - 3.5 MW power generation based on the biomass gasification, 6 MWTh based on the biomass gasification for process heat and forestry business model to produce 36,400 tonnes of wood chips will be located at Nueva Gerona, capital city of Isla de la Juventud while the fourth business model - 1.5 MW power generation through wind energy park will be located at Playa de la Bibijagua.

130. A pilot mini-grid (25 kW) based on biomass gasifier technology will be set up at Cocodrilo to demonstrate the potential of biomass gasifier technology for isolated mini grids to provide early hands on experience and also meet the energy needs of local communities.

131. **Output 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).

132. **Sub-activities:**

- 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.

- 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.
- 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 processes¹⁶.
- 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.
- Power purchase agreements, legal issues and fund flow arrangements will be facilitated and operational issues finalized for smooth operations of business models.

133. **Output 4.2:** Training imparted on the operational and management issues to business models and their linkages with productive use activities.

134. **Sub-activities:**

- 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.
- 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.

135. **Output 4.3:** Close supervision of performance of business units conducted and corrective steps taken on regular basis.

136. **Sub-activities:**

- Supervision and interim evaluation of performance of business units will be undertaken to standardize the operations and providing technical assistance, wherever needed.
- 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.

137. **Output 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.

138. **Sub-activities:**

¹⁶ Linked with equipment purchase are issues relating to on-site training, technology transfer and diffusion for strengthening of the local manufacturing capacities, which will also be handled by UNIDO.

- 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.
- 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.
- This mini-grid will essentially be a pilot demonstration plant as start-up activity, and besides meeting the local energy needs, would also act as a knowledge base for larger biomass gasifier plants to be set up as a part of main business models.
- Local community and women groups will be sensitised and closely involved in the implementation of the proposed biomass gasifier based demonstration unit at Cocodrilo.
- Although upfront costs of project design and procurement of the equipment for the proposed mini grid at Cocodrilo will be met through GEF and donor funds (consultations have revealed high degree of interest among some bilateral agencies to fund and support a large part of mini-grid activities at Cocodrilo), the project strategy would envisage generating enough revenue through sale of electricity for domestic and productive use activities to meet the operational and maintenance (O & M) costs, and in the process, make the proposed mini grid at Cocodrilo sustainable and self reliant.
- Besides demonstration, the proposed mini grid at Cocodrilo would provide an excellent opportunity for replication in the mainland. A targeted dissemination strategy will facilitate replication of such pilot models on the mainland at remote locations not served by the main grid.
- 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.
- More details about the mini-grid to be set up at Cocodrilo and replication strategy are given at Annex H.

Activity 5. *Establishment of project management structures for the implementation, coordination and monitoring of the project activities and dissemination of results.*

139. The main objective of this activity is to develop an implementation mechanism for all the components and activities of this project, and set up a strong project management structure for close coordination and monitoring of the project activities and deliverables in terms of time, cost, quality, etc. including capacity building and information dissemination strategies. This activity will help in developing a dedicated management and technical team with inter-disciplinary expertise to ensure the ultimate success of the proposed project. Formats for project activity, sub-activity, task based monitoring, evaluation and lessons learned will be prepared, discussed and finalized. These will be tested for specific tasks and activities, and applied in the implementation of the project activities.

140. **Output 5.1:** Project team selected and management structure agreed with the national counterparts.

141. Sub-activities:

- 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.
- 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.

142. Output 5.2: Capacity building and training of the key stakeholders – technical experts, planners, investors and experts achieved.

143. Sub-activities:

- 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.
- 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.
- A Technical and Financial Service Unit will be set up and trained whose responsibilities would include, among others, implementation of the replication strategy.

144. Output 5.3: Close monitoring and evaluation of the project activities achieved.

145. Sub-activities:

- 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.
- 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.

146. Output 5.4: An effective information dissemination programme and strategy developed and implemented.

147. Sub-activities:

- The information dissemination activity will complement any effort already being done by the Government of Cuba and other agencies, and will be additional to what has been generally a part of generic information dissemination on the potential of renewable energy technologies for power generation.
- 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 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 will also be prepared and disseminated.
- 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.

148. **Output 5.5:** Lessons learned and results disseminated to a wider audience and a regional network created.

149. **Sub-activities:**

- 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.
- 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.

4.3 *Business Models Design*

150. Technical design and financial parameters of the four business models were worked out keeping in view the resource availability, local demand for electricity and energy services, costings of existing power and heat supply on the Isla de la Juventud¹⁷, available infrastructure, and commercial feasibility. Detailed information on technical and financial parameters of the business models are given at Annex E.

i) **Biomass fuel production and supply model**

151. The Isla de la Juventud has more than 100,000 ha. of forests, and the local forestry company accounts for ownership of 32,500 ha of forests on the island - 22,100 ha being producer forests and 10,400 ha plantations developed as part of a reforestation program initiated in 1961. In addition, 2,300 ha of degraded lands can be included that are covered with medium and heavy growth of Marabú woody weed and other shrubs.

152. At present, potential of forests and forestry residues available with the local forestry company cannot be achieved optimally because of lack of resources to start up the necessary management structure as well as purchase of modern equipment necessary for the handling of the forests produce on commercial and sustainable basis.

153. During the PDF-B phase of the project, a comprehensive survey as well as an inventory of the forest resources available with the local forestry company was carried out, using aerial photograph techniques and digital maps integrated into a GIS system. The preliminary results revealed a usable total wood potential of 48,200 tonnes per year during the next ten years, keeping in view the availability of the several fast growing indigenous tree species - Pines sp., Casuarina sp and Albizia sp. on the island. Additional details about the forests types, tree species and biomass production are given at Annex G.

154. The local forestry company also carried out an Environmental Impact Assessment study, and the result showed that the biomass production under the project would not in any way affect the sustainability of the island ecosystem. Instead, additional degraded areas will be used for raising

¹⁷ Briefly, costs of diesel based power generation on the mainland of Cuba is about 4.5 Cents per kWh while on the Isla de la Juventud, it works to about 8.5 Cents per kWh including costs of blended fuel, transportation costs and additional capacities required for the peak power. As per PPA entered with GEN Power under BOT arrangements, power generated through fuel oil is purchased by the local electricity utility at the rate of 9 Cents per kWh. Further, landed costs of Fuel oil, Diesel and LPG on the Isla de la Juventud are US \$ 197 per tonne, US \$ 247 per tonne and US \$ 200 per tonne respectively.

energy plantations under the proposed project, which would enhance the green cover of the island. As suggested by GEF, a forestry expert was requested to undertake an independent review of the technical information generated during the preparatory phase concerning quantity and quality of biomass production on the Isla de la Juventud and outline a forestry certification programme to certify sustainable forest management practices that will be recognized internationally. The forestry expert has since submitted his report¹⁸ agreeing with the findings and reports of the Cuban forestry experts on the sustainability of forestry resources on the Isla de la Juventud. The report is enclosed as a separate annex.

Design

155. 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 3.5 MW gasifier for power generation and 6 MW Th 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 through sustainable forests harvesting practices). To meet this requirement, a business model has specifically been designed to ensure the sustainable provision of biomass for the gasification plants. As mentioned earlier, several obstacles have been identified as critical - lack of infrastructure, lack of modern technology, poor capacities of the potential actors, high investment costs, and lack of forestry management experience, etc., - for the success of the forestry component. Hence the project activities have been specifically designed to overcome these obstacles by proposing a business model for bio-fuel production through sustainable harvesting techniques and practices. Costings of biomass fuel and other fuels in terms of energy content have been given at Annex F.

156. The different sources of biomass production will be as follows:

157. **Producer Forests:** Conforming to the forestry management plan, 27 ha of producer forests will be used for the production of 1,700 tonnes every year (at a yield of 63 tonnes per ha). The possible impact due to this activity was evaluated under the Environmental Impact Assessment carried out during the PDF phase, and no significant change or adverse impact in the environmental state of the affected forests¹⁹ is anticipated.

158. **Thinning Operations:** Conforming to the forestry management plan, 1725 ha of plantation forests per year will be thinned yielding 24,150 tonnes per year (yield assumed 14 tonnes per ha). This activity will contribute significantly to improve the environmental situation of the plantation forests. At the end of this project, plantation forests will be managed scientifically, and consequently, would witness an increased value in their biodiversity and commercial products.

159. **Forests regeneration:** 190 ha of degraded forests will be planted and added every year yielding 10,640 tonnes (at a yield of 56 tonnes per ha). This would facilitate in regenerating 1140 ha of degraded forest area during the project life of 6 years, and improve local ecosystem for the conservation of the flora and fauna by using appropriate species.

160. The end product of the forest harvesting will be woodchips to be fed to biomass gasifiers. Cutting activities, by means of internal combustion chain saws, will be established in the forest itself. The chipping activity will be located at a distance of up to 25 km, from the electricity generation plant.

¹⁸ While confirming the availability of adequate biomass on the Isla de la Juventud to meet the requirements of the project for power generation on sustainable basis, the expert has made suggestions on putting in place a mandatory forest certification programme as per the guidelines laid down by the Forest Stewardship Council.

¹⁹ Producer forest areas to be harvested - 27 ha every year under the proposed project is much less than the forests area already being covered under ongoing forestry operations to meet local needs on the island.

161. The exploitation of Marabu weed will be demonstrated and its potential use in the biomass gasification technology explored in addition to the amounts required for plant operation described above.

Institutional arrangements

162. The Empresa Forestal Integral (EFI) of the Isla de la Juventud, a partner of the Grupo Empresarial de Agricultura de Montaña (GEAM), will 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 envisages 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.

163. The local forestry company on the Isla de la Juventud is ready to set up an agreement with foreign companies in order to establish the business model. This company would be a supplier of technology and a co-financer of the project, and will transfer its own experience on modern forestry management that could be replicated elsewhere.

ii) Biomass Gasifier Business Model for Power Generation

Rationale

164. At present the structure of power generation on the island is as follows:

- There are 3 units of 3.5 MW MAN modern generators that use light fuel-oil as fuel with a specific consumption of 220 g/kWh. These units accounted for 83 % of power generated in 2001. The average fuel-oil cost is around 197 US\$/tonne.
- Four old units with 400 – 500 kW capacity (Czechoslovak diesel generators) with more than 120,000 hours of exploitation and specific fuel consumption in the order of 288 g/kWh are also in use. These engines are used to cover the peak demand and generated about 5 % of the total electricity generation in 2001. This higher grade diesel costs around 322 US\$/tonne.
- Eight old Russian diesel generators units with five of them having more than 280,000 hours of exploitation with specific fuel consumption in the order of 280 g/kWh. They are currently being used as reserve for the system, exhibiting a very high maintenance cost. Last year the power generated by these units was around 12 % of the total demand. These engines are also running on diesel oil with a fuel price in the order of 322 US\$/tonne.

165. The above scenario reveals that while old diesel sets generate only 17% of total electricity, they use up to 30% of the total expenditure on fuel for power generation on the island.

Design

166. Under this component of the project, business model design will be as follows:

- A biomass gasification system will be established to supply gas to a dual mode internal combustion engine based power plant of capacity 3.5 MW;
- Considering current local technological experience and power generation infrastructure, the integration of biomass gasification and diesel/fuel oil engines will be adopted.

167. There could be two options on the ownership/operational side – a) first option could be that both - the biomass gasification and power generation components are owned by same investors; and b) second feasible option could be that the biomass gasification plant will be owned by an independent biomass gas producer, which will have an established long-term purchasing agreement with the operator of the power plant in the island. The power plant will use the producer gas from the

biomass plant to reduce its consumption of fuel oil. There are many key stakeholders²⁰ involved in this component including the local forestry company, the independent biomass gas producer, the power plant operator, technical expert teams and OBE, the local utility.

168. The component would incorporate full water treatment scheme – flocculation, separation of the sludge from the cooling water and recycling it after passage through a spray-cooling tower. The sludge would constitute about 1 % of the biomass throughput, and would be disposed off as landfill on the area earmarked by local administration.

169. Discussions with the Cuban authorities and investors have 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 taking a joint venture approach. Various implementation options (joint ventures, BOT approach etc.) would be considered and firmed up in the first year of implementation phase keeping in view the financial and institutional issues to facilitate investments.

iii) **Biomass Gasifier Business Model for Process Heat**

Rationale

170. The small industrial capacity of Isla de la Juventud has been severely affected by a shortage and lack of reliable supply of fuel. Across the industrial spectrum, four promising industries have been identified for the pilot project intervention because of their specific needs, their potential contribution to the local economy and enhanced employment opportunities, and their ability to achieve cost effectiveness.

171. Under the proposed intervention, the four identified industries will not only change over to renewable sources of energy to meet their demand for process heat but also would make efforts to upgrade their manufacturing technologies, introduce energy efficiency measures and strengthen market linkages.

172. Details of the current technology use at these four industries are given below:

Table 3

Local Enterprises to be supplied with small Biomass Gasifiers for Process Heat

No	Enterprise	Unit to be retrofitted	Type of combustible used
1	Isla de la Juventud Meat Complex Enterprise.	Steam generator.	Fuel-oil.
2	Isla de la Juventud Milk Complex Enterprise.	Steam generator	Fuel-oil.
3	Isla de la Juventud Ceramic Enterprise.	Furnaces	LPG
4	Isla de la Juventud Fishing Association.	Steam generator	Diesel

Design

173. Under the proposed intervention, four gasifier units will be fitted to adapted burners in local industries to provide process heat. All the selected industries will 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 scheme.

²⁰ Consultations held with key stakeholders and investors revealed their willingness to invest in renewable energy technologies based business models provided they get assured supply of biomass on an agreed price, and the PPAs get finalized on agreed terms with the local electricity utility on the island.

Table 4
Thermal Power Needed at Local Enterprises²¹

	Meat company	Milk Company	Fishing Company	Ceramics Company
Thermal power to be installed	2.4 MWth	1.4 MWth	1.4 MWth	0.5 MWth
Power Plant annual operating time	3,180 hrs	6,000 hrs	3,000 hrs	6,000 hrs
Biomass hourly consumption @30% moisture	0.75 tonne/hr	0.45 tonne/hr	0.45 tonne/hr	0.15 tonne/hr

174. 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.

175. Energy auditing of these units will be carried to identify areas where energy efficiency measures and technologies can be introduced to improve their cost effectiveness and in the process, helping in further reduction in GHGs. Cogeneration was not found to be a viable option during the PDF phase with all four companies involved in the heat production. However, it will be looked into again during the main phase if there exists any cogeneration potential, especially in milk/dairy plant.

iv) Wind Farm Business Model at Playa Bibijagua

Rationale

176. Reliable wind resource data has been generated under the PDF phase studies for preparing a proper techno-economic feasibility study. The Climate Center of the Meteorological Institute has been carrying out wind meteorological measurements at different locations in the island for as many as 20 years. ECOSOL, a local enterprise, has installed three wind data collection stations that have been gathering data on an average for 16 months.

177. Under the UNEP/GEF SWERA project, GEPROP and ECOSOL have analysed the data collected at each station and, with the aid of WASP (in collaboration with the Danish Risoe), have extrapolated the analysed data to the whole of the island to create a digital wind map for the Isla de la Juventud. The finalized wind map revealed average winds of up to 7 m/s mostly located in the southern and northeast coastal region of the island. The estimated carrying capacity for intermittent supply on the island grid was estimated at up to 3 MW but since there is no experience with an intermittent source, a wind farm of 1.5 MW was considered as the best option.

Model design

178. The most favourable site for locating the wind farm has been identified as Playa Bibijagua. This site is ideal for two reasons. Firstly, it has strongest wind intensity, and secondly, it is not far from the existing grid and grid connection could easily be facilitated.

179. It is proposed to set up a 1.5 MW wind farm, which represents a penetration of 10% with respect to the maximum demand in 2000.

180. The wind plant will be run by a consortium of international and local firms as Independent Power Producer (IPP). One of the local firms involved will be ECOSOL. The Independent Power

²¹ See Annex F giving costing of fuels in terms of heat value.

Producer will supply the electricity generated from the wind farm to the main electric grid at an agreed price to the local public utility.

181. The wind farm developers will have access to the WASP data at ECOSOL to make the final selection of wind turbine and micro-siting of wind systems after finishing local wind measurements. Three simulations were done for the Playa de la Bibijagua site (one with 2 x 750 kW machines, one with 2 x 600 kW machines and finally one with 7 x 200 kW machines). The results indicated a capacity factor of between 20 and 30 %, which is an acceptable range according to the international experience. Since Isla de la Juventud lies in the path of hurricanes, the project envisages incorporating hurricane resistant features while selecting the wind technology package (i.e. collapsible designs) within the given cost/risks estimates.

5. RISKS AND SUSTAINABILITY

5.1 *Sustainability*

182. Since the early 1990s, Cuba has been working on its economic policy to attract private investments, and has introduced a number of policies and measures to engage foreign enterprises in the local production of goods and services. Policy initiatives in hotels, tourism, trade, oil exploration and exploitation, garment and electricity generation have already been implemented with the participation of foreign companies. The Ministry for Investment and International Cooperation is actively promoting new investment opportunities in the power sector. Public and entrepreneurial partnerships in Cuba have also been evolving very positively. One of the most important measures undertaken in recent years is the introduction of the law for the promotion and protection of foreign investment, to support associations of Cuban and foreign partners, by means of joint venture companies as well as by economic contracts. The energy sector is included among the priority economic areas authorised for foreign partnerships, and some private initiatives have already been implemented: a gas-powered generation plant by means of a joint venture company; a BOT contract (with Gen Power) for diesel-power generation on the Isla de la Juventud; risk contracts for off-shore petroleum exploration, etc.

183. Another policy measure, which had significant impact on the energy consumption, was the introduction of the regulation that forced local enterprises to pay for their energy bills in hard currency. The price for electricity and fuels for enterprises are calculated by adding the cost of the imported fuel to the cost of processing (refining) oil in the country. This is the basis for the local promotion of energy saving measures, and for calculating the price under power purchase agreements with the Energy Services companies. Energy subsidies are only granted to the residential consumers, and to some public services like the health and education systems. These measures along with the Government's global strategy to promote renewable energy technologies ensured a very conducive scenario for the sustainability of the proposed project.

184. Further, the project activities have been designed in such a way so as to provide techno-commercial and management mechanisms, which are suitable for long-term sustainability to be achieved through active involvement of key partners in the various activities. Another measure to ensure sustainability will be the capacity building element mainstreamed into each activity and outputs.

185. Strengthening linkages with other ongoing renewable energy projects and programmes in Cuba including UNDP/GEF renewable energy projects (i.e. national communications to UNFCCC, small hydro development and Bagasse based power generation) will be an important element of sustainability. This will be achieved by close cooperation between the projects, and through participation in crucial meetings and exchanging information on regular basis. Since UNIDO project team office is housed in UNDP building itself in Cuba, it is expected that there will be an active cooperation and close contact between both project teams. UNDP's representation will be included

in important coordination committees to be constituted for the effective implementation of the proposed RE IJ project.

186. Specifically, the key end results of the proposed project to ensure the sustainability are as follows:

- On-line data base generation, monitoring, analysis and dissemination of information on power generated and exported from the renewable energy projects - biomass gasifier and wind power,
- Skill up-gradation of the key stakeholders including financial institutions, R&D institutions, entrepreneurs and project developers, experts, consultants and engineers, Central & Local Governments and institutions, equipment and technology providers to ensure their close long term involvement.
- Establishment of a management mechanism for forest certification standards, pre-investment studies, consultancy services, training, R & D, leasing & financing, insurance, and information dissemination to ensure long term availability of institutional service support.

5.2 *Replicability*

187. The salient features of the project that would ensure replication on a wide scale are: overall policy framework to attract private sector investment to promote renewable energy based power generation, technology design and packaging, targeted financing incentives and mechanism for speedy processing of new project profiles, sustainable management of forests, developing certification standards, reduction in development time and cost, continuous monitoring of technical and financial inputs, and information sharing on lessons learned. Specifically during implementation, the project will promote technologies that: (i) are commercially proven; (ii) have excellent prospects for long-term market penetration once the identified barriers are overcome; (iii) can be produced or assembled locally, to ensure their wider acceptance and public support; and (iv) have the capacity to reduce greenhouse gas emissions. The financing mechanism (risk and replication management fund) applied to demonstration and follow-on investments will boost short-term supply, test regulatory and commercial procedures, and promote early commercialization and in-country and regional replication of renewable resources. Technical and financial advice for streamlining procedures and refining them, combined with capacity building among stakeholders will reduce the development time and costs of future projects. The public access to reliable and high quality data on renewable energy resources, performance of new technologies and cost-effectiveness will enhance the confidence level, and would strengthen the market linkages and growth. To enhance the replicability of the project, GEF technical assistance will support dissemination of project outcomes through appropriate channels, including regional workshops involving bilateral and multilateral donors, country officials and private investors.

188. There is a huge potential on the main land of Cuba in the form of forestry wood (where ever sustainable harvested), bio-wastes, crop residues and energy plantations on the degraded lands by planting indigenous fast growing species, which will be available at lower prices due to better collection and handling techniques. Mandatory forestry certification will be designed to verify good forest management practices, which would also include protection and conservation of biodiversity. Once the supply chain of biomass raw material becomes reliable and new technologies such as biomass gasifiers are demonstrated on the Isla de la Juventud and the proposed business models succeed in enhancing the confidence level of investors and government alike, replication potential could be as high as 200 MW on the main land in next 10-15 years itself as economics will work out much favourably for investors to replicate the business models.

189. Further, there exists ample scope for the development of other alternative and renewable sources of energy (i.e. production and commercialization of biogas starting from organic residuals, solar thermal energy use for the heating of the water in industrial facilities, cogeneration from

bagasse and wastes from sugar mills, independent small producers of renewable based electricity for agricultural watering), whose development is also limited by technical or financial barriers, and these technologies also require the support and application of similar financial and institutional mechanisms as being tried in the proposed RE IJ project to facilitate their penetration in the market.

190. At project completion, the risk and replication management fund will provide the financial mechanism for a national level revolving fund to support the pre-feasibility and feasibility studies for new renewable energy projects. This fund will also provide the technical and administrative means to implement support services²². Repayment of interest free loan released to the investors through risk and replication management fund will be fully invested in replication activities, and will act as a precursor for a national level renewable energy revolving fund in Cuba. Compañía Fiduciaria/Nueva Banca in Cuba will manage and invest this fund with commensurate fiduciary responsibility and accountability. Interest earned would exceed management costs allowing for some defaults to occur without much running down the fund. If the market grows as anticipated, it may be possible to establish a renewable energy equity fund that is capitalized by various local and foreign investors and bi/multilateral agencies. Such a fund mobilization strategy will be developed during the project implementation phase, and could be a significant outcome.

191. To the extent that this project is successful, the Cuban experience can easily be replicated in other countries of the region having biomass and wind resource potential, where similar Government commitment exists but policy and financing barriers hamper the implementation of renewable energy projects. UNEP will disseminate the project experience in the region through regional meetings and globally through various media.

192. Key dissemination and replication activities within Cuba will be executed by GEPROP and UNIDO. These are detailed in activities section. Broader significance of the activities for the region will be disseminated and replication encouraged by UNEP through workshops and publications. This activity is budgeted under Coordination, and is further described there. The outcome will be shared with the projects referenced in the project brief but mainly impacting wind and biomass technologies and use of the financial modalities. The CARICOM would be a good source of baseline information and serve as a parallel dissemination channel.

193. A UNEP cosponsored regional dissemination meeting would take place on Isla de Juventud after the business models are operational. Another meeting could be held in the French Caribbean Island of Guadeloupe with additional co-finance possible from France for renewable energy. Guadeloupe has a collapsible wind farm, and will build a waste incineration for power plant. They also have small hydro and geothermal energy installations.

194. The Solar and Wind Energy Resource Assessment project has received US \$ 200,000 new funding from the Dutch Ministry of Environment for enhancement and expansion of the SWERA project. US \$ 50,000 of this funding will be directed to the Caribbean region. Already, Dominican Republic and Belise have been identified for assessment activities. Regional dissemination meetings will fit with the intent of this funding, and to promote the regional solar and wind resource information developed by SWERA. These two events would be expected to draw representatives from the CARICOM countries. Travel costs will be the main expense. The meetings would discuss regional targets and action plans for renewable energy. The UNESCO Paris dissemination activities, UNIDO, and UNEP/DTIE Energy Program fact sheets, website, and other mechanisms will carry the Isla de Juventud project concept information.

²² ADEME (French Agency for the Environment and Energy Management) has confirmed to collaborate in the project by way of funding and developing feasibility studies and operationalization of the financial mechanisms proposed under the project. ADEME will closely with Compañía Fiduciaria to coordinate activities relating to capacity building at the national level in terms of financial sustainability of pilot demonstration projects on Economic Profitability and the Innovative Profitability Index Method.

195. UNIDO and the Global Sustainable Energy Islands Initiative (GSEII) have been jointly working with UN Foundation to develop a project to promote potential clean energy and renewable energy investment opportunities in the three Island Nations of St. Lucia, Dominica and Grenada. UNIDO has received planning grant, and is in the process of developing a full project. The lessons learned from implementation of the business models under the proposed RE IJ project will be disseminated in the Island Nations of St. Lucia, Dominica and Grenada for replication.

196. Indicators of replication will be the number of wind farms and biomass gasifiers being installed in the CARICOM and Caribbean. Grid connected installations are easily tracked through utility data; small biomass gasifier heating units could be tracked by manufacturer if they are willing to share the data. The mid term evaluation would capture the available data.

5.3 Risk analysis

197. This project presents several levels of risks:

- ***Low performance and reliability of the technology***
The project has low risks regarding execution as management, co-ordination and close monitoring have been integrated into a strong, yet flexible, implementation arrangements and choosing the right technologies and technology providers. Special consideration will be given to the wind farm to deal with the hurricane proven technologies.
- ***Reluctance of Regulators to Uphold Renewable Energy Policy Guidelines***
Sometimes, the lack of regulatory framework and/or its hostility toward renewable or intermittent source of energy could present a high risk. In the proposed project, since the Government has adopted a national policy to reduce fossil fuel dependency for electricity generation and use renewable energy as a substitute, wherever found feasible, to minimize the risk. Furthermore, the preparatory phase of this project has been done in close consultation with the regulatory body and among the activities planned, some activities are targeted towards capacity building and policy analysis as well as modernising the regulatory framework.
- ***Biomass Supply Risks***
This risk is significant as seen by the potential investors. It is based on the lack of any previous substantive experience so far as renewable energy technologies are concerned, and weak institutional and commercial infrastructure available locally to supply biomass fuels. A major capacity building programme has been designed for the local forestry company to overcome this risk. The assessment of available biomass resources revealed that the supply far exceeds the demand excluding the use of Marabu weed.
- ***Delay in identifying project promoters***
Since policy is already in place to facilitate private sector participation in the provision of public services, including electricity services, this risk is low. Moreover, development costs related to the contractual agreements in respect of joint ventures will be financed under the present project. This situation will be closely monitored during the project finalisation and implementation.

The private investors, especially those from outside Cuba, may not feel comfortable investing in the country in view of the poor state of the economy. Recent trends in investments in Cuba counter this risk to a great extent and UNIDO/UNEP have letters of intent for foreign and national investments and purchases that are more than sufficient to warrant project initiation.

- ***Slow Progress***

This risk is associated with the timely agreements (legal, PPAs etc.) between all partners, which would impact on the progress of the project activities. There are many different actors and players involved in the activities of the project and that may delay the implementation of the project. This risk is considered low as the full-scale project has been developed in close consultation with various key actors, and is supported at the highest political and administrative level. The local implementing agency-GEPROP- has fully been involved in project design. No major shift in Government policy is expected prior to the implementation of the project activities. As a result, final project implementation is not expected to be a lengthy, time-consuming process.

- **Environmental impact**

Since Isla de la Juventud has a fragile ecosystem, over exploitation of natural resources and carrying capacity of the island pose a significant risk that must be taken into account at every phase of the project. The environmental impact assessment carried out during the PDF phase revealed that implementation of this project will not disturb the local ecosystem²³ in any way. However, consequent tourism and population growth, and their impact on electricity demand within the Isla de la Juventud, will be monitored closely. This risk will be further addressed by putting in place a mandatory forest certification programme as per the guidelines laid down by FSC.

- **Replicability**

This risk factor is related to the replication of the Isla de la Juventud experience to other parts of Cuba, both the mainland as well as the region. This risk is also considered quite low. After the successful demonstration of the joint venture approach in Isla de la Juventud to sell renewable energy-based electricity to the grid using the PPA concept, it is expected the investors, both local and foreign, will find business models interesting and worth replicating. A positive experience in the Isla de la Juventud will go a long way towards generating investor confidence in IPP / PPA arrangements in the electricity sector in Cuba.

198. The following table gives a brief overview of major risks and their mitigation in project design. It includes not only risks external to the overall project, but also risks that are inherent to the design of biomass and wind power projects in general.

Table 5
Potential Risks and Mitigation Measures

Risks	Mitigation measures
Low performance and reliability of the technologies	<i>Risk level: Low</i> Proven renewable energy technologies proposed; Continuous, rigorous technical performance monitoring & reporting; Maintenance contracts will ensure quick rectification of problems; Hurricane risk management and robust technologies proposed.
Reluctance of Regulators to Uphold Renewable Energy Policy Guidelines	<i>Risk level: Moderate</i> Capacity building activities to focus on building suitable regulatory environment for renewables; Participation in the project activities to ensure optimal communication.
Biomass Supply Risks	<i>Risk level: Moderate to high</i> Long-term supply contracts to be established between the local forestry company and the

²³ This point was also confirmed by the independent forestry expert, who undertook a field trip to Isla de la Juventud, and reviewed the reports that were prepared by the national forestry experts and institutions during the PDF phase activities.

	<i>gas from biomass</i> producers to ensure supply of biomass feedstock; Pre-feasibility study shows that biomass supplies are sufficient to justify investments; A large capacity building activity to create the proper business-institutional structure that will sustain the biomass production; Cross participation of the investors both in the gas production plant and in the biomass production plant will be supported.
Delay in identifying project promoters & sponsors	<i>Risk level: Moderate</i> Promoters and sponsors involved at the project design stage; Risk and Replication Management fund mechanisms to be put in place to induce investors.
Slow progress	<i>Risk level: low</i> Commitment of the key stakeholders have been obtained; Local implementing agency involved from inception of project preparation activities; Close monitoring of the project proposed.
Environmental impact	<i>Risk Level: Low</i> Closely monitoring of the environmental risk factors; Selection of the right technology; Adoption of a sustainable forestry management. Mandatory forest certification scheme in place.
Replicability	<i>Risk Level: Moderate</i> Close monitoring of the project proposed; A comprehensive information dissemination thrust proposed both at the national and international level to ensure replicability of business models.

6. **STAKEHOLDER PARTICIPATION AND IMPLEMENTATION ARRANGEMENTS**

6.1 *Project stakeholders*

199. A number of the relevant Government institutions in Cuba dealing with energy, environment and electrification issues and with international collaboration participated in the project during the implementation of the PDF-B phase. National agencies and the local Isla de la Juventud administration helped to carry out the necessary feasibility studies and analysis essential for the formulation of the full-scale project.

200. The key stakeholders of the full-scale project are as follows:

- The Isla de la Juventud power utility (OBE) will be in charge of buying electricity from the Independent Power Producers, who will be producing electricity from biomass and the wind energy park.
- ALASTOR Energy Enterprise would coordinate installation and operation of industrial gasifiers with private investors joining the project for producing process heat.
- ECOSOL, as a Renewable Energy Enterprise, will operate the Wind Power Farm selling the power generated. Association of ECOSOL with a foreign company capable of providing technology and co-financing support is also envisaged as an attractive option.
- The Isla de la Juventud Integral Forest Enterprise (local forestry company) will be in charge of supplying chipped wood for fuelling the biomass power plant generator and process industry gasifier. They will facilitate development of mandatory forest certification standards and putting in place an independent reviewing mechanism to certify sustainable forests management practices on the Isla de la Juventud.

- Ministry of Science, Technology and Environment (CITMA) - National Focal Point for GEF matters and main authority for environmental policy, strategy, regulations, inspection, management and education. The Centre for Management of Priority Programmes and Projects - GEPROP, the main national counterpart agency for the project is under the administrative control of CITMA.
- Ministry of Foreign Investment and Economic Collaboration (MINVEC) – MINVEC oversees all aspects of international technical assistance and cooperation initiatives. MINVEC is the channel for joint-venture proposals in Cuba, and is the national counterpart of UNIDO.
- Ministry of Economy and Planning (MEP) - At the macro level, MEP plays the key role in the national planning and control of the energy resources, national or imported. At the same time MEP elaborates the main development policy and strategy of the energy sector.
- Ministry of Finance and Prices (MFP) - As the leading governmental ministry in pricing policy, deals at the macro level with the establishment of tariffs/prices, in line with the economic and social policies of the Government. In coordination with the Ministry of Economy and Planning and the Ministry of Basic Industry, MFP establishes the regulatory framework for tariffs/prices of energy services, in particular electricity.
- Ministry of Basic Industry (MINBAS) – MINBAS regulates the most important power plants in the country, accounting for 80% of the installed capacity for electricity generation (74% by oil and 6% by gas). MINBAS also controls the UNE, the utility responsible for the national electricity grid that supplies electricity to most of the country. It is the main institution for the transmission and distribution of electricity. MINBAS and UNE, according to national policies, have been entitled to buy electricity
- Local Administration that benefits from the innovative renewable energy technologies and energy efficiency schemes promoting self-sufficiency in energy matters and reducing oil imports. During the PDF B phase, the local administration council was kept informed about the project activities, and they have confirmed their full support to the project implementation.
- The local enterprises and industrial plants which will use the process heat generated by biomass gasifier systems, will constitute an important group of key stakeholders.
- Investors, companies and entrepreneurs, who will invest in business models, will be the key stakeholder to establish the commercial viability and sustainability of the project.
- Community participation is important for the sustainability and the future of the project. It is important that the island residents and local administration are actively involved in the implementation of the main project, and their active support is secured.

Public Involvement

201. The project team, in close collaboration with local administration, will ensure active public participation at every stage of the implementation phase, and to enhance local ownership of the project activities. The project team will organise “awareness meetings” with the local people on the Isla de la Juventud to secure their support to the business models proposed under the project, and to explain to them the benefits that would accrue to them. This is particularly true for the proposed mini pilot project at Cocodrilo, which will be a community demonstration pilot plant based on the biomass gasifier technology, and would strengthen the electricity supply to the local community based at Cocodrilo. Using the mechanism of Local Advisory Committee, which was created during the PDF phase and comprises of key stakeholders at the local level, the project team will reach out to the general public, civil society, women groups and industrial associations to sensitise them about linkages between renewable energy technologies and productive use activities, and opportunities for income generation activities under the project. It is expected that the successful implementation of business models would greatly improve the financial status of participating enterprises, and consequent enhanced employment opportunities on the Isla de la Juventud.

6.2 Project Implementation Arrangements

202. For the GEF, UNEP is the Implementing Agency, which will oversee the successful achievement of the project objectives, while UNIDO will execute the project activities. The national counterpart agency will be the Centre for Management of Priority Programmes and Projects (GEPROP) under the Ministry of Science, Technology and Environment, Government of Cuba, and Compañía Fiduciaria – a national level trust fund financial and banking company.

203. UNIDO will set up a Project Management Unit (PMU) expanding the existing national field office to coordinate and execute the project activities. The project staff and experts will report to PMU on their inputs, which will be headed by a project coordinator. The project coordinator, who will be appointed by UNIDO, will coordinate and ensure timely implementation of the project activities. A Project Steering Committee (PSC) will be set up to oversee the project implementation. The project steering committee would comprise of the key Government agencies (including Ministry of Science, Technology and Environment, Ministry of Foreign Investment and Economic Collaboration, Ministry of Finance and Ministry of Economy), local administration, financial community, public utility, civil society and the private sector. The PSC would advise on inter-ministerial coordination and cooperation, besides serving as a platform for sharing information on the project's progress.

204. The Local Advisory Committee (LAC) comprising of key stakeholders including local administration, local electricity utility, local forestry company, NGOs and local industrial organizations (created during the PDF phase) will be responsible for the coordination and monitoring the project activities at the local level. The LAC will facilitate public participation in the implementation phase, and would ensure local ownership of the project through information dissemination on regular basis. The LAC will also ensure that all key decisions on location of various facilities under the proposed project are taken after taking into account inputs provided by the public representatives, NGOs and local industrial associations. The LAC will assist in mainstreaming gender issues into the project activities by involving women groups in decision-making processes at every stage.

205. The Ministry of Science, Technology and Environment, which also hosts the GEF Operational Focal Point, will facilitate coordination with other developmental and renewable energy programmes being implemented by the Cuban Government and other donor agencies on the Isla de la Juventud and the rest of the country. The Ministry of Foreign Investment and Economic Collaboration (MINVEC), which oversees all aspects of international technical assistance and cooperation initiatives in Cuba, will be the channel for joint-venture proposals. MINVEC will also facilitate dialogue with other multi/bilateral agencies, and would extend support in mobilizing additional resources from these agencies, and in linking up with their projects in the country. The Ministry of Finance and Prices (MFP) would help in establishing the regulatory framework for tariffs/prices of energy services based on renewable energy technologies.

206. Implementation of the project activities would require close monitoring and rigorous evaluation to meet the key objectives. The Project Management Unit will coordinate the project activities and monitor indicators in Cuba for the sustainability and replicability of the project outputs beyond its life. The project team will also link up with other ongoing GEF projects in Cuba, specifically with UNDP/GEF supported project on co-generation using Sugarcane Bagasse and Trash, and use their experience in dissemination strategy. UNDP project coordinator will be invited to the steering committee meetings for better coordination and exchange of information between both projects. A close supervision and monitoring of indicators for outputs and outcomes will be undertaken by the UNIDO and the project management unit (PMU) to establish global and local benefits accrued from the project. UNEP will review UNIDO project monitoring reports, and as necessary join the Steering Committee meetings. Further details on the monitoring, evaluation and reporting along with the proposed management structure are given at Annex 8.

7. INCREMENTAL COSTS AND PROJECT FINANCING

7.1 Incremental costs

207. This project is designed to remove barriers to the renewable energy technologies based power generation on the Isla de la Juventud in Cuba. In doing so, it would aim at achieving the stated objectives of GEF Operational Program 6 as well as meeting secondary objectives of reducing the risks to the environment.

208. The up-front cost of the proposed alternative is higher than the respective baseline projects, i.e. fuel-oil based thermal power plant of equivalent capacity. A fund to provide for high upfront costs has been proposed for supporting the business models through the GEF funds. It is proposed to support a new and innovative funding mechanism to provide interest free loan to ensure the long-term replicability, and to share risks with investors. As it is unlikely that the project activities would take place in the absence of GEF, UNEP and UNIDO support, the project can largely be considered to be incremental.

209. In all, GEF will provide US \$ 5.337 million, out of which US\$ 3.279 million will be earmarked for technical assistance activities such as building local and national capacity through training, establishment of policy and regulatory framework, power purchase agreements and the project management structure to coordinate project activities. Rest of the GEF funding to the tune of US \$ 2.058 million will contribute to setting up of a new and innovative financial mechanism – a Risk and Replication Management fund, which essentially will be an interest free loan for promoting private sector investments during the demonstration phase, and also to meet costs on building capacity of financial institutions in renewable energy project appraisals, financial analysis and managing revolving funds. On completion of the project, repayment of this fund will support replication and pre-feasibility studies for new renewable energy projects in the pipeline.

210. The RRM fund is to act as a national revolving equity fund for promoting renewable energy technologies in the country. This fund, which essentially will be an incremental cost, shall be provided by GEF. A detailed assessment of incremental costs on technical assistance activities and innovative financial mechanism is given in Annex 8.

7.2 Global and local environmental benefits

211. The project will focus on renewable energy technologies that will provide global environmental benefits and will emphasise the role of renewable energy technologies in meeting power needs of a small island – Isla de la Juventud which is at present heavily dependent on fossil fuels to meet its energy needs. The project would focus on renewable energy technologies that are making a difference in terms of the global environment as well as the local environment, consistent with the goals of global environment conventions.

212. In terms of the energy services provided to the electricity consumers of the Isla de la Juventud, the quality of energy supply will be much improved due to the greater reliability of supply of the biomass fuel which is available locally, and therefore fewer chances of electricity cuts due to power shortages. This will greatly help small businesses as well as private consumers. In terms of the power generation efficiency, which is a current OBE focal point of concern, it will be improved due to shutting off old fossil fuelled engines, bringing as a consequence saving on maintenance activities as well as reliable operating conditions.

213. In terms of global benefits, the implementation of this project will result in a net GHG emission reduction of 26,000 tonnes of CO₂ per year (once business models become fully operational), or nearly 390,000 tonnes over the 15-year lifetime of the project equipment. To the extent that the success of the Isla de la Juventud project can be replicated in other non-electrified remote areas of Cuba, this figure would easily triple during a ten-year period following the project.

214. In addition to the above, there is an additional global environmental benefit of reducing the risks to local flora and fauna from future oil spills. By reducing the fuel oil requirements of the island by nearly 5,400 tonnes per year that represents 15 shipments of fuel-oil and diesel per year, both the probability and intensity of future oil spill risks are reduced.

215. In terms of the local environment, using renewable energy in place of diesel generation will reduce emissions and pollution that might be of local concern if population and tourist industry growth were to develop as predicted. With reference to the local environmental implications of the substitution by renewables and use of local biomass resources, all local environmental regulations will be observed. Mandatory forestry certification will be designed as per FSC guidelines for providing market incentives for sustainable forest management.

7.3 Project financing

216. During the PDF phase, UNIDO and GEPROP organized consultations both at Havana and Vienna to engage private sector investors and companies in business models being proposed under the project. In all, three meetings and consultations were held at Havana and Vienna where about 12 companies participated. During the consultations, four companies showed a keen interest in investing and joining the project, and they were involved in detailed discussions. 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 have, in-principle, agreed 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. These letters have been put on file and shared with the GEF Sec. The GEF will provide 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). The incremental cost calculations for the project are based on the economic analysis of each activity and global benefits thereof. The GEF assistance will be used in all those activities that will enable the implementation of the CO₂ reduction activities and remove barriers such as technical assistance, financial, capacity building, training, project management, etc.

217. Technical assistance is needed for the following activities:

- Assist the government in developing and implementing a legal and policy framework for renewable energy technologies based power generation and distribution;
- Facilitate early clearance of renewable energy projects proposed by investors by streamlining the process (adopting a single window clearance approach);
- Selection of technology package and transfer biomass and wind technology know-how to a broad base of stakeholders;
- Remove environmental and policy barriers to renewable energy technologies;
- Provide policy planning and project evaluation capacity to the local government;
- Build capacities of local/national institutions and agencies involved in dissemination of renewable energy technologies and
- Adopt an information dissemination and replicability strategy for business models implemented under the project.

218. TA would, among others, also include business, finance and technical skills for bankers, renewable energy entrepreneurs and personnel working in the energy sector. Training courses will focus on the provision of business tools, training on financial mechanisms to financial intermediaries, and capacity building of major stakeholders in renewable energy technologies - biomass and wind energy technologies.

219. A new and innovative financial modality (RRM Fund) to provide interest free loan to investors to partially meet their upfront risk costs for undertaking business models is being proposed in the project to address the financial barriers. During the duration of the project, the project management team along with the Compañía Fiduciaria – a national level trust fund financial and banking company, will administer the RRM Fund under the overall supervision of the national steering committee, and backstopped by UNIDO.

Risk and Replication Management Fund (RRM Fund)

220. A risk and replication management fund of US \$ 1.92 million is proposed under the project to cover early project development and operating costs to share risk of new investors. The fund, which essentially will be an interest free loan, would cover a small part of the private investment component that will be taken as a GEF risk sharing contribution to the private investors. After the pay back period of the respective investment, or when investment has been recovered, the private investor will have to repay the GEF contribution to a revolving fund at the rate that will not affect his capacity to fulfil his obligations with the final payment and it will be possible to start financing replication activities in the shortest possible period of time. The fund is to be set up at the national level as Risk and Replication Management Fund (RRMF) with the Compañía Fiduciaria, which has extensive experience in this area.

221. The design of the RRM fund will include legal and contractual measures to avoid inappropriate use of funds or unnecessary losses. On completion of the project, the RRM fund will act as a precursor to a national level renewable energy development fund, and also pay for the pre-feasibility and feasibility studies on a cost-share basis with private developers for new renewable energy projects in the pipeline.

222. At present, national and regional lenders and investors are not providing funds for renewable energy projects due to their unfamiliarity with the sector, and partially due to the lack of a clear legal and policy framework for investing. Well-prepared projects, using best practices and providing high-quality engineering and financial analysis are more likely to become success stories for the emerging renewable energy markets in Cuba, and would facilitate transfer of skills to consultants and developers. The risk and replication management fund²⁴ has been proposed to provide interest free loans to attract private investments, and meet a part of upfront costs on the civil construction, technology package and contractual costs on four business models in the project. The RRM Fund and grants of interest free loans to four business models will be coordinated by the Compañía Fiduciaria under the overall supervision of the national steering committee, and backstopped by UNIDO and partners such as ADEME.

223. As a part of risk and replication management fund, the development costs covered by the GEF will be capitalized in the total project costs, and will be replenished into a national level revolving fund primarily meant for replication activities, and for carrying out the pre-feasibility and feasibility studies to attract investments on future renewable energy projects in Cuba. In this way, GEF funds will reach more broadly into the market based approach besides reducing the initial risk on investments. ADEME will also coordinate activities relating to capacity building at the national level in terms of financial sustainability of pilot demonstration projects on Economic Profitability and the Innovative Profitability Index Method.

²⁴ During PDF-B studies, several alternative scenarios were studied, and after running several financial models, it was established that meeting a part of the upfront costs on the civil construction, technology package and contractual costs through an interest free loan under a RRM fund would be the most balanced figure, mainly because it would ensure a reasonable IRR for sustainability of business models. It was also determined that the payback of the risk and replication management fund (RRMF) for each business unit could be done after providing for a grace period. In this way, the financial indicators of the project would be strengthened, and the key financial barriers would be addressed by putting in place a new and innovative financial mechanism (RRMF) that may lead to a national level renewable energy development fund at the end of the project.

224. The RRM fund facility will be used to support development of a pipeline of potential projects in Cuba. This initial project identification and screening will be carried out during the implementation phase, and will provide the Technical and Financial Service Unit and GEPROP with sufficient cash flow to begin using the Risk and Replication Management Fund on the completion of business models.

225. In order to ensure long-term commitment, proper business finance and higher project performance, on completion of project, it is envisaged to explore the setting up of a national level renewable energy development fund to support new projects. This fund will not just ensure the replication and satisfactory performance of new projects, but also to reduce the risks associated with the supply of biomass, gas and electricity through renewable energy technologies respectively.

226. It is noted that bilateral funding is likely come into play as well. Ongoing consultations with bilateral agencies to join hands in strengthening new and innovative financial mechanisms have started yielding results. ADEME (French Agency for the Environment and Energy Management) has now confirmed to collaborate and co-finance the project activities to the tune of about \$ 200,000, especially concerning the operationalization of the financial mechanism proposed in the project. New funding so received will be used to undertake feasibility studies, and to expand the investment volume.

227. A summary of the financial structure of the project is given in Annex 1 A and B.

8. MONITORING EVALUATION AND DISSEMINATION

228. Monitoring, evaluation and dissemination will form an integral part of the project. The project will follow all standard UNEP, GEF and UNIDO procedures for monitoring and reporting. This process will include a mid-term assessment and end of project assessment undertaken by UNEP and UNIDO. A close supervision and monitoring of indicators for outputs and outcomes will be undertaken by the UNIDO and the project management unit (PMU) to establish global and local benefits accrued from the project. UNEP will review UNIDO project monitoring reports, and as necessary join the Steering Committee meetings in order to represent to the GEF M&E the status and impact of the project.

229. The Project Steering Committee (PSC) will be responsible for the general monitoring and supervision of the project implementation. PSC and Local Advisory Committee on the Isla de la Juventud will provide task managers at UNEP and UNIDO with independent assessments of the progress of the project based on annual reports provided by the PMU, which will themselves be based on those received from experts, contractors and consultants. They will make recommendations for adjustments to the work plans that may be necessary as a result of this review process.

230. Annual progress will be evaluated by the PSC against work plans and reports that the PMU will develop at the start of the project as well as at regular intervals. These will be based on the log frame matrix and monitoring arrangements (see Annex 8). At the inception of each activity, a work plan will be established, whereby the sub activities will further monitored on time-bound milestones or indicators. Progress against these milestones will be reported to the Local Advisory Committee and recommendations from them will then be passed on from the PMU to the PSC, UNEP and UNIDO.

231. Each Business Model will also be annually reviewed against work plans established by the PMU in a similar manner to that described above. These will be developed initially in collaboration with the lead investors/contractors to whom Business Models will be awarded, based on guidelines

provided by the PSC. The PMU will review each annual report and work plan and pass it on to the UNIDO, UNEP and PSC with comments as necessary.

232. The lessons to be learned from the project will be disseminated through a wide range of media to a number of targets to ensure that maximum benefit can be gained from the project. This dissemination will be through both - mechanisms designed to achieve this and elements that are integral to the project. Business Models by their very nature are designed to disseminate the lessons learned as far as possible. Where relevant they will be used as focal points for various projects activities such as the exchange programme, and will be proposed as locations for training and awareness workshops and meetings. Experience gained under mandatory forest certification programme will be disseminated to rest of the country for replication and wide scale adoption. The progress and results of these activities will be regularly available through hard copy and electronic newsletters. A publication addressing the best practices used and lessons to be learned will also be produced. More generally, newsletters will be provided regular updated on activities at the national and regional level.

233. As well as dissemination outside the project, there will also be mechanism within the project to ensure that lessons learned can be shared across the country. This is especially important in terms of making sure that valuable principles established and experience gained on the Isla de la Juventud can be applied in the rest of the country. The project will be subject to a joint review by UNEP, UNIDO and the Government of Cuba once a year. The national project coordinator shall prepare and submit to each review meeting a progress report highlighting the milestones achieved.

234. Sustainability prospects of business models implemented under the project will be evaluated by UNEP/UNIDO at the project conclusion, by examining the funding situation for continued operation, such as co-financing and revenue generation, commitment of investors and cooperating organizations and demonstration of growing demand for renewable energy technologies based power generation and process heat services among key stakeholders in Cuba.

SECTION 3 - WORKPLAN AND TIMETABLE, BUDGET AND FOLLOW-UP

Work plan and Timetable

235. A tentative Work plan and Timetable can be found in **ANNEX 2**.

Budget

236. The project funding will be used to finance the activities mentioned in Section 2. A detailed budget following UNEP format can be found in **ANNEX 1A** of this document. This budget is based upon the GEF approved budget provided in GEF format in **ANNEX 1B**. The total budget proposed for the full phase activities is US\$ 16.041 million with a GEF contribution of US\$ 5.337 million, co-funding amounting to US\$ 170,000 from UNIDO, US\$ 50,000 from UNEP, in-kind/cash contribution in the amount of US\$1.624 million from the Cuban Government, US \$ 200,000 from ADEME and US \$ 8.66 million from the private sector.

Follow-Up

237. The follow-up activities will include dissemination of lessons learned and results of the project, documentation of best practices, networking of institutions to strengthen cooperation between institutions for promoting replication of business models, strengthening national as well as regional manufacturing base for renewable technologies and operationalization of national fund to support renewable energy based power generation in Cuba.

SECTION 4 - INSTITUTIONAL FRAMEWORK AND EVALUATION

Institutional Framework

238. All the activities proposed under the project will be completed in a period of 6 years. The implementation of the project will be monitored in accordance with the objectives and activities outlined in Section 2 of this document by the UNIDO Headquarter staff (Industrial Energy and Climate Change Branch) as well as by the UNIDO field Office in Cuba. UNEP as the implementing agency will monitor progress and GEF eligibility as well as integration with regional programs in this technology area. In addition to the UNIDO and UNEP monitoring and evaluation, the two national counterpart agencies will have a major role in this process. This will be beneficial firstly because of their local knowledge and understanding and secondly, as it is expected that during implementation, these agencies will be full and firm project partners.
239. The UNEP/DGEF Co-ordination will monitor implementation of the activities undertaken during the execution of the project. The UNEP/DGEF Co-ordination will be responsible for clearance and transmission of financial and progress reports to the Global Environment Facility. UNEP retains responsibility for review and approval of the substantive and technical reports produced in accordance with the schedule of work.
240. Prior to contracts, sub-contracts, or letters of agreement being entered into by UNIDO, UNIDO will submit to DTIE GEF Co-ordination Unit copies of all these documents. Within ten working days, DTIE GEF Co-ordination Unit will review, provide guidance and give UNIDO substantive clearance on the technical content of these contracts, sub-contracts and letters of agreement.
241. All correspondence regarding substantive and technical matters should be addressed to:

At UNIDO:

Dr. Pradeep Monga
Senior Industrial Development Officer
Energy and Cleaner Production Branch
UNIDO, Vienna International Centre
P.O. Box 300
A-1400
Vienna
Austria
Tel: (43-1) 26026 3018
Fax: (43-1) 26026 6855
Email: p.monga@unido.org

At UNEP:

Tom Hamlin
Climate Change Task Manager
UNEP
Tour Mirabeau,
39/43 quai André Citroën
75739 Paris cedex 15
France
Tel: (33 -1)-4437-3003
Fax: (33 -1)-4437-1474
Email: tom.hamlin@unep.org

With a copy to:

Dr. Cahit Gurkok
Director
Energy and Cleaner Production Branch,
UNIDO, Vienna International Centre
P.O. Box 300
A-1400
Vienna
Austria
Tel: (43-1) 26026 4575
Fax: (43-1) 26026 6855
Email: c.gurkok@unido.org

Mr. Ahmed Djoghlaif
Assistant Executive Director
Division of GEF Coordination, UNEP
P. O. Box 30552
Nairobi, Kenya
Tel: (254-20)-624 165
Fax:- (254-20) 624 041
Email: Ahmed.Djoghlaif@unep.org

242. All correspondence regarding administrative and financial matters should be addressed to:

At UNIDO:

Ms. Amita Misra
Director Finance, UNIDO
Vienna International Centre
P.O. Box 300
A-1400
Vienna, Austria
Tel: (43-1) 26026 3671
Fax: (43-1) 26026 66825
Email: a.misra@unido.org

With a copy to

Mr. A. Noro
Finance Officer, UNIDO
Vienna International Centre
P.O. Box 300
A-1400, Vienna, Austria
Tel: (43-1) 26026 3978
Fax: (43-1) 26026 66825
Email: a.noro@unido.org

At UNEP

Mr. S. Kurdjukov
Officer-in-Charge
Budget and Financial Management Service (BFMS)
UNEP
P.O. Box 30552

Nairobi, Kenya
Tel: (254-20) 623 637
Fax: (254-20) 623 755

With a copy to:

Ms. Elaine King
Fund Management Officer
Division of GEF Coordination, UNEP
P.O. Box 30552
Nairobi, Kenya
Tel: (254-20) 624 605
Fax: (254-20) 623 162/624 041/624 042
Email: Elaine.King@unep.org

Evaluation

243. Standard evaluation of the project will be carried out according to the well established GEF Evaluation Procedures and Guidelines.
244. Because of the complex nature of ascertaining the different socio-economic benefits of this project and innovative approach being adopted to implement business models and new financial mechanisms in Cuba, a number of additional methods of evaluation will be employed to gauge the effect of business models and their impact on replication potential in the region. In terms of the power generation and process heat generation components of the project, the respective Ministries and National Agencies will conduct inbuilt and continuous monitoring and evaluation of the effectiveness of the business models. The Ministry of Science, Technology and Environment (CITMA) - National Focal Point for GEF matters and Ministry of Foreign Investment and Economic Collaboration (MINVEC) which oversees all aspects of international technical assistance and cooperation initiatives, will conduct regular monitoring and evaluation of the project activities. All monitoring and evaluation procedures will be coordinated between the different stakeholders in an open forum manner. Furthermore, many of the cooperating institutions and partner agencies are expected to be involved in the M&E process to different degree.
245. Every year, UNEP Division of GEF Coordination will undertake a desk evaluation using the format given in **ANNEX 7**, to measure the degree to which the objectives of the project have been achieved. This will be in addition to the standard mid-term and final evaluations of the project per UNEP procedures as outlined in Section 2 paragraph 228 as well as supervision missions conducted by the UNEP Task Manager.

SECTION 5 - MONITORING AND REPORTING

Management Reports

Progress Reports

246. Within 30 days of the end of the reporting period, UNIDO will submit to UNEP, with a copy to Division of GEF Coordination, using the format given in **ANNEX 5A**, half-yearly progress reports as at 30 June and 31 December.
247. The Inventory of Outputs/Services should be submitted with all Progress Reports and the Terminal Report. The report is due within 30 days of the end of each half-yearly period when submitted with a Progress Report or within 60 days of the completion of a project when submitted with a Terminal Report. The format of the report is given in **ANNEX 5B**.

Terminal Reports

248. Within 60 days of the completion of the project, UNIDO will submit to UNEP, with a copy to UNEP/DGEF Coordination, a Terminal Report detailing the activities taken under the project, lessons learned and any recommendations to improve the efficiency of similar activities in the future, using the format provided in **ANNEX 6**.

Substantive Reports

249. At the appropriate time, UNIDO will submit to UNEP three copies in draft of any substantive project report(s) and, at the same time, inform UNEP of its plans for publication of that report(s). UNEP will give UNIDO substantive clearance of the manuscript, indicating any suggestions for change and such wording (recognition, disclaimer, etc.) as it would wish to see figure in the preliminary pages or in the introductory texts.
250. It will equally consider the publishing proposal of UNIDO and will make comments thereon as advisable. It may request UNIDO to consider publication on a joint imprint basis. Should UNIDO be solely responsible for publishing arrangements, UNEP will, nevertheless, receive 10 free copies of the published work in each of the agreed languages, for its own purposes.

Financial Reports

251. UNIDO shall submit to UNEP quarterly project expenditure accounts and final accounts for each project, showing amount budgeted for the year, amount expended since the beginning of the year, and, separately, the unliquidated obligations as follows:
- (i) Details of project expenditures on an activity-by-activity basis, reported in line with project budget codes as set out in the project document, as at 31 March, 30 June, 30 September and 31 December each year, providing details of unliquidated obligations separately (see formats in **ANNEX 4A** and **ANNEX 4B**). The expenditure accounts will be dispatched to UNEP within 30 days after the end of the quarter to which they refer.
 - (ii) The expenditure account as at 31 December is to be received by UNEP by 31 March each year.
 - (iii) A final statement of account, in line with UNEP project budget codes, reflecting actual final expenditures under the project, when all obligations have been liquidated.
 - (iv) Within 30 days of the reporting period, UNIDO shall submit to UNEP GEF Coordination Office, a cofinancing report for the project as at 30 June and 31 December, using the format provided in **ANNEX 1C** showing:

- (a) Amount of cofinancing realized compared to the amount of cofinancing committed to at the time of project approval, and
- (b) Cofinancing reporting by source and by type.

- ◆ Sources include the agency's own cofinancing, government cofinance (counterpart commitments), and contributions mobilized for the project from other multilateral agencies, bilateral development cooperation agencies, NGOs, the private sector, and beneficiaries.
- ◆ Types of cofinance. Cash includes grants, loans, credits and equity investments. In-kind resources are required to be:
 - dedicated uniquely to the GEF project,
 - valued as the lesser of the cost and the market value of the required inputs they provide for the project, and
 - monitored with documentation available for any evaluation or project audit.

Terms and Conditions

Non-expendable equipment

- 252. UNIDO will maintain records of non-expendable equipment (items costing US\$1,500 or more as well as items of attraction such as pocket calculators, cameras, computers, printers, etc.) purchased with UNEP funds (or with trust funds or counterpart funds administered by UNEP). UNIDO will submit an inventory of such equipment to UNEP, indicating description, serial no., date of purchase, original cost, present condition, location of each item attached to the half yearly progress reports, using the format in **ANNEX 5C**.
- 253. Within 60 days of completion of the project, UNIDO will submit to UNEP a final inventory of all non-expendable equipment purchased under the project indicating description, serial number, original cost, present condition, location and a proposal for the disposal of the said equipment. Non-expendable equipment purchased with funds administered by UNEP remains the property of UNEP until its disposal is authorized by UNEP, in consultation with UNIDO. UNIDO shall be responsible for any loss or damage to equipment purchased with UNEP administered funds. The proceeds from the sale of equipment (duly authorized by UNEP) shall be credited to the accounts of UNEP, or to the appropriate trust fund or counterpart fund.

Responsibility for Cost Overruns

- 254. UNIDO is authorized into commitments or incur expenditures up to a maximum of 20 percent over and above the annual amount foreseen in the project budget under any budget sub-line, provided the total cost of the UNEP annual contribution is not exceeded. This may be done without prior authorization, but once the need for these additional funds becomes apparent, a revised budget request should be submitted to UNEP immediately. Cost overruns are the responsibility of UNIDO unless a revised budget has been agreed with UNEP.
- 255. Any cost overrun (expenditure in excess of the budgeted amount) on a specific budget sub-line over and above the 20 per cent flexibility mentioned above should be met by UNIDO, which originally assumed responsibility for authorizing the expenditure, unless a revision has been agreed to by UNEP prior to the authorization to cover it. Savings in one budget sub-line may not be applied to overruns of 20 percent in other sub-lines, even if the total cost to UNEP remains unchanged, unless this is specifically authorized by UNEP upon presentation of the request. In such a case, a revision to the project document amending the budget will be issued by UNEP.

Claims by Third Parties against UNEP

256. UNIDO shall be responsible for dealing with any claims which may be brought by third parties against UNEP and its staff, and shall indemnify UNEP and its staff against any claims or liabilities resulting from operations carried out by UNIDO under this project document, except where such claims and liabilities arise from negligence or misconduct of the staff of UNEP.

Cash Advance Requirements

257. An initial cash advance of US\$ 500 000 will be made upon signature of the project document by both parties and will cover expenditures expected to be incurred by UNIDO during the first three months of the project implementation. Subsequent advances are to be made quarterly, subject to:
- (i) Confirmation by UNIDO at least two weeks before the payment is due, that the expected rate of expenditure and actual cash position necessitate the payment, including a reasonable amount to cover "lead time" for the next remittance; (see format of request in **ANNEX 3**) and
 - (ii) The presentation of:
 - A satisfactory financial report showing expenditures incurred for the past quarter, (see format in **ANNEX 4A**) under each project activity and
 - Timely and satisfactory progress reports on project implementation.

Publications

258. For publications issued with UNIDO, both the cover and the title page of the publication will carry the logo of UNEP and the title United Nations Environment Programme together with that of UNIDO. UNIDO will submit three copies of any manuscript prepared under the project for clearance prior to their publication in final form. UNEP's views on the publication and any suggestions for amendments of wording will be conveyed expeditiously to the agency, with an indication of any disclaimer or recognition which UNEP might wish to see appear in the publication.

Amendments

259. The Parties to this project document shall approve any modification or change to this project document in writing.

LIST OF ANNEXES

- ANNEX 1: A: Budget in UNEP Format
 B: Budget by Project Component Activity
 C: UNEP/GEF Report on Planned Project Cofinance and Actual Cofinance Received
- ANNEX 2: Timetable and Work plan
- ANNEX 3: Format for Cash Advance Statement
- ANNEX 4: A: Format for Quarterly Project Expenditure
 B: Format of Quarterly Reporting on Unliquidated Obligations
- ANNEX 5: A: Format for Half-yearly Progress Report to UNEP
 B: Format for Inventory of Outputs/Services
 C: Format for Inventory of Non-Expendable Equipment
- ANNEX 6: Format for Terminal Report
- ANNEX 7: Format for Self-evaluation Fact Sheet
- ANNEX 8: Executive Summary (revised)**
A: Incremental Cost Matrix
B: Logical Framework Planning Matrix
C1: STAP Roster Review
C2: Response to STAP Roster Review
L: Response to GEF Sec Review for CEO endorsement and Work Program, UNDP Comments and GEF Council Comments
D: Operational Focal Point Endorsement
D1: MINVEC Endorsement
D2: ADEME Cofinance Letter
D3: Cuba Government Cofinance Letter
- ANNEX 9: Other Supporting Documents (in a separate compressed file folder)**
E: Financial and Technical Details
E1: Note on the Risk and Replication Fund
E2: ADEME Support
E3: Note on Foreign Investments in Cuba
F: Heat Value of Fuels
G: Biomass Assessment
G1: Independent Biomass Sustainability Review (Forestry Expert Report)
G2: Additional Biomass Assessment Info

H: Cocodrilo
I: (Implementation has been moved to the main Project Document page 67)
J: Monitoring and Evaluation Structure
K: Maps
- ANNEX 10 A: Terms of Reference Project Coordinator and Technical Expert**
B: Terms of Reference for the Project Steering Committee

ANNEX 1A BUDGET IN UNEP FORMAT

[illegible]

[illegible]

[illegible]

5203	Website		40,000		10,000		10,000		5,000		5,000		5,000		5,000		0
5204	Unspecified		60,000		5,000		10,000		10,000		10,000		10,000		10,000		5,000
5299	Sub-Total		230,000		35,000		40,000		35,000		35,000		35,000		35,000		15,000
5300	Sundry																
5301	Communications (telex, phone, fax)		125,000		15,000		20,000		20,000		20,000		20,000		20,000		10,000
5399	Sub-Total		125,000		15,000		20,000		20,000		20,000		20,000		20,000		10,000
5400	Hospitality																
5401	Hospitality		3,000		500		500		500		500		500		500		0
5499	Sub-Total		3,000		500		500		500		500		500		500		0
5500	Evaluation																
5501	Review & Monitoring		20,000		0		0		0		10,000		0		0		10,000
5599	Sub-Total		20,000		0		0		0		10,000		0		0		10,000
5999	Component Total		468,000		60,500		75,500		70,500		80,500		70,500		70,500		40,000
99	Grand Total*		5,337,000		517,500		2,693,500		643,500		495,500		420,500		388,500		178,000

* UNIDO support costs will be met out of the GEF budget as applicable.

ANNEX 1B

BUDGET BY PROJECT COMPONENT ACTIVITY Summary of financial structure of the project (in million US \$)

	Total Cost (million USD)	Cuban Government contribution	GEF contribution	UNEP / UNIDO	Private investment	ADEME
Activity 1. Establishment of a policy and regulatory framework to provide enabling environment to the development of renewable energy	0.200	0.030*	0.170	0.000	0.000	0.000
Activity 2. Building local and national capacity to utilize the commercial potential of renewable energy technologies	2.216	0.255	1.791	0.170**	0.000	0.000
Activity 3. Setting up appropriate financial mechanisms and structures to encourage private sector investment in renewable energy projects	2.296	0.038	2.058 ***	0.000	0.000	0.200 *****
Activity 4. Implementation of business models to demonstrate commercial feasibility of renewable energy technologies for power generation and productive use	10.679	1.211 ****	0.808	0.000	8.660 *****	0.000
Activity 5. Establishment of project management structures for coordination, monitoring and dissemination of results from the project (UNEP/UNIDO)	0.650	0.090	0.510	0.050 *****	0.000	0.000
TOTAL	16.041	1.624	5.337	0.220	8.660	0.200

* Government of Cuba's in-kind contribution as diverted effort to put a policy framework in place for promoting renewable energy technologies.

** UNIDO in-kind/cash contribution (US \$ 170,000) for activities such as capacity building, study trips and training workshops.

*** GEF funding will primarily be used to set up a risk and replication management fund, and to meet costs on capacity building of financial institutions on financial appraisals, contractual obligations and modalities for a revolving fund and also to meet UNIDO support costs as applicable.

**** Government of Cuba's contribution to meet costs on land, building and related infrastructure including providing logistics support to the project team and experts.

***** Consultations held with private investors and companies during the PDF phase yielded documented results (letters of intent to bid on file).

***** UNEP matching in-kind contribution (US \$ 50,000) for information dissemination and replication efforts in the Caribbean.









***** ADEME has confirmed to collaborate and co-finance the project activities to the tune of about \$ 200,000, especially concerning with feasibility studies and operationalization of the financial mechanisms proposed in the project

ANNEX 1C

UNEP/GEF REPORT ON PLANNED PROJECT COFINANCE AND ACTUAL COFINANCE RECEIVED (report required as at 30 June and 31 December during project execution)

Title of Project:	Generation and Delivery of Renewable Energy Based Modern Energy Services in Cuba; the Case of Isla de la Juventud						
Project Number:							
Name of Executing Agency:	UNIDO						
Project Duration:	From: August 2004			To: July 2010			
Reporting Period:	From:			To:			
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	Received to date
UNIDO							
UNEP							
Government of Cuba							
ADEME							
Investors							
<i>Additional Cofinance:-</i>							
Total	0	0	0	0	0	0	
<i>All amounts in US dollars</i>							
Name:	Tom Hamlin						
Position:	Task Manager						
Date:							

ANNEX 2 WORK PLAN AND ACTIVITIES TIME FRAME

Activities		2004 August	2005	2006	2007	2008	2009	2010 July
1. Designing and establishing an institutional, policy and legal framework								
1.1	Review of national policies and legal provisions on renewable energy based rural electrification undertaken and gap areas defined.							
1.2	Process initiated to integrate renewable energy planning within national energy planning mechanism and development process.							
1.3	National quality assurance standards on renewable energy based power projects performance and evaluation benchmarks set up and widely disseminated.							
1.4	Preparation of Power Purchase Agreements, legal agreements and model guidelines developed and circulated to potential investors and key stakeholders							
1.5	Guidelines on environment impact assessment of renewable energy based power projects and mandatory certification standards formulated and disseminated.							
1.6	Incentive schemes, tax waivers and model schemes for attracting renewable energy investors and service providers developed and suggested to the policy makers.							
1.7	Capacities in national manufacturing facilities and markets for renewable energy technologies, especially for biomass and wind equipment assessed and action plan prepared for training and technology transfer.							
1.8	Information disseminated on the policies, standards, norms and quality issues to the public and private sector, consumers and other key stakeholders like service and maintenance providers.							

Activities		2004 August	2005	2006	2007	2008	2009	2010 July
Building national and local capacities to promote commercial utilization of renewable energy technologies.								
2.1	Capacity of key stakeholders built on renewable sources databases, resource technology projects, standards and benchmarking.							
2.2	Training imparted to investors on technology designing in terms of specifications, inputs and outputs, capital and operating costs, minimum viable project sizes and economic viability indicators.							
2.3	Training imparted to experts and planners on management and financial services for operating renewable energy based power projects and for implementing replication strategy.							
2.4	Training workshops carried out for UNE, OBE, ECOSOL, ALASTOR and Local Forestry Company, and private enterprises such as ceramic, meat and fish processing factories, on the effective use of renewable energy systems for income generation activities.							
2.5	National manufacturing capacities strengthened to manufacture, assemble and maintain the renewable energy based power systems (specifically biomass and wind technologies), and to achieve reduction in costs of implementing these renewable energy technologies.							
2.6	Capacity of technical and financial institutions built to evaluate and appraise renewable energy based power projects.							
3. Setting up financial mechanisms and structures to encourage private sector investment in renewable energy based power projects								
3.1	RRMF set up at Compañía Fiduciaria to attract private investment in business models on renewable energy based power generation.							

[illegible]

Activities		2004 August	2005	2006	2007	2008	2009	2010 July
4.4	Linkages established with productive use and income generation activities – small and medium scale industries based on local resources and skills in the project area.							
4.5	Setting up of a pilot mini-grid based on biomass gasifier technology at Cocodrilo to demonstrate the potential of biomass gasifier technology for isolated mini grids.							
4.6	Close supervision of performance of business units conducted and corrective steps taken on regular basis							
5. Establishing project management structures for 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.							
5.2	National Steering Committee and Local Advisory Committee established and made operational.							
5.3	A Technical and Financial Service Unit set up and trained whose responsibilities would include, among others, implementation of the replication strategy							
5.4	Capacity building and training of the key stakeholders – technical experts, planners, investors and experts in the management of renewable energy based investment models achieved.							

Activities		2004 August			2005			2006			2007			2008			2009			2010 July		
5.5	Close monitoring and evaluation of the project activities achieved and consultations with key stakeholders held once in every year.																					
5.6	An effective information dissemination programme and replication strategy developed and implemented.																					
5.7	Lessons learned and results disseminated to a wider audience and a regional network of agencies, institutions and experts created to promote renewable energy technologies in the region.																					

ANNEX 3

FORMAT FOR CASH ADVANCE STATEMENT

Statement of cash advance as at
And cash requirements for the quarter of

Name of Cooperating agency/

Supporting organization

Project No.

Project title

I. **Cash statement**

1. Opening cash balance as at

US\$ _____

2. Add: cash advances received:

Date

Amount

.....

.....

.....

.....

.....

.....

.....

.....

3. Total cash advanced to date

US\$ _____

4. Less: total cumulative expenditures incurred

US\$ (_____)

5. Closing cash balance as at

US\$ _____

II. **Cash requirements forecast**

6. Estimated disbursements for quarter

ending

US\$ _____

7. Less: closing cash balance (see item 5, above)

US\$ (_____)

8. Total cash requirements for the quarter

US\$ _____

Prepared by _____

Request approved by _____

Duly authorized official of Cooperating agency/
Supporting organization

ANNEX 4A

FORMAT OF QUARTERLY PROJECT EXPENDITURE

Quarterly project statement of allocation (budget), expenditure and balance (Expressed in US\$) covering the period.....to.

Project No.

Agency Name

Project title:

Project commencing:(date)

Project ending:(date)

Object of expenditure by UNEP budget Code	Project budget allocation for year.....		Total expenditure for quarter	Total unliquidated obligations*	Cumulative expenditure for year	Unspent balance of budget allocation for year.	
	m/m (1)	Amount (2)	(3)	(4)	m/m (5)	m/m (6)	Amount (2)-(5)
1100 International Project Personnel 1101 Project Personnel 1199 Sub-total 1200 Consultants 1299 Sub-total 1300 Administrative support 1301 Administrative staff 1399 Sub-total 1500 Project Travel 1501 National Travel 1599 Sub-Total 1600 Travel 1601 UNIDO staff 1681 UNEP staff 1999 Component Total 2200 Sub-contracts 2201 Nat grassroots NGOs 2299 Sub-total 3200 Group Training 3201 Study Tours 3299 Sub-total 3300 Meetings/conferences 3301 Meetings/Workshops							

3399 Sub-total							
3999 Component Total							
4100 Expendable equipment							
4101 Office supplies							
4102 Library acquisitions							
4103 Computer software							
4120 Unspecified							
4199 Sub-total							
4200 Non-expendable equipment							
4201 Computer hardware							
4202 Office equipment							
4220 Unspecified							
4299 Sub-total							
4300 Premises rent							
4301 Office rental							
4302 Maintenance of premises							
4399 Sub-total							
4999 Component Total							
5200 Reporting cost							
5201 Evaluation report							
5202 Cofinancing/Business Plan							
5203 Final Project Proposal							
5299 Sub-total							
5300 Sundry							
5301 Communications							
5399 Sub-total							
5999 Component Total							
99 GRAND TOTAL							

*See breakdown of unliquidated obligations, by object of expenditure attached as **ANNEX 4B**

Signed: _____
Duly authorized official

NB: The expenditure should be reported in line with the specific object of expenditures as per project budget

ANNEX 4B

FORMAT OF SEMI-ANNUAL FINANCIAL REPORTING ON UNLIQUIDATED OBLIGATIONS

Project No. _____

Agency Name: _____

Unliquidated obligations during _____
(period covered)

Expressed in US\$

UNEP allocation	1100	1200	1300	1600	2200	3200	3300	4100	4200	4300	5200	5300	Total 99
TOTAL													

NB: The unliquidated obligations should be reported in line with the specific object of _____ expenditures as per project budget

ANNEX 5A

FORMAT FOR HALF YEARLY PROGRESS REPORT TO UNEP

As at 30 June and 31 December

(Please attach a current Inventory of Outputs/Services and
Inventory of Non-Expendable Equipment when submitting this report)

1. Background Information

1.1 Project Number:

1.2 Project Title:

1.3 Division/Unit:

1.4 Coordinating Agency or Supporting Organization (if relevant):

1.5 Reporting Period (the six months covered by this report):

1.6 Relevant UNEP Programme of Work (2002-2003) Subprogramme No:

1.7 Staffing Details of Cooperating Agency/ Supporting Organization (Applies to personnel /
experts/ consultants paid by the project budget):

Functional Title	Nationality	Object of Expenditure (1101, 1102, 1201, 1301 etc..)

1.8 Sub-Contracts (if relevant):

Name and Address of the Sub-Contractee	Object of Expenditure (2101, 2201, 2301 etc..)

2. Project Status

2.1 Information on the delivery of outputs/services

	Output/Service (as listed in the approved project document)	Status (Complete/ Ongoing)	Description of work undertaken during the reporting period	Description of problems encountered; Issues that need to be addressed; Decisions/Actions to be taken
1.				
2.				
3.				

2.2 If the project is not on track, provide reasons and details of remedial action to be taken:

3. Discussion acknowledgment (To be completed by UNEP)

Project Coordinator's General Comments/Observations	First Supervising Officer's General Comments
Name: _____	Name: _____
Date: _____	Date: _____
Signature: _____	Signature: _____

Annex 5B

Attachment to Half-Yearly Progress Report FORMAT FOR INVENTORY OF OUTPUTS/SERVICES

a) Meetings (UNEP-convened meetings only)

No	Meeting Type ⁴	Title	Venue	Dates	Convened by	Organized by	# of Participants	List attached Yes/No	Report issued as doc no	Language	Dated
1.											
2.											
3.											

List of Meeting Participants

	Name of the Participants	Nationality
1.		
2.		

b) Printed Materials

No	Type ⁵	Title	Author(s)/Editor(s)	Publisher	Symbol	Publication Date	Distribution List Attached Yes/No
1.							
2.							
3.							

⁴ Meeting types (Inter-governmental Meeting, Expert Group Meeting, Training Workshop/Seminar, Other)

⁵ Material types (Report to Inter-governmental Meeting, Technical Publication, Technical Report, Other)

c) Technical Information / Public Information

No	Description	Date
1.		
2.		
3.		

d) Technical Cooperation

No	Type ⁶	Purpose	Venue	Duration	For Grants and Fellowships		
					Beneficiaries	Countries/Nationalities	Cost (in US\$)
1.							
2.							

e) Other Outputs/Services (e.g. Networking, Query-response, Participation in meetings etc.)

No	Description	Date
1.		
2.		
3.		

⁶ Technical Cooperation Type (Grants and Fellowships, Advisory Services, Staff Mission, Others)

Annex 5C

Attachment to Half Yearly Progress Report
FORMAT OF INVENTORY OF NON-EXPENDABLE EQUIPMENT
UNIT VALUE US\$1,500 AND ABOVE AND ITEMS OF ATTRACTION

Project title:.....

Implementing Agency

Internal/SO/CA (UNEP use only).....

FPMO (UNEP use only).....

Description	Serial No.	Date of Purchase	Original Price US\$	Present Condition	Location	Remarks Recommendation for disposal

The physical verification of the items(s) above was done by: Name

(Duly authorized official)

Title:

Signature:

Date:

ANNEX 6

FORMAT FOR TERMINAL REPORT (For External Projects only)

<i>1. Background Information</i>	
1.1	Project Number
1.2	Project Title
1.3	UNEP Division/Unit
1.4	Implementing Organization
<i>2. Project Implementation Details</i>	
2.1	Project Needs and Results (Re-State the needs and results of the project)
2.2	Project Activities (Describe the activities actually undertaken under the project, giving reasons why some activities were not undertaken, if any)
2.3	Project Outputs (Compare the outputs generated with the ones listed in the project document)
2.4	Use of Outputs (State the use made of the outputs)
2.5	Degree of achievement of the objectives/results (<i>On the basis of facts obtained during the follow-up phase, describe how the project document outputs and their use were or were not instrumental in realizing the objectives / results of the project</i>)
2.6	Determine the degree to which project contributes to the advancement of women in Environmental Management and describe gender sensitive activities carried out by the project.
2.7	Describe how the project has assisted the partner in sustained activities after project completion.
<i>3. Conclusions</i>	
3.1	Lessons Learned (Enumerate the lessons learned during the project's execution. Concentrate on the management of the project, including the principal factors which determined success or failure in meeting the objectives set down in the project document)
3.2	Recommendations (Make recommendations to (a) Improve the effect and impact of similar projects in the future and (b) Indicate what further action might be needed to meet the project objectives / results)

<i>4. Attachments</i>	
4.1	Attach an inventory of all non-expendable equipment (value over US\$ 1,500) purchased under this project indicating Date of Purchase, Description, Serial Number, Quantity, Cost, Location and Present Condition, together with your proposal for the disposal of the said equipment
4.2	Attach a final Inventory of all Outputs/Services produced through this project

Annex 7
FORMAT FOR SELF -EVALUATION FACT SHEET
(To be completed by UNEP Task Manager and acknowledged by Executing Agency)

- 1. Project Title:**
- 2. Project Number:** (include number of latest revision)
- 3. UNEP Programme of Work Component Number: (3 digits), or Relevant UNEP Programme of Work (2004-2005) Subprogramme Number and Specific Objective Number**
Include a statement of how effective the project has been in attaining this component/objective and its contribution to overall Subprogramme implementation.
- 4. Performance Indicators:**
UNEP Programme of Work: {State the relevant Performance Indicators (with the Quantity figure) from the Programme of Work, and compare against actual results}
- 5. Scope:**
- 6. Implementation:**
- 7. Duration:**
 - (a) Initial {(as indicated in the original project document). List day/month/year of start and end of project. List project duration in terms of total months}.
 - (b) Actual {(as indicated in the latest project revision). List day/month/year of start and end of the project. List project duration in terms of total months}.
 - (c) Reasons for the variance {when there is a difference between the initial and actual duration, list the consecutive project revisions (number and date of approval), and summarize justification for each revision}.
 - (d) List day/month/year of start of current year Work plan.
 - (e) List day/month/year end of current Work plan.
- 8. Cost:**
 - (a) Initial {(as indicated in the project document). List the total project cost (UNEP and "Others") and give breakdown by funding source. Give actual figures and contribution in terms of percentages}.
 - (b) Actual {(as indicated in the latest project revision). List the total project cost (UNEP and "Others" and give breakdown by funding source. Give actual figures and contribution in terms of percentages}.
 - (c) Reasons for the variance {(When there is a difference between the initial and actual cost, list the consecutive project revisions (number and date of approval) involved in amending the project costs. List any other reasons for discrepancy}.
 - (d) Relate expenditure to achievement of outputs (e.g. 100% expenditure and 82% output completion).
 - (e) Relate expenditure to achievement of outputs to date against overall project Work plan.
- 9. Project status at the time of evaluation:**
- 10. Needs:**
 - (a) Identified needs (as indicated in the original project document).
 - (b) Satisfied/realized needs (List needs fulfilled due to implementation of the project).

11. Results:

- (a) Expected Results (as indicated in the original project document).
- (b) Actual Results (indicate actual results achieved/attained from project implementation) during current year.
- (c) Actual results to date against overall project work plan.
- (d) Reasons for the variance (state the reasons for the difference between expected and actual results).
- (e) State corrective action(s) to be taken.

12. Outputs:

- (a) Expected Outputs (as indicated in the original project document).
- (b) Actual Outputs (List actual outputs resulting from project implementation emphasizing activities undertaken during current year)
- (c) Reasons for the variance (state reasons for the difference between expected and actual outputs) during current year.
- (d) Actual outputs to date against overall project work plan.
- (e) State corrective action(s) to be taken.

13. What are UNEP's substantive inputs to the project?

(Do not repeat UNEP's financial contribution).

14. What are the catalytic effects of the project on other agencies or governments?

- (a) Intellectual:
- (b) Financial

15. On Gender - describe

- (a) Project's contribution to the advancement of women with regard to their participation in ecosystem related provisions of Agenda 21, Chapter 24.
- (b) Sensitive activities carried out by the project, for example: level of participation in decision making process in the planning and development and implementation of the project and women's participation in capacity-building and awareness activities.

16. On Sustainability

Describe sustainability of the project in terms of: enabling environment (e.g. national or regional legislation and policies); institutional capacity (human resource and planning and management systems); and financial sustainability (reliability of funding sources).

17. Describe the problems encountered during project implementation:

<u>Problems:</u>	<u>Causes:</u>	<u>Consequences:</u>
(a) Substantial/Programmatic		
(b) Institutional		
(c) Financial		

18. Lessons learned from the achievement and/or weaknesses of the project:

19. Further follow-up action required:

- (a) Action Required:
- (b) Responsible unit(s):
- (c) Schedule:

20. Evaluated by:

Name and position of Evaluator:

Date: _____

Noted by:

Cooperating Agency/Supporting Representative:

Date: _____

21. Approved by:

Name of Regional Director

Date: _____