PROJECT BRIEF

1. Identifiers:

Project Number:	2113
Project Title:	**Eastern Caribbean Geothermal Development Project**
Duration:	7 years
GEF Implementing Agency:	United Nations Environment Programme (UNEP)
Executing Agencies:	Organization of American States (OAS)
	Agence française de Développement (AFD)
Requesting Countries:	Commonwealth of Dominica
	St. Lucia
	St. Kitts & Nevis
Eligibility:	Dominica ratified UNFCCC on June 21, 1993
	St. Lucia ratified UNFCCC on June 14, 1993
	St. Kitts & Nevis UNFCCC on January 7, 1993
GEF Focal Areas:	Climate Change
GEF Programming Framework:	Operation Programme 6 – Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs
Contact:	Bernard Jamet, UNEP

---

2. Summary:

The Eastern Caribbean Geothermal Development Project ("Geo-Caraïbes") will implement a regional strategy that will create the conditions for successful deployment of commercially viable geothermal power production and overcome the barriers to the development of geothermal power in the three Project Countries. The resulting electricity from geothermal power generation in the Commonwealth of Dominica, St. Lucia, and/or St. Kitts & Nevis will supply a large portion of the electricity requirements for each country, thereby offsetting electricity consumption from diesel-powered generation and reducing the emission of greenhouse gases of up to 250 thousand tons of CO_2 per year.

The Project will reduce the risk-costs associated with geothermal development with the goal of creating the conditions for commercial geothermal development in the Eastern Caribbean. The Project is organized around three principal elements that are conditions precedent for successful geothermal development:

1. **Resource Characterization**. To definitively establish the resource base through thermal gradient and slim hole drilling and use this information to attract potential private developers.

2. **Improving financial viability via the Establishment of a Risk Reduction Financial Tool lowering the geothermal risk.** Establish a Risk Reduction Financial Tool to mitigate risks for project developers undertaking production drilling activities.

3. **Institutional Strengthening and Capacity Building** activities designed to address in parallel the institutional, legal, and regulatory barriers to geothermal development in the three Project countries.

---

3. Costs and Financing (US $):

GEF:			
Project			7,500,000
PDF – B			700,000
IA Administrative Costs			
Monitoring & Evaluation			
		Sub-total (GEF)	**8,200,000**
Co-financing	**In-kind**	**Cash**	
PDF-B Phase			
AfD	50,000	250,000	300,000
Organization of American States	100,000		100,000
Participating Governments	90,000		90,000
		Sub-total PDF-B phase	***490,000***
Full Project Phase			
FFEM		2,400,000	2,400,000
AfD	350,000	1,200,000	1,550,000
Interreg[1]		1,320,000	1,320,000
Organization of American States	350,000		350,000
Participating Governments	1,050,000		1,050,000
		Sub-total Full Project phase	***6,670,000***
		Sub-total (Co-financing)	**7,160,000**
Total Project Cost			**15,360,000**

[1] **Interreg** is financed under the European Regional Development Fund (ERDF) of the European Union and is designed to stimulate interregional cooperation. The INTERREG III B Programme "Caribbean Space" covers cooperation in the Project countries and one of its priorities is to promote the use of renewable energy.

4. Associated Financing (US $):

Power Station Investments[2]		201,900,000
Production Drilling		84,400,000
Interconnection Lines		61,800,000
TOTAL (3 PROJECTS)		**348,100,000**

5. Operational Focal Point Endorsement(s):

Country	**Name of Signatory**	**Title**	**Supervising Ministry**	**Date of Letter**
Dominica	Eliud T. Williams	Permanent Secretary	Communications, Works and Housing	16 June 2003
St. Kitts & Nevis	Hilary Hazel	Permanent Secretary	Finance, Development and Planning	26 May 2003
St. Lucia	Martin Satney	Permanent Secretary	Physical Development, Environment and Housing	7 May 2003

6. IA Contact: Mr. Bernard Jamet, UNEP, tel: +33 ; email: bjamet@unep.org
Mr. Mark Lambrides, OAS, tel +1 202; email: mlambrides@oas.org
Mr. Jean-Baptiste Avrillier, AfD, tel + 33 1 ; email: jbavrillier@afd.fr

[2] Investments of 90 MW in Dominica, 10 MW in St. Kitts & Nevis, and 7,5 MW St. Lucia.

TABLE OF CONTENTS

LIST OF ACRONYMS/ABBREVIATIONS

AfD	Agence Française de Développement
ARGeo	African Rift Geothermal Facility
CARICOM	Caribbean Community and Common Market
CPACC	Caribbean Planning for Adaptation to Climate Change
CPEC	Country Project Executive Committee
CREDP	Caribbean Renewable Energy Development Project
CTF	Coordination Task Force
DSD	Department of Sustainable Development (of the OAS)
DTIE	Division of Technology, Industry and Economics (of UNEP)
ESD	Energy for Sustainable Development
FFEM	Fonds Français Pour l'Environnement Mondial
GAP	Geothermal Advisory Panel
GEF	Global Environment Facility
GHG	Greenhouse gasses
GSEII	Global Sustainable Energy Islands Initiative
GWh	Gigawatts hours
IPP	Independent Power Provider
KWh	Kilowatts hours
M&E	Monitoring and Evaluation
MDG	Millennium Development Goal
MOU	Memorandum of Understanding
MW	Megawatts
OAS	Organization of American States
OECS	Organization of Eastern Caribbean States
OP	Operational Program
PDF	Project Development Facility
PIR	Project Implementation Review
PPA	Power Purchase Agreement
PSC	Project Steering Committee
REIA	Renewable Energy in the Americas
RMP	Risk Management Process
RRFT	Risk Reduction Financial Tool
SEP	Sustainable Energy Plan
SER	Self-Evaluation Review
SIDS	Small Islands Developing States
SRU	Seismic Research Unit
UNCITRAL	United Nations Commission on International Trade Law
UNDP	United Nations Development Programme
UNEP	The United Nations Environment Programme
WSSD	World Summit for Sustainable Development

I. BACKGROUND AND CONTEXT

I.1 GENERAL

1. The countries of the Eastern Caribbean depend heavily on imported fossil fuels to meet their electricity generation requirements. Diesel generators are the principle electricity source for all of the region's utilities, given their low initial capital cost and relative ease of operation. Dependency on small diesel gen-sets results in many serious challenges for these Small Islands Developing States ("SIDS"), including vulnerability to volatile international oil prices, significant drain on foreign exchange, and susceptibility to environmental impacts associated with fossil fuel consumption. Further, use of diesel fuel for electricity generation results in carbon emissions and contributes to global climate change. Alternatives to diesel gen-sets, including renewable energy technologies, natural gas, and coal, have not been successfully developed within the Eastern Caribbean countries. The small size of the power generation requirements make achievement of economies of scale a serious challenge, and the high front-end capital costs associated with many of the renewable alternatives pose a hurdle to the fragile Eastern Caribbean economies.

I.2 RELEVANT GEF OPERATIONAL PROGRAM SHORT TERM CRITERIA

2. The Project is consistent with GEF Operation Programme 6 – "Promoting the Adoption of Renewable Energy by Removing Barriers and Reducing Implementation Costs" ("OP #6"). In accordance with OP #6, the Project identifies and addresses barriers to the adoption of renewable energy (geothermal), including exploration risks, the lack of a conducive policy and regulatory framework, financial constraints, and a limited regional capacity to implement geothermal energy projects.

3. The Project will focus specifically on the three Eastern Caribbean countries – the Commonwealth of Dominica ("Dominica"), St. Kitts & Nevis, and St. Lucia – that possess adequately large geothermal resources, and represent potentially attractive opportunities for commercial geothermal investments.

4. GEF support will advance the national policies to develop renewable energy sources in each of the three countries, lead to viable, public-private partnerships in electricity production, and contribute to regional integration and yield important environmental benefits. Specifically, the delivery of a stable, low cost, baseload electricity supply will off-set the use of high-cost, imported hydrocarbon fuels, and thereby enable economic development while mitigating the environmental impacts associated with diesel-powered generation.

I.3 OTHER GEF PROJECTS IN THE REGION

5. The Geo-Caraïbes project will collaborate with the GEF-Funded Caribbean Renewable Energy Development Project (CREDP). In response to the region's dependence on fossil fuels and in an effort to overcome the barriers associated with renewable energy project development, most countries in the English-speaking Caribbean are participating in CREDP, including each of the Geo-Caraïbes partner countries. CREDP is executed by the CARICOM Secretariat and the German aid agency, GTZ. CREDP addresses a broad range of barriers facing renewable energy development in the region. It delivers multiple services including information dissemination, capacity building, policy reform, and financing assistance for a range of renewable energy systems. However, the CREDP will not address the specific needs of geothermal development, including the more significant upfront investments required for resource exploration and the unique policy and regulatory measures that are necessary. The OAS (Geo-Caraïbes co-executing agency) serves on the CREDP Project Steering Committee. In addition, managers of the respective projects will communicate regularly to insure that maximum leveraging of the respective projects is achieved.

6. The CREDP Project provides general policy and regulatory advice to the member states in the Eastern Caribbean. This activity does not include the provision of specific policy development services for the establishment of geothermal resource laws. Throughout the execution of the Geo-Caraïbes PDF-B, the preparation of geothermal policies and regulations has advanced considerably. As these activities continue through the Full Project, Geo-Caraïbes will consult with the policy task leaders of the CREDP project to ensure coordination and to avoid potential conflicts with regard to other policy reform activities in preparation.

7. CREDP has identified a series of potential renewable energy projects in the region. The projects identified as a result of national consultations form the CREDP project pipeline. The CREDP Project Steering Committee outlined potential support activities to catalyze the development of the many projects in its pipeline. The geothermal energy projects, and related geothermal technical and market assistance, were assigned to the responsibility of the Geo-Caraïbes Project. This reflects the fact that the limited funding available to CREDP, and the wide scope of its mandate (CREDP support 16 countries; considers at least 5 renewable energy sources; and provides policy, technical assistance, and capacity building support), do not make possible direct support for geothermal projects.

I.4 PROJECT BACKGROUND

8. Most of the Eastern Caribbean countries are volcanic in origin and therefore may have the potential for geothermal power generation, with the exception of Antigua and Barbuda. As of 2005, of the Eastern Caribbean countries, only Guadeloupe currently produces electricity from geothermal resources. Map 1, below, illustrates the location of the countries of this region and of the volcanoes in each country.

MAP 1: EASTERN CARIBBEAN REGION.

Source: The University of the West Indies
Seismic Research Unit ("SRU") (2005).

9. Multiple studies of the geothermal potential in many of the Eastern Caribbean countries date back over 40 years; however, with the exception of the 15 MW geothermal power project "Bouillante" in Guadeloupe, there has been no successful development of this resource in the region.

10. With the objective of addressing the challenges that have heretofore limited the commercial development of geothermal power production in the Eastern Caribbean, the concept for the Geo-Caraïbes Project was launched. The PDF Block B grant activities concerning the design of the Project began in March 2004. At that time, three Project Countries – Dominica, St. Kitts & Nevis, and St. Lucia – confirmed their commitment to

participate the regional geothermal development Project. The United Nations Environment Programme ("UNEP") though its Division of Technology, Industry and Economics ("DTIE") assumed the role of Implementing Organization, and the Organization of American States ("OAS") assumed the principal role of Executing Organization. Further, the Agence Française de Développement ("AFD"), which was actively involved in the development of geothermal energy in the Caribbean, was associated to the Project as Co-Executing Agency. The PDF-B Project fieldwork began in January 2004, and continued over seventeen months through May 2005.

I.5 BASELINE SITUATION

I.5.1 Demographic and Economic Indicators

11. The Project Countries have relatively small populations by international standards. Their respective populations are: Dominica, 78,000 inhabitants; St. Lucia, 155,000 inhabitants; and St. Kitts & Nevis, 45,000 inhabitants. Among developing countries, these nations fall in the World Bank Country Classification as Upper-Middle Income Economies. The basic demographic and economic indicators of the three Project islands can be viewed in Table 2, below.

TABLE 2: ECONOMIC INDICATORS.

General data			**Economic data**[3]	
Country	**Population (2002)**[4]	**Area (sq. Km)**[5]	**GDP (US$) per capita**	**GDP per capita annual growth rate (%) (1990-2002)**
Dominica	78000	754	3662[6]	1.4
St. Kitts & Nevis	45000	261	7745	3.5
St. Lucia	155000	606	4124	0.2

12. The basic economic structure of the three countries is similar and was traditionally based on agriculture (bananas, sugar) Currently, there are trends towards the provision of more services (tourism, offshore banking and information services) as well as higher value added agriculture (agri-business and agro food processing). Both trends, as well as the general increasing living standards on the islands, create conditions for increased electricity demand.

I.5.2 Electric-Sector Structure in Geo-Caraïbes Countries.

13. By international standards, the electricity sector in the Project Countries is small. St. Lucia has the largest installed capacity with 56.8 megawatts (MW). The installed capacity in both Dominica and St. Kitts & Nevis is less than 40 MW. Table 3, below, presents a summary of the electricity sector in the three Project Countries

[3] Human Development Report 2004, United Nations Development Program (UNDP), website: http://hdr.undp.org/statistics/data/index_alpha_indicators.cfm, visited 02 June 2005.
[4] World Data Table, World Health Organization (WHO), website: http://www.who.int/entity/cardiovascular_diseases/en/cvd_atlas_29_world_data_table.pdf., visited 03 June 2005.
[5] The World Fact Book 2005, Central Intelligence Agency (CIA), website: http://www.cia.gov/cia/publications/factbook/ (last updated 17 May 2005)
[6] 1993-2003 Selected Economic Indicators, Central Statistical Office (CSO), Commonwealth of Dominica, 2005

TABLE 3: OVERVIEW OF THE ELECTRICITY SECTOR OF PROJECT COUNTRIES.

Energy Sector (General)							
Country	**Utility**	**Ownership**	**Gen. Capacity (MW)**	**Max. Demand (MW)**	**Electricity Generated (GWh)**	**Electricity consumption (kWh /capita)[7]**	**Average Electricity Cost (US$/kWh)**
Dominica	DOMLEC[8]	private	22.0	13.2	45.49	1017	0.32
St. Kitts & Nevis	St. Kitts Electr. Dep.[9]	state	34.5	20	121.55	2701	0.17
St. Lucia	LUCELEC[10]	private	56.8	46.6	308.54	1991	0.24

14. The islands of St. Lucia and St. Kitts & Nevis depend entirely on the import of petroleum-based fuel for their electricity production, as shown in Table 4, below. Dominica is the only one of the three Project Countries in which renewable energy provides a measurable portion of the power supply. In 2004, diesel generators fueled by imported oil accounted for 76% of generation and hydropower accounted for 24% of generation. There have been no new investments in hydropower generation in more than ten years, while thermal generation has grown modestly.

TABLE 4: OVERVIEW OF THE PRIMARY ENERGY CONSUMPTION FOR PROJECT COUNTRIES.

Energy Sector (Technical)				
Country	**Utility**	**Primary Energy consumption for electricity production (TJ)**		
		Petroleum	**Hydro**	**Total**
Dominica	DOMLEC[11]	429	135	**564**
St. Kitts & Nevis	St. Kitts Elec. Dept.[12]	1082	.	**1082**
St. Lucia	LUCELEC[13]	2612	.	**2612**

15. In the Eastern Caribbean, the small sizes of the populations and the corresponding economies have led the utilities to make use of diesel gen-sets to satisfy the bulk of the electricity requirements of their customers. Their modular nature, relative low investment costs, and ease of use, have made diesel gen-sets the norm for Small Island Developing States around the world. However, these systems have many disadvantages, including the high life-cycle costs of the power supplied, the poor reliability of the supply, and the negative environmental impacts associated with their use.

16. The electricity costs in the Project Countries are among the highest in the Americas. Electricity rates in the region have risen significantly in recent years. Among the Project Countries, in 2004, retail electricity was most expensive in Dominica, where the average electricity price was US$0.32/kWh14. This price includes the fuel surcharge of US$ 0.07/kWh. The price of electricity in St. Lucia was US$0.24/kWh, while in St. Kitts & Nevis

7 Calculated based on generated electricity divided by population size
8 2004 Annual Report, Operating Statistics 1999-2004, Dominica Electricity Services (DOMLEC), June 2005.
9 Only includes data from St. Kitts Electricity Department. 2004 Operating Statistics St. Kitts Electricity Department, 2005.
10 2004 Annual Report, Operating Statistics St. Lucia Electricity Services, 2005
11 2004 Annual Report DOMLEC, Operating Statistics, Dominica Electricity Services, 2005
12 Only includes data from St. Kitts Electricity Department 2004 Operating Statistics St. Kitts Electricity Department, 2005
13 2004 Annual Report LUCELEC, St. Lucia Electricity Services, 2005
14 2004 Annual Report DOMLEC

the average price was US$0.17/kWh. In the case of St. Kitts & Nevis this price is heavily subsidized by the state-owned utility. In any case, the high prices of electricity in each of the countries are a significant burden on their economic development, and cause considerable hardships for their populations. Recent data from the Dominica utility, DOMLEC, point out that, in June 2005, the fuel surcharge reached an all time high level of US$0.11/kWh because of the high price of diesel fuel. This diesel price rise caused the electricity price to increase up to US$0.36/kWh in the month of June. This tariff is among the highest in the Eastern Caribbean and is currently the source of major concern and protest among many Dominican residents. Table 5, below, presents a summary of electricity prices among the Project Countries.

TABLE 5: ELECTRICITY PRICES IN THE PROJECT COUNTRIES.

Utility					
Country	**Utility**	**Average Electricity Cost (US$/kWh)[15]**	**Domestic ($/kWh) per month**	**Commercial ($/kWh) per month**	**Industrial ($/kWh) per month**
Dominica	DOMLEC	0.36[16]	0.35[17]	0.38[18]	0.34[19]
St. Kitts & Nevis	St. Kitts Electr. Dep.[20] & NEVLEC	0.17	0.15	0.19	0.19
St. Lucia	LUCELEC	0.24[21]	0.19	0.24	0.24

I.5.3 Energy Production and Climate Change in the Eastern Caribbean

17. The Eastern Caribbean islands are among the most vulnerable areas in the world to the affects of Climate Change. Given the reliance on fossil fuels for electricity production in the Eastern Caribbean, the development of renewable energy supply sources would mitigate the greenhouse gasses ("GHG"), in particular the CO_2 emissions of the existing electricity production systems. Thus, while reduction of greenhouse gases from the Eastern Caribbean countries maybe perceived as relatively small in global terms, it is essential that such countries take the lead in this area and demonstrate to the rest of the world the means by which GHG emissions may be offset.

18. By introducing renewable energy technologies, GHG emission reduction can be achieved according to the estimates presented in Table 6, below. These estimates are based on a projected installation of 90 MW for Dominica, 10 MW for St. Kitts & Nevis and 7.5 MW for St. Lucia. In each case geothermal is expected to offset electricity generation from diesel gen-sets. Geothermal power technology has a zero-emission factor for CO2 emissions. In the case of Dominica, the Project assumes that 90 MW of geothermal may be developed, which includes domestic consumption as well as supply of electricity to the French Antilles via submarine electricity transmission lines.

---

[15] Average fuel cost including fuel surcharge

[16] 2005 DOMLEC operating statistics, June 2005.

[17] This is the average of US$0.218/kWh (first 50 kWh) and US$0.252/kWh (excess 50 kWh) + fuel surcharge of US$0.113/kWh (figures for June 2005)

[18] This is US$0.268/kWh + fuel surcharge of US$0.113/kWh (figures for June 2005)

[19] This is the average of the standard rate of US$0.238/kWh and off peak rate of US$0.219/kWh + fuel surcharge of US$0.113/kWh (figures for June 2005)

[20] 2005 Data Operating Statistics, St. Kitts Electricity Department, 2005.

[21] 2003 Annual Report LUCELEC, Operating Statistics St. Lucia Electricity Services, 2005.

TABLE 6: ANNUAL CO_2 EMISSION REDUCTION USING GEOTHERMAL ENERGY.

Energy and Environment							
Country	**Current thermal capacity (diesel fueled) (MW)**	**Total Electricity production (GWh)**	**Emission factor (tCO2/ GWh) (Diesel Oil)[22]**	**Metric tons of CO2**	**Possible geothermal capacity (MW)**	**Possible electricity production (GWh)**	**Possible CO2 offset (metric tons CO2)**
Dominica[23]	14.4	45.49	266.7	12,133	90	792	211,226
St. Kitts & Nevis[24]	34.5	121.55	266.7	32,417	10	88	23,469
St. Lucia[25]	56.8	308.54	266.7	82,288	7.5	66	17,602
Total	**105.7**	**475.58**		**126,838**	**107.5**	**946**	**252,297**

19. The organization of a host country electricity market has a significant impact on the conditions for the development of renewable energy projects, including geothermal power. In each of the Project Countries, vertical monopolies (generation, transmission, and distribution) control the electricity supply. The governing electricity supply acts in the Project Countries offer no provision for independent power providers ("IPPs"), and provide the existing utilities a guaranteed rate of return on their investments. As a result, there is little incentive for these utilities to take on the additional risks associated with renewable energy projects. In both Dominica and St. Lucia, the utilities (DOMLEC and LUCELEC respectively) are privately owned companies, operating under long-term contracts with the government. In St. Kitts & Nevis separate government-owned monopolies have been established in each of the two island jurisdictions, St. Kitts and the Nevis Island Administration (St. Kitts Electricity Department and NEVLEC).

I.5.4 National Energy Policies

20. The current energy policies of the Project Countries offer no incentive or encouragement to producers or consumers of electricity either to increase efficiency or to generate with alternative energies. Given the increasing costs of electricity and growing recognition of the vulnerability that each country faces regarding its electricity sector, in 2002, both Dominica and St. Lucia prepared national Sustainable Energy Plans ("SEPs") that identify projects and program activities designed to increase utilization of sustainable energy options. These SEPs embody recommended policy, regulatory and incentive measures; establish targets and timetables for action; and call for the development of specific renewable energy project proposals. The Government of St. Lucia has secured Cabinet approval for its SEP, which lays out a plan to reduce greenhouse gas emissions by 35% by the year 2010, and initial steps have been taken toward its implementation. Key institutions in St. Lucia have made further commitments favoring the use of renewable energy technologies, over and above those adopted in its SEP. The government has approved a policy removing all import duties on renewable energy equipment. Moreover, the national utility – LUCELEC – made a public announcement in November 2002 of its commitment to incorporate at least 10%

[22] Emission factor for Diesel Oil, The GHG indicator: UNEP guidelines for calculating Greenhouse Gas Emissions for Businesses and Non-Commercial Organizations, UNEP, 2000.
[23] 2004 Annual Report DOMLEC, Operating Statistics Dominica Electricity Services, 2005.
[24] Only includes data from St. Kitts Electricity Department. 2004 Operating Statistics, St. Kitts Electricity Department, 2005.
[25] 2004 Annual Report LUCELEC, Operating Statistics St. Lucia Electricity Department, 2005.

renewable energy in its generation portfolio by 2007. These measures have been supported by the General Secretariat of the OAS through the Global Sustainable Energy Islands Initiative ("GSEII"), which works with governments of the region to develop Sustainable Energy Plans and to catalyse the development and use of sustainable energy systems

21. Other renewable energy Projects on-going in the region include the GEF-Funded, Caribbean Renewable Energy Development Project ("CREDP"). CREDP is executed by the CARICOM Secretariat and implemented by the United Nations Development Programme ("UNDP"), and addresses a broad range of barriers facing renewable energy development in the region. It delivers multiple services including information dissemination, capacity building, policy reform, and financing assistance for a range of renewable energy systems. However, the CREDP will not address the specific needs of geothermal development, in particular the significant upfront investments required for resource exploration. The OAS currently serves on the CREDP Steering Committee.

I.6 BASELINE DEVELOPMENT WITHOUT GEF INTERVENTION

I.6.1 Alternative Energy Supply Sources

22. The development of alternative electricity supplies in the project countries is a priority for energy security and economic development throughout the region. Potential alternatives to diesel fuel based production include both a gas pipeline as well as renewable energies.

23. The development of a natural gas pipeline is currently being studied which would run from Trinidad & Tobago, throughout the islands in the archipelago and terminate in Puerto Rico or possibly Guadeloupe. The concept for this project is currently in development.

24. The use of renewable energy systems in the region is limited, but there are efforts on the part of each of the Project Countries to increase the use of these alternatives. In the case of Dominica, hydropower provides for approximately 40% of the installed capacity. Wind power is an option in each of the islands, but the only serious proposal for wind development is in St. Lucia where a 5 MW project is being considered by LUCELEC. The wind resources in the region are moderate, but not consistent year round. Biomass is an option of interest in the region, but its potential is limited by the relatively small agricultural sector in each country. Solar water heating systems are uncommon in the Project Countries but their increased use is likely assist in off-setting the demand for power.

25. Geothermal power offers the only baseload renewable energy alterative in the Eastern Caribbean (given that Dominica has exhausted all significant hydro reserves). The existence of potential geothermal resources has been known in the region for many years, but too many barriers have prevented the geothermal development option from being commercially viable.

I.6.2 Identified Barriers to Geothermal Development

Project activities to date have identified barriers to the further development of geothermal resources in the following general areas:

1. Technical knowledge
2. Energy Sector Policy

3. Financial viability
4. Environmental and Social Barriers

The following table summarizes the principal barriers in each of the areas:

Table 7: Identified Barriers to Geothermal Development in Project Countries

I. Technical knowledge
• No complete archive or appropriate cataloguing of information pertaining to geothermal exploration or to baseline geo-scientific data exists in any of the of the Project Countries • The lack of sufficient baseline scientific data prevents a satisfactory pre-feasibility study of geothermal prospectives in the Project Countries • The current level of technical expertise in the Project Countries is insufficient to enable satisfactory oversight of geothermal exploration and production projects. • The lack of awareness and understanding of geothermal energy potential, combined with distrust of high cost technical development projects, may create skepticism among the population of the region. • Lack of environmental baseline information concerning geothermal development, despite existing environmental expertise and monitoring and environmental management frameworks. • Insufficient capacity of Project country governments to operate environmental monitoring systems specifically related to geothermal development. • Issues exist regarding the coexistence of geothermal energy production and World Heritage sites (St. Lucia and Dominica). • The development of a geothermal power plant(s) for the export of electricity to the French Antilles and laying of an inter-island electricity transmission line will require development of interconnection capabilities.

II. Energy Sector Policy

- No regional approach to geothermal resource development
- IPP's lack legal authority to generate electricity
- Resistance of local utilities to long-term purchase contracts of IPP electricity
- No effective capacity to enable power sales
- Legal framework inadequate for successful geothermal development. No mechanism for promoting regional policy reform consensus
- No institutional organization for managing environmental resources
- Legal & institutional framework inadequate to create conditions for commercial geothermal power plants; lack of capacity for selecting developers
- Lack of capacity to regulate technical aspects of geothermal development (eg safety and environmental impact mitigation)
- No due diligence mechanism in place
- Lack of capacity for promoting commercial development
- Lack of capacity for promulgating information concerning geothermal development
- Lack of human resources to participate in or govern geothermal resource development
- Lack of internal capacity to monitor or regulate licenses
- No established clear policy with respect to seizing private lands a for geothermal development purposes
- Ministries lack technical expertise to testify on law and promulgate regulations.

III. Financial Viability

- Costly, front-end resource studies and drilling are required prior to commercial production of geothermal based electricity.
- The scale of the geothermal production investments in each of the Project countries is relatively small
- Uncertainty regarding future commercial and energy sector conditions in the Project countries.
- Currently no means to package or bundle the individual investments in the separate Project countries into a common financial mechanism.

IV. Social and Environmental Issues

- Local residents in possession of land with geothermal resources may prefer alternative uses of the land than for electricity generation plants.
- The installation of transmission and interconnection HV lines will create significant esthetic impacts on the visual environment.
- Some residents may believe that exploratory drilling activities will instigate larger, potentially dangerous levels of geothermal activity (eruptions, etc.)
- Interconnection lines will have to skirt the borders of the natural park area in Dominica.

The GEF project concept was developed to directly address the barriers in each of these areas.

I.7 DEVELOPMENT WITH GEF INTERVENTION

26. As a result of the GEF Intervention, it will be possible for geothermal energy to meet a significant portion of the baseload requirements in each of the Project Countries. Given the current supplies and projected demand, preliminary studies indicate that 10 MW of geothermal power may be developed in both St. Lucia and St. Kitts & Nevis for their domestic requirements.

27. In the case of Dominica, the conditions exist which may allow for up to 10 MW of geothermal power for domestic consumption and up to 80 MW for electricity exports. Dominica is located relatively near the French Antilles, and Guadeloupe and Martinique have projected significant power support needs during the next ten years. An increased capacity geothermal facility on Dominica that provides electricity for both domestic and export use would not only improve the economic rate of return on the project but it would also act as an example for inter-island electricity interconnection.

28. Through the development and use of geothermal power in the Eastern Caribbean, electricity consumers in the region will benefit from supply of competitive, renewable energy resources that will stimulate economic activity, increase employment opportunities, assist in the reduction of poverty

29. GHG emission reductions can be achieved by geothermal facilities which offset the emissions from alternative, diesel generation production. Based on a projected installation of 90 MW for Dominica, 10 MW for St. Kitts & Nevis and 7.5 MW for St. Lucia, the maximum CO_2 reductions could reach approximately 250,000 tons of CO_2 per year (or almost 2 million tons over the project duration).

II. PROJECT RATIONALE AND OBJECTIVES

II.1 GENERAL

30. Electricity demand in the Project countries is increasing with the changing structure of the economies from traditional agriculture based activities to more high-value agriculture processing and the growth of service industries including tourism, off-shore banking and data services. Increased living standards also lead to the wider use of a range of electrical appliances (including air-conditioners). The need for increased investment in electrical production capacity thus exists.

31. Technical studies to date indicate that the existence of excellent geothermal resources for electricity production in the Project Countries. There is also a demonstrated government will to support alternative sources of energy in order to diversify away from reliance on diesel-generating sets. Nevertheless, the spontaneous development of geothermal resources in the Project countries has failed to occur for a variety of reasons.

32. Project activities to date have identified three areas in which targeted activities are definitely required in order to realize the sustainable development of geothermal electricity production in the Project countries. The fundamental basis, or rationale, for the GEF project lies carrying out carefully designed activities in three component areas in order to mitigate the identified barriers and meet the project objective of enabling commercial development of geothermal energy in the Eastern Caribbean.

33. Recognizing that the results of the technical studies indicate differing resources, hurdles and potential markets, these differences will result in differing development approaches and results. The Project will, with Project country input and relevant confirmed scientific data, promote commercial development in parallel in all three Project countries.

II.2 PLANNED GEF INTERVENTION

34. The Geo-Caraïbes Project has been formulated to reduce the risk-costs associated with the main cornerstones geothermal development, namely resources, financing, and market and policy. The Project goal is to create the conditions for commercial geothermal development in the Eastern Caribbean. Taking global geothermal development experience as precedent, three areas were identified in which specific actions need to be undertaken to encourage successful geothermal development:

The rationales of the three main components of the Geo-Caraïbes Project are presented in the following sections:

II.2.1 Resource Characterization

35. Private-sector development is often stifled by the lack of useable, reliable data. The front-end loaded costs particular to geothermal projects create a threshold entry barrier. By arming the Project Countries with reliable, verifiable technical data from exploratory drillings, the countries will be positioned knowledgeably to attract a broader range of investor-developers. Potential geothermal resources must be identified and assessed, and

reserves estimated. Geological, geochemical and geophysical investigations, including drilling of boreholes, is required to establish the economic reserves of a geothermal prospect.

II.2.2 Risk Reduction Financial Tool

36. The high-risk nature of geothermal development matched with high up-front costs for exploration as well as capital costs implies that a large proportion of the cost of a Project must be expended before the probability of failure declines to a level similar to that of other power development projects. The high risks and capital intensity discourage public and private developers from investing in small high enthalpy geothermal Projects even though acceptable rates of return can be demonstrated.

37. The existence of a dedicated risk reduction financial tool will reduce perceived costs of exploration and appraisal to public & private developers and play a catalytic role in establishing geothermal energy as a strategic option in the power expansion planning of the countries in the region. It will provide support for exploration and appraisal drilling to both public and private developers at equal conditions. As a result, reduced risks and costs at this early stage of geothermal development can be expected to encourage the pursuit of Projects up to the final stage of an operational power plant.

II.2.3 Institutional Strengthening and Capacity Building

38. The three Geo-Caraïbes Project Countries have requested assistance in creating conditions that spur private-sector investment in geothermal power development. The institutional strengthening and capacity building activities will concentrate on legal predictability and stability, which implies a stable political environment, a reliable legal framework, an effective regulatory environment, and clear and reliable take-off rules stipulated in Power Purchase/Sales Agreements ("PPAs"). These conditions are a prerequisite to private-sector investment in geothermal development and share equal weight with resource availability, finance, and market accessibility.

II.3 PROJECT OBJECTIVES

II.3.1 Main Objectives

39. The overall goal for the Geo-Caraïbes is to enable the commercial development of geothermal energy in the Eastern Caribbean. The commercial use of geothermal resources in the Project countries will lead not only to more competitively priced electricity, but will also displace the typical diesel production, thus reducing up to 250,000 tons of CO_2 annually. This goal requires mitigating the principal barriers that have limited its development to date.

40. The two principal development objectives of the Geo-Caraïbes Project are: (i) to overcome the barriers to the development of geothermal power and (ii) to implement a regional strategy that will create the conditions for successful deployment of one or more commercially viable geothermal power plants in the region. This latter objective takes into consideration that geothermal development will progress at different speeds in the three Project countries.

II.3.2 Concordance with GEF Strategic Objectives

41. The Project falls under GEF Strategic Priorities S3 ("Power sector policy frameworks supportive of renewable energy and energy efficiency") and S4 ("Productive uses of renewable energy"). The Project contributes toward these priorities (i) by supporting local capacity building and technical assistance; (ii) by promoting sector reforms that support geothermal electric generation; and (iii) by providing financial and other incentives for geothermal developments, with a particular focus on the private-sector project financing.

42. Moreover, the Project also represents a response to the Millennium Development Goals ("MDGs"), and to the agreements reached at the World Summit for Sustainable Development ("WSSD"). Target 9 of Goal 7 of the MDGs ("Ensure Environmental Sustainability"), calls on the global community to "Integrate the principles of sustainable development into country policies and programs and reverse the loss of environmental resources." The indicators linked to this target refer to sustainable energy and emissions. The WSSD Plan of Implementation, which aims at (i) eradicating poverty, (ii) changing unsustainable patterns of consumption and production, and (iii) protecting and managing the natural resource base, includes energy as a priority concern and adopts the concept of "energy for sustainable development" ("ESD").

III. ACTIVITIES, OUTPUTS AND EXPECTED RESULTS

43. Drawing on global experience with respect to functioning geothermal operations, the GEF project activities were conceived to address the current conditions in three areas: technical knowledge, energy sector policy, and financial viability. Technical assistance and support will be required in each area to improve conditions to attract private investors.

44. Technical knowledge activities will include building the technical database of geothermal resources, training local experts in geothermal exploration and production, as well as implementing appropriate environmental monitoring structures. It will also include the feasibility study of regional interconnection lines between Dominica, St. Lucia, St. Kitts & Nevis and other islands.

45. Financial viability activities will focus on the means to decrease the typical high-risk/high-cost capital barrier to establish the economic viability of a geothermal prospects that currently prevents commercial resource development, Even where commercial interest is high, economic benefits to the host nation maybe greatly eroded by the high initial exploratory and drilling costs with their concomitant high interest and ROI rates. To improve economic returns, significant rationale also exists for aggregating electricity demand among several islands to allow for economies of scale.

46. Finally, the long -term sustainability of geothermal activities in the region requires the implementation of transparent geothermal policies and regulations. Further, the project will support the education and training of technical, regulatory and economic leaders in the Project Countries so that there is a cadre of stakeholders that understand and can market the particular characteristics of geothermal operations.

The key activities for each area are described in detail in the following sections:

III.1 RESOURCE CHARACTERIZATION

47. Technical activities will continue to assist in facilitating successful commercial development of geothermal power generation in all three of the Participating countries. Each country will tread a different path to commercialization, and the technical activities will thus vary between the three target prospects, both in nature and in speed of implementation. (*An outline of the typical phases of geothermal development is presented in Text Box 1*).

Text Box 1: Typical Phases of Geothermal Development

Phase I:	**Desktop surveys** are undertaken as there is a very superficial conceptual recognition that because of hot springs or volcanic activity a Geothermal resource may be in the area. Existing non-geothermal data that is used may include regional and detailed mapping, regional geophysical surveys, e.g., surveys for oil and mineral exploration now in the public domain, or purchase of remote reference surveys from airplane or satellites. Further surface exploration, geology and geochemical surveys and studies to evaluate resource for potential geothermal development are used: • to determine origin of geothermal fluids • in connection with the surface characteristics to determine flow characteristics of surface, ground and geothermal waters.	Questions to answer at this phase are: • Does the prospect have favorable characteristics / indicators to host a geothermal resource? • What is the range of characteristics; specifically temperature, permeability, and fluid properties? • Where is the best zone within the larger prospect area for detailed scientific studies?[26] Success probability after completion of Phases I to III is only 20%. [27] Cost of a Phase I Survey is between $50,000 and $200,000 depending upon its complexity. These surveys are normally conducted by Government Ministries or Authorities, but one such survey in Uganda has been completed by a private company.
Phase II:	**Reconnaissance Survey, Resource Assessment and Quantification of Reservoir Conditions and Potential** - (i.e. more detailed surface investigation of possible water sources, chemistry, etc. that are indicators of a geothermal resource). The following types of information must be collected and evaluated: • Reconnaissance geology and field reports • Regional hydrology and other related geological reports • Hot springs and fumarole physical descriptions • Well logs • Inventory of existing wells	Cost to complete this and Phase 3 can be several hundred thousand to $1 million depending upon the complexity of the geological/geophysical studies required or desired.

[26] Project Mgt and Financing course for Japanese Organizing Committee for World Geothermal Congress, May 28-June 10, 2000, Gordon Bloomquist, Convener, Intr'l Geothermal Association, p. 141

[27] Risk and Risk Management in Geothermal Exploration and Development, P. Barnett, J. Randle and A. Fikre-Mariam, Sinclair Knight Merz Ltd, Auckland, New Zealand, Kreditanstaldt fur Wiederaufbau, Germany, p. 181

	• Seismic Data • Remote sensing data • Geochemistry of hot springs, fumaroles and wells. • Down hole drilling surveys • Slim hole drilling and heat flow studies.	
Phase III:	**Pre-Feasibility Study** is done to justify expensive exploration drilling. Further assessments can take place prior to securing lease area rights but carries risk of lost investment if area is leased to another party. • Fatal flow analysis completed prior to leasing to determine any significant geotechnical, institutional, or environmental constraints to prevent commercial development. • Phases II and III activities or scientific surveys can be developed mutually to ensure appropriate data is available before Phase IV is commenced. • Preliminary Feasibility Assessments should consist of a multidisciplinary team the objectives are to identify and prioritize lands that have a reasonable probability of successful development and target specific prospects for acquisition through lease or purchase. Issues to address are varying degrees of resource potential, market conditions, and environmental constraints to development preventing commercial development of the project.	Prospects should have strong indications of commercial sustainability, surface manifestations of the geothermal reservoir, recent volcanic activity, or some other geological, geochemical or geophysical advantage versus other areas.
Phase IV:	**Exploration / Appraisal Drilling.** Exploration / appraisal drilling for resource confirmation. • Drilling testing of at least 2-3 production wells and 1 injection well is necessary to compile sufficient reservoir data to build a representative production model of the reservoir. Geological and well testing data is summarized into a reservoir assessment report to support institutional financing. • The following activities are required: o Geophysical surveys o Slim hole drilling and heat flow measurements o Slim hole reservoir confirmation well	Cost projections range from $750K per well to $2.5 million per well, a total of $5 to $10 million. Including well testing, exploration programs require $3 million to $6 million to complete.[28] Probability of success after this stage is 40%.[29]

[28] Project Mgt and Financing, course for Japanese Organizing Committee for World Geothermal Congress, May 28-June 10, 2000. R. Gordon Bloomquist, Convenor, Int'l Geothermal Assoc., p. 112.
[29] Risk and Risk Management in Geothermal Exploration and Development, P. Barnett, J. Randle and A. Fikre-Mariam, Sinclair Knight Merz Ltd, Auckland, New Zealand, Kreditanstaldt fur Wiederaufbau, Germany, p. 181

	drilling o Exploration well drilling and reservoir production testing o Environmental and regulatory approvals for drilling o Environmental baseline data collection Management team(s) changes to manage details and use more intensive and costly exploration program.	
Phase V:	**Delineation Drilling.** Confirmation drilling phase is dominated by logistical imperatives of the expensive drilling process. The primary focus is to obtain information from the geothermal reservoir. • Success of subsequent exploration wells often depends on timely interpretation of data from these wells integrated with existing data. • Issues to address are comparison of data between wells and comparison of down hole data with the range of surface data such as resistivity. • Questions to be answered are: o What are the reservoir characteristics, such as temperature, pressure, permeability, fluid properties? o What are the reservoir characteristics in the un-drilled parts of the reservoir? o What is the likely productivity of the wells, and where are the best candidates? o Are there any drilling difficulties such as swelling clay, hard rock formations, lost circulatory zones? What is the reservoir hydrology or up flow and outflow locations and mechanisms?	Probability of success after this phase is projected at 80 %.[30] This additional drilling has a cost which can be up to $10 million additional dollars.
Phase VI:	**Bankable Feasibility Study** to determine the commercial viability of the project. These business plans evaluate the technical, legal, economic, environmental and financial aspects of a project, and are required by financial institutions to assess the creditworthiness of a project. The evaluation of the geologic, geochemical and geophysical data and the market, demand, legal and tax analysis will proceed .	

[30] Ibid.

Phase VII:	**Initial Production Drilling** in coordination with preparation of detailed designs and tender documents. The most critical item is to obtain a power purchase agreement (PPA). This development phase is a critical step between exploration and construction of the geothermal project. The developer works to obtain a power sale contract, complete environmental studies, obtain regulatory approvals and key construction permits. It is important to define project capital costs and develop a detailed economic performance model and obtain financing to the lending institution's satisfaction, ensuring the economic feasibility of the project.	The following core tasks will ensure construction can begin: • Complete the reservoir assessment report, cost $50 K to $150K. • Obtain power sales contract for sale of power, cost of negotiation of power agreement $25K to $50K. • Obtain all pre-construction environmental approvals, cost $250K to $ 2million. • Complete preliminary design and cost estimate, cost $50K to $100K. A project finance package can be developed after the above are concluded.[31]
Phase VIII:	**Financial Closure.** Guarantees (pre-export financing); export credit insurance (post-export financing); loan guarantees and direct loans (buyer financing) are finalized.	
Phase IX	**Production Drilling.** Steam Field Development includes production drilling, well testing and preliminary design. Well field development overlaps with construction phase, completion of reserve wells, and injection wells. The key focus is to develop commercial grade resources at the well-head to satisfy the power plants daily steam requirements, including resource reserves needed to meet the lending institution's financial requirements. Early completion of this phase, prior to construction startup, lowers the risk profile significantly and shifts the risk profile from the developer responsible for resource delivery to the engineer, and contractor who become responsible for design, construction and performance of the power plant.	The cost of well-field development will vary due to the type and depth of the resource. In general each production well will cost between $1 million to $2.5 million to complete. Testing can cost about $50K to $150K per well.

III.1.1 Resource Characterization – Previous Activities

48. The PDF-B phase of the Geo-Caraïbes Project included compilation and archiving of previously collected geo-scientific data and identification of the best prospects for

[31] Project Mgt and Financing, course for Japanese Organizing Committee for World Geothermal Congress, May 28-June 10, 2000. R. Gordon Bloomquist, Convenor, Int'l Geothermal Assoc., p. 116.

commercially viable exploitation in each country. Based on the review of previously collected data, the collection of a broad range of new scientific data has been obtained in the best prospect areas of St. Kitts & Nevis and Dominica. New data collection was not performed in St. Lucia due to a continuing exclusive MOU with a commercial developer. In this case the developer is preparing its development strategy for submission and approval by the Government of St. Lucia. A summary of the work executed in the PDF-B, and its findings can be found in Annex D.

A summary of the resource characterization findings from the PDF-B studies follows:

St. Lucia

- *Sulphur Springs.* With modern technology, the resource proven in the Sulphur Springs deep borehole may be commercially exploitable, depending on the market conditions for generated electricity. The acidic water conditions are treatable, and there appears to be sufficient temperature and flow rate to operate any one of a number of generating options.

- *Qualibou Depression.* Other areas in the Qualibou depression appear to have good up flow of hot fluids based on recent geophysical data. The Belmont deep well probably just missed such a zone, and others exist in several areas.

The resource evidence in St. Lucia is consistent with the preliminary objectives of the developer. The developer has stated that it will seek to develop 7.5 MW of geothermal capacity in the first phase. This will allow it to demonstrate the characteristics of the resource and to determine what, if any additional capacity is added in subsequent phases.

St. Kitts & Nevis

- *Thermal features.* Geothermal indicators, in the form of surface thermal features, occur on both islands. The experts review of these features and their value as geothermal indicators was undertaken during an initial Geo-Caraïbes field mission to St. Kitts & Nevis in April 2004. The experts found substantial evidence to support the conclusion that the western side of Nevis Island provided the best opportunity for future commercial geothermal development and recommended that an exploration mission comprising geological, geochemical and geophysical work should concentrate in this area. The experts did not find evidence of readily identifiable resources on the island of St. Kitts.

- *Geological and geochemical exploration.* Previous geothermal exploration on Nevis had been limited to geological and some geochemical work. While useful, some of that work proved to be inconsistent, especially with regard to the temperatures and chemistry of waters sampled from the numerous water wells drilled in western Nevis. The geological and geochemical work commissioned by Geo-Caraïbes. Concentrated on rationalizing the existing data through a comprehensive re-sampling and reanalysis of surface thermal features and accessible water wells, sampling and analysis of new water wells, offshore vents and previously unsampled surface features, and a comprehensive geological

appraisal of western Nevis with special emphasis on defining surface structural features.

- *Geophysical investigation.* The geological and geochemical work was supported by geophysical investigations. These investigations, undertaken at the same time as the geology/geochemistry, comprised both high-resolution gravity and Self Potential (SP) techniques. The geophysical investigations concentrated on an area centering on Farm Estate, just to the south of Charlestown, the capital of Nevis, and the site of the most long-lived and consistently hottest of the surface thermal features on the island.

The preliminary geoscientific evidence suggests that there are substantial geothermal resources. An initial development would likely include up to 10 MW of geothermal power to supply the both islands of St. Kitts and Nevis.

Dominica

- *Wotten Waven.* A substantial geothermal reservoir exists beneath the Wotten Waven area, likely stretching from Boiling Lake in the east to Fond Cani in the west. The heat source(s) for this reservoir may be one or more major magma bodies at a depth of 5 to 10 km which, in the past 50,000 years or so, have fed numerous eruptions including that of the Roseau Tuff (the highest volume eruptive event in the Eastern Caribbean in the past few hundred thousand years).

- *Thermal Features.* Leaks to the surface from the primary geothermal reservoir are present but are rare; however, the experts concluded that the many warm and hot springs, soufrières and other thermal features covering a broad area represent small perched aquifers heated by conduction and/or mixing from the deep reservoir.

- *Structural control.* There appears to be some structural control on surface emanations and, possibly, on the upward passage of primary geothermal fluids towards the surface. These structural controls likely include both tectonic and volcanic features of local as well as regional significance.

- *Seismicity.* The occurrence of seismicity beneath the Wotten Waven area and throughout southern Dominica suggests an active hydrothermal system and that fracture permeability at depth may enhance geothermal exploitation potential. Thus, gaining an understanding of structural control on geothermal manifestations is critical to successful exploitation.

The potential exploitable geothermal energy in Dominica, as determined by the multiple investigations undertaken during the PDF-B and juxtaposed with the previous studies is likely to exceed several dozen MW, may exceed 100 MW. Subsequent investigations, including further surface studies and exploratory drilling will be required to demonstrate it potential.

III.1.2 Proposed Activities:

49. For each of the Project Countries, the Project calls for the completion of resource assessments leading to the commercialization of the geothermal project investment. Among the various interventions contemplated for this component are:

a. Detailed geophysics and geochemical surveys in potential drilling locations to better define local subsurface characteristics and optimum drill sites.

b. Exploration activities, possibly including further geophysical testing or drilling of test wells to prove and characterize the geothermal resource. The Geo-Caraïbes Project will work in close consultation with the Government(s) and with international geothermal development community to ensure that any additional exploratory activities will lead to a successful bid for rights to commercial development.

c. Preparation of a comprehensive geothermal model for each country.

50. Project technical activities will concentrate on refining the existing geothermal reservoir models and locating optimum exploration drilling sites. Information collected during PDF-B has greatly enhanced the understanding of the likely geothermal reservoirs, but further information is required before a working hypothesis can be tested by the drilling of exploratory boreholes. A possible schedule of technical work is summarized below:

i. Detailed geophysical surveys in potential drilling locations to better define local subsurface characteristics and optimum drill sites.

ii. Implementation of a further phase of exploration activities, possibly including further geophysical testing or drilling of test wells to prove and characterize the geothermal resource. The Geo-Caraïbes Project will work in close consultation with the Governments and with the international geothermal development community to ensure that any additional exploratory activities will lead to a successful bid for rights to commercial development.

iii. Depending on the results of these exploration activities, a prospectus for commercial development of the geothermal resource may be compiled. The Geo-Caraïbes Experts, in partnership with the Government, will seek to maximize the exposure of any prospectus and actively solicit bids from the international geothermal community.

iv. Should a commercial bid be accepted, the Geo-Caraïbes Experts will act as advisors to the Governments in their technical oversight of commercial development, which would include technical review of bids for access to the Risk Reduction Financial Tool.

III.1.3 Outputs:

In each of the Project countries:

i. Generation of refined geothermal models based on the results and interpretation of detailed geophysical surveys, including recommended drilling sites with the lowest risk.
ii. Design and implementation of the further exploration phases.
iii. Creation of a prospectus for development of the geothermal resource.
iv. Documented provision of advice to the Government regarding technical aspects of commercial geothermal development.
v. Generation of documents describing the results of periodic reviews and synthesis of all resource-related information.

III.2 RISK REDUCTION FINANCIAL TOOL

51. Most geothermal power development around the world has been launched following significant financial investments by the public sector in the evaluation, characterization, and proving of geothermal resources. Due to the high-risk nature of the development, particularly the drilling stage, this implies that it is seen as "too risky" to invest limited funds, compared with conventional power generation options. This major barrier must be removed in order to encourage the region to pursue geothermal development as a strategic option for power generation.

52. The Risk Reduction Financial Tool (RRFT) will provide a financial tool to lower exploration and appraisal risk. Public or private developers will thus have easier access to finance for the development of their proven geothermal fields and expected power generation plants. (*The range of possible financing mechanisms is presented in Text Box 2*).

Text Box 2: Possible Financing Mechanisms for Geothermal Development

Direct grant, covering the entire cost of an initial well (or wells). This would be the most attractive to a developer (second only to having a productive well already drilled and available), but would require a very high degree of confidence in the developer and significant and continuous oversight to ensure appropriate use of funds

Cost-shared grant, in which the developer is required to contribute to a part of the resources required for drilling (typically anywhere from 20% to 50% of the total cost). In-kind contributions (manpower, materials, equipment, etc.) may be permitted to count toward the cost-share portion. There are several current or recent funding programs that use this structure, including programs administered by the US Department of Energy (e.g. the Geothermal Resource Exploration and Definition, or GRED program), the California Energy Commission, and the InterAmerican Development Bank. The cost-sharing mechanism helps to ensure that the developer is serious and substantial and leverages the available funding, potentially extending it to more projects. However, there are also several potential drawbacks:

The developer may be resistant to reasonable oversight of the work by the funding entity, by

virtue of its cost-sharing contribution.

The developer may insist on retaining either confidentiality or a proprietary interest in the results of the drilling, again based on the cost-share contribution.

The cost-share contribution is subject to abuse, for instance by exaggerating or inflating the value of labor, materials or other components. This can occur whether or not in-kind contributions are specifically allowed. A cost-share structure therefore does not necessarily reduce the funding agency's burden of investigation and oversight, though, as noted above, adequate oversight may be more difficult to enforce.

"Soft" loan or contingency fund, in which funds disbursed are required to be paid back to the funding agency under specified terms if the project is commercially successful, but do not need to be repaid if the project does not proceed. This type of funding has been used successfully in the past for initial geothermal exploration wells (for example, many of the geothermal discoveries in Central America were made on this basis). Spread over a sufficient number of projects (and time), the soft-loan mechanism leverages the use of the funds through loan repayments; in addition, it may encourage developers to make efficient use of funds once a project is underway. A full-funding and soft-money approach allows for a high degree of oversight by the funding agency. Potential drawbacks include:

The absence of developer risk creates a potential for abuse if the developer is not serious in pursuing a successful project.

The initial funding requirement may be high (if several projects are funded simultaneously), and a high failure rate could lead to fewer projects being funded.

Guarantees, which aim to reduce the risk of a loan and therefore ease access to commercial financing and reduce the interest rate required by the financing structure. Instead of providing direct funding, a guarantor takes on a contingent liability that is called only in the event of non-performance. Most guarantors are either public or multilateral structures.

Even if the amount of financing available was sufficient to finance all the planned drilling works, full cost financing would be dangerous, since it minimizes the developer's involvement in the project.

For the same reason, a guarantee is an interesting instrument since it lets the developer secure the commercial financing of his project himself.

Main Features of the Proposed Risk Reduction Financial Tool

III.2.1 Basic Principles

It will cover the risks of the exploration and appraisal phases. The types of activities considered are the deep commercial size wells:

- This excludes preliminary investigations (which mean that another additional system covers theses costs).
- This also excludes the cost of production drilling and the cost of power plant implementation.

It will consist in a contingency grant and cover 60% of the eligible cost, taking in consideration that. Probability of success after this stage is 40%.[32]

The Risk Reduction Financial Tool will constitute a facility in which funds disbursed are required to be paid back under specified terms if the project is commercially successful, but do not need to be repaid if the project does not proceed.

A grace period for the repayment period would be necessary to avoid a heavy debt charge for project sponsors. A two years time lapse between application approval and repayment could be considered.

For more details on the mechanism of the Risk Reduction Financial Tool, please refer to Annex F.

III.2.2 Activities

53. The specific activities are the following:

1. Preparation of RRFT implementation:

   Identification of the legal and management issues concerning the operation of the RRFT including negotiations with governments.

2. Designation of the RRFT manager and implementation of RRFT:

   Selection of RRFT manager based on specific criteria, including: financial stability and size, experience in managing international funds, and knowledge of specialized financial mechanisms.

3. Development of Guideline Procedures for the RRFT:

   Detailed guideline procedures of the RRFT will be developed which specify the roles and responsibilities of the different RRFT stakeholders. These procedures will indicate the project flow process, from project identification and negotiations with developers, to the drilling stage and the procedures and required documents for debt write-off in the case of drilling failure.

4. Use of RRFT to support drilling activities:

   Actual use of RRFT in stimulating drilling activities. Concerning the negotiation phase to the beginning of drilling activities. In the case of drilling failure, the write-off of the developer's debt related to the defined drilling activities.

5. Monitoring of drilling projects supported by RRFT

   As detailed in the guideline procedures, monitoring of the RRFT activities will occur on a scheduled basis to ensure its effectiveness with regards to stimulating drilling activities in the Project countries and its internal management.

[32] Risk and Risk Management in Geothermal Exploration and Development, P. Barnett, J. Randle and A. Fikre-Mariam, Sinclair Knight Merz Ltd, Auckland, New Zealand, Kreditanstaldt fur Wiederaufbau, Germany, p. 181

III.2.3 Outputs

1. Implementation of the RRFT, modelling of the financial mechanism.
2. Designation of the Risk Reduction Financial Tool manager and establishment of Risk Reduction Financial Tool by the implementation Agency,
3. Develop Guideline Procedures
4. Support for exploration drilling. Use of financial mechanism (Debt write- off upon judgment of the Geothermal Advisory Panel (GAP).)
5. Monitor drilling projects underwritten by the RRFT and executed by developers.

The Manager will benefit from the technical and financial experience and expertise of Agence Française de Développement (AfD).

III.3 INSTITUTIONAL STRENGTHENING AND CAPACITY BUILDING

54. The Institutional Strengthening and Capacity Building activities will address a host of institutional and human capacity needs in each of the three project component areas. These studies, support and training initiatives are intended to be carried out prior to or in parallel with the Resource Characterization and Risk Reduction Financial Tool.

55. The individual activities concern mainly the legal and regulatory framework governing investments in geothermal energy in the Project countries. In addition, the activities addresses tender procedures and project selection. A review of legal and regulatory work initiated in the PDF-B is provided in Annex D.

III.3.1 Activities

1. Review existing project conditions for private sector participation in geothermal development, based on the work done by the legal team during the PDF-B Phase
2. Provide models for Concession, and purchase contracts
3. Assist in preparing Expression of Interest project notices and short list criteria.
4. Develop and coordinate tender process
5. Assist due diligence procedures and data room coordination during tender process
6. Assist partner countries in contract negotiations with private investors

III.3.2 Outputs

1. Projects Selected
2. Preliminary Institutional Assessment
3. Partner governments are well informed on appropriateness and / or deficiencies including required amendments relating to existing project conditions with regard to private sector participation in geothermal development.
4. Advice concerning key underlying agreements and contracts (PPA, concession agreement, generation license, connection agreements, fees and permits, etc).
5. Sound and transparent tender processes for concessions for geothermal development or power plant construction and / or operation encourage private-sector investment in geothermal development in the Region.
6. Sound and appropriate contractual frameworks for private sector participation in geothermal development.

IV. RISKS AND SUSTAINABILITY

IV.1 PROJECT RISK ASSESSMENT

56. Critical assumptions and risks to the long-term viability of geothermal development and use in the Eastern Caribbean have been identified These assumptions and risks are built into the design of the Project components and activities, are indicated in the attached logical framework (Annex B), and are also set forth in Table 13, below.

TABLE 8: RISK / MITIGATION STRATEGY.

Risk	Mitigation Strategy
Economic	
High cost of exploration. Development costs for geothermal power plants are significant and entail a higher level of risk than those encountered for conventional diesel power plants prevalent throughout the region. Drilling costs often exceed $2 million per hole and there is no guarantee that the resource will prove attractive for exploitation. In the case of many SIDS, drilling costs are even higher, since drilling rigs and other heavy equipment needs to be transported from other countries. The high cost of geophysical surveys and exploratory drilling, or drilling risk, prevents many developers from completing the Project preparation cycle, and from attracting the necessary finance.	- The Geo-Caraïbes Project is designed to address the high- initial development costs associated with this resource via the Risk Reduction Financial Tool.
Cost of electricity and competing fuel sources. In order for geothermal power electricity production to be successful in the Eastern Caribbean, it must cost less than the current price of electricity. Additionally, the high up-front investment costs of geothermal power production, especially when compared to fossil fuel, often prove to be a barrier to its development. *Petroleum* In St. Lucia and St. Kitts & Nevis, practically all of the electricity is generated with imported petroleum. Dominica is the notable exception, as it produces 30-50% of its electricity using that nation's abundant hydrological resources. With the current	- Case studies of the pilot geothermal Projects and cost-benefit analysis will be distributed in Dominica, St. Lucia, and St. Kitts & Nevis illustrating the competitive operating costs of this resource and the economic and environmental benefits that it brings. - Research on fossil fuel price fluctuations and the stability of geothermal costs will be presented throughout the region. - The Risk Reduction Financial Tool will address the high up-front development costs for geothermal energy.

price of a barrel of petroleum over US$60, geothermal is likely to prove to be a less expensive option, but if the price of petroleum drops significantly, this may not be the case. *Natural Gas* Trinidad and Tobago's Natural Gas Company, in conjunction with the Caribbean Pipeline Company, Guardian Holdings, and AIC Financial Group, has been conducting a feasibility study for a proposed undersea natural gas pipeline - known as the Intra-Caribbean Natural Gas Pipeline. The pipeline would be 400-miles long, running from Trinidad to Guadeloupe, connecting with the other Eastern Caribbean Islands en route. It would have a proposed capacity of 100 Mmcf/d. A more ambitious pipeline has also been proposed, with a capacity of two Bcf/d-pipeline, passing through the Caribbean, including Puerto Rico, the Dominican Republic and Cuba, with a terminus in Miami.	
Technical	
Quantity and quality of the resource. The character of the geothermal resources (resource volume; resource temperature; resource chemistry; redundant; and depletion over time) is a significant technical risk that must be addressed. Several previous geochemical and geophysical analyses in the Eastern Caribbean indicated characteristics that impacted the viability of the resource given earlier technologies.	- The Project is accounting for resource quantity and quality risks by providing the governments, utilities, and private developers with as much geophysics, geochemistry, and geology on the geothermal field as possible prior to exploratory drilling. It will also be establishing a Risk Reduction Financial Tool to protect developers against unsuccessful exploratory drilling. - Recent technological advances permitting the use of a broader range of fluids, including very acidic ones, addresses some of the past concerns regarding resource quality. Further, by shifting the location of well sites (as in the case of St. Lucia) many of the prior concerns about corrosive volcanic gases/fluids may be resolved.
Political	
Lack of support/ commitment by the government(s). The relative importance and the status of the development of geothermal resources in each of the countries are different. It is essential to maintain the support and commitment of	- The countries involved in the PDF-B Project preparation have all indicated official support for the implementation of the Project in Annex G: Letters of Endorsement.

the three Geo-Caraïbes Countries throughout the process.	- All participating countries have submitted commitment letters from the respective governments and stakeholders.
Lack of funding from Geo-Caraïbes partner governments, donors and commercial financial institutions for geothermal development including eventual power plant. Partner government funds are scarce and their access to funding from donors and financial institutions is limited.	- The Geo-Caraïbes Project, by removing technical, institutional and financial barriers, reduces funding needs and leverages finance from private investors, donors and commercial financial institutions
Lack of interest among private developers. Private developers perceive technical, financial and institutional risks in developing geothermal resources in the region.	- The Risk Reduction Financial Tool is designed to mitigate upstream risks for developers. - Development and adoption of geothermal resource laws and related regulations will increase efficiency and transparency for private developers in their interactions with governments. It will assist both the developers and the respective governments in developing workable contracts and partnerships.
Lack of appropriate institutional and regulatory structure in host countries. The Geo-Caraïbes countries lack consistent geothermal resource development legislation and regulations. Some key issues include: - Political will of governments to go forward – grant licenses, pass legislation, etc. - Passage of needed legislation/regulatory framework - Collaboration with beneficiary countries in the case of interconnection. - Capacity of institutions to deal with geothermal issues	- Elaboration of Geothermal Resource Development Laws, related legislation, and a consistent process for license granting directly addresses this issue. Capacity is being built on the national level by involving and training local lawyers, government officials, and technicians throughout this process. - Ongoing assistance will be provided in institutional and regulatory reform to encourage public/private development of geothermal resources.
Short term vision. The development of geothermal resources requires significant preparation time before commercial operations, thus turning away potential investors interested in more rapid financial returns and also frustrating Geo-Caraïbes countries that may be expecting more immediate returns.	- The Geo-Caraïbes Project is designed for a long-term duration of 7 years. - The development of geothermal resources is intended to be part of a long-term strategy to be incorporated in national energy plans. - Transfer of know-how and experience

	from successful operations in the region will staggered implementation cycles.
Social/Cultural. Land owners in possession of land with geothermal resources may prefer alternative uses of the land. There may a perception among the population that geothermal development activities may trigger seismic activity.	- Appropriate legislation concerning land seizures/ compensation. - Public communication and education is included as part of the project concept. Appropriate documentation may be prepared to dispel this perception.

IV.2 PROJECT RISK AND MANAGEMENT APPROACH

57. Geo-Caraïbes will use the risk management process described below, which will feed the monitoring and control process described in the M&E chapter.

58. UNEP/DGEF has used the standard risk management definitions to implement its Risk Management Process (RMP) into its wider M&E Framework. Based on the GEF Council's request to explore RMP, the Division is now using a risk management approach at the Project level that covers the need of the Project to proactively handle the risks on their Project, allowing for corrective planning and execution to take place if necessary.

Identification of Project Risks.

59. The Geo-Caraïbes Project will evaluate prospective development projects and their potential risks, in order to be able to build a Project plan that maximizes the probability of success. Risk identification will be done as part of a feasibility study, at the beginning of the active Project work, and at each new phase of a large Project. The process of identification is assisted by the use of a risk factor table that captures commonly encountered risks as well as specific risks to the focal area and Project.

Analysis of Project Risks.

60. The Geo-Caraïbes Project will analyze the identified risks to establish the Project exposure to each risk and to determine which risk items are the most important ones to address. This analysis will be supported by a top risk chart.

61. While the initial risk analysis deals with the risks identified early in the Project, sustained analysis is needed as the Project proceeds. In some cases new risks can be identified. The top risk chart will be attached to the Progress Report. The risks may or may not be addressed with a mitigation action, depending on the cost of that action and the ranking of the risk.

Handling Project Risks.

62. The Geo-Caraïbes Project may handle Project risks in different ways. Alternatives include:

- Accept the risk, with no investment of effort or cost. This is appropriate when the cost of mitigation exceeds the exposure, and the exposure is acceptable.
- Transfer the risk to someone else, or agree to share the risk. This is appropriate when a partner is better able to handle the risk
- Fund and staff the efforts to reduce the probability that the risk will become a problem.
- Fund and staff the effort to reduce the loss associated with the risk should it become a problem.

63. Appropriate handling actions will be determined at the Geo-Caraïbes Steering Committee level.

Tracking and Controlling Project Risks.

64. Throughout the Project, the Geo-Caraïbes management will track progress handling the risks to ensure that:

- Actions which should reduce the probability of occurrence are effective
- Actions which should reduce the loss associated with the risk are effective
- A contingency plan is designed for risks where there is no possible mitigation

65. In addition the team watches additional risks that need to be addressed, as well as changes in impact or probabilities to previously identified risks.

66. The Geo-Caraïbes risk management process is intended as an early warning Project management tool to allow for corrective actions to take place (which responds to both GEF Council requests of identification and response to risk) and therefore the process must happen at the Project level – and before the Project at the design level –as by the time a Project reaches the portfolio level it would be too late for corrective action.

IV.3 SUSTAINABILITY

67. The sustainability of the Project will be determined not only by the commitment of the Executing Agencies and Implementing Agencies, but also by the governments of the Project Countries involved. The overall risk can be reduced if the citizens of the Project Countries participate in the Projects implementation as a result of the public education and awareness which has been proposed. Educating and involving the stakeholders on the key objectives of the Project can further minimize the risks involved in the Project.

68. This stakeholder involvement in the Project and its activities should be viewed as an essential component of the Project. Involving the stakeholders and the public in the Project activities ensures the sustainability of the Project, as pressure will be brought to bear on the

political powers – that – be to maintain the development of the Project, thus ensuring the continuance of the Project.

69. To further develop the Geo-Caraïbes Project, closer relationships should be formed with similar regional GEF-funded Projects. Such relationships can be fostered through agreements with these similar Projects. This can be facilitated by UNEP, and other GEF Implementing agencies, as well as the Executing Agencies. Cooperation can take place in the ways discussed below.

70. The Project managers involved in regional renewable energy Projects should work together, not only to share information and help promote the Project, but also form closer regional ties and participation between the countries.

71. Economic/financial risk can be detrimental to the sustainability of the Project. The Project Countries are especially vulnerable as they are small economies that can be easily affected by any negative change in the global economy. This change could not only affect the governments' involvement in sustaining the Project, but also their ability to take on more financial burden once the GEF's financial responsibility is ended.

72. The risk of changes or upheavals in the government(s) could also affect the commitment to the Project. This risk can be reduced through policy affecting the various Project components, which would increase the awareness of the sustainable development needs of the Geo-Caraïbes Project and the many benefits of the Project.

73. Policy reform in each of the Project Countries will help to achieve the regional Project objectives and sustainability.

74. The sustainability and stability of the Executing Agencies is very important to the sustainability of the Project. Regional/Institutional sustainability is helped by the continued presence of the Executing Agencies (OAS and AfD) in the region, and the inclusion of the principles of the Geo-Caraïbes Project into these institutions.

IV.4 REPLICABILITY

75. Replicability is a key feature of the Project design. Many Eastern Caribbean islands are volcanic and present important geothermal development potential. The successful development of geothermal energy in the Project countries could realistically serve as an example for potential investors in other countries of the region and prove the technical and economic feasibility of geothermal power generation in the Eastern Caribbean. The implementation of the proposed Risk Reduction Financial Tool, as well as the creation of the proper institutional and legal framework, should also provide practical feedback for the other islands, as the lessons learned from this experience (both positive and negative) could then be applied to neighboring countries. Ultimately, the scope of geothermal development could therefore be extended beyond the three countries of the Project.

76. In the same way, the promising prospect of an electrical interconnection between Dominica and both Guadeloupe and Martinique, if confirmed feasible, can also be replicated for possible exports of geothermal-based electricity from St. Kitts & Nevis and St. Lucia to other islands. Future studies to be undertaken in order to prepare interconnection links

between neighboring islands, including analysis of submarine cable laying conditions and interconnected network operating studies, will also provide useful indications for the next possible interconnections. These new links could then be considered as the next steps towards a larger Caribbean backbone transmission network.

V. STAKEHOLDER PARTICIPATION

V.1.1 Project Objectives for Stakeholder Engagement.

77. The Project shall lay the foundation for sustainability by pursuing a three-fold objective: (i) engaging a broad spectrum of the Project Country stakeholders at each pivotal decision point to maximize their buy-in to the geothermal-development goal articulated by the regional policy; (ii) establishing public awareness of the benefits of sustainable geothermal energy and thereby overcoming misinformation, and (iii) establishing a trained cadre of Project Country professionals

78. Precedent demonstrates that the success of Projects and policy reforms depends on the degree to which Projects and policies encompass stakeholder interests. The Full Project objectives – and the legislative, regulatory and institution framework that implement them – must take into account the potential and perceived affect on stakeholder interests. Failure to assure shared goals among all the stakeholders may well result in opposition to and delay of the Project. Sustainability in a geothermal power Project is best ensured if the major stakeholders – the utilities, the private-sector opinion makers and prospective developers – share common goals with the government decision-makers.

79. Considerable investments in Stakeholder Engagement have been made during the PDF-B phase. A complete description of the multiple stakeholder initiatives and a schematic illustrating the specific stakeholders of interest in the Project Countries may be found in Annex D.

80. Full Project implementation requires that the major stakeholders share a realistic understanding of the nature of geothermal energy. On small-community islands, such as exist in the Project Countries, misinformation in the general public can be destructive to Projects. The Full Project will institute public awareness education.

81. Long-term sustainability requires education and training of both a technical and a regulatory cadre in the Project Countries in order to promote, govern and regulate geothermal resources on a commercial basis.

82. Stakeholder participation and consultation is a fundamental principle of the Geo-Caraïbes Project, impacting every aspect from technical studies to selection of geothermal resource developers. Integrating key stakeholders in the decision-making process provides them with genuine opportunities to influence the execution of the Project from inception to completion, ensuring stakeholder "ownership" of the Project and its related activities. Of equal importance, such stakeholder participation builds the knowledge base that is the foundation of sustainability.

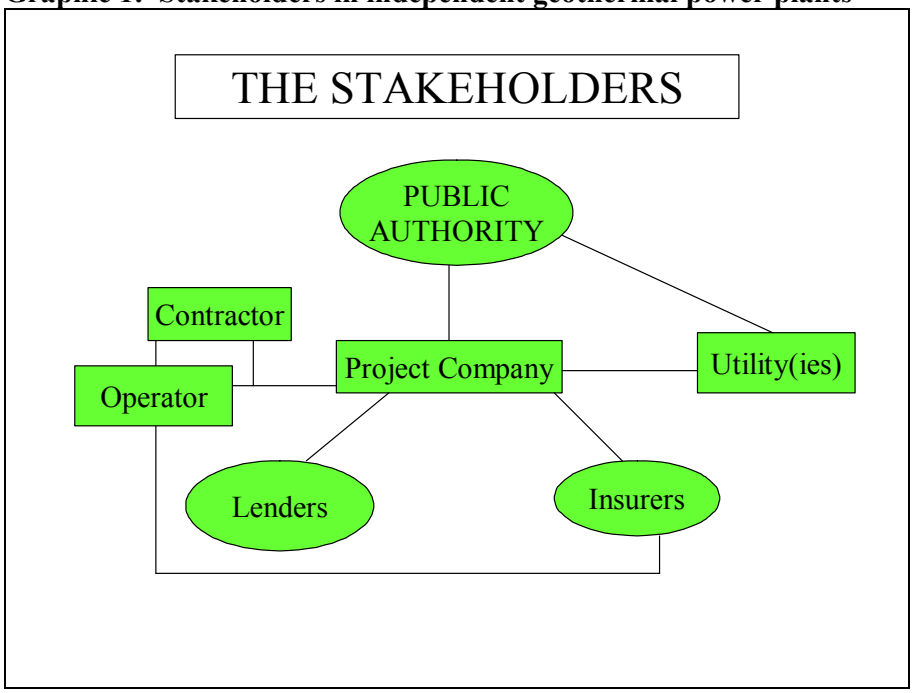
V.1.2 Overview of Stakeholder Incorporation.

83. In any independent geothermal power project there is several stakeholders:

i. the Public Authority (ies),
ii. the buying institution (s) (usually a utility in a base power situation),
iii. the selling institution (the developer – usually a coalition of private companies associated in a special purpose vehicle),
iv. the actors in charge of contracting and operating the geothermal field and the generation plant
v. the lending institutions, and
vi. The insurers

The following graphics illustrates the relationships:

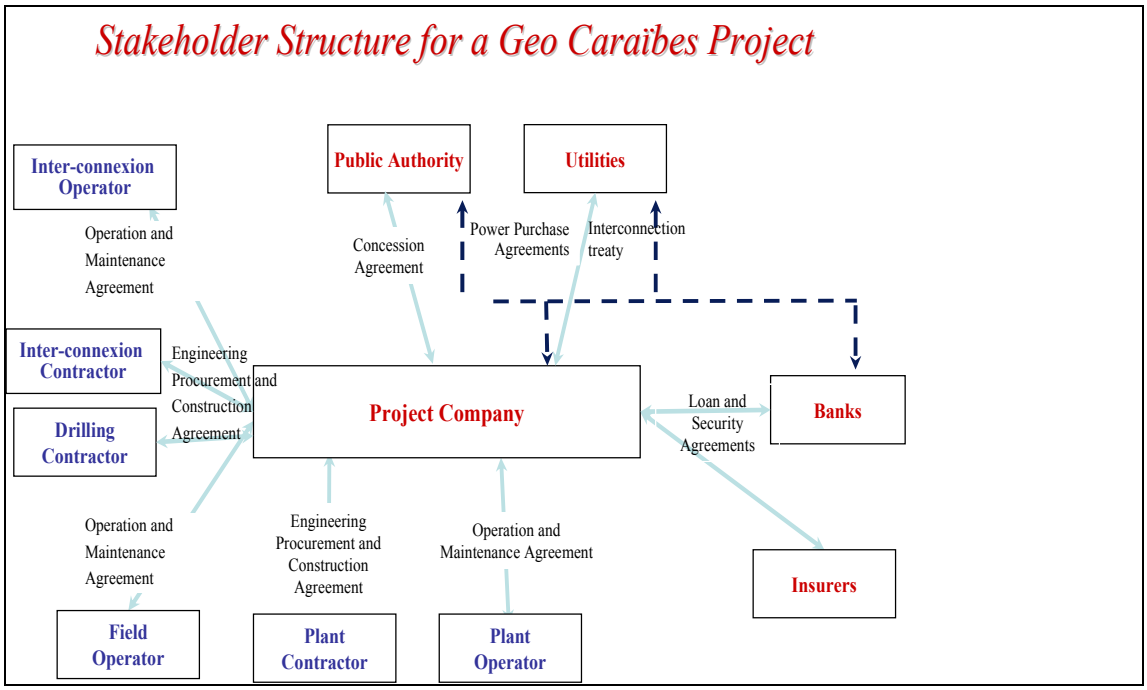
Graphic 1: Stakeholders in independent geothermal power plants



In addition, we have to consider some specificities linked to the Geo-Caraïbes context:

- Need to plan connection lines to sell power for internal or foreign market (concerning the three focused islands)
- Choice for the Project Company managing directly or outsourcing the different tasks for generating and transmitting geothermal electricity

Graphic 2: Stakeholder Structure for a Geo-Caraïbes Project



84. The Public Authorities will be integrated in the management of the Project and one representative of the concerned Government will chair each Country Project Executive Committee (see sectionVII.1.3)

85. The technical assistance provided under the GEF Project will ensure a sound and appropriate legal and regulatory framework to facilitate the commercial development of the geothermal potentials of the three countries.

86. This support will be based on the set of recommended legal principles and model legal provisions on privately financed infrastructure projects prepared by the United Nations Commission on International Trade Law (UNCITRAL) and adopted by the United Nations General Assembly (72nd plenary meeting – 9 December 2003). It will be tailored and adapted to the specific situation of each of the three countries.

VI. INCREMENTAL COSTS & PROJECT FINANCING

VI.1 SUMMARY PROJECT COSTS

				$
1	**Resource Characterization**			**8 270 000**
	a	**Improving Technical Knowledge and Capacity**		**1 970 000**
			Geo-scientific Data Collection and Analysis	1 570 000
			Techncial Capacity Building and Outreach	200 000
			Feasibility for Inter-island interconnection	200 000
	b	**Thermal Gradient Holes**		**1 500 000**
	c	**Slim Holes**		**4 800 000**
2	**Risk Reduction Financial Tool**			**5 200 000**
	a	**Risk Reduction Financial Tool Design**		**700 000**
			Identifty financial requirements for sustainable projects	200 000
			Assess financial tools	200 000
			Preliminary Risk Reduction Financial Tool Design	300 000
	b	**Risk Reduction Financial Tool Implementation**		**4 500 000**
3	**Institutional Strengthening and Capacity Building**			**700 000**
			Policy Reform	200 000
			Institution Building	150 000
			Capacity Building	150 000
			Legislative and Regulatory Consel	200 000
			TOTAL PROJECT BUDGET	**14 170 000**

VI.2 INCREMENTAL COST ANALYSIS

VI.2.1 Incremental Cost Analysis

87. All participating countries in are experiencing increasing electricity demand growth via natural population growth, increased living standards, as well as the changing structure of the economies from basic agricultural to higher value agricultural processing and the introduction of services (tourism, offshore banking and data information services).

88. Diesel electricity production sets currently provide the majority of electricity in the Participating countries. Alternative energy sources include the potential natural gas pipeline from Trinidad and Tobago that is currently being studied, as well as different renewable energies. Hydropower accounts for 40% of installed capacity on Dominica, while wind power (5 MW) is under consideration on St. Lucia. Biomass and solar water heating are

possible small scale options. Significant geothermal resources exist on the islands, however, and they represent the sole alternative energy source that can provide baseload energy supply.

89. Despite the existence of the geothermal resources, development has not occurred for a variety of technical, institutional and financial reasons. GEF financing at this juncture, however, can provide an important stimulus and an operational structure for promoting the needed development of this renewable energy resource.

2 scenarios are identified:

90. **Baseline scenario**: Geothermal exploration[33] is continued (or not) in the different Project countries depending upon national priorities and policies. Interreg financing (see Project financing section) is currently under review for additional geothermal studies for approximately $US 1.32 milion. In lieu of any further geothermal studies, the most likely general future energy production development in the three countries would include:

- continued reliance on diesel generation for the national network,
- the legal and regulatory framework will remain largely unchanged in the Project countries, which promotes a lack of legal security that discourages potential private investors.
- continued reliance on small, diesel power production sets in off-grid areas which despite relatively low capital investment costs, demonstrate high operating costs, especially with imported fuel prices currently hovering over $60 per barrel of oil;
- continued emission of greenhouse gases;
- the slower adoption and development of these clean and renewable energy technologies in the region.

91. **Alternative (GEF – scenario)**: GEF financing allows for the confirmation and characterization of geothermal resources, the establishment of a financial mechanism to offset the commercial risk perceived by investors, and to provide critical institutional strengthening and capacity building to overcome current barriers. Leveraged private investments are made in the three Project countries for geothermal production of more than 100 MW, which reduces approximately 250,000 tons of CO_2 emissions per year.

92. The incremental cost of the Geo-Caraïbes project is the cost of the Alternative (GEF – scenario) minus the costs of already existing programmes and activities supported by regional governments, etc in the Baseline scenario. The proposed GEF financing would serve to cover these incremental costs.

VI.2.2 Incremental Cost Estimate

93. The incremental cost estimate indicates what the GEF project would add to the baseline scenario of activities.

[33] Interreg financing is currently under review and will provide approximately $US 1.32 million for geothermal activities in the region (with or without the GEF project). It is thus considered as Baseline..

Project Component	Baseline Scenario	Alternative Scenario	Incremental Cost Estimate
Resource Characterization	1,320,000	8,270,000	6,950,000
Risk Reduction Financial Tool	0	5,200,000	5,200,000
Institutional Strengthening and Capacity Building	0	700,000	700,000
TOTAL	**1,320,000**	**14,170,000**	**12,850,000**

(*Detailed Incremental Cost Tables are presented in Annex A*).

94. The global and domestic benefits generated by the GEF activities are summarized below:

Global Benefits

- Resource characterization is completed. Exploratory drilling commences on the three islands (staggered) which permits geothermal development activities to advance significantly.

- The appropriate risk reduction financial tool is defined and identified geothermal projects are evaluated and structured to share risks between public and private participants. Once the RRFT is established, private investors feel more confident in sharing risks of geothermal exploratory work.

- Databases, forums, training and evaluation of policies, legal and regulatory frameworks concerning geothermal energy are coordinated. Legal and regulatory framework is evaluated and modified to encourage private investment in geothermal development in the three project countries.

- Geothermal commercial production begins which leads to reductions of CO_2 emissions of up to 250,000 tons per year.

Domestic Benefits

- Resource characterization is completed. Exploratory drilling commences on the three islands (staggered). Local experts and authorities are involved and trained. Development of data regarding geothermal resources that allows for the characterisation of the resources, attraction of developers, and proper environmental monitoring.

- Specific, geothermal, renewable energy sites in the three Project countries are evaluated and prepared to be exploited. Given successful exploration results, geothermal resources are exploited, generating less CO_2 than fossil fuel sources.

- Local experts are involved and trained. New information, know-how and expertise is gained from regional and international interaction Legal, regulatory and policy frameworks are coordinated and improved to facilitate commercial geothermal development.

- Development of geothermal resources leads to a diversification of energy sources, interconnection with other countries in the region, and a reduction of CO_2 emissions of up to 250,000 tons per year.

VI.3 PROJECT FINANCING

VI.3.1 GEF

Main Project Components					$	
				GEF	OTHER	TOTAL
1			Resource Characterization	4 500 000	3 770 000	8 270 000
	a		Improving Technical Knowledge and Capacity	700 000	1 270 000	1 970 000
	b		Thermal Gradient Holes	800 000	700 000	1 500 000
	c		Slim Holes	3 000 000	1 800 000	4 800 000
2			Risk Reduction Financial Tool	2 600 000	2 600 000	5 200 000
	a		Risk Reduction Financial Tool Design	400 000	300 000	700 000
	b		Risk Reduction Financial Tool Implementation	2 200 000	2 300 000	4 500 000
3			Institutional Strengthening and Capacity Building	400 000	300 000	700 000
			TOTAL PROJECT BUDGET	7 500 000	6 670 000	14 170 000

VI.3.2 Co-Financing

95. **Organization of American States**. OAS managed the PDF-B phase of the GEF project. In the Full Project Phase, OAS will provide in kind contributions for project management, staff and support for Coordination Task Force.

96. **Agence Française de Développement.** AfD participated in the PDF-B phase of the GEF project. In the Full Project Phase, AfD will provide both in-kind and cash contributions for project management, staff and support for the Coordination Task Force.

97. **Fonds Français pour l'Environnement Mondial.** FFEM will provide funds for the resource characterization and RRFT mechanism.

98. **Participating Governments.** Participated via in-kind contributions during the PDF-B phase. During the full Project phase, participating governments will continue to provide in-kind contributions of support staff, office logistics, transport, and office space.

99. **Interreg** is financed under the European Regional Development Fund (ERDF) of the European Union and is designed to stimulate interregional cooperation. The INTERREG III B Programme "Caribbean Space" concerns cooperation between 44 countries (not including French overseas Regions). One of the INTERREG III-B Programme's priorities is to promote the use of renewable energy within the cooperation area, including support for pilot projects.

100. The Interreg financing is composed of contributions from several institutions and governments. In this instance, the financing is broken down in the following: FEDER 47%, ADEME, 26%, BGRM, 20%, Dominica, 6%, Guadeloupe, 3% and Martinique, 2%. The current financing package has been presented to the committee and is under review with an initial decision expected in April, 2006.

VI.3.3 Associated Financing

101. Once the geothermal resources have been characterized, and the first production drillings have confirmed the resources, the respective governments may begin a tender procedure to attract commercial developers. The GEF Project will assist the governments in this negotiation and leverage these future investments.

102. Initial estimates of the required investments needed for commercial production total to approximately US$ 350,000,000, including 200,000,000 of power station investments and the remainder split between interconnection lines and production drilling. These commercial operations may be split among different operators for the geothermal field operation, electricity generation and power transmission activities.

VII. WORK PLAN

VII.1 PROJECT IMPLEMENTATION ARRANGEMENTS

VII.1.1 Project Implementation

103. The Project will be implemented by the United Nations Environmental Programme ("UNEP"). The UNEP focuses on promotion of clean energy in developing countries. It assists decision-makers in government and the private sector to make better, more informed energy choices, which fully integrate environmental and social costs. The UNEP runs a number of activities in the renewable energy field. These activities, generally focused on the needs of developing and transition economies, involve various facets of the technology research, development, transfer and commercialization process. In particular, it is working in Eastern Africa on a related regional geothermal development Project. The UNEP works with a broad spectrum of partners in these efforts, including industry associations, NGOs, financial institutions and the private sector.

104. Within the GEF, UNEP is accorded a role in implementing regional Projects, and SIDS is a priority for UNEP. In addition to implementation requirements, UNEP will execute activities consistent with comparative advantage in chairing the Project Steering Committee, capturing synergies with other GEF Projects, and global dissemination.

VII.1.2 Project Execution.

105. As requesting/implementing agency, UNEP will have overall responsibility for the implementation of the Full Project. UNEP will appoint the OAS Office for Sustainable Development and Environment (OAS/OSDE) and AFD Agence Française de Développement as co - executing agencies.

106. The OAS is a multi-lateral organization representing the interests of 34 countries of the Americas. The GS/OAS has national offices located in 14 Caribbean countries (including Dominica, St. Lucia, and St. Kitts & Nevis) and permanent missions to the OAS from all member countries. Its Office for Sustainable Development and the Environment (OSDE) serves as the coordinating institution for the Renewable Energy in the Americas (REIA) initiative. The OSDE has successfully executed several GEF-supported Projects by The World Bank and/or the United Nations Environment Programme (UNEP) including: The Caribbean: Planning for Adaptation to Climate Change (CPACC); Strategic Action Programme for the Bi-National Basin of the Bermejo River; and Formulation of a Strategic Action Program for the Integrated Management of Water Resources; the Sustainable Development of the San Juan River Basin and its Coastal Zone; and the PDF-B Stage of Geo-Caraïbes.

107. REIA offers technical, policy and financial assistance for the promotion of sound energy solutions throughout the region, and currently serves as a leading institution in the regional Projects, Global Sustainable Energy Islands Initiative (GSEII) and on the Steering Committee for the execution of the UNDP/GEF Project, Caribbean Renewable Energy Development Project (CREDP).

108. The Agence Française de Développement (AFD) is a public institution serving the general interest by providing development financing. It is active in over 60 countries in

Africa, the Pacific region, Asia, the Caribbean, the Indian Ocean, the Mediterranean and Central and Eastern Europe, as well as in French overseas areas. It has a network of 45 agencies and offices throughout the world. A specialised financial institution, AFD finances economic and social projects carried by government local authorities, public companies, and the private and associative sectors on five continents. These projects focus on urban development and infrastructures, rural development, industry, financial systems, and education and health. AFD offers a range of financial instruments—subsidies, guarantees, shareholdings, and all forms of assisted and commercial loans—in response to each situation.

VII.1.3 Project Management and Oversight.

109. To ensure proper management and oversight in Project execution, the following institutional entities will be employed:

110. **The Project Steering Committee (PSC)** will comprise nominated representatives of the three Project countries, donors, UNEP, OAS, AFD and other stakeholders as the committee may invite from time to time. It will provide overall guidance and oversight of the Project and ensure coordination of the activities in all three Project countries. It will also monitor progress and performance.

111. **A Country Project Executive Committee (CPEC)** will be created under the Project steering Committee umbrella to oversee the Geothermal development in each country (Dominica, St Kitts & Nevis, St Lucia). It will include representatives of the considered country, and of the beneficiaries in case of interconnection. It will have a full time Country Project Executive Manager. He will be responsible for the day to day management of the country project. The Country Project Executive Committee will benefit from the technical, juridical and financial studies done during the PDF-A and PDF-B phases. Each CPEC will receive technical assistance from the Coordination Task Force and short-term consultancy inputs

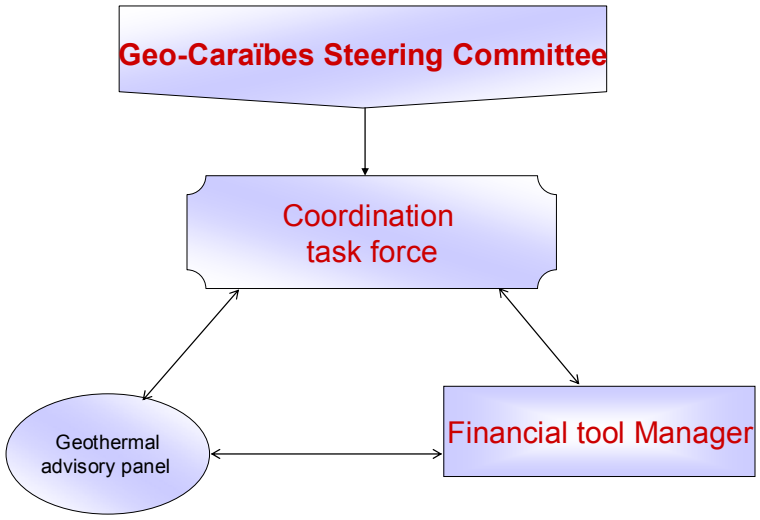
112. **A Coordination Task Force (CTF)** will be established by UNEP, as a CTF, to handle the overall management, coordination, administration and financial management of the Project. CTF is a UNEP/OAS/AFD coordination unit. A permanent technical assistant and a several part-time experts will manage the Project. It will establish the management and monitoring guidelines for the Geo-Caraïbes Project; coordinate all activities related to the Country Project Executive Committees in conjunction with the Geothermal Advisory Panel and the Financial tool manager; coordinate with international donors and organizations. It will elaborate project eligibility criteria. In coordination with the Financial Tool Manager, which will be approved by the Geo-Caraïbes Steering Committee. It will be responsible for all technical and financial reporting, for procurement and supervision of all services, and for maintaining liaison with all Project partners

113. **A Geothermal Advisory Panel (GAP)** will be established by the Implementing Agency (UNEP) in order to provide neutral expertise and to guide and review surface assessments and Pre-feasibility studies. It will be composed of reputable international experts. It will support the Coordination Task Force in the preparation of surface investigation activities. It will prepare a methodological framework for the analysis and the assessment of the project from a scientific and technical point and prepare a template for periodic reporting on the drilling execution by the sponsor. It will assess the submitted projects on geological, geophysical, geochemical and other relevant aspects; monitor drilling execution; provide an

assessment report to the Financial Tool Manager; report to the Coordination Task Force regarding the status of the projects receiving support from the Financial Tool.

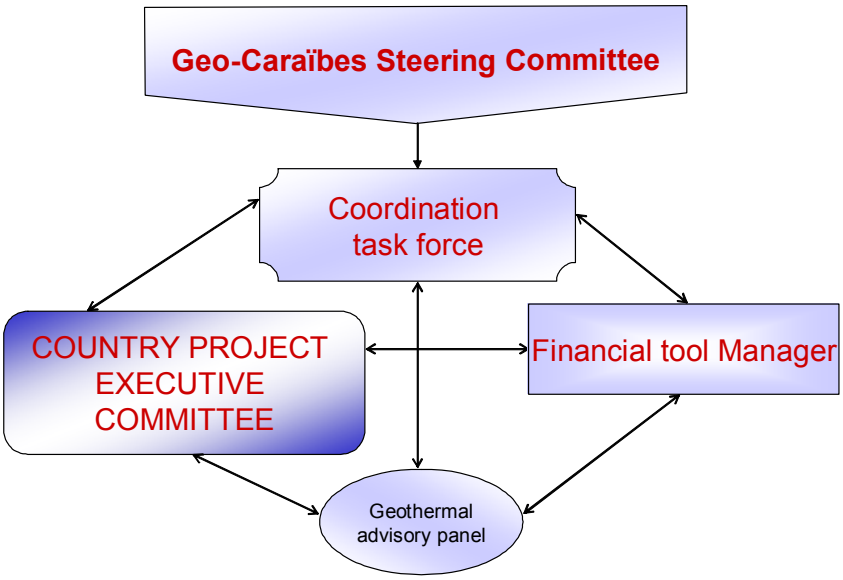
114. **Financial tool Manager – RRFT Manager**. A Risk Reduction Financial Tool Manager will be appointed by the PSC. The Manager will benefit from the technical and financial experience and expertise of Agence Française de Développement (AFD).

Graphic : Geo-Caraïbes Project Organisational Chart



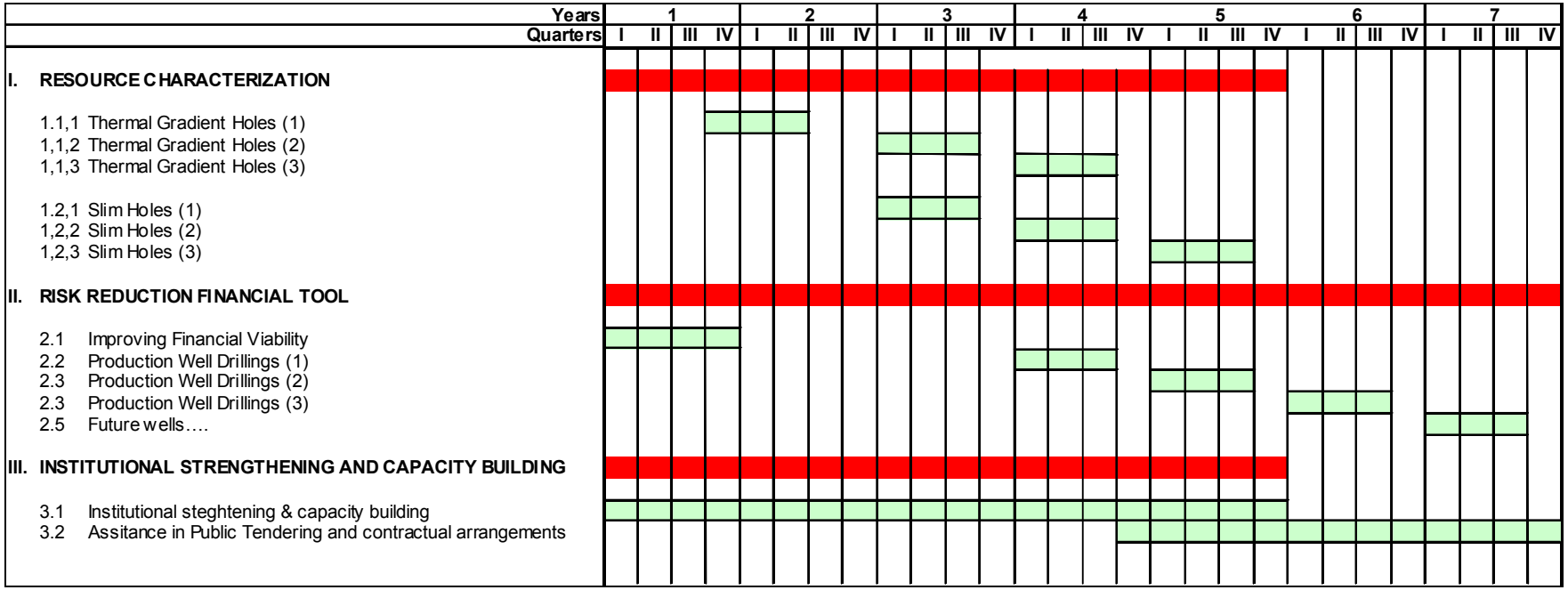
Organisational Chart of the Project

Graphic: Geo-Caraïbes Country Project Management



Country Project management organisation

VII.2 PROJECT SCHEDULE



VIII. MONITORING AND EVALUATION FRAMEWORK

115. For purposes of achievement, learning, measurement and accountability, Geo-Caraïbes will follow the internal UNEP-GEF Monitoring and Evaluation (M&E) approach and procedures as described below.

VIII.1 APPROACH TO M & E AND PROCESS DEFINITIONS

116. Geo-Caraïbes is approaching M&E as the systematic and deliberate set-up of an integrated structure, processes and tools to support project management in its aim of continuously improve decision-making. The project will use the following management processes:

1. **Project Planning Process:** the development of a document used to guide execution and control. This document will be prepared at the very early stage of the project start with the view of being formally approved by the Steering Committee during its first session and become an official guideline of the programme.
2. **Risk Management Process**: systematic identification, analysis and response to project risk. This process feeds into the Monitoring and Control process.
3. **Monitoring and Control Process**: capture, analysis and report on project performance as compared to plan to manage change into the work plan.
4. **Review Process**: identification of project's best practices and lessons learned which feed back into the planning process.
5. **Internal Evaluation Process**: measurement and further identification of expected project results (outputs, outcomes, impact) indicators, involving the definition of appropriate standards.
6. **Independent Evaluation Process**: external analysis/assessment of the success of the project.

VIII.2 KEY USERS, RESPONSIBILITIES, & TIMELINESS

117. The various entities involved in the project will share M&E and reporting responsibilities as follows:

118. **Planning Process**: Each Country Project Executive Committee (CPEC) will be responsible for preparing a first 5 year phase work plan (including activities, timing, logframe, budget) and two bi-annual work plans each year for their national/thematic components. To that purpose a national/thematic planning meeting will be held twice a year.

119. The Coordination Task Force (CTF) will be responsible for preparing a first 5 year phase work plan and an annual work plan each year for the whole project, including the regional network activities, the technical assistance developments and the financial perspectives. To that purpose a regional planning meeting will be held once a year, integrating the elements of planning received from the CPEC, as well as from the Manager of the financial tool. This process will result in a planning document to be submitted and approved by the Project Steering Committee (PSC).

120. **Risk Management Process**: Each CPEC will be responsible for preparing a national/thematic risk factor table and a top risk chart on an annual basis. The top risk chart will have to be attached and commented in the annual CPEC progress report.

121. The Coordination Task Force (CTF) and the Risk Reduction Financial Tool Manager will be responsible for preparing their respective component's risk factor table and top risk chart, as well as reviewing the CPECs progress reports. The CTF will bring up to the Project Steering Committee (PSC) any issue of concern resulting from this analysis.

122. **Monitoring and Control Process:** Each CPEC will be requested to produce quarterly a financial report and annually a national/thematic bi-annual Progress Report describing the implementation status vis-à-vis timeline and budget, to be submitted to the CTF. In addition, an updated work plan to be discussed at the next planning meeting, explaining reasons for changes, will be submitted on a bi-annual basis.

123. The Risk Reduction Financial Tool Manager and the CTF will be responsible for producing an annual consolidated Progress Report, including financial statements, as well as an updated work plan to be discussed at the next planning meeting and then submitted to the Project Steering Committee for approval.

124. The CTF will launch a Mid-Term Evaluation/Audit to be executed by UNEP Monitoring and Evaluation Office during the third year after project starts.

125. Review Process: The CTF will be responsible for producing an annual project implementation review (PIR) report to the GEF Secretariat as well as preparing an annual self-evaluation review (SER) to UNEP Monitoring and Evaluation office.

126. The CTF will be responsible for feeding back the learning of the review process into the next planning meeting.

127. **Internal Evaluation Process:** Each CPEC will be responsible for measuring and further develop national/thematic output and outcome indicators defined during project design. To this purpose an internal evaluation meeting to update the Log Frame matrix indicators will be held once a year.

128. The Financial Tool Manager and the CTF will be responsible for measuring and further develop their respective components and project overall output and outcome indicators defined during project design. To this purpose an internal evaluation meeting to update the Log Frame matrix indicators will be held once a year.

129. **Independent Evaluation Process**: An independent evaluation of progress will be carried out, by an external advisor not involved in the current Geo Caraïbes operations, every two years. In addition, the CTF and UNEP are responsible for scheduling and coordinating an external, independent Final Evaluation (at the end of the project) to assess attainment of the project objective and possible impacts, and if necessary, a Mid-Term Evaluation.

130. **Training/Capacity Building:** The CTF will make sure that the CPECs and the Financial Tool managers are equipped with, understand the purpose and will use the M&E working tools related to the management processes described above. To this purpose an

M&E meeting will be held at project launch, in view of making everyone familiar with these tools as defined below:

1. Planning Process:
   National/thematic sub-log frames for national/thematic work plans.
   Network & Technical assistance and RMF & TAF sub-log frames for respective components work plans.
   Project overall log frame for project work plan.

2. Risk Management Process:
   Risk factor tables and top risk charts.
   Network & Technical assistance and RMF & TAF risk factor table and top risk chart
   Project overall risk factor table and top risk chart.

3. Monitoring and Control Process:
   Progress report template.
   UNEP mid-term evaluation/Audit guidelines.

4. Review Process:
   GEFSec PIR annual guidelines.
   UNEP SER electronic template.

5. Internal Evaluation Process:
   Log Frame Matrix.

6. Independent Evaluation Process:
   UNEP standard for Terminal Evaluations.