GLOBAL ENVIRONMENT FACILITY
INVESTING IN OUR PLANET

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February 16, 2010

Dear Council Member:

I am writing to notify you that we have today posted on the GEF's website at www.TheGEF.org, a medium-sized project proposal from IADB entitled ***Barbados: Sustainable Energy Framework for Barbados***, to be funded under the GEF Trust Fund (GEFTF).

The general objective of this project is to promote and support sustainable energy and energy conservation programs in order to ensure a sustainable development in Barbados, providing alternatives to minimize the dependency on fossil fuels and resulting in a positive environmental footprint on the use of energy resources.

The project proposal is being posted for your review. We would welcome any comments you may wish to provide by March 02, 2010, in accordance with the new procedures approved by the Council. You may send your comments to gcoordination@TheGEF.org.

If you do not have access to the Web, you may request the local field office of the World Bank or UNDP to download the document for you. Alternatively, you may request a copy of the document from the Secretariat. If you make such a request, please confirm for us your current mailing address.

Sincerely,

Attachment: Project Document
GEFSEC Review Sheet

Copy to: Country Operational Focal Point
GEF Agencies, STAP, Trustee

REQUEST FOR CEO ENDORSEMENT/APPROVAL

PROJECT TYPE: MSP
THE GEF TRUST FUND

Submission Date: December 18th, 2009
Re-submission: February 3rd, 2010

PART I: PROJECT INFORMATION

GEFSEC PROJECT ID: 3891
GEF AGENCY PROJECT ID: BA-X1001
COUNTRY(IES): Barbados
PROJECT TITLE: Implementing Energy Efficiency and Renewable Energy Projects under the Sustainable Energy Framework for Barbados
GEF AGENCY(IES): IDB
OTHER EXECUTING PARTNER(S): Ministry of Finance, Investment, Telecommunications and Energy (MFITE) – Energy Division
GEF FOCAL AREA(s): Climate Change
GEF-4 STRATEGIC PROGRAM(s): SP1 and SP3
NAME OF PARENT PROGRAM/UMBRELLA PROJECT: N/A

Expected Calendar (mm/dd/yy)	
Milestones	**Dates**
Work Program (for FSPs only)	N/A
Agency Approval date	31/02/2010
Implementation Start	03/01/2010
Mid-term Evaluation (if planned)	N/A
Project Closing Date	03/01/2012

A. PROJECT FRAMEWORK

Project Objective:

The **general objective** of this project is to promote renewable energy (RE) and energy efficiency (EE) in Barbados, thus reducing the country's dependency from imported fossil fuels, enhancing security and stability in energy supply, and improving overall environmental sustainability in the country.

The **specific objectives** of this project—related to the respective project Components described below—are:

(i) To help the Government of Barbados (GoB) develop a Sustainable Energy Framework (SEF) for Barbados, and achieve institutional strengthening in the areas of RE and EE (see Component 1)
(ii) To help the GoB achieve EE in the country's key sectors, and to implement energy efficiency pilot projects (see Component 2)
(iii) To help the GoB identify and promote the most effective alternatives for RE generation, and to implement renewable energy pilot projects (see Component 3)
(iv) To ensure wide dissemination of all project activities and results, thus contributing to spreading sustainable energy practices in Barbados (see Component 4).

Project Components	**Indicate whether Investment, TA, or STA[2]**	**Expected Outcomes**	**Expected Outputs**	**GEF Financing[1]**		**Co-Financing[1]**		**Total ($)** c=a+ b
				US$ (000) a	%	US$ (000) b	%	
Component 1				**0**	**0%**	**170**	**100%**	**170**
Preparation of Sustainable Energy Framework for Barbados (SEF) and Capacity Building	TA	Design of a comprehensive policy and regulatory framework for sustainable energy, with technical and	Barbados energy balance and prospective needs; Sustainable Energy Framework; Institutional training on RE and EE	0		170		170

		legal conditions set at the institutional level to encourage RE and EE						
Component 2				**500**	**8%**	**5,739**	**92%**	**6,239**
Policy and Implementation Support for Energy Efficiency (EE)	TA	EE practices fostered in residential, commercial, and public sectors	▪ Assessment of EE potential: 7 audits in public sector buildings, 25 audits in residential buildings, and 8 audits in commercial (non-tourism) buildings; protocol and standardized reporting model for audits; targets for EE by sector; estimate of financial impact and financing requirements for EE. ▪ Design of financial mechanisms and incentives for EE ▪ Mitigation measures recommended for environmental impact of measures (e.g. CFLs) .	0		724		724
	Investment	▪ 1,232MWh/yr saved, USD299.5k saved, 1,079tCO2 reduced ▪ 947MWh/yr saved, USD230.2 saved, 829tCO2 reduced ▪ EE savings demonstrated thanks to the implementation of the SEF EE Pilot Program to promote the	▪ Distribution and installation of CFLs in households: 15,000 CFLs in 3,000 households involved in campaign ▪ Distribution of Power Monitors and awareness campaign: 3,000 monitors and households involved in campaign	500		15		515

		use of CFLs and energy conservation in low- and middle-income households						
	Investment	▪ Creation of a Fund for EE and RE through proposed loan from IDB to GoB (in preparation)	▪ About USD5 million in financial support for replication of Pilot Program results	0		5,000		5,000
Component 3				**500**	**8%**	**5,746**	**92%**	**6,246**
Policy and Implementation Support for Renewable Energy (RE)	TA	▪ Use of RE as an alternative source for electricity generation is stimulated	▪ Estimate of RE technical and economic potential in Barbados based on economic viability and willingness to pay; Recommendation of framework to buy/sell RE to the grid; Establishment of financial mechanism and incentives for RE ▪ Mitigation measures recommended for environmental impact of RE projects.	0		454		454
	Investment	▪ 125.6MWh/yr displaced, equivalent to US$28.6k/yr in savings and 110.1 tCO2/year reduced ▪ 21.9MWh/yr displaced, equivalent to US$ 4.9k/year in savings and 19.2tCO2/yr reduced ▪ Demonstration of RE as an alternative source for electricity	▪ 28 PV systems installed, equivalent to75kWp in installed capacity (on grid) ▪ One micro wind system installed equivalent to 10kW of installed capacity	500		292		792

		generation thanks to the implementation of the SEF RE Pilot Program for small grid-connected RE systems with bidirectional metering						
	Investment	▪ Creation of a Fund for EE and RE through proposed loan from IDB to GoB (in preparation)	▪ Financial support for replication of Pilot Program results	0		5,000		5,000
Component 4				**0**	**0%**	**25**	**100%**	**25**
Dissemination of Findings	TA	▪ SEF introduced to the public	▪ At least two workshops to validate and disseminate findings of TA and pilot project activities and results			25		25
Project management, monitoring, audits and contingencies				**0**	**0%**	**125**	**100%**	**125**
Total Project Costs				**1,000**	**8%**	**11,805**	**92%**	**12,805**

[1] List the $ by project components. The percentage is the share of GEF and Co-financing respectively of the total amount for the component.
[2] TA = Technical Assistance; STA = Scientific & Technical Analysis.

B. **SOURCES OF CONFIRMED CO-FINANCING FOR THE PROJECT** (expand the table line items as necessary)

Name of Co-financier (source)	*Classification*	*Type*	*Project*	*%**
GoB	National Government[1]	Cash and Proposed IDB Loan	10,435	89%
IDB	Executing Agency	Grant	1,000	8%
BL&P	Private Sector/Electric[2] Utility	Cash and in-kind	200	2%
Pilot Program private sector participants	Private sector[3]	Cash	170	1%
Total Co-financing			11,805	100

* Percentage of each co-financier's contribution at CEO endorsement to total co-financing.

C. FINANCING PLAN SUMMARY FOR THE PROJECT ($)

[1] USD10 million from proposed Investment Loan from the IDB (under preparation) for replication of investment support to EE/RE projects; and USD435k in cash for co-financing to the SEF Technical Assistance.
[2] Up to USD10k for bidirectional meters; and USD190 in kind (information, data, supervision/inspection of renewable installations)
[3] USD15k for the SEF EE Pilot Program (cost sharing of USD5/household for CFLs and Power Monitors), and USD155k for the SEF RE Pilot Program (cost sharing for Solar PV and Wind systems, 25 percent of system turnkey cost)

	Project Preparation a	*Project B*	*Total c = a + b*	*Agency Fee*	*For comparison: GEF and Co-financing at PIF*
GEF financing	0	1,000	1,000	100	1,100
Co-financing	0	11,805	11,805		1,435
Total	0	12,805	12,805	100	2,535

D. GEF RESOURCES REQUESTED BY AGENCY(IES), FOCAL AREA(S) AND COUNTRY(IES)1

N/A

E. **CONSULTANTS WORKING FOR TECHNICAL ASSISTANCE COMPONENTS**:

Component	*Estimated person weeks*	*GEF amount($)*	*Co-financing 000($)*	*Project total 000($)*
Local consultants*	48	0	460	460
International consultants*	72	0	850	850
Total			1310	1310

Details to be provided in Annex C.

F. PROJECT MANAGEMENT BUDGET/COST

Cost Items	*Total Estimated person weeks*	*GEF amount ($)*	*Co-financing ($)*	*Project total ($)*
Local consultants*	60		95	95
International consultants*				
Office facilities, equipment, vehicles and communications*			25	25
Travel*			5	5
Others**				
Total			**125**	**125**

* Details to be provided in Annex C. ** For others, it has to clearly specify what type of expenses here in a footnote.

G. DOES THE PROJECT INCLUDE A "NON-GRANT" INSTRUMENT? Yes ☐ No ☒

H. DESCRIBE THE BUDGETED M &E PLAN:

The Monitoring and Evaluation (M&E) of the outputs and outcomes presented in the Project Results Framework (Annex B), as well as the monitoring of the day-to-day activities of the project, will be supported through the development of an integrated and cost-effective project M&E system. This M&E system will be presented and finalized at the Project's Inception Meeting after reaching a consensus on the fine-tuning of indicators, sources of verification, and the final definition of the project team M&E responsibilities.

The M&E system will be coordinated by the Project Execution Unit (PEU) in the Executing Agency, which will be the Energy Division within the Ministry of Finance, Investments, Telecommunications and Energy (MFITE). The PEU will monitor the progress in achieving outputs and outcomes based on the Results Framework. Within the first 6 months, the PEU will ensure the consolidation of the baseline information for all indicators in the Results Framework. M&E results will be shared with other institutions participating in the project, in particular with the Barbados Light & Power Company (BL&P).

The PEU, in collaboration with the IDB, will prepare an annual Project Implementation Review (PIR) in accordance with GEF requirements to be submitted to the GEF Secretariat. The PIR will include progress in achieving global environmental benefits, and an assessment of the sustainability and replicability of project results. Estimated cost for the monitoring[4] of this project is US$ 80,000.

A mid-term evaluation (MTE), contracted by the IDB, will be carried out when 40% of the GEF resources have been disbursed or 20 months after the project contract goes into effect, whichever comes first. The MTE will determine if the project strategy is performing according to established objectives, or if adjustments are necessary. The findings and conclusions of the MTE will be presented and consulted with key stakeholders and beneficiaries in a mid-term evaluation workshop. In case adjustments are needed in the project implementation strategy, an Action Plan (AP) will be agreed between the IDB and the MFITE/PEU, establishing responsibilities and dates for completion of corrective actions.

The IDB will monitor the implementation of the AP. In addition, a final evaluation contracted by the IDB will determine, among other things, the extent to which project objectives have been reached in terms of (i) the project's contribution to promoting and implementing sustainable energy in Barbados; and (ii) the sustainability of project outcomes and outputs, and their contribution to global environmental benefits.

Results of the evaluation, including lessons learned and good practices, will be disseminated and shared extensively. Evaluation activities, estimated to require US$ 20,000, will be funded by the IDB. An independent third party will be hired for the evaluation.

PART II: PROJECT JUSTIFICATION

A. STATE THE ISSUE, HOW THE PROJECT SEEKS TO ADDRESS IT, AND THE EXPECTED GLOBAL ENVIRONMENTAL BENEFITS TO BE DELIVERED:

Country and sector issues

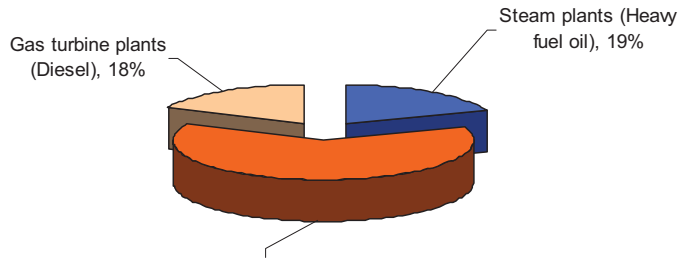
Barbados, a small island country of 431 square kilometres and a population of about 272,000, ranks high among Latin America and Caribbean (LAC) countries in terms of economic and social indicators: for example, the country ranks 37th in the United Nation's Human Development Index, which corresponds to a high human development.

However, Barbados' high dependence on fossil fuels risks jeopardizing the sustainability of its economic and social development, as well as the country's competitiveness. The entirety of the country's electricity is fossil-fuel generated, including heavy fuel oil (82 percent, of which 19 percent with steam plants, and 63 percent with low-speed diesel plants), and diesel fuel (18 percent), as shown in Figure 1 below and according to the 2008 report of the Barbados Light & Power Company (BL&P), the national electricity utility.

[4] The monitoring will be done as part of the project manager's activities, and require an estimated one-third of the project manager's total time dedicated to the project.

FIGURE 1

Share of generation by plant type and fuel (2008)



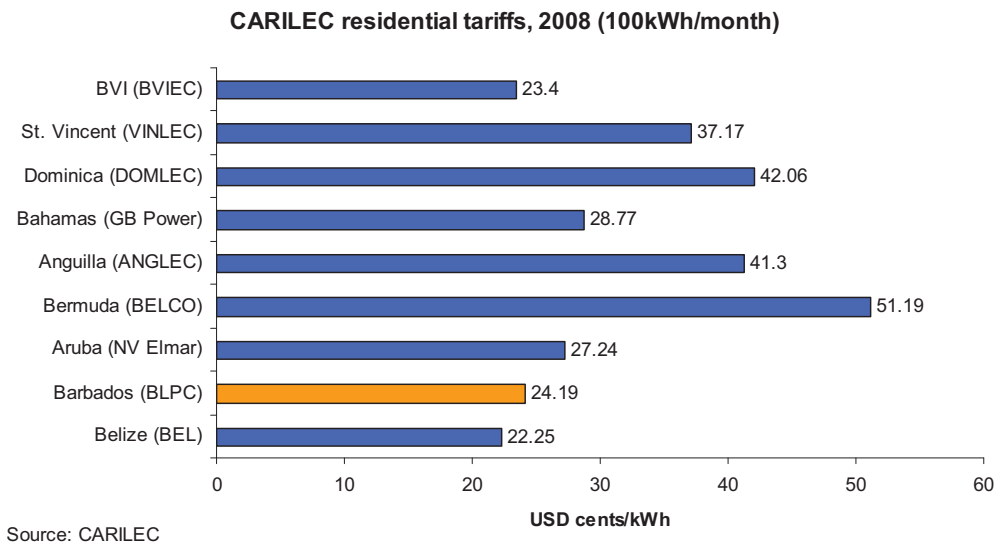
Source: BL&P

Power generation represents the main use of fuels in the country (50%), followed by transport (33%). Barbados has some oil production, but domestic demand (about 10,000 bbl/d) greatly exceeds local supply (about 1,000 bbl/d). This results in imports in excess of 9,000 bbl/d, which represent a significant expenditure and drain on Barbados' foreign reserves, particularly considering a recent high degree of volatility in international oil markets. Oil prices reached record levels in July 2008 (USD147 per barrel), dropped to USD32 per barrel by February 2009 in association with the global economic downturn, have rebounded to levels around USD70 per barrel as of November 2009, and are expected to increase further if the brighter economic outlook is proven.

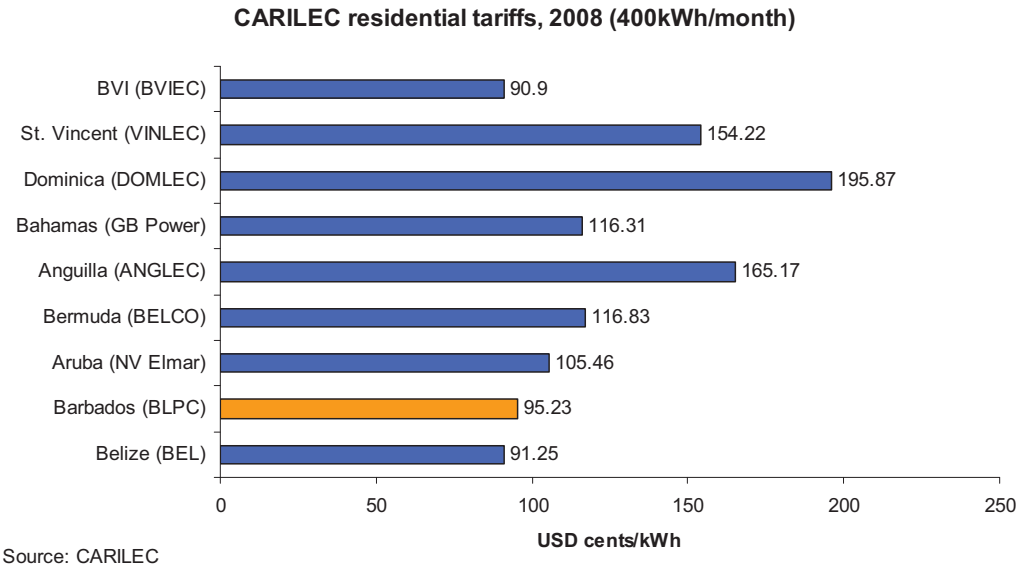
The Government of Barbados (GoB) is committed to promoting sustainable energy practices both on the supply (renewable energy sources) and on the demand side (energy efficiency and conservation) as a means to reduce the country's dependency on fossil fuels, enhance security and stability in energy supply, improve the economy's competitiveness, and achieve greater environmental sustainability.

To achieve such objectives, Government entities have conducted several efforts to date to promote sustainable energy in Barbados. For example, the GoB set a general target for 10 percent of electricity generation to come from renewable sources by 2012 and 20 percent by 2026, and launched a Public Sector EE program in 2007. The BL&P conducted a Demand Side Management (DSM) study in 1999, and in May 2009 submitted to the Fair Trading Commission (FTC) its first application for a tariff review in 26 years. As shown in Figure 2 below, residential base tariffs in Barbados were among the lowest in the Caribbean Electric Utility Service Corporation (CARILEC) in 2008. However, a full pass-through of fuel costs through the Fuel Clause Adjustment (FCA) makes final electricity prices in Barbados very high. The BL&P expects the new rate structure to provide more correct signals on the actual price of electricity, encouraging EE and RE investments.

FIGURE 2



Source: CARILEC



Source: CARILEC

In spite of such efforts, however, actual implementation of sustainable energy measures is still limited due to various types of barriers that thwart their viability, as presented in more detail below.

Key barriers to EE and RE investments

The key barriers to investment in EE and RE projects in Barbados include: policy barriers; legal and regulatory barriers; institutional barriers; professional and technical capabilities barriers; perception and awareness barriers; and economic and financial barriers.

Policy barriers. There is no clear national policy that provides structured guidance to the implementation of RE and EE projects and initiatives. A draft National Energy Policy was prepared in late 2006, and identified key issues faced by the sector as well as options to overcome them, but it was never formally adopted. Barbados still needs a comprehensive energy policy that will integrate sustainable energy in the country's energy matrix, establish stable and reliable conditions for private sector initiatives, provide clear and measurable objectives for RE and EE, and define priorities, actions, responsibilities and resources needed for the implementation of sustainable energy initiatives. The proposed project aims at providing such a policy.

Legal and regulatory barriers. The main Acts that regulate Barbados' energy sector—the Electric Light and Power Act (ELPA) and the Utilities Regulation Act (URA)—do not contain provisions that preclude the implementation of sustainable energy, but they do not include provisions that promote it either. The BL&P is the only entity provided with the right to sell electricity and, although this is not an exclusive right, there is no appropriate commercial framework for Independent Power Producers (IPPs) to operate, in particular with RE applications. The general targets indicated by the GoB for RE generation (10 percent by 2012, and 20 percent by 2026) are not set by law as a renewable portfolio standard, nor are they accompanied by any targeted and effective incentive for RE (although the BL&P has applied for a pilot RE tariff, as will be explained below). Therefore, these targets do not yet provide an adequate reference for investment in RE plants.

Progress has been made recently to improve the legal and regulatory framework for sustainable energy. BL&P's recent application for a tariff review, mentioned above, includes a proposal to introduce, on a three-year pilot basis, a "Rider for RE" for customer-owned, grid-connected small RE sources. On the demand side, the BL&P also requested the introduction (also on a three-year pilot basis) of new rate options for larger consumers, specifically a time-of-use tariff and an interruptible service rider. In addition to tariff measures, customs and fiscal incentives have been considered and proposed, and in several cases implemented, such as the waiver of import duties for RE systems, and the reduction of such duties from 20 percent to 5 percent for EE equipment and efficient vehicles not to be found locally.

The proposed project aims at providing a comprehensive and coherent policy and regulatory framework that will actually facilitate the implementation of RE and EE projects. This will consolidate efforts made to date, and allow a longer-term application of measures introduced as pilots.

Institutional barriers. In spite of increased interest in and efforts for the promotion of sustainable energy, the key institutions involved in Barbados' energy sector have limited familiarity of RE and EE, due to the country's long experience almost exclusively with fossil fuel-generated electricity. Such institutions, and their respective functions, are the Energy Division of MFITE for the policy function (and within the Energy Division, the Renewable Energy and Energy Conservation Unit), the FTC for the regulatory function, and BL&P for the business function.

MFITE's Energy Division needs to provide leadership and guidance in implementing a sustainable energy policy, and in achieving consensus and commitment from all public and private sector stakeholders. While skills in sustainable energy are diffused in GoB entities, there is a need to increase capacity in this and other agencies. In addition, the sector needs to undergo significant expansion through greater consistency and coherence in the strategies and actions of MFITE, which are needed to ensure the creation of a reliable setting to implement RE and EE projects.

The FTC needs to ensure that tariffs and conditions for investment support sustainable energy. BL&P's application for a rate review, as mentioned, includes proposed new tariff options on the demand and the supply side, although initially on a three-year pilot basis only. Critically, the BL&P application also includes a request of a new rate structure, which has not changed since 1983. The proposed rate structure is suggested by the BL&P to allow prices to reflect actual cost of service. The BL&P indicates that the new tariff structure is expected to provide correct price signals to customers, encouraging energy efficiency and allowing investment in new technologies. The extent to which the new rate structure will allow reaching these objectives, however, is still uncertain.

The BL&P is preparing the integration of small RE sources in the grid on a pilot basis. However, it may need to further strengthen its familiarity with the key aspects of RE sources and the assessment of their viability, as well as its ability to plan for and integrate RE sources in the system. A few feasibility studies have been completed, such as one for a 10MW wind farm in St. Lucy, but they have not led to full project implementation. Similarly, the 1999 DSM study identified key opportunities that would help to meet objectives that are important for BL&P, such as reduced investments in generation and load stability. However, this DSM study has not fully led to take advantage of such opportunities.

Barbados needs a stronger institutional structure that will lead and coordinate initiatives across the country, promote the development and the enforcement of policy and projects, and actively involve all stakeholders. The proposed project aims at determining capacity building needs (addressing human and financial resources, as well as technical skills and

required infrastructure), and at designing a capacity development plan for the institutional strengthening of key energy sector entities.

Professional and technical capabilities barriers. As in many other countries with limited experience in sustainable energy, there is a shortage of in-country professional and technical capabilities for EE and RE in Barbados. Specialized EE services—such as energy auditing, installation and maintenance of efficient equipment, and performance contracting—are insufficiently provided compared to opportunities. Similarly, there are scarce local skills and experience in the evaluation, development, and financing of grid-connected renewable energy projects. These projects, due to their intermittent nature, will also probably require new skills and upgrades in the transmission network, as well as in system operation and dispatching. Most part of the equipment is not manufactured locally, but imported from other countries.

The limited supply of specialized capabilities in RE and EE contributes to the limited demand for and implementation of sustainable energy projects. There are, however, some exceptions, most notably a thriving Solar Water Heater (SWH) industry that has accomplished a very high penetration rate of this technology in Barbados households (over 60 percent) and in limited applications in small and medium enterprises (SMEs).

The project aims at overcoming such capabilities barriers, building on results obtained to date. In particular, the pilot projects in RE and EE aims at demonstrating the viability of some of the most promising technologies, and encouraging the development of technical and professional capabilities.

Awareness barriers. Limited awareness of the costs and benefits of sustainable energy projects is widespread in all sectors of Barbadian society, and affects other types of barriers. Although knowledge of solar water heaters is significant and these systems are accepted as standard by most sectors of society, there is limited awareness of the costs and benefits of most other sustainable energy technologies. The general public does perceive the need to conserve and use energy more efficiently. However, there is inadequate awareness of what options are available, and of their costs and financial viability.

There is prevalence in the country of micro, small, and medium enterprises, which are usually less able and interested in assessing investments that are not directly linked to their production activity, and generally have a more limited ability to plan beyond the short term. As a consequence, any EE measures implemented are those requiring little or no cost—and yielding the least energy and financial savings. On the supply side, as noted, there is little familiarity with RE technologies apart from SWH, and therefore little confidence in their viability.

Limited awareness about RE and EE also affects financial institutions, whose professionals are often not used to correctly evaluating risks and benefits of sustainable energy projects. This shapes their propensity to provide credit for implementing such projects, and leads them to adopt conservative lending practices when they do concede loans for RE and EE.

Finally, awareness barriers also involve government entities, which—in spite of more recent initiatives showing increased attention to RE and EE—still do not fully convey their commitment to sustainable energy with coherent policy, programs, and financial incentives.

The proposed project aims at enhancing a correct perception of sustainable energy among all sectors of Barbados, and includes the dissemination of project results. In particular, GEF resources will be used to implement technologies that still have a limited application in the country, with the objective of testing their viability and, based on positive results, encouraging their replication.

Economic and financial barriers. Regarding economic barriers, the BL&P indicated that relatively low base energy tariffs—in spite of high final retail prices when the Fuel Clause Adjustment is included—do not provide adequate price signals and incentives to conserve and use energy more efficiently. Similarly, RE projects' viability may be at risk if the level of prices needed by developers to make the projects viable is not consistent with the rate structure provided by public authorities. BL&P's application for a rate review is expected to be an important step in ensuring EE and RE

project viability thanks to a clearer and more transparent rate structure, although the extent of its success still needs to be tested. Economic resources available for the development of RE and EE are also limited, and final users of RE and EE technologies often have limited capacity to pay the higher prices required for their development.

Regarding financial barriers, most SMEs—which represent the majority of commercial and industrial companies in Barbados, as well as the entities most likely to implement RE and EE projects—have limited access to credit from local financial institutions. In turn, financial institutions adopt conservative lending practices, including high interest rates, short terms, high requirements for collateral, and limited or no project finance. Financial institutions often lack the knowledge of RE and EE systems, and are therefore unable to effectively evaluate the risk associated in financing such projects. The exception to this is the financing of solar water heaters, for which financing is readily available.

In spite of recent efforts, financial incentives and mechanisms for RE and EE will be required at higher levels in order to ensure sustained growth of the sector. The Government intends to launch a USD10 million "Smart Energy" Fund (or "Fund"), to be capitalized with resources from the proposed Investment Loan from the IDB. The Fund is intended to support private sector EE and RE projects through various financial instruments, such as low-interest loans to households for purchase of solar panels, tax rebates for solar electric systems, and substitution of incandescent bulbs with compact fluorescent lights (CFLs).

The proposed project includes the assessment of RE and EE projects' financial requirements, and the design of financial mechanisms to support their implementation. GEF funds are intended to support the implementation of selected technologies to assess their viability and determine their potential for larger-scale replication.

Project Rationale

Current RE technologies—particularly intermittent ones—cannot completely replace the firm power provided by fossil fuel generation in Barbados. Intermittent resources such as wind and solar power—lacking sufficient hydropower and geothermal potential—represent the country's main renewable energy potential. However, Barbados' dependence from imported fossil fuels can be reduced to some extent by introducing RE sources in the country's energy matrix, and promoting a more efficient use of energy as well as energy conservation.

The viability of RE projects generally tends to grow with increases in the price of oil which, in spite of a significant drop between late 2008 and early 2009, has rebounded over 2009. In any case, the GoB rightly intends sustainable energy to be a hedging strategy against oil price volatility itself, and therefore a means to enhance security and stability in energy supply.

The project's support to EE will generate substantial savings, both in energy and in financial terms. EE consists of a more efficient use of energy, leading to a permanent reduction in energy unitary consumption in productive processes. As such, EE corresponds to an increase in productivity (amount of production per unit of energy consumed). The project will therefore enhance the competitiveness of the Barbadian economy.

The Demand Side Management study commissioned by BL&P in 1999 revealed a significant untapped potential for the implementation of EE measures, with estimated technical and economic savings potential in the order of 30 percent. The Barbadian economy is predominantly based on services (over 50 percent of GDP excluding tourism, according to the Barbados Central Bank), and thus requires significant power for lighting, cooling, refrigeration, and electrical appliances. In the commercial sector (excluding tourism, which is covered by the separate CHENACT project—see below, section E), small offices offer the greatest potential for savings (21 percent of consumption in the sector), in particular for air conditioning systems (76 percent), followed by lighting (18 percent). In the residential sector, lower- and middle-income households represent about 43 percent of consumption each, and offer good opportunities for EE in refrigeration (43-50 percent) and lighting (20-22 percent). Lighting in the residential sector is still mostly based on incandescent bulbs, with a limited diffusion of fluorescent bulbs. Fluorescent lights are used in the commercial sector, although often they are not of the most efficient type (T12 instead of the more efficient T8). On the other hand, as noted, SWH have a penetration rate of over 60 percent.

Most importantly, the project will generate significant reductions in the emission of greenhouse gases (GHG). Due to an energy generation mix of the interconnected grid composed only of fossil fuels (see Figure 1), the grid emission factor in Barbados is very high (estimated at about 0.88tons CO_2e/MWh), in spite of a very low level of losses (6.3 percent). Electricity generated from grid-connected RE sources will displace fossil fuel-based generation, similarly to how electricity saved by EE measures will reduce such generation. The project will therefore contribute to mitigating global warming and other global climate change problems.

The project will also assess CO_2 reductions from potential EE and RE measures. While this assessment will not be at a project level (and therefore not include the preparation of Project Idea Notes or Project Design Documents), it will provide a basis to identify the most promising technologies, and to estimate the overall potential for the sale of carbon credits in the regulated and voluntary international carbon markets. Given Barbados is a small island country, the scale of RE and EE projects is likely to affect their viability to generate carbon credits. However, the project also aims at identifying the most promising technologies for replication, thus supporting a programmatic approach (Program of Activities) that would aggregate carbon reduction project activities. The potential sale of carbon credits would provide an additional revenue stream to eligible projects, enhancing their financial viability.

In addition to global benefits, the promotion of sustainable energy will help Barbados achieve greater environmental sustainability in its own territory. Tourism represents over 12 percent of GDP (Barbados Central Bank), and employs over 10 percent of the working population. The preservation of the country's natural resources is therefore an investment in its sustainable economic growth.

Considering the barriers identified above, and the observations regarding project rationale, the proposed GEF Project aims at promoting sustainable energy in Barbados through a combination of Technical Assistance and a Pilot Program financed by GEF resources, with co-financing from the GoB and the BL&P. The SEF Pilot Program—including an EE as well as a RE Component—will complement efforts made under the SEF Technical Assistance. The SEF Pilot Program will have a combined effect of demonstrating the benefits of EE and RE measures, and encouraging their replication on a larger scale.

The proposed GEF Project is structured under four Components, complementary to each other, described in detail below:

- Component 1: Preparation of Sustainable Energy Framework for Barbados (SEF) and capacity building
- Component 2: Policy and implementation support for Energy Efficiency (EE)
- Component 3: Policy and implementation support for Renewable Energy (RE)
- Component 4: Dissemination of findings

The Detailed budget for this project is presented in Annex I (page 58)

Component 1: Preparation of Sustainable Energy Framework for Barbados (SEF) and capacity building

This Component—funded entirely with resources provided by the IDB—will be based first of all on a review of the existing situation in Barbados' energy sector. This will include an analysis of both (i) the current energy matrix, including the balance between generation (supply) and consumption (demand), and covering cost issues as well as benchmarking with other comparable countries; and (ii) the current policy, legal, and regulatory framework for energy, and its adequacy to promote RE and EE in the country.

Based on the current energy matrix, this Component will then focus on establishing prospective energy needs in Barbados in the longer term, depending on key assumptions regarding population growth, economic growth by sector, and market penetration of main energy-consuming technologies. The comparison between the current energy matrix and the prospective energy needs will allow assessing the capacity of Barbados' power generation to meet forecasted demand. This, in turn, will allow defining the gap (or shortfall) in generation that will need to be covered by conventional and—in a portion also to be assessed under this Component—renewable energy sources.

Based on the current energy framework, and considering prospective energy needs, this Component will then identify the key barriers to the promotion of sustainable energy, and provide recommendations to overcome such barriers by adopting renewable energy, energy efficiency, and energy conservation measures. Drawing on these recommendations as well as from more detailed information provided under Components 2 and 3, this Component will develop a Sustainable Energy Framework (SEF) for Barbados. The SEF will represent a comprehensive and coherent framework for promoting sustainable energy in Barbados, and provide the following:

- Objectives and targets for RE and EE in the short, medium, and long term
- Recommendations for the preparation of legislation and regulation on RE and EE
- Recommendations for actions and programs for project implementation, including incentives and market support mechanisms
- Assessment of environmental benefits
- Resources required for SEF implementation.

Finally, this Component will assess the current institutional capabilities to implement the recommended policies, programs and legislation in terms of availability of financial and human resources, as well as of specific skills and experience in sustainable energy. Based on such assessment, this Component will determine capability building needs for the key institutions involved in the SEF, and design a capability development plan specifying objectives, audience, process, activities, and resources for the training recommended. The implementation of said plan will provide the institutional strengthening required for a successful implementation of the SEF.

Component 2: Policy and implementation support for Energy Efficiency (EE)

This Component will consist of two subcomponents. The first one (2.1) will provide technical assistance to promote EE practices in Barbados. The second one (2.2) will implement the SEF EE Pilot Program to promote CFLs and energy conservation in low- and middle-income households in Barbados. Findings from both the TA and investment activities of this Component 2 will inform Component 1, to allow an optimal definition of the SEF.

Subcomponent 2.1—Technical assistance to promote EE practices in Barbados. This subcomponent—funded with resources provided by the IDB as well as by the GoB, in addition to in-kind resources by BL&P—will start by assessing the EE potential in Barbados, and analyzing such potential by user group.

Energy efficiency audits will be conducted based on a protocol and standardized reporting model defined under this subcomponent. The GoB will provide resources to conduct energy efficiency audits in:

- Seven (7) government-owned buildings
- Twenty-five (25) residential buildings
- Eight (8) commercial buildings (excluding hotels, which will be covered by the CHENACT project, see below, section E).

Results of the audits will allow establishing targets for energy savings in the residential, commercial, and public sectors. The most suitable EE technologies for Barbados will also be identified, based on insight from the audits as well as from successful EE programs in other comparable countries. The projected financial impact of implementing the potential estimated will be assessed, based on reasonable assumptions on the penetration rate of EE measures identified in the various sectors.

This subcomponent will provide recommendations on how to expand and improve any existing EE programs for the key sectors of Barbados (public, residential, and commercial—excluding tourism). Recommendations will aim at achieving the most effective impact with resources available, focusing on major energy consumers and on key end-uses identified for each sector.

This subcomponent will also involve an assessment of the capabilities of local and regional Energy Service Companies (ESCOs) to support EE implementation in Barbados. This activity will allow identifying capability building needs for

ESCOs, informing activities under Component 1. The GoB is currently considering the implementation by ESCOs of EE measures and retrofits under a performance contracting scheme for various public buildings for which walk-through audits were already carried out in 2007. Such activity is expected to be included under the GoB work plan for the current year 2009-2010.

Based on the estimated EE potential, this subcomponent will recommend financial instruments and potential funding resources to support EE project implementation. Possible financial instruments may include soft loans, interest rate subsidies, grants or contingent loans for audits, and a loan guarantee scheme, among potential options. Financial instruments for EE projects will likely be included under an expanded Smart Energy Fund, which would also integrate financial instruments to support RE projects.

Finally, this subcomponent will involve an environmental assessment of the EE measures proposed for the SEF EE Pilot Program under subcomponent 2.2. The assessment will cover the disposal of incandescent lights, and the installation of CFLs containing small amounts of mercury.

The BL&P will contribute in-kind to this subcomponent with relevant sector information and studies, such as its Demand-Side Management (DSM) study for Barbados. Such in-kind contribution from BL&P will also benefit EE pilot activities implemented under subcomponent 2.2.

Subcomponent 2.2—SEF EE Pilot Program: promotion of CFLs and energy conservation in low- and middle-income households in Barbados. The SEF EE Pilot Program will be funded with resources provided by the GEF, with co-financing from participating households. The SEF EE Pilot Program will target a representative sample of three thousand (3,000) low- and middle-income households in Barbados. For each household involved, the EE Pilot Program will:

1. Replace five incandescent light bulbs (estimated average installed capacity 60W) with five 15W compact fluorescent lights (CFLs)
2. Promote energy conservation by introducing a power monitor for residential meters (a power monitor is a device that is easily installed on a meter, shows real-time electricity consumption and expenditure on a handheld monitor, and induces behavioural changes that can lead to savings of up to 15-20 percent)

A full description of the EE chosen technologies are described in Annex G.

An awareness campaign in the residential sector, also implemented under this subcomponent, will accompany and strengthen the introduction of CFLs and power monitors.

Component 3: Policy and implementation support for Renewable Energy (RE)

This Component will consist of two subcomponents. The first one (3.1) will provide technical assistance (TA) to assess alternatives for renewable energy in Barbados, and recommend measures to support RE project implementation. The second one (3.2) will implement the SEF RE Pilot Program to promote small grid-connected RE generation systems with bidirectional metering. Findings from these two first subcomponents (3.1 TA, and 3.2 Investment) will inform Component 1 to allow an optimal definition of the SEF.

Subcomponent 3.1—Technical assistance to assess alternatives and recommend support for RE in Barbados. This subcomponent—funded with resources provided by the IDB—will first of all focus on assessing the potential for deployment of RE technologies in Barbados, in particular those that previous analyses and preliminary information suggest to be the most viable for electricity generation or substitution in the country. These are solar power, wind power, ocean thermal energy conversion (OTEC), and non-electric RE applications (geo-exchange, ocean exchange, solar thermal, thermally driven cooling processes, and industrial process waste heat recovery). The assessment will include considerations on each technology's cost, scale, dispatching potential, location, environmental impact, and

competitiveness based on various oil price scenarios as well as on the potential competition from increased natural gas-based generation deriving from the projected Eastern Caribbean Gas Pipeline Project.

The assessment will also cover potential RE tariff or net metering arrangements, and evaluate the proposed pilot "Rider for RE" included in BL&P's application for a rate review to the FTC. Useful insight deriving from the implementation of small grid-connected RE systems under subcomponent 3.2 (see below) will be taken into account thanks to data provided by BL&P, in particular regarding the functioning and effectiveness of the proposed Rider for RE.

Based on the RE potential assessment, this subcomponent will then determine financial requirements for RE projects, and provide financing recommendations for RE project implementation. This will include estimating the size and timing of investments in RE, and recommending various sources and instruments of funding for RE projects. The possible expansion and modification of current instruments (the Smart Energy Fund) will be considered, as well as new complementary financial instruments and mechanisms to promote RE project implementation.

Subsequently, this subcomponent will provide technical assistance to support the preparation of power purchase schemes, considering both larger commercial independent power producers (IPPs) and small power producers (SPPs). This activity will take into account information and any progress made by the BL&P based on the application of the proposed Rider for RE. In particular, the viability of mechanisms to facilitate the purchase and sale of power to/from the grid—such as net metering—will be considered. The BL&P is considering bidirectional meters with load profile capability (provision of detailed information on electricity being sold or purchased from the grid, including time of day).

This subcomponent will also assess the potential for Waste to Energy (WE) in Barbados, based on activities conducted until now by the Solid Waste Project Unit of the Ministry of the Environment and their potential expansion. A preliminary configuration and an environmental impact assessment (EIA) will also be prepared for a WE plant in Barbados.

Finally, this component will provide an environmental assessment of the RE systems—small Solar PV and a wind system—installed under the SEF RE Pilot Program under Subcomponent 3.2.

Subcomponent 3.2—SEF RE Pilot Program: promotion of small grid-connected RE generation systems with bidirectional metering. This subcomponent will promote the installation of twenty-nine (29) small grid-connected RE generation systems (28 Solar PV systems, and 1 micro Wind system). The systems will have a total combined installed capacity of 85kW, and will be implemented under one same Sustainable Energy Framework Pilot Program/Renewable Energy component (SEF RE Pilot Program).

The SEF RE Pilot Program will join the efforts of various stakeholders. GEF resources will cover 75 percent of the turnkey cost of RE systems. Cost sharing will be required from Pilot Program participants, and will include: (i) 25 percent of the RE systems' turnkey cost, and (ii) operation and maintenance (O&M) costs throughout the systems' lifetime. The BL&P will provide bi-directional meters for all systems, supervision and inspection of all installations, and information on the systems' performance. The 25% cost sharing percentage was established taking into consideration that a higher percentage would exclude numerous potential customers at the low and middle income levels due to their restricted income level and their impossibility to pay a higher cost sharing contribution.

The SEF RE Pilot Program will be implemented within a renewable energy pilot program proposed by BL&P to the Fair Trading Commission (FTC). BL&P's proposed RE pilot program—included in BL&P's application to the FTC for a revision in its rate structure—aims at allowing residential and non-residential customers to connect small Solar PV and Wind systems to the grid under a three-year interconnection agreement. Residential systems will have a maximum capacity of 5kW, while non-residential systems will have a capacity of 50kW. BL&P proposed that customers who install such systems sell excess energy to the grid at a rate—called "Rider for Renewable Energy"—equal to BBD 31.5 cents, or 1.8 times the Fuel Clause Adjustment (FCA), whichever greater. BL&P's proposed pilot program has an initial limit of 200 new RE systems (Solar PV or Wind), or a combined installed capacity of 1.6MW, whichever comes first. The RE systems installed under the SEF RE Pilot Program will therefore be an incentivized subset of the systems

installed under BL&P's pilot program. The FTC is expected to approve special tariffs and terms for the SEF Pilot Program equal to those proposed by the BL&P for the Rider for Renewable Energy.

The SEF RE Pilot Program will install various technologies to identify the most suitable ones for Barbados. The following twenty-nine (29) small RE systems will be installed:

- Twenty-eight (28) mini Solar PV Systems, of which:
  - Fifteen (15) x 2kWp fixed-mounting, thin film cell PV Systems
  - Ten (10) x 3kWp fixed-mounting, high efficiency cell PV Systems
  - One (1) x 5kWp single axis tracking, low-concentration PV System
  - Two (2) x 5kWp dual axis tracking, high-concentration PV System

- One (1) x 10kW micro Wind System.

Please find a full description of the RE technologies chosen for this component in Annex H.

Component 4: Dissemination of findings

This Component—financed entirely by the IDB—will provide for at least two workshops to validate and disseminate the findings of the project's technical assistance and Pilot Program activities. Several thematic meetings will also be held under this Component, to discuss the progress and findings of activities with interested parties, and steer subsequent activities in the most effective direction. Results of this Component will help MFITE, in coordination with BL&P, in planning and implementing a long-term public education and awareness strategy for sustainable energy in Barbados.

Expected Global Environmental Benefits to be Delivered

The project will contribute to generate global environmental benefits in the form of greenhouse gas (GHG) emission reductions. The mitigation of GHG emissions derives from the implementation of the SEF Pilot Program in its EE and RE components:

- The SEF EE Pilot Program will reduce GHG emissions by implementing two types of EE technologies—CFLs and power monitors—that will reduce the demand of energy generated by grid-connected thermal plants
- The SEF RE Pilot Program will reduce GHG emissions by implementing two types of RE technologies—solar PV and wind systems—that will displace energy generated by grid-connected thermal plants.

Based on GEF guidelines, total CO_2 emission reductions (ERs) that will be achieved by implementing the SEF Pilot Program are composed of:

- Direct emission reductions, and
- Indirect emission reductions.

Direct Emissions Reductions. Direct ERs include direct project ERs and direct post-project ERs. Direct post-project emissions reductions are not considered since no GEF funds will be used after the project is completed. On the other hand, the Government of Barbados and the IDB are preparing a proposed Investment Loan (USD10 million) that will set up such a financial mechanism for EE and RE. The Government is also considering funds for USD500k for purchase of further solar PV and wind systems in its own premises. These two factors, as explained below, account for high replication of indirect ERs.

Direct ERs were estimated based on the following assumptions:

SEF EE Pilot Program/CFLs lifetime direct ERs: 4,731 tCO_2

- Electricity savings: 1,232 MWh/year (thanks to the installation of 15,000 CFLs)
- Lifespan of efficient lighting technology: 4.4 years (equivalent to 8,000 hours, 5 hours per day)
- CO_2 emission factor: 0.88 tCO_2/MWh (estimated by applying IPCC carbon content factors to BL&P data of 19% generation by steam plants using heavy fuel oil, 63% by low-speed diesel plants using diesel oil, 18% by gas turbine plants using diesel fuel, and 6.3% overall system losses).

SEF EE Pilot Program/power monitors lifetime direct ERs: 16,589 tCO_2

- Electricity savings: 947 MWh/year (based on a 10% savings assumption on average low/middle income household consumption)
- Power monitor lifetime: 20 years
- CO_2 grid emission factor: 0.88 tCO_2/MWh (estimated on grid configuration described above).

SEF RE Pilot Program/solar PV systems lifetime direct ERs: 2,201 tCO_2

- Electricity savings: 125.6 MWh/year (based on installation of 29 PV systems with capacity ranging from 2kWp to 5kWp)
- Lifespan of PV technology to be employed: 20 years
- CO_2 grid emission factor: 0.88 tCO_2/MWh (estimated on grid configuration described above).

SEF RE Pilot Program/wind system lifetime direct ERs: 384 tCO_2

- Electricity savings: 21.9 MWh/year (based on installation of one wind system with capacity of 10kWp)
- Lifespan of wind technology to be employed: 20 years
- CO_2 grid emission factor: 0.88 tCO_2/MWh (estimated on grid configuration described above).

Indirect Emissions Reductions. Indirect ERs are those that can take place over 10 years following project implementation. Indirect ERs contemplate the replication effect of the project due to further EE and RE activities fostered by the project, in accordance with GEF emission reduction guidelines. GEF guidelines indicate two approaches for calculating indirect ERs: a "bottom-up" approach, and a "top-down" approach:

- The "bottom-up" approach quantifies indirect ERs as the probability of the project to replicate its effects, and is based on a replication factor. For all technologies, we use a replication factor of 10. While this may appear high, it is actually a conservative estimate given that
    - The Government intends to set up a Fund for EE and RE to replicate the effects of the SEF Pilot Program on a large scale. The Fund will be capitalized with a proposed loan of USD10 million, that is ten times the overall amount for the GEF Pilot Program. However, the Fund will likely support EE and RE projects with an even higher degree of leverage than the SEF Pilot Program
    - The Government is already considering to provide USD500k for the installation of up to twenty-two grid-connected systems (twenty 2kWp Solar PV systems, and two 2kW micro Wind systems) on its premises—this amount alone is equal to the GEF funding for the SEF RE Pilot Program
    - The SEF Technical Assistance will design various policy and awareness mechanisms also intended to replicate the results of the SEF Pilot Program.
- The "top-down" approach calculates emission savings over a period of 10 years. The savings potential is determined by the potential market penetration of the technology in the market. A causality factor describes how critical the GEF intervention is for the replication effect to take place. Assumptions on estimated market potentials and GEF causality factors are described below.

The following assumptions were used for estimating indirect ERs:

SEF EE Pilot Program/CFLs: 47,306 tCO_2 (bottom-up), 74,463 tCO_2 (top-down)

- Replication factor: 10, as explained above

- Market potential: it is estimated that over the next 10 years it would be possible to install 300,000 CFLs in 60,000 households. Accumulated ERs are estimated assuming that 30,000 CFLs are being installed per year, equal to 6,000 additional households per year each installing 5 CFLs (universal coverage at present would involve reaching 88,000 households)
- GEF Causality Factor: 60 percent (substantial but modest GEF causality), given the current limited diffusion of CFLs in households, but also the considerable potential for sustainable market development due to awareness of this technology's high savings (75 percent). It is assumed that households would continue using CFLs after the lifetime of the first devices installed comes to an end.

SEF EE Pilot Program/power monitors: 165,887 tCO_2 (bottom-up), 46,963 tCO_2 (top-down)

- Replication factor: 10, as explained above. The total for bottom-up is higher than for top-down, because this technology will likely diffuse only if supported by the Fund
- Market potential: it is estimated that power monitors could reach up to 30,000 households in ten years. This number is less than half of current households (88,000)
- Causality Factor: 100 percent (critical GEF causality), given the current lack of diffusion of this technology.

SEF RE Pilot Program/solar PV systems: 22,012 tCO_2 (bottom-up), 52,976 tCO_2 (top-down)

- Replication factor: 10, as explained above
- Market potential: 5 percent of national annual generation for households. It is assumed that the familiarity with solar technology (solar water heating) will foster residential demand for small PV systems
- Causality Factor: 40 percent (modest but substantial GEF causality). Barbados has already experienced solar technology for water heating and is therefore likely to develop a market without a large external intervention.

SEF RE Pilot Program/wind system: 3,837 tCO_2 (bottom-up), 33,950 tCO_2 (top-down)

- Replication factor: 10, as explained above. The total for bottom-up is lower that for top-down, because the SEF RE Pilot Program only supports one Wind system
- Market potential: 1 percent of national annual generation for the commercial sector. It is assumed that the adoption of wind systems would be more limited than that of PVs, due to higher costs and complexity of wind systems, and that for these same reasons wind systems would mostly be installed in the non-residential sector
- Causality Factor: 60 percent (substantial but modest GEF causality). Barbados has some experience with small wind systems, but results have been unsatisfactory or limited. Therefore a market is less likely to develop without a substantial although modest external intervention.

The expected global direct and indirect emissions reductions (tons of CO_2e) are summarized in Table 1.

TABLE 1 : EXPECTED GLOBAL EMISSIONS REDUCTIONS OF THE PROJECT (TONS OF CO_2E)[5]

Technology	Direct	Direct post-project	Indirect (bottom-up)	Indirect (top-down)
CFLs	4,731	-	47,306	74,463
Power Monitors	16,589	-	165,887	46,963
Sub-total EE technologies	21,319	-	213,194	121,426
Solar PV systems	2,201	-	22,012	52,976
Wind systems	384	-	3,837	33,950
Sub-total RE technologies	2,585	-	25,849	86,926
Grand total	**23,904**	**-**	**239,042**	**208,352**

[5]Each estimate was done over the corresponding lifetime for each project.

Refer to attached spreadsheets for calculations of emissions reductions shown above.

C. DESCRIBE THE CONSISTENCY OF THE PROJECT WITH NATIONAL AND/OR REGIONAL PRIORITIES/PLANS:

This project is highly consistent with Barbados' national priorities and plans in a number of ways. From the point of view of general development objectives, the project is consistent with the Barbados Sustainable Development Policy (2004) and its key principles: (i) quality of life, (ii) conservation of resources, (iii) economic efficiency, (iv) equity, and (v) participation. Sustainable energy is involved in achieving all such principles—it improves life quality, ensures effective conservation of natural resources, promotes economic efficiency, enhances equity in access to energy for current and future generations, and requires broad participation and involvement of all sectors of the economy.

From a sector-specific point of view, the project is consistent with the objectives of the GoB to reduce the country's dependency from imported fossil fuels, enhance security and stability in energy supply, and improve overall environmental sustainability. Outlining the Government program in February 2008, after the latest Parliamentary elections, the Prime Minister announced the Government's intention "to be bold and move aggressively in the area of energy conservation", and to "provide significant incentives" for the deployment of RE and EE technologies, as well as for Bioenergy. Preliminary quantitative targets established for the participation of renewable sources in the country's electricity generation matrix are of 10 percent by 2012, and 20 percent by 2026. Barbados has also called for exploring the potential of increased used of biofuels in the transportation sector.

The Government of Barbados has led by example in sustainable energy project implementation. It launched a Public Sector Energy Efficiency Program in 2007, covering EE in public buildings, a public lighting program, and an EE vehicle program (mandating a 1,600cc standard energy size, or smaller, for all GoB vehicles, and requiring a justification for any exception). 15 government-owned buildings were audited already under the Public Sector EE Program. A tender for the retrofitting of such buildings is expected to be launched by the end of October 2009. About USD3million have been allocated for the retrofitting, which is expected to begin by the end of 2009 or the beginning of 2010. The GoB is also considering the implementation by ESCOs of EE measures under a performance contracting scheme for various other public buildings.

Finally, the GoB has developed a concept for a Smart Energy Fund, which is to provide low-interest loans to households for purchase of solar panels, tax rebates for solar electric systems, solar electric systems for government facilities, and substitution of incandescent bulbs with CFLs, among possible measures (specific measures will be identified by Technical Assistance subcomponents 2.1 and 3.1). The Smart Energy Fund is being supported by the IDB through an Investment Loan (Sustainable Energy Implementation Program, BA-L1020). The USD10 million proposed Investment Loan will support the establishment of such Fund and replicate the results of the SEF Pilot Program. The operation seeks to design a financial mechanism that provides adequate funding instruments for RE projects and EE improvements in the residential sector, government buildings and small and medium enterprises (SMEs). There are several alternatives that are being analyzed with GoB as to the structure of the economic mechanism, which could range from being a: (i) direct investment product; (ii) subsidy mechanism that would complement the funding required to purchase RE or EE technologies; (iii) partial guarantee mechanism to minimize the risk exposure of local commercial bank and facilitate financing to local end users; or (iv) a mixture of the afore mentioned. Regardless of the final structure, the financial mechanism will ultimately facilitate the acquisition of RE and EE technologies, and therefore contribute to reduce electricity costs, improve energy security, diversify the energy matrix by adopting RE and EE and enhance environmental benefits, such as carbon emission reductions. Through the financing of EE equipment the project will generate substantial energy savings, both financially and from the energy consumption point of view. The financing of RE projects will increase self generation and distributed generation with the possibility to sell excess energy to the grid, hence lowering the energy bill for end users, and contributing to reduce fossil fuel electricity generation that would have been necessary without the project. Additionally, the GoB is also considering an allocation of USD500,000 for the installation of up to twenty-two grid-connected small RE systems on its premises (20 Solar PV systems and two wind systems).

The project is also highly consistent with the new rate structure proposed by BL&P to the FTC. Such new rate structure is currently being assessed by the FTC, and—as also noted above—includes new rates both on the supply side (Rider for Renewable Energy), and on the demand side (an Interruptible Service Rider, and a Time-of-Use Tariff).

D. DESCRIBE THE CONSISTENCY OF THE PROJECT WITH GEF STRATEGIES AND STRATEGIC PROGRAMS:

This project is consistent with GEF Strategic Program 1 (Promote EE in residential and commercial Buildings) and GEF Strategic Program 3 (Promote market approaches for RE).

E. JUSTIFY THE TYPE OF FINANCING SUPPORT PROVIDED WITH THE GEF RESOURCES.

GEF funding will help overcome the barriers for establishing EE measures and increasing the RE component of the energy matrix in Barbados. The project will reduce energy consumption in the residential sector, increase the utilization of RE and at the same time contribute to the reduction of GHG emissions. GEF funding will be used to fund the SEF Pilot Program for the identified strategy. GEF funding (USD1 million) will be leveraged by US11.8 million of co-financing from the GoB, IDB and BL&P, as well as from end users. The funding requested from GEF represents about 8 % of the total project costs.

F. OUTLINE THE COORDINATION WITH OTHER RELATED INITIATIVES:

In addition to the proposed USD10 million Investment Loan from the IDB (Sustainable Energy Implementation Program, BA-L1020), the project is also closely related to another proposed loan to the GoB from the IDB currently under preparation. As noted, this is a USD50 million Policy-Based Loan (or PBL), Support for Sustainable Energy Framework for Barbados (BA-L1022). The first tranche of the loan (USD30 million) is expected to be disbursed in 2010, while the second tranche (USD20 million) is to be disbursed in 2011. The PBL will help the GoB define and implement energy regulation that will feed from the findings of the SEF. The specific use of funds from the PBL will be determined at the discretion of the GoB.

The project is also closely related to the Caribbean Hotel Energy Efficiency Action Program (CHENACT), which is carried out by the IDB, the GoB, the Caribbean Hotel Association (CHA), the Caribbean Alliance for Sustainable Tourism (CAST), the Caribbean Tourism Organization (CTO), and the United Nations Environment Programme (UNEP). The CHENACT Program seeks to promote EE and phase out ozone depleting substances (ODS) in the tourism industry in the Caribbean, using Barbados as a case study and conducting an assessment at regional level. The findings of the EE activities contemplated for the SEF will be valuable for the preparation and execution of the CHENACT Program, and as such will be taken into consideration throughout the project cycle. The CHENACT Program is expected to be launched in October 2009.

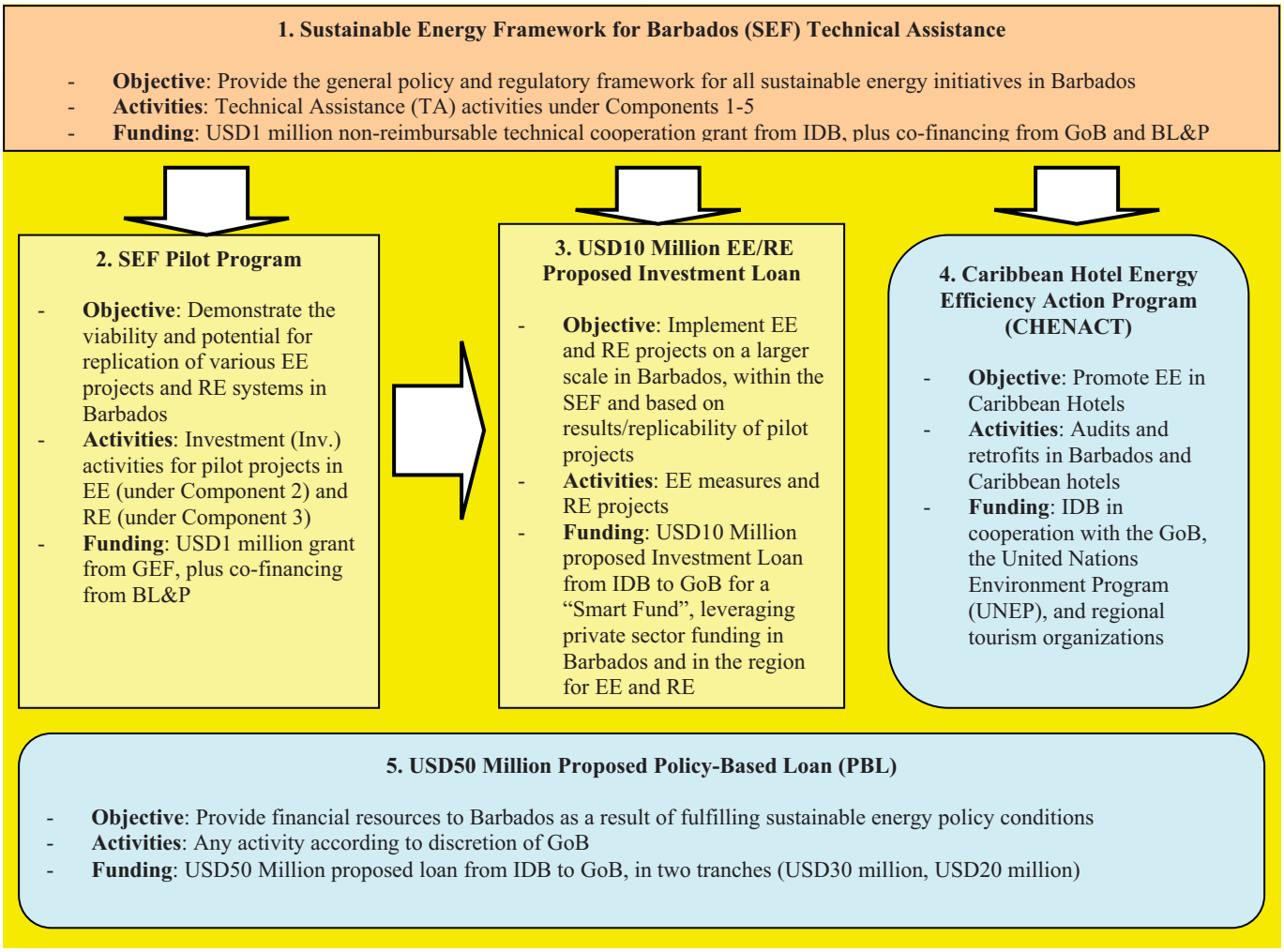
EE and RE pilot projects will be implemented under one "Sustainable Energy Framework Pilot Program" (SEF Pilot Program). The SEF Pilot Program's EE and RE components will be funded by resources provided by the GEF, with co-financing from the Barbados Light & Power Company (BL&P), the electric utility.

- The EE component of the SEF Pilot Program ("SEF EE Pilot Program") will promote EE through Compact Fluorescent Lights (CFLs) and energy conservation devices (power meters) in low- and middle-income households
- The RE component of the SEF Pilot Program ("SEF RE Pilot Program") will install small grid-connected RE systems (mostly solar photovoltaic (PV), and one micro Wind system) with appropriate metering to allow the measurement of electricity fed into the grid as part of a planned sales agreement with BL&P.

The SEF Pilot Program will be implemented as a complement of the Sustainable Energy Framework for Barbados (SEF). This consists of the SEF Technical Assistance funded by the IDB (USD1 million) and Government of Barbados counterpart co-financing (USD0.435 million). The SEF will provide the general framework for all sustainable energy initiatives in the country. In addition to the co-financing to the SEF Technical Assistance, a proposed USD10 million Investment Loan from the IDB to the GoB, currently under preparation, is also expected to provide further USD5 million in co-financing for EE projects, and USD5 million in co-financing for RE projects.

There are two further initiatives related to the SEF Technical Assistance and the SEF Pilot Program: (i) the Caribbean Hotel Energy Efficiency Action Program (CHENACT); and (ii) a proposed USD50 million Policy-Based Loan (PBL) from the IDB to the GoB (in two tranches of USD30 million and USD20 million, respectively), currently under preparation. The diagram below shows the relationship between (1) the SEF Technical Assistance, (2) the SEF Pilot Program, (3) the proposed EE/RE Investment Loan (under preparation), (4) the CHENACT Program, and (5) the proposed Policy-Based Loan (under preparation).

Figure 3: GEF project and related initiatives



G. DISCUSS THE VALUE-ADDED OF GEF INVOLVEMENT IN THE PROJECT DEMONSTRATED THROUGH INCREMENTAL REASONING :

Currently there is only one EE incentive scheme in Barbados—the Public Sector EE Program—that involves the retrofit of government buildings. The current regulatory framework does not adequately allow for the connection of RE generation to the grid. In an effort to identify potential opportunities to reduce dependence on fossil fuels, the GoB has requested IDB´s technical assistance to develop a Sustainable Energy Framework (SEF).

The implementation of the GEF-funded SEF Pilot Program will represent the first nation-wide incentive mechanism for EE and RE projects in Barbados. It will also help tackle barriers described above by providing solid data, information, and lessons learned. Knowledge acquired from the SEF Pilot Program will be essential for the development of policy and legislation for the country, and will optimize the use of the proposed USD10 million Fund for the implementation

of EE and RE projects. The inclusion of RE in the energy matrix and the implementation of EE measures will generate energy and economic savings as less oil will have to be imported. Significant carbon emissions reductions will also be achieved, and fossil fuels consumption will be reduced, creating a positive environmental impact for Barbados.

GEF funding will be critical for the project to build a reliable and convincing case demonstrating that thanks to EE and RE investments Barbados will save energy, involve civil society (residential consumers), diversify its energy matrix, and reduce fossil fuel imports.

H. INDICATE RISKS, INCLUDING CLIMATE CHANGE RISKS, THAT MIGHT PREVENT THE PROJECT OBJECTIVE(S) FROM BEING ACHIEVED AND OUTLINE RISK MANAGEMENT MEASURES:

Environmental Risks

CFLs contain mercury: as their use increases, and if disposal is not carefully handled, CFLs can potentially represent a health and environmental threat for Barbados. The latter, is highly unlikely as the mercury content for a 15W CFL will not exceed 4 mg. Nevertheless, an environmental assessment (EA) for CFLs was carried out under Component 2 which provides an overview of mitigation measures for CFLs' final disposal.

Regulatory and Utility-related Risks

The risk that BL&P will not offer the Rider for Renewable Energy if it does not obtain an increase in rates is very low. This is fundamentally due to the fact that applying the Rider would not entail any commercial loss for BL&P, because BL&P calculated the Rider based on true avoided fuel cost. This means that, through the Rider, BL&P would pay for distributed generation no more than what it would cost to produce electricity itself with conventional technologies using fossil fuel. The methodology for calculating the Rider based on avoided fuel cost has been presented to the FTC, and is sound (it calculates the displaced conventional generation by technology type, starting from the most expensive diesel-burning gas turbines).

Technical Risks

Technical risks for CFLs and power monitors are low. For CFLs, it should be noted that low technical risk come at a cost—a unit cost of USD5 per lamp was assumed. Budgeting this conservative cost for CFLs is absolutely necessary to ensure good-quality, long-lasting lamps are purchased. Lower-cost CFLs can easily be found, but they are a very poor and harmful choice: there have been numerous cases where cheap CFLs have been procured and lasted a fraction of their promised duration, jeopardizing the market potential of this excellent technology. Of course, if possible, more CFLs will be purchased with the same budget—but quality and long-term sustainability will not be compromised for quantity and short-term impact. Our conservative estimate also addresses the risk of having to reduce the actual quantity of CFLs compared to the expected one.

Adequate procurement rules will address most technical risks with PVs and Wind systems as follows:

PV panels proposed are reliable, but eventually the balance of plant equipment may not perform well under the conditions of Barbados' electric grid. However, this risk can be minimized by properly specifying equipment from well-established suppliers with multi-year track records of satisfactory performance. The selected equipment suppliers will also need to offer a comprehensive set of product warranties on their products.

There is also a potential risk that low quality solar and wind systems will reach Barbados' market place and perpetuate the often stated observation that these systems are of low quality, and an unreliable long-term option. Component quality issues can be addressed by adequate procurement standards for buying PV and wind power systems. The GEF project will also seek to mitigate the risk through mechanisms that promote good quality products entering the market to ensure a sustainable/long-term market development, such as satisfaction guarantees.

Market Risks

The viability of RE and EE projects is strongly correlated to the price of oil. If oil prices drop, so does the interest to adopt EE measures or implement RE technologies. Given the volatility of oil prices, the GoB has decided to support the proposed project to reduce dependency of Barbados on foreign oil, diversify the country's energy matrix, and hedge the country's risky exposure to the oil market.

Main market-related risks associated with the project include the following:

- There is a risk that the EE and RE investments will not develop a market that ensures sustainability of Barbados' supply and service industry. The Smart Fund develop under the IDB loan BA-L1020, which is also counterpart funding for this project in components 2 and 3 of the proposed GEF project will provide support to market development activities that result in lower risks for suppliers and enable cost reductions
- There is also a risk of changes in electricity tariffs. The market entrance point for PV and wind systems is based on the assumption that tariffs be adequate for the systems to be financially viable. However, the electricity tariff in Barbados is linked to the cost of fossil fuels. A consistent drop in fuel prices might undermine the investment pace. Oil futures as of November 2009, however, trade at about USD140/bbl.

Project Implementation Risks

Operations of the PEU are dependent upon several inputs and on the work with a variety of organizations. Any delay or inadequate performance on the part of the partner organization may affect the operations of the PEU. Effective management and leadership qualities of the team manager can help overcome these difficulties.

Other Risks and Issues

Since Barbados is in the tropical cyclone belt, the installed equipment for the SEF Pilot Program purchased with GEF funds could be damaged or destroyed. Minimizing the risk to damage or destroy the equipment will require examining multiple sites and developing contingency measures with the local project team.

The current electricity regulatory framework does not adequately provide for the sale of renewable energy to the grid. This, however, is expected to change thanks to the current application for a rate review of BL&P to the FTC, as well as to recommendations on regulatory measures under the SEF Technical Assistance.

There is a risk that the distribution of subsidized CFL's may lead to distortions on the CFL retail market. However, this risk is mitigated through the selection of beneficiaries targeted at the low income level, whom at present do not prioritize the purchase and use CFLs and therefore their share in the CFL retail market should be minimal.

In regards of beneficiaries attempting to resell CFL's at discounted prices, the supervision and monitoring activities by BL&P and GoB will establish periodic and/or random visits to beneficiaries and any penalties that are deemed appropriate in case of misuse of the equipment.

Sustainability (including Financial Sustainability)

The successful implementation of the project in terms of its action plan, goals and products. It will be guaranteed by the timely provision of the necessary resources (human, financial, technical, and institutional) to bring the project to successful completion.

Consistent with the RE and EE initiative that the IDB is implementing in Barbados, long-term sustainability will be ensured through activities related to resource and technological assessment, policy changes, human and institutional development, capacity building, and increased public awareness. Each of the relevant barriers identified during project preparation and within project scope has been targeted by project activities with appropriate allocations of the necessary resources to bring the project to successful completion.

Replicability

The Government is already considering a financial instrument (the Fund, to be capitalized with a proposed loan from the IDB) to ensure the project's replicability. In addition, project activities will strengthen local capabilities and awareness. Project activities will have the support of the Government and BL&P, and have been designed to accompany the technical aspects of the project with the creation of knowledge and the strengthening of the policy framework. The scale-up of activities carried out by the SEF Pilot Program will be ensured through programmatic activities related to policy changes, and to human, technical and institutional capacity building. Finally, the project dissemination strategy will engage relevant stakeholders and build consensus around the use of energy efficient devices as well as the installation of renewable energy systems in the country.

Monitoring and Evaluation

EE and RE projects' performance will be monitored on a regular basis, both in terms of its physical and operational status, as well as user satisfaction and benefits to both the grid and users. Records will be kept and lessons learned will be documented. Provisions will be taken to monitor the systems' performance for a reasonable period after project termination.

A final report will be prepared by MFITE at the end of the project, to be submitted to the IDB and GEF for evaluation by external reviewers. This report will include a summary of technical and non-technical results, as well as a compendium of the main lessons learned. A final, independent evaluation will also be carried out. Since the project has significant demonstration value for the GEF, appropriate arrangements will be made by the MFITE to facilitate access to data and/or on-site visits by interested parties from other parts of Barbados and the world, in order to facilitate project replication by third parties.

I. EXPLAIN HOW COST-EFFECTIVENESS IS REFLECTED IN THE PROJECT DESIGN:

The proposed project will create local and global environment benefits by reducing energy consumption, and reducing fossil-fuel based generation. This translates directly into carbon emission reductions, given that Barbados' energy matrix is mainly fossil fuel-based.

The estimated abatement cost of the total carbon emission reduced is GEF **US$3.8/tCO$_2$e** based on the following assumptions: the allocation of GEF Financing of USD 1 million will result in estimated direct GHG emissions reductions of 23,904 tCO$_2$e, as well as indirect GHG emissions reductions of 239,042 tCO2e (bottom-up approach). This abatement cost is in line with the cost effectiveness of other GEF financed projects, according to a 2004 review of GEF projects[6]. The review shows that ongoing EE and RE projects have an average abatement cost of USD4/tCO$_2$e, and projects under preparation have one of USD6/tCO$_2$e. This project is below the average of similar ongoing GEF projects.

In conclusion, the cost of the proposed interventions under this project is considered effective for achieving the expected environmental, energy, economic, and social benefits. The project design is considered to be the most efficient alternative to achieve positive results in the short and medium term, as this project paves the way for more EE and RE projects that will contribute to reducing CO_2 emissions and diversify Barbados´ energy matrix.

PART III: INSTITUTIONAL COORDINATION AND SUPPORT

INSTITUTIONAL ARRANGEMENT

The project will be done in cooperation with the Government of Barbados and BL&P. Established in 1911, BL&P is the sole electricity provider in Barbados, and currently serves about 100,000 residential and commercial customers. Over 60 percent of company shares belong to national investors, the largest being the Barbados National Insurance Board, the same organization that is in charge of the national social security scheme. Rules for quality of service and tariffs applicable to BL&P are administered by the Fair Trading Commission (FTC). As noted, BL&P is currently considering investments in renewable energy for its own generation park, and intends to promote distributed RE generation in the residential and non-residential sectors. Introducing sustainable energy measures in these sectors is also a short-term priority of the Government, as a critical way to reduce overall energy consumption as well as the dependency on imported fossil fuels.

PROJECT IMPLEMENTATION ARRANGEMENT

Executing Agency**:** The Energy division of MFITE will coordinate the execution of all project components.

[6] World Bank, "*WB-GEF Energy Efficiency Portfolio Review and Practitioners' Handbook"*, World Bank Environment Department, Climate Change Team, 2004

Monitoring and Evaluation: The project will be closely monitored in accordance with IDB established monitoring procedures. The IDB office in Bridgetown will provide ongoing performance monitoring with backstopping from IDB technical staff in Washington. A mid-term evaluation will be carried out at the end of the second year of implementation, funded by the IDB. Further procedures for overall project review will be detailed at project document formulation stage.

Based on the Logical Framework matrix and on the already identified project outputs, clear and quantifiable performance indicators and benchmarks will be further refined in the project document formulation process. Substantive project monitoring will be implemented along these defined parameters. Additional details on the monitoring and evaluation framework are reported under Part II, Section G.

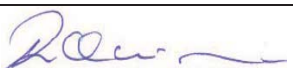
Procurement: Contracts for works, procurement of goods and services, and contracts for the services of consultants will be responsibility of the MFITE in accordance with GoB procurement procedures and practices. Procurement will be consistent with Policies for the Selection and Contracting of Consultants Financed by the IDB (GN-2350-7), and Policies for the procurement of works and goods financed by the IDB (GN-2349-7). The hiring of consultants and procurement of goods will require the non-objection of the IDB.

PART IV: EXPLAIN THE ALIGNMENT OF PROJECT DESIGN WITH THE ORIGINAL PIF:

The project design is consistent with the original PIF, and strengthened thanks to further co-financing by the Government of Barbados (in particular the proposed USD10 million Investment Loan under preparation), the BL&P (in cash for bi-directional meters, and in-kind), and cost sharing by SEF Pilot Program beneficiaries. The Analysis of Bioenergy Alternatives mentioned at the PIF level has been included as co-financing of Subcomponent 3.1.

PART V: AGENCY(IES) CERTIFICATION

This request has been prepared in accordance with GEF policies and procedures and meets the GEF criteria for CEO Endorsement.

Agency Coordinator, Agency name	Signature	Date *(Month, day, year)*	Project Contact Person	Telephone	Email Address
Ricardo Quiroga IDB GEF Executive Coordinator Environment, Rural Development and Disaster Risk Management Division Inter-American Development Bank		December 18th, 2009	Christiaan Gischler Energy Specialist Inter-American Development Bank	202-6233411	christiaang@iadb.org

ANNEXES

ANNEX A: LIST OF ACRONYMS

BL&P	Barbados Light & Power Company
CFL	Compact Fluorescent Light
CHENACT	Caribbean Hotel Energy Efficiency Action Program
DSM	Demand-Side Management
EE	Energy Efficiency
FCA	Fuel Clause Adjustment
GoB	Government of Barbados
IDB	Inter-American Development Bank
M&E	Monitoring & Evaluation
MFITE	Ministry of Finance, Investment, Telecommunications and Energy
O&M	Operation and Maintenance
PBL	Policy-Based Loan
PEU	Project Execution Unit
PIR	Project Implementation Review
PV	Photovoltaic
RE	Renewable Energy
SEF	Sustainable Energy Framework for Barbados
SME	Small and Medium Enterprise
STC	Standard Testing Conditions
SWH	Solar Water Heater
TA	Technical Assistance

ANNEX B: PROJECT RESULTS FRAMEWORK (THE BASELINE AND TARGET HAS TO BE NUMERIC IF POSSIBLE)

Goal	**Reduce GHG emissions by displacing fossil fuel-based energy generation with Renewable Energy, and reducing consumption of fossil fuel-based energy with Energy Efficiency**				
	Indicator	***Baseline***	***Target***	***Sources of verification***	***Risks and assumptions***
Objective: promote and support the development and implementation of sustainable energy sources in Barbados providing alternatives to reduce dependency on imported fossil fuels					
Component 1: Preparation of Sustainable Energy Framework for Barbados (SEF) and Capacity Building					
Outcome 1.1 (TA): Design of a comprehensive policy and regulatory framework , with technical and legal conditions set at the institutional level to encourage RE and EE					
Output 1.1.1: Barbados energy balance and prospective needs	▪ Assessment of current energy and capacity balances ▪ Projections of future energy and capacity balances	▪ Outdated energy and capacity for consumption balances by end-use and sector ▪ Incomplete energy and capacity balances for generation	▪ Projections of energy and capacity balances including the potential for EE and RE projects based on their economic viability	▪ SEF TA Reports	▪ Information available from BL&P in cooperation with Government
Output 1.1.2: Sustainable Energy Framework	▪ SEF Policy document presented to Government of Barbados	▪ Energy policy does not adequately address sustainable energy	▪ Comprehensive sustainable energy framework encompassing EE and RE	▪ SEF TA Reports	▪ Consensus-based process involving the GoB in the definition of the SEF
Output 1.1.3: Institutional training on EE and RE	▪ Identification of capacity building needs of entities involved in SEF implementation, and delivery of training	▪ Inadequate skills and knowledge of key institutions on EE and RE	▪ Government and utility entities develop skills and knowledge to manage and implement the SEF and related incentive programs	▪ SEF TA Reports	▪ Knowledge and awareness of most updated trends in EE and RE
Component 2: Policy and Implementation support for Energy Efficiency (EE)					

Outcome 2.1 (TA): EE practices fostered in residential, commercial, and public sectors					
Output 2.1.1: Assessment of EE potential	▪ Adequate assessment of EE potential by end use and among the various sectors (residential, commercial, industrial, public)	▪ Limited assessment of EE potential outside public sector	▪ 7 audits in public sector buildings, 25 audits in residential buildings, and 8 audits in commercial (non-tourism) buildings ▪ Protocol and standardized reporting model for audits ▪ Targets for EE by sector ▪ Estimate of financial impacts and financing requirements for EE	▪ SEF TA Reports	▪ GoB conducts audits across sectors ▪ BL&P provides existing information and studies
Output 2.1.2: Expansion and improvement of existing programs	▪ Design of an EE Fund ▪ Environmental Assessment of SEF EE Pilot Program measures	▪ No EE financial mechanisms or incentives outside public sector	▪ Design of financial mechanisms and incentives for EE ▪ Mitigation measures recommended for environmental impact of measures (e.g. CFLs)	▪ SEF TA Reports	▪ Endorsement of Fund design by GoB through consultative process
Outcome 2.2 (Inv): EE savings demonstrated thanks to the implementation of the SEF EE Pilot Program to promote the use of CFLs and energy conservation in low- and middle-income households					
Output.2.2.1: Replacement of incandescent bulbs with CFLs	▪ Incandescent light bulbs replaced ▪ Low- and middle-income houses involved ▪ Awareness campaign delivered in support of CFLs installation	▪ Low market penetration of CFLs in households	▪ Increased market penetration of CFLs in households: 15,000 CFLs, 3,000 households involved in campaign ▪ 1,232MWh/yr saved, USD299.5k saved, 1,079tCO2 reduced	▪ Monitoring of the SEF EE Pilot Program	▪ Cooperation of GoB and BL&P for SEF Pilot Program implementation
Output 2.2.2: Installation of power monitors	▪ Power monitors installed ▪ Low- and middle-income houses involved ▪ Awareness campaign delivered in support of power monitor installation	▪ Low awareness of end-use EE opportunities	▪ Awareness fostered with distribution of Power Monitors and awareness campaign: 3,000 monitors and households involved in campaign ▪ 947MWh/yr saved, USD230.2 saved, 829tCO2 reduced	▪ Monitoring of the SEF EE Pilot Program	▪ Cooperation of GoB and BL&P for SEF Pilot Program implementation
Component 3: Policy and Implementation support for Renewable Energy (RE)					

Outcome 3.1 (TA): Use of RE as an alternative source for electricity generation is stimulated					
Output 3.1.1: Assessment of RE potential in Barbados	▪ Adequate assessment of RE potential by technology	▪ Limited knowledge of technical and economic potential for RE installation	▪ Estimate of RE technical and economic potential in Barbados based on economic viability and willingness to pay	▪ SEF TA Reports	▪ Information on costs and performance to be required from system vendors
Output 3.1.2: Indicative power purchase/sale schemes	▪ Power purchase/sale schemes for RE	▪ No adequate framework to buy/sell RE to the grid	▪ Recommendation of framework to buy/sell RE to the grid	▪ SEF TA Reports	▪ Endorsement by FTC and cooperation of BL&P
Output 3.1.3: Determination of financial requirements for RE investment, and design/improvement of financial instruments for RE promotion	▪ Quantification of financing requirements for RE ▪ Design of a RE Fund ▪ Environmental assessment of SEF RE Pilot Program measures	▪ No financial mechanism or incentive for RE project installation	▪ Establishment of financial mechanism and incentives for RE ▪ Mitigation measures recommended for environmental impact of RE projects	▪ SEF TA Reports	▪ Endorsement of Fund design by GoB through consultative process
Outcome 3.2 (Inv): Demonstration of RE as an alternative source for electricity generation thanks to the implementation of the SEF RE Pilot Program for small grid-connected RE systems with bidirectional metering					
Output 3.2.1: Installation of PV systems	▪ PV systems installed and operating	▪ No investment support for PV systems, limited installation	▪ 28 PV systems installed ▪ 75kWp installed capacity ▪ 125.6MWh/yr displaced ▪ USD28.6k/yr saved ▪ 110.1tCO2/yr reduced	▪ GoB	▪ Economic viability and interest of beneficiaries given cost sharing requirement
Output 3.2.2: Installation of a micro wind system	▪ Wind power system installed and operating	▪ No investment support for wind systems, limited installation	▪ One micro wind system installed ▪ 10kW installed capacity ▪ 21.9MWh/yr displaced ▪ USD4.9k/yr saved ▪ 19.2tCO2/yr reduced	▪ GoB	▪ Economic viability and interest of beneficiaries given cost sharing requirement
Component 4: Dissemination of findings					
Outcome 4.1: SEF introduced to the public					

Output 4.1.1: Workshop to inform stakeholders	▪ Workshop sessions	▪ No dissemination program ▪ Limited resources for awareness campaigns	▪ Investments in result dissemination	▪ Workshop ▪ Course material	▪ Interested audience
Output 4.1.2: Long term education strategy	▪ Component in national educational guidelines	▪ No information about RE and EE in school curricula	▪ RE and EE information as part of school curriculum	▪ Course material ▪ Teaching guidelines	▪ Adoption of developed material by school teaches

ANNEX C: RESPONSES TO PROJECT REVIEWS (from GEF Secretariat and GEF Agencies, and Responses to Comments from Council at work program inclusion and the Convention Secretariat and STAP at PIF)

Review Criteria	Questions	Secretariat Comment at PIF/Work Program Inclusion	IDB Comments
Eligibility	1. Is the participating country eligible?	Yes, the country ratified the UNFCCC by 23/03/94.	
	2. Has the operational focal point endorsed the project?	Yes, Lionel, O. Weekes, GEF Focal Point, December 17, 2008 has endorsed a GEF grant of $1,000,000 including agency fees whereas the total GEF grant is $1,100,000. A corrected resubmission of the endorsement letter is required, including corrected PIF (Part III, A). [Update: March 27, 2009, JB] Yes. Lionel, O. Weekes, GEF Focal Point has endorsed a GEF grant of $1,100,000 including agency fees on the 2009-03-06.	
	3. Which GEF Strategic Objective/ Program does the project fit into?	GEF CC SO 1: To promote energy-efficient technologies and practices in the appliance and building sectors GEF CC SO 3: To improve the efficiency and performance of existing power plants GEF CC SO 4: To promote on-grid renewable energy	
	4. Does the Agency have a comparative advantage for the project?	Yes, as stated in the Council paper GEF/ C.31/ 5 rev.1 on Comparative Advantages - GEF Agencies, IADB has a comparative advantage in this kind of project in the Caribbean region.	
Resource Availability	5. Is the proposed GEF Grant (including available for (if appropriate):		
	The RAF allocation?	Yes	
	The focal areas?	Yes	
	Strategic objectives?	N/A	
	Strategic program?	N/A	
Project Design	6. Will the project deliver tangible global environmental benefits?	Quantitatively no amount of GHG emissions saved has been stated. GEF funding will support solely the investment of a currently uncertain number of energy efficiency and renewable energy demonstration projects which will save some GHG emissions and intend to remove barriers for further investments. The project will build the capacity for design and implementation (procurement) of EE and RE programs and potentially deliver environment benefits. Qualitatively the main benefits will be indirectly through policy and framework changes, capacity building.	
	7. Is the global environmental benefit measurable?		
	8. Is the project design sound, its framework consistent & sufficiently clear (in particular for the outputs)?	The proposed project to be co-financed by the Sustainable Energy Framework for Barbados (SEFB) technical cooperation (TC) seeks to establish an adequate regulatory framework for the implementation of RE and EE practices, as well as promote and support sustainable energy and energy conservation programs in order to ensure a sustainable	

		development in Barbados, providing alternatives to minimize the dependency on fossil fuels. Component I: Preparation of the Sustainable Energy Framework for Barbados and capacity building Component II: Policy and Implementation Support for Energy Efficiency The GEF funds will finance the design and implementation of a pilot project for EE practices, EE audits and retrofit of key government buildings. Component III: Analysis and Policy Support for Renewable Energy options The GEF funds will finance the design and implementation of a pilot demonstration project for RE, mainly an on-grid solar PV system with net metering. Component IV: Analysis of Bioenergy Alternatives Component V: Dissemination of finding	
	9. Is the project consistent with the recipient country's national priorities and policies?	Yes. The project is consistent with the Barbados Sustainable Development Policy, its targets for RE generation, public sector EE program, and EE vehicle program.	
	10. Is the project consistent and properly coordinated with other related initiatives in the country or in the region?	Yes. This project is closely related to the Caribbean Hotel Energy Efficiency Action Program ("CHENACT"), carried out by the IDB. Further coordinated with UNEP and the Government of Barbados.	
	11. Is the proposed project likely to be cost-effective?	Cost effectiveness has not been estimated at PIF stage and will be developed through project preparation.	
	12.Has the cost-effectiveness sufficiently been demonstrated in project design?		
	13.Is the project structure sufficiently close to what was presented at PIF?		
	14. Does the project take into account potential major risks, including the consequences of climate change and includes sufficient risk mitigation measures?	The following risk has been addressed: resources assessment influenced by climate change. Mitigation measures: use of best available technologies and methodologies.	
Justification for GEF Grant	15. Is the value-added of GEF involvement in the project clearly demonstrated through incremental reasoning?	All GEF funding for the project is used for financial support (without further cofinancing) to pilot and demonstration activities in EE and RE. Without the pilot investments the project would lack a demonstration component which is essential to make a convincing case for switching to RE and EE practices. The argument used in the PIF that "the demonstration projects should show economic benefits due to savings in fossil fuel" is vague.	

		(Economic benefits for more efficient applications are guaranteed the moment the investment cost is practically zero as somebody else will take care of them.)	
	16. How would the proposed project outcomes and global environmental benefits be affected if GEF does not invest?		
	17. Is the GEF funding level of project management budget appropriate?	GEF funding for project management is zero.	
	18. Is the GEF funding level of other cost items (consultants, travel, etc.) appropriate?		
	19. Is the indicative co-financing adequate for the project?	Yes. GEF funding is used solely for pilot and demonstration activities in EE and RE. Co-financing is $ 1,435,000 (435k$ cash Government, 1,000k$ grant IDB/SECCI). Co-financing ration is 1:1.435	
	20. Are the confirmed co-financing amounts adequate for each project component?		
	21. Does the proposal include a budgeted M&E Plan that monitors and measures results with indicators and targets?		
Secretariat´s	STAP		
	Convention Secretariat		
	Agencies' response to GEFSEC comments		
	Agencies' response to Council comments		
Recommendations at PIF	22. Is PIF clearance being recommended?	PIF clearance will be recommended after the following issues have been addressed: C1: A corrected resubmission of the endorsement letter is required, including corrected PIF (Part III, A). C2: Typo error in the Project Framework (Part I, A) - Component III - column 2: indication missing for 2. subcomponent. C3: Please rephrase the incremental reasoning regarding "economic benefits", (Part II, E) [Update: March 27, 2009, JB] Comments 1 and 3 have been addressed satisfyingly. Comment 2: indicator (INV, TA, STA) still missing, but considered a minor error, please correct at CEO endorsement. PIF clearance is recommended.	C1: Corrected endorsement letter attached and PIF part III A has been corrected C2: Error corrected C3: Text rephrased: The RE demonstration project should show economic benefits and investment recover due to: (i) the avoided cost of fuel that the utility otherwise would have if electricity was generated with fossil fuels; and (ii) net reduction in the residential energy bill, and (iii) possible additional income from selling power to the grid. The EE demonstration project

			should show economic benefits due to: (i) reductions in energy bills in residential and government buildings; and (ii) investment in EE appliances recovered through energy savings
	23. Items worth noting at CEO Endorsement.	Please elaborate as detailed as possible on the objectives, strategy, design, implementation and dissemination of the planned investments in EE and RE.	
Recommendation at CEO Endorsement	24. Is CEO Endorsement being recommended?		

ANNEX D: CONSULTANTS TO BE HIRED FOR THE PROJECT USING GEF RESOURCES

REGARDING THE CFL AND POWER MONITORS PILOT PROJECT:

Position Titles	*$/ person week**	*Estimated person weeks***	*Tasks to be performed*
Local			
Consulting Services			
Design Awareness Campaign	Local consulting firm for up to US$50,000 funded with GEF resources.		Design and production of information material on EE pilot project, namely Program's functioning, benefits, and application requirements.
	US$4,000	5	Design of awareness strategy Design of leaflets with EE pilot information Printing of information material (US$30,000)
Non consulting services			
EE pilot implementation services	Total of US165,000 of which GEF will provide approximately US$150,000 and end users US$15,000.		(i) Distribution via billing channel of information material prepared; (ii) processing of applications; and (iii) installation of equipment and demonstration of its functioning in 3,000 households.
			○
Justification for Travel, if any:			

* Provide dollar rate per person week. ** Total person weeks needed to carry out the tasks.

ANNEX E: STATUS OF IMPLEMENTATION OF PROJECT PREPARATION ACTIVITIES AND THE USE OF FUNDS

A. EXPLAIN IF THE PPG OBJECTIVE HAS BEEN ACHIEVED THROUGH THE PPG ACTIVITIES UNDERTAKEN. NA

B. DESCRIBE FINDINGS THAT MIGHT AFFECT THE PROJECT DESIGN OR ANY CONCERNS ON PROJECT IMPLEMENTATION, IF ANY: NA

C. PROVIDE DETAILED FUNDING AMOUNT OF THE PPG ACTIVITIES AND THEIR IMPLEMENTATION STATUS IN THE TABLE BELOW:NA

Project Preparation Activities Approved	*Implementation Status*	*GEF Amount ($)*				*Co-financing ($)*
		Amount Approved	*Amount Spent Todate*	*Amount Committed*	*Uncommitted Amount**	

	(Select)					
Total						

* Any uncommitted amounts should be returned to the GEF Trust Fund. This is not a physical transfer of money, but achieved through reporting and netting out from disbursement request to Trustee. Please indicate expected date of refund transaction to Trustee.

ANNEX F: CALENDAR OF EXPECTED REFLOWS

Provide a calendar of expected reflows to the GEF Trust Fund or to your Agency (and/or revolving fund that will be set up)

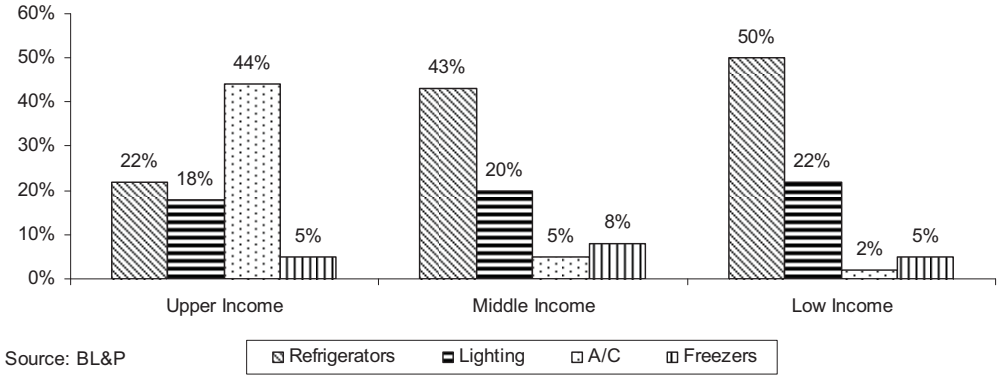
ANNEX G: SEF Energy Efficiency Pilot Program

a) SEF EE Pilot Program rationale. This section explains why the residential sector is proposed, and why CFLs and power monitors for residential meters are recommended as EE measures for this sector.

The residential sector represents a very high share of energy consumption in Barbados. The residential sector represented about one-third of electricity sales of BL&P in 2008: 301GWh, compared to 643GWh for the commercial sector—which includes tourism, supported by the separate CHENACT Program.

FIGURE 4

Residential end-uses of electricity in Barbados



Source: BL&P

Within the residential sector in Barbados—according to the DSM study commissioned by BL&P in 1999 (the latest end-use survey conducted in the country)—lighting represents one of the key end-uses in low- and middle-income households. According to 1999 data, as shown in **Error! Reference source not found.** above, lighting represents the second highest end-use for both middle-income (20 percent) and low-income households (22 percent). Unlike the commercial sector, the residential sector still mostly uses incandescent light bulbs. Refrigeration represents a higher end-use compared to lighting in low- and middle-income households. However, efficient refrigerators would have a relatively low effectiveness in terms of savings achieved per USD spent, due to their very high unit cost (about USD900). Estimated effectiveness of new refrigerators would only be 0.3kWh/USD per year,[7] and 2.7kWh/USD over a 10-year lifetime—far lower than the effectiveness of CFLs, as explained below. A/C systems represent the highest end-use only for upper-income households, which the SEF EE Pilot Program does not target (support to upper-income households is not necessary).

The replacement of incandescent light bulbs by compact fluorescent lights (CFLs) is one of the most effective EE measures in the residential sector. In terms of savings achieved per USD spent, this activity can achieve on average 16.4kWh/USD per year,[8] and 72kWh/USD over a 4.4-year lifetime (8,000 hours). Table 3 below summarizes the main parameters for the first measure proposed, involving the replacement of five incandescent light bulbs (with an average capacity of 60W) with five 15W CFLs per household.

[7] Considering a 15 cubic feet new refrigerator consuming an estimated 37kWh/month with a unit cost of USD900, replacing a 15c.f. traditional refrigerator consuming an estimated 57kWh/month.

[8] Considering 15W CFLs with a unit cost of USD5, operating 5 hours per day and 365 days per year, replacing incandescent lights (60W average power) with a similar operation pattern.

TABLE 3

1. CFLs		Baseline (incandescent)	SEF EE Pilot Program (CFLs)	Difference/ Savings
Number of households involved	No.	3,000	3,000	-
Light bulbs to be replaced per household	No.	5	5	-
Total lightbulbs to be replaced	No.	15,000	15,000	-
Bulb average power	kW	0.060	0.015	**0.045**
Installed capacity, all bulbs	kW	900	225	**675**
Daily hours of operation	Hrs.	5	5	-
Days per year of operation	Days	365	365	-
Consumption and savings, all bulbs	kWh/yr	1,642,500	410,625	**1,231,875**
Percentage savings	%			**75%**
Cost per CFL	USD		5	
Total cost of measure 1 (CFLs)	USD		75,000	
Yearly effectiveness (savings/cost)	kWh/USD		16.4	
Lifetime effectiveness (4.4 years' savings/cost)	kWh/USD		72.0	

The five most used lights in each house will be substituted (such as in the kitchen, living room, bedrooms and exterior). An average 5 hours of operation per day are estimated for these lights. Estimated savings would be in the order of 75 percent over the baseline.

The residential sector is critical for promoting awareness, as it naturally involves all citizens. Citizens involved in residential awareness campaigns can in turn diffuse energy conservation behaviour learned on their own consumption patterns (and with an impact on their own bill) in other sectors where they work, such as the commercial or the public one.

Power monitors are compatible with all residential meters in Barbados, easy to install and use, and a very effective instrument to enhance awareness. These feedback devices show real-time electricity consumption and expenditure, which residents can easily associate to appliances in operation or being turned off. Awareness about the cost of keeping appliances operating for no purpose has a significant effect on residents' behaviour and consumption patterns. Various studies have estimated that behavioural changes induced in residential consumption by feedback devices like power monitors can lead to savings on the electricity bill of up to 15 or even 20 percent.[9] The effectiveness of power monitors in terms of savings achieved per USD spent is also high—assuming a more conservative savings rate of 10 percent, effectiveness would be of 4.2kWh/USD per year, and 84.7kWh/USD over a 20-year lifetime.[10] Table 4 below summarizes the main parameters for the second measure proposed, involving the introduction of one power monitor per household.

[9] See for example Sarah Darby, *The Effectiveness of Feedback on Energy Consumption*, University of Oxford, April 2006 http://www.eci.ox.ac.uk/research/energy/downloads/smart-metering-report.pdf; Kurt Roth, *Home Energy Displays*, ASHRAE Journal, July 2008 http://www.tiaxllc.com/publications/home_energy_displays.pdf; and Dabby Parker and David Hoak, *How Much Energy Are We Using? Potential of Residential Energy Demand Feedback Devices*, Florida Solar Energy Center, 2006 http://www.fsec.ucf.edu/en/publications/pdf/FSEC-CR-1665-06.pdf.

[10] Considering a Power Monitor with a unit cost of USD75 achieving behavioral savings of 10 percent on consumption.

TABLE 4

2. Power Monitors for residential meters		**Baseline (w/o Power Monitor)**	**SEF EE Pilot Program (w/Power Monitor)**	**Difference/ Savings**
Number of households involved	No.	3,000	3,000	**-**
Power monitors per household	No.	-	1	
Total power monitors installed	No.	-	3,000	
Household monthly consumption (1st band)	kWh/month	126	113	**13**
Household monthly consumption (2nd band)	kWh/month	400	360	**40**
Est. annual consumption and savings, per household	kWh/yr	3,156	2,840	**316**
Percentage savings per household	%			**10%**
Est. annual consumption and savings, all households	kWh/yr	9,468,000	8,521,200	**946,800**
Percentage savings, overall	%			**10%**
Cost per Power Monitor	USD		75	
Total cost of measure 2 (Power Monitors)	USD		225,000	
Yearly effectiveness (savings/cost)	kWh/USD		4.2	
Lifetime effectiveness (20 years' savings/cost)	kWh/USD		84.2	

The distribution of CFLs and power monitors will be supported by an awareness campaign, which is described in detail below. The GoB may also consider providing own resources to test efficiency devices such household capacitors for a small subset of participating households.

b) Awareness campaign. The awareness campaign will address the benefits of EE and energy conservation in the residential sector broadly, as well as specific benefits and advice for the EE equipment introduced under the SEF EE Pilot Program. The awareness campaign will both precede and accompany the implementation of the SEF EE Pilot Program:

- *Before the SEF EE Pilot Program*, EE information and material will be disseminated to all BL&P residential customers, namely through leaflets distributed via billing channel. Potential beneficiaries of the Pilot Program will also be informed of the Program's functioning, benefits, and application requirements. This will allow the selection of the participating households (see below, "Selection of beneficiaries")
- *During implementation of the SEF EE Pilot Program*, participating households will receive, together with the equipment (CFLs and power monitors), specific EE information and a live explanation/demonstration of the equipment's functioning. An instructor will perform the delivery of all equipment as well as the explanation/demonstration of its functioning:
    - First, the instructor will help install the power monitor, and explain its use by showing how consumption readings change by turning key appliances on or off (such as stereos or air conditioners)
    - Then, the instructor and the resident will make a real-time reading of the household's consumption while all incandescent lights to be replaced are turned on, and register the reading's results
    - Finally, the instructor will help install CFLs and make another reading of consumption while all replaced CFLs are turned on. The instructor and the resident will compare the two readings to show savings achieved by CFLs. Care will be taken that the same appliances (such as refrigerators or air conditioners) be operating or non-operating during these two readings (adjusting the appliances' thermostat if necessary).

Given the simple installation of power monitors and CFLs, the instructor will perform the above operations in no more than one hour per household. This will allow (i) a powerful demonstration of savings associated to CFLs; (ii) an explanation of the use and functioning of the power monitor for other household appliances; (iii) a check that lighting fixtures comply with safety standards, and any needed recalibration of meters; and (iv) a preliminary investigation on the potential willingness to pay of beneficiaries for CFLs when these need to be replaced.

The awareness campaign material and information disseminated to participating households will explain specific benefits, and provide guidance for the use of equipment provided:

- *For CFLs*—higher efficiency (more power converted to light and less to heat, approximately 20 percent against 10 percent), higher efficacy (3-5 more lumen per watt, allowing to achieve same or higher luminosity with a lower bulb power), higher price but longer lifetime (up to 10-20 times more), tips to enhance CFL lifetime (limit short-duration on/off switching), instructions on what to do in case CFLs break (air-out, clean-up steps),[11] and disposal precautions (due to very small quantities of mercury).[12] It should be noted that, unlike other CFL programs, beneficiaries will *not* be told not to change their lighting consumption patterns, given that this would contradict the use of the power monitor—behavioural changes will only be those induced by the monitors
- *For power monitors*—instructions on installation and use, and information on savings achieved (up to 10-15 percent).

The design of the awareness campaign, and the production of related information material, will be contracted competitively based on GoB procurement methods that will include publishing of the appropriate Request for Proposals in local newspapers. A budget of USD50,000 will be assigned to the awareness campaign design and production of material.

The implementation of the awareness campaign will include (i) the distribution via billing channel of information material prepared; (ii) the processing of applications; and (iii) the installation of equipment and demonstration of its functioning. Implementation will be performed by BL&P/MFITE contractors under a budget of USD165,000 (USD55 per participating household, with a USD5 cost sharing per household—see below "Cost and beneficiary cost sharing").

The *ex post* dissemination of the awareness campaign's results will be done—together with that of other Components' results—under Component 5.

c) Selection of beneficiaries. The SEF EE Pilot Program will target three thousand (3,000) low- and middle-income households in Barbados, selected on a first-come, first-served basis. The Program will provide each of these households with five (5) CFLs, and one (1) power monitor for residential meter, in addition to awareness information.

Based on the number of residential households by income level shown in the 1999 DSM study commissioned by the BL&P, and assuming a growth rate calculated on the current total number of BL&P residential customers (BL&P Annual Report, 2008), it is estimated that there are a total of about 47,000 low-income and about 41,000 middle-income households in Barbados. The two groups represent a similar share of about 43 and 44 percent of residential customers, respectively. Participant households will provide for a representative enough sample of the low- and middle-income residential sector in Barbados.

Barbados is divided into eleven parishes—some urban, others rural, others presenting a combination of the two. In accordance with indications from GoB, households involved in the SEF EE Pilot Program will represent all parishes, proportionally to the relative number of customers per parish. A minimum number of 100 beneficiaries per parish will be established to ensure that also the smallest parishes are adequately represented. Consumer bands will also be represented proportionally. About 16 percent of BL&P customers consume less than 126kWh/month (first band), and most (between 60 and 70 percent) consume between 126kWh/month and 400kWh/month (second band). These two bands roughly correspond to low- and middle-income households, respectively, although there are low-income households that consume more than 126kWh/month.

The selection of beneficiaries will be done transparently on a first-come, first-served basis:

[11] See US Environmental Protection Agency information at http://www.epa.gov/mercury/spills/#fluorescent.
[12] See Energy Star information at http://www.energystar.gov/index.cfm?c=cfls.pr_cfls.

- BL&P will identify, for each consumer band within each parish, a pool of potential beneficiaries (greater than the maximum beneficiaries for a consumer band in a given parish) who present an adequate load profile
- Potential beneficiaries will be informed, with a detailed brochure sent to their homes, about the functioning, benefits, and availability of the SEF EE Pilot Program on a first-come, first-served basis, until the maximum established for each band within each parish is reached
- Potential beneficiaries will apply to the SEF EE Pilot Program by filling out a form whereby they also give their consent that the data collected on their load profile be elaborated and published (by consumer band and by parish, not by individual household). Forms will be either dropped off at a BL&P premise, or mailed in
- Beneficiaries will be defined on a first-come, first-served basis, and informed of a time band when the visit to the household will take place for equipment installation and demonstration.

d) Cost and beneficiary cost sharing. The SEF EE Pilot Program will require both cash and in-kind cost sharing by beneficiaries:

- Beneficiaries will be required to pay a cash cost sharing of USD5 (BBD10) prior to installation of equipment at their residence. Beneficiaries will be informed that this cost-sharing corresponds to the cost of only one of the five CFL bulbs, and to only 5 percent of the total value of the equipment they receive (USD100, consisting of 5 CFLs at USD5 each and one power monitor at USD75). The sum will be collected by the instructor contracted to perform equipment installation and explanation. Although beneficiaries will likely associate their cost sharing to one CFL, each household's cash cost sharing will effectively accrue towards implementation costs
- Beneficiaries will also be required to provide an in-kind cost sharing to obtain the CFLs and the power monitor. This in-kind cost sharing will consist of the time devoted during the installation of the equipment, the explanation of the power meter functioning, and the various consumption readings. Some households in Barbados use bayonet sockets, which are not compatible with CFLs that require screw-in sockets. Households with bayonet sockets who wish to participate will need to replace them with screw-in sockets, and this will also be considered a limited cost sharing on the beneficiaries' side. Socket adaptors are also available at low cost.

A collection/distribution point for CFLs and monitors was also considered as a potential means to provide for beneficiary in-kind cost sharing, but discarded. This option would have required beneficiaries to personally turn in functioning incandescent lights taken from their residence, and receive CFLs and the monitor in exchange. However, this option was discarded because of (i) safety reasons—light sockets should not remain empty for a protracted period, because this could lead to electric shock, particularly with children; (ii) awareness reasons—the house-to-house distribution and installation of CFLs and power monitors will allow instructors to explain and demonstrate the functioning of equipment, and compare readings together with beneficiaries to enhance EE awareness.

15W CFLs have an estimated unit cost of USD5, for a total cost per household of USD25. While this cost may seem high, it should be considered that (i) it is necessary to ensure good quality CFLs are procured—cases of low-quality CFLs in Latin America and the Caribbean are only too well known, and the consequences of short lifetime are disastrous and long-lasting; and (ii) CFLs in Barbados currently market at above this unit cost and as much as USD7-8, so the Pilot Program would actually offer them at a competitive cost. Of course, offers for a greater quantity of good quality CFLs under the same total budget will be welcome—but the SEF EE Pilot Program will not compromise quality and long-term benefits for the sake of quantity and short-term impact.

Power monitors have an estimated unit cost of USD75. The design of the awareness campaign and the production of material will require an estimated budget of USD30,000. Implementation of the campaign (processing of applications, installation and demonstration of equipment) will carry an estimated cost of USD55 per household, or USD165,000 for all participating households. USD15,000 of implementation costs will be covered by beneficiary cost sharing (USD5 each).

Table 5 summarizes costs, cost sharing, and cost covered by GEF resources for the entire EE package per household.

TABLE 5

EE Package Unit Cost (per household)		Cost per household	Consumer cost sharing, USD5per household	Cost covered by SEF EE Pilot Program (GEF resources)
CFLs	USD	25	-	25
Power Monitors	USD	75	-	75
Implementation (application, installation, demonstration)	USD	55	5	50
Total	USD	155	5	150

Table 6 below shows the overall cost to be covered by GEF resources, estimated at USD500,000 for all households and including design and implementation of the awareness campaign. Total cost of the SEF EE Pilot Program is estimated at USD515,000, of which USD15,000 represented by consumer cost sharing for implementation.

TABLE 6

EE Package Total Cost (all households)		Total cost	Consumer cost sharing, USD5per household	Cost covered by SEF EE Pilot Program (GEF resources)
CFLs	USD	75,000	-	75,000
Power Monitors	USD	225,000	-	225,000
Implementation (application, installation, demonstration)	USD	165,000	15,000	150,000
Total	USD	465,000	15,000	450,000
Awareness campaign design and production of material	USD	50,000		50,000
Total Cost	**USD**	**515,000**	**15,000**	**500,000**

e) Disposal of used equipment and environmental sustainability. The disposal of used incandescent bulbs will be done in accordance with environmental best practices and national laws and regulations. The environmental assessment (EA) conducted under subcomponent 2.1 will cover the details of environmental risks and disposal practices required for used equipment, as well as environmental impact and precautions for new equipment. The recommendations found in the EA will not expire with the conclusion of this pilot project. Since GoB and IDB plan to give continuity to the pilot with a larger and more comprehensive program (the Sustainable Energy Implementation Program, BA-L1020) for implementation and financing of EE and RE measures, coordinated efforts will be made to consolidate the enforcement of sound environmental practices for the substitution and disposal of inefficient equipment. Additionally, an EA will accompany the loan BA-L1020 following the environmental safeguards of the IDB, expanding its scope to all the potential RE and EE appliances to be financed by that operation, including their final disposal, in coordination with the Ministry of Environment and the MFITE. It is expected that the GoB could use this EA for future similar programs. As noted, CFLs contain very small amounts of mercury. Information on the handling and disposal of used CFLs will be provided to end beneficiaries. The Solid Waste Program Unit of Barbados already operates a facility for the final disposal of municipal and hazardous solid waste. The loan BA-L1020 will coordinate with the Solid Waste Program Unit to include a disposal program for electric appliances, including CFLs.

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The environmental impact of power monitors is limited to their batteries. Information on appropriate battery disposal at the end of power monitors' lifetime (estimated 20 years) will be provided to Program participants.

f) Purchase of equipment and required standards. The stocks of CFLs and power monitors will be purchased through bulk orders to ensure the most convenient price. At least two proposals for each type of equipment will be requested, although bidders will be allowed to submit offers for both types of equipment.

Minimum required standards for the two types of equipment will be the following, subject to approval by the Government Electrical Engineering Department of Barbados:

- *For CFLs*—C22.2 No.250.0-08, 3rd edition standard will be required. This is a tri-national standard adopted throughout North America, in accordance with the *Canadian Electrical Code (CEC), Part I* (C22.1), with the *US National Electrical Code (NEC)* (ANSI/NFPA 70), and with the *Mexican National Electrical Code* (NOM-001-SEDE). Stray or errant UV light is adequately addressed under this standard. A maximum mercury content of 4mg/bulb will also be ensured by the standard
- *For power monitors*—Compatibility with residential meters in Barbados will be required. In particular, this will involve wireless power monitors compatible with meters with visible rotating wheel, or the Itron or Schlumberger Centron meters.[13]

g) Expected results. Table 7 below summarizes the expected outputs of each of the measures, and of the overall SEF EE Pilot Program, in terms of:

- *Energy and financial savings per household*—each participating household will achieve an estimated 726kWh/yr of annual savings, equivalent to about USD177/yr at proposed new BL&P rates and an estimated Fuel Clause Adjustment.[14] Over the equipment's lifetime (4.4 years for CFLs, and 20 years for the power monitor), each participating household will save an estimated 8.1MWh, equivalent to about USD1,972
- *Energy and financial savings for all households*—the entire SEF EE Pilot Program, covering 3,000 households, is expected to achieve estimated annual savings of almost 2,200MWh/yr, equivalent to about USD530,000 at proposed new BL&P rates. Over the equipment's lifetime, the entire SEF EE Pilot Program is expected to achieve savings of about 24.3GWh, equivalent to about USD5.9 million
- *Emissions reductions*—electricity saved thanks to the SEF EE Pilot Program is expected to correspond to about 1,908tCO_2/yr, or about 21,319tCO_2 over the equipment's lifetime.

TABLE 7

Yearly Savings	**Energy savings (%)**	**Savings per household (kWh/yr)**	**Savings per household (USD/yr)**	**Total Program savings (MWh/yr)**	**Total Program savings (USD/yr)**	**Total Program emissions reductions (tCO2/yr)**
CFLs	75%	411	100	1,231.88	299,526	1,079.17
Power Monitors	10%	316	77	946.8	230,211	829.44
Total		726	177	2,178.7	529,738	1,908.6

Lifetime Savings	**Energy savings (%)**	**Savings per household (kWh/lifetime)**	**Savings per household (USD/lifetime)**	**Total Program savings (MWh/lifetime)**	**Total Program savings (USD/lifetime)**	**Total Program emissions reductions (tCO2/lifetime)**
CFLs (4.4yrs)	75%	1,800	438	5,400.00	1,312,992	4,730.63
Power Monitors (20yrs)	10%	6,312	1,535	18,936.00	4,604,225	16,588.73
Total		8,112.0	1,972.4	24,336.0	5,917,217	21,319.4

In addition to savings and emissions reductions, the SEF EE Pilot Program will also achieve an important output in terms of awareness. 3,000 households will gain direct and powerful experience in energy efficiency and conservation. The dissemination of Program results under Component 5 will allow extending awareness to Barbadian society as a whole.

The SEF EE Pilot Program will also allow assessing the following aspects:

- Willingness to pay for CFLs, and level of incentive needed
- Confirmation of savings estimates made *ex ante*

[13] See for example compatibility requirements at http://www.blackanddecker.com/Energy/PowerMonitorCompatibility.htm.
[14] Considering an average of new residential rates of USD 24 cents, based on BL&P's application to the Fair Trading Commission, and a constant Fuel Clause Adjustment of BBD 25 cents (USD15 cents including 15% VAT).

- Potential cost (and logistical implications) of replicating similar initiatives on a larger scale, in particular under mechanisms created with the USD10 million Investment Loan by the IDB to the GoB
- Effectiveness of awareness initiatives on energy conservation in the residential sector, and any key awareness gaps to be addressed.

Depending on the market viability and public receptiveness to CFLs, a policy to outright ban the sale of incandescent lamps may be part of the mid-term policy recommendations for the SEF (Component 1). The European Union has implemented such a policy since September 2009, Canada will do so by 2012, and the US is also planning to do so by 2012.

The SEF EE Pilot Program will procure two types of equipment, described in the tables below:

- Power Monitors, and
- Compact Fluorescent Lights.

Power Monitors	**Specification**
Number of Power Monitors required	Three thousand (3,000)
Power	15 Watts
Residential meter compatibility	Compatibility with visible rotating wheel meters, or Itron or Schlumberger Centron meters

Compact Fluorescent Light Bulbs (CFLs)	Specification
Number of CFLs required	Fifteen thousand (15,000)
Lighting type	Compact Fluorescent Lights with electronic ballast, in one body, for use in residential sector
Power	15 Watts
Base type	Standard base of 2.54 com of diameter (medium screw-in base E-26) to allow direct replacement of incandescent bulbs
Minimum lifetime	10,000 hours
Maximum mercury content	4 milligrams per bulb
Environmental conditions	Temperature 10-45 °C, humidity 50-95%
Electromagnetic interference	
Power factor	The minimum capacity power factor will be 0.6. The maximum inductive power factor will be 0.90
Harmonics distortion	No bigger than 20%
Nominal tension	120 VCA
Operation tension (minimum-maximum)	90-140V
Frequency	60Hz, ±0.5 %
Lighting stability	90% of the lighting after 100 hours of operation, at least 80% after 2,000 hours of operation, at least 75% after 4,000 hours of operation
Lighting efficiency	Equal or more than 60 lumens/Watt
Color rendering index	Minimum 80 CRI
Color temperature	Cool White, temperature more or equal than 4,200 °K at nominal intensity
Maximum temperature in the base	no more than 80°C
Quality of materials	a) no burn materials, fusion point equal or more than 250°C. b) Materials can not to emit toxic gases. c) minimum thermal capacity of 155°C. d) It is recommended that materials have certification of UL
Electric parts	All cables might be inside the ballast, cover and isolated. No nude cables. No parts with electric tension. Compensation of the power factor must be integrated to the protection system and to a discharge system to avoid danger or fire
Package of lamps	the packages will have in English language, labels about the model, origin, factory, nominal voltage, maximum and minimum voltage level, lifetime, luminous flux, color temperature, colour rendering. Warnings about the management of the package, information about the ballasts: model, origin, factory
Standard required	C22.2 No.250.0-08, 3rd edition standard (tri-national standard adopted throughout North America, in accordance with the *Canadian Electrical Code (CEC), Part I* (C22.1), with the *US National Electrical Code (NEC)* (ANSI/NFPA 70), and with the *Mexican National Electrical Code* (NOM-001-SEDE)

ANNEX H: Renewable Energy Pilot Program

a) SEF RE Pilot Program rationale. To reduce its virtually complete dependence on fossil fuels, Barbados needs to explore the most viable RE technologies that will allow the country to make the most of local energy resources. High levels of solar radiation in Barbados[15] (5.66kWh/m^2 per day), regular year-round (ranging from 4.8 kWh/m^2 in December to 6.2 kWh/m^2 in April), suggest that Solar PV is a highly viable technology in the country. This is confirmed by the high penetration rate of solar thermal technology in the country (SWH), which stands at over 60 percent.

The main benefits of the Solar PV technology are the following:

- Simple maintenance and long life span (25 years or more), mostly due to lack of moving parts (for fixed-mounting PV modules), and to the longevity of all PV modules
- Viability for retrofit or new installations on any suitable surface (shadow-free, appropriate inclination) such as household rooftops
- Established and successful international experience in developing grid-connected solar PV solutions.

Barbados has also been exploring wind power potential. A feasibility study for a 10MW wind farm at Lamberts, in the Parish of St. Lucy, was completed by BL&P. Based on BL&P proprietary information, the wind regime data collected at the Lamberts site shows an interesting potential of 7.7meters/second at 40 meters of height, and a capacity factor of about 33 percent. Turbines to be installed at the Lamberts site would have a capacity of 0.9-1.0MW each. The Environmental Impact Assessment for the planned Lamberts wind farm has been completed, and the BL&P submitted an application for a permit to develop the site. The decision on the application is still pending. The micro Wind system installed under the SEF RE Pilot Program (10kW) would explore the viability of smaller but still grid-connected solutions in Barbados.

The SEF RE Pilot Program will help overcome some of the specific barriers faced by small grid-connected RE systems, such as Solar PV or micro Wind systems. These barriers—and the way the SEF RE Pilot Program will help overcome them—are the following:

- *Current legislation does not adequately provide for the sale of renewable energy to the grid*—the FTC is expected to provide a ruling on the proposed tariffs and terms for the SEF RE Pilot Program, corresponding to tariffs and terms proposed by BL&P for the Rider for RE. The SEF RE Pilot Program will therefore allow Barbados to explore the viability of residential and non-residential power purchase schemes
- *Small RE systems have a high upfront cost, and long payback periods*—the Pilot Program will provide a significant incentive for participants: a capital subsidy equal to 75 percent of the systems' turnkey cost. Such incentive will reduce payback periods to one-fourth of their normal value
- *There is little knowledge and awareness in Barbados about small RE systems' performance, costs, viability of their integration in the grid, and impact on energy bills*—the bidirectional meters provided by BL&P will clearly collect and store information on energy delivered and received by residential customers/producers, as well as on the systems' load profile (time of day of energy delivered/received). The SEF RE Pilot Program will facilitate the implementation of a range of evolutionary (but proven) technologies, and allow identifying their viability, any issues, and any required modifications
- *Key institutional entities (MFITE, BL&P) have limited experience in grid-connected RE systems, and local electricians and installers have limited technical/professional capability*—the systems will provide key local stakeholders with direct experience on small grid-connected RE systems, and enhance their capabilities.

b) RE technologies considered for the SEF RE Pilot Program. The SEF RE Pilot Program will assess the potential implementation of a range of small-scale alternatives, particularly PV systems. A variety of candidate arrangements of PV components is proposed to identify the best solution for Barbados. The most promising PV cell technologies were considered: mono-crystalline, amorphous silicon/thin film, and triple junction cells. Three different mounting methods

[15] United Nations Environment Program, African Rural Energy Enterprise Development, *Commercialization of Solar Dryers for Agricultural Products*. http://www.areed.org/training/technology/solar_dryer/dryer_annex3.pdf. Estimates confirmed by data provided by BL&P on solar radiation for previous pilot systems.

were considered: fixed mounting, single axis tracking, and dual axis tracking. All inverters sourced will be capable of 120V or 240V 50Hz AC output, as required for grid connection on the distribution network in Barbados.

Solar PV De-Rating. PV panels are rated based on their peak output at standard test conditions. Standard test conditions are usually at 25°C cell temperature, wind speed of 1 m/s, and 1,000 Watts per square meter incident radiation. Typical operating conditions will result in cell temperatures of over 50°C. Because of this difference between standard test conditions and typical operating conditions, panels will generally output significantly lower power levels than their rated specifications. To adjust for this, an operating temperature of 50°C was assumed, and the projected energy output was "de-rated" to nominal operating conditions. In addition to temperature, there are a number of external factors that also impact the projected power output for PV systems. An average de-rating factor of 0.87 for the balance-of-system components is based on the assumptions below.

Table 8

Component De-Rating Factors	Range	Assumption	Assumption Bases
PV module nameplate DC rating	0.80-1.05	1.0	
Inverter and Transformer	0.88-0.96	0.95	Based on 2-3kW Massively Parallel Inverter
Mismatch	0.97-0.99	0.99	Massively parallel configuration reduces losses from mismatched panels
Diodes and connections	0.99-0.997	0.995	
DC wiring	0.97-0.99	0.98	This is conservative and depends on wire sizing
AC wiring	0.98-0.993	0.99	
Soiling	0.30-0.995	0.99	Quarterly scheduled cleaning in conjunction with performance triggered cleaning
System availability	0.00-0.995	0.98	Needs to updated to be no higher than BL&P availability
Shading	0.00-1.00	1.0	
Sun-tracking error	0.95-1.00	0.99	
Age	0.70 – 1.00	1.0	
Overall De-Rating Factor		**0.87**	

The definition of the specific factors is not as relevant as the fact that estimates of power output for PV technologies are realistic and achievable in practice. This will ensure that cost-benefit analyses are accurate and representative, which is key to the successful piloting of these technologies. Specific technologies will respond differently to temperature or have other technical characteristics impacting their generation capacity. These factors will be noted and discussed within the description of the proposed pilot.

Inverter Technology. One of the major issues with conventional PV array configurations relates to the relative performance of each cell within a panel, or of each panel within an array. Because components are wired in series, the current flowing through each panel must be the same. This would be analogous to a single lane highway where the speed of the vehicles is limited by the slowest vehicle on the highway. To address this issue, next-generation inverters allow wiring of all panels in a parallel configuration. This allows each panel to output at its maximum power regardless of the output of neighbouring panels within the array. To continue the analogy, this is equivalent to a highway with one lane for every vehicle on the road. As a result, inverter technologies, like that found in the SUNERGYTM system by Sustainable Energy Technologies, can yield a 5-15% increase in annual kWh output. This configuration is known as "Massively Parallel", and is recommended for all pilot PV systems. An ancillary benefit of the massively parallel configuration is low-voltage wiring to each panel. This allows a safe installation thanks to reduced high-voltage connections. Periodic shading that would normally reduce the output of the entire array is no longer an issue in this configuration, allowing for a more uniform appearance on the roof if desired for aesthetics.

RE System Configurations. Four Solar PV system configurations and one micro Wind system configuration are described below.

Configuration A: 2kWp Fixed-mounting, Thin Film Solar PV Systems

Thin-film panels (also know as amorphous silicon panels) will be used for Configuration A. Fifteen of these systems will be installed in private sector buildings with funding from GEF and cost sharing from Program participants.

Amorphous panels are less expensive per unit area than conventional mono-crystalline technologies. However, they also have a lower efficiency. This requires a larger installation area, but allows lower costs per Watt installed (estimated USD7/W, or a turnkey cost of USD14,000 per system).

Thin-film panels are extremely robust and are suitable to the most severe climate conditions. Under extreme heat, these panels do not de-rate their power output as quickly as mono-crystalline types. A new generation of thin-film panels, being more sensitive to low light levels, also assures increased power output in overcast and diffuse sunlight (early and late day), something that mono-crystalline panels cannot provide. Testing in various real-world conditions (dusty, foggy, hazy) indicates an average 10 percent gain in kWh output over equivalent peak rated mono-crystalline systems.

Configuration A systems will be mounted on rooftops using a fixed position array. Fixed mounting is subject to larger wind loading, but involves no moving parts. Fixed arrays are optimally oriented facing due South at an angle equal to the latitude of the location. The solar radiation incident to this orientation was estimated using the National Renewable Energy Laboratories utility called PVWatts. PVWatts was developed by the United States research facility for the purpose of analysing crystalline type PV arrays. The annual output for amorphous silicon panels was therefore adjusted accordingly, as well as for other configurations described below.

Table 9 below shows estimated outputs for Configuration A, based on solar radiation information provided by BL&P, and on simulations using PVWatts adjusted for this configuration. The estimated annual output of 3,564kWh would correspond to an annual value of about USD812 per system.

TABLE 9

A: Thin Film Fixed Mounting (2kWp)

Month	Global Radiation (kWh/m2/day)	AC Energy (kWh)	Energy Value (USD)
1	5.57	305	69
2	6.07	295	67
3	6.03	323	74
4	6.20	318	72
5	5.81	308	70
6	5.45	279	64
7	5.67	300	68
8	5.75	306	70
9	5.44	278	63
10	5.51	294	67
11	5.19	270	61
12	5.34	288	66
Total year	5.67	3,564	812

Configuration B: 3kWp Fixed-mounting, high efficiency cell PV Systems

Ten high-efficiency 3kWp systems will be installed in private sector buildings with GEF funding and cost sharing from Program participants. Next-generation high efficiency panels—such as the Sanyo Hetero Junction with Intrinsic Thin Cell (HIT) series of panels—offer higher laboratory efficiencies of 23 percent. This means that 23 percent of the light shining on the cells is converted to electricity, as opposed to normal cell efficiencies of up to 15 percent. The overall system efficiency will be lower due to downstream losses, such as inverter losses.

The combination of increased rated capacity and higher efficiency will result in a similar roof area to Configuration A, in spite of the 50 percent increase in rated capacity. Cost per Watt installed is slightly greater than Configuration A, at USD8/Watt (turnkey cost per system of USD24,000 for a 3kW capacity).

The estimation from PVWatts was increased by 7 percent due to HIT technology's lower temperature degradation factor. HIT panels have a temperature loss factor of 0.3percent/K compared to the PVWatts assumption of 0.5%/K. This indicates that for HIT panels operating at a temperature of 50°C, or 25°C higher than the standard conditions, the output will drop by 7.5%. Under the same operating temperatures, a conventional crystalline array's output would drop by 12.5%. Table 10 shows estimated output for Configuration B. An annual output of 4,811kWh would correspond to about USD1,096 per year.

TABLE 10

B: High Efficiency Fixed Mounting (3kWp)

Month	Global Radiation (kWh/m2/day)	AC Energy (kWh)	Energy Value (USD)
1	5.57	411	94
2	6.07	398	91
3	6.03	437	99
4	6.20	429	98
5	5.81	416	95
6	5.45	377	86
7	5.67	405	92
8	5.75	413	94
9	5.44	376	86
10	5.51	396	90
11	5.19	364	83
12	5.34	389	89
Total year	5.67	4,811	1,096

Configuration C: 5kWp single axis tracking, low-concentration PV System

One 5kWp system utilizing low concentration, mono-crystalline PV arrays (LCPV) will be installed in a premise to be indicated by GoB. The system will be installed with GEF funding and cost sharing from the beneficiary, likely a research/education institution. The system will be wired with a massively parallel arrangement. Mirrored panels, such as the JX Crystals 3Sun product, use one-third of the silicon material of a typical high efficiency panel. Metal reflectors intensify the sun on the cells, resulting in high output at approximately one-half the price per panel.

A single axis tracker will be employed to further improve the annual energy output. Single axis trackers are used to align one angle of the array such that it is perpendicular to the direct rays of the sun. Single axis trackers most often adjust the panels to follow the sun's East-West position. Sometimes single axis trackers match the elevation angle as the sun rises and falls. Initial calculations using the NREL PVWatts online tool indicate about 21 percent increase in annual output over a fixed orientation array. A single axis tracker, used to keep the mirrors aligned with the sun, will likely require a flat roof arrangement. Table 11 shows estimated output (8,019kWh/year, or about USD1,826).

TABLE 11

C: Low Concentration PV (LCPV) Single Axis tracking (5kWp)

Month	Global Radiation (kWh/m2/day)	AC Energy (kWh)	Energy Value (USD)
1	5.57	686	156
2	6.07	663	151
3	6.03	728	166
4	6.20	715	163
5	5.81	693	158
6	5.45	629	143
7	5.67	676	154
8	5.75	688	157
9	5.44	626	143
10	5.51	661	150
11	5.19	606	138
12	5.34	648	148
Total year	5.67	8,019	1,826

Due to the mirrors supplanting significant cell area, configuration C allows a lower cost per Watt while still using low-cost conventional silicon cell technology (USD6.75/W including a single axis tracker, or USD33,750 turnkey cost per system for a 5kW capacity).

Configuration D: 5kWp dual axis tracking, high-concentration PV System

Two 5kWp dual axis tracking systems will be installed using parallel wiring on a flat roof in the same premise of Configuration C as indicated by GoB. Using very high efficiency high-concentration PV (HCPV) cells—like the multi-junction units from Cyrium Technologies—maximum power output can be achieved with the smallest area footprint. Excellent results are demonstrated by companies like Sol3G with system efficiencies in excess of 35 percent. Due to very high concentration ratios (in excess of 1,000 times magnification), dual axis tracking systems are necessary: the systems' functioning can be compared to moving an eye across the eyepiece of a microscope—unless the eye is perfectly centred over the eyepiece, no image can be seen. The same is true for the optics of the HCPV collector as they track the sun. Only the direct light available from the disc of the sun itself is collected by this type of system. This means that diffuse radiation is not captured by this type of system. Climates with a majority of clear days are best suited to this technology.

One of the significant advantages of a HCPV is a migration path for the cell technology. Conventional mono-crystalline cell technology is a very mature technology, and the efficiencies are approaching the limits of physics. Ultra high efficiency PV cells are currently the focus of significant research efforts. Multi-junction cell technology is advancing with significant jumps. Current HCPV systems are around 38 percent efficient. Projections for the coming five years are for 42 percent efficiencies, and close to 50 percent within the coming 10 years. The cells in HCPV systems can actually be replaced with the newer more efficient cells while leaving the balance of the collector untouched. This means that in year 1 the systems will achieve their rated performance, but in year 5 the system may be upgraded with the new cells at a very small incremental cost. If the systems then achieve 42 percent, this amounts to an overall 11 percent performance boost. This contrasts the degradation of conventional panels, where performance typically drops by 3-5 percent over the same time period. Table 12 shows estimated output for Configuration D (about 8,019kWh/year, or USD1,826).

TABLE 12

D: High-Concentration PV (HCPV) Dual Axis Tracking (5kWp)

Month	Beam Radiation (kWh/m2/day)	AC Energy (kWh)	Energy Value (USD)
1	4.28	686	156
2	4.66	663	151
3	4.63	728	166
4	4.76	715	163
5	4.46	693	158
6	4.18	629	143
7	4.35	676	154
8	4.42	688	157
9	4.18	626	143
10	4.23	661	150
11	3.99	606	138
12	4.10	648	148
Total year	4.35	8,019	1,826

An additional benefit may be applied to locations with a significant hot water or process heating load. If such a candidate location is identified, then hybrid systems PV/thermal concepts would further improve the useful energy garnered from the system. Such hybrid systems use liquid cooling to keep the PV cells operating at a lower temperature. The thermal energy collected may then be used to heat domestic hot water or other processes. This can result in overall effectiveness over 70 percent of solar radiation extracted as useful energy.

Table 13 below summarizes the costs of the five Solar PV configurations considered.

TABLE 13

PV Configuration Costs		**A**	**B**	**C**	**D**
Panel	USD/Wp	3	4	2.5	4.5
Transportation	USD/Wp	1.4	1.4	1.4	1
Tracking/Mounting System	USD/Wp	0.5	0.5	0.75	0.85
Inverter/Transformer	USD/Wp	0.6	0.6	0.6	0.6
Installation	USD/Wp	0.5	0.5	0.5	0.5
Indirect Margins	USD/Wp	1	1	1	1
Total Installed Cost per W	**USD/Wp**	**7**	**8**	**6.75**	**8.45**

Configuration E: Horizontal Axis Micro Wind System (10kW)

One 10kW micro Wind installation using a single horizontal axis wind turbine will be installed on a non-residential premise (Configuration E). Micro wind turbines typically have a significantly lower utilization factor than their utility-scale cousins. BL&P's feasibility study for the Lamberts site indicated an annual capacity factor of 33 percent. A more conservative 25 percent capacity factor assumption for the 10kW turbine was used. The lower capacity factor is due to the lower hub height and the lower performance power curve within the effective wind regime.

c) Procurement of equipment, installation, and maintenance training. Procurement of all systems will be done by the GoB on a competitive basis, before beneficiaries are selected. Terms of Reference will specify the systems' requirements as they are described above. Bidders will be allowed to associate to offer more than one system, or offer one or more systems only. Procurement will cover the purchase of equipment, as well as installation of systems and a short training on systems maintenance to be provided to local technicians. As all systems implemented under the BL&P pilot program, installations of the SEF RE Pilot Program will need to conform to BL&P "Requirements for Grid Interconnection of Renewable Generation Systems", including the need for every installation to be certified by the

Government Electrical Engineering Department of Barbados, and to meet all applicable safety and performance standards.

d) Selection of beneficiaries. The participant for Configurations C and D (Solar PV with tracking systems) will be selected by the GoB. All research/education institutions in Barbados will have equal access to the information gathered from Configurations C and D.

Participants for Configurations A and B (Solar PV with fixed mounting) and Configuration E (Micro Wind), instead, will be selected on a first-come, first-served basis on a national scale. However, further selection arrangements during execution will be made if deemed necessary.

After the exact cost of the systems is established through procurement, a notice will be published and will describe the SEF RE Pilot Program incentive scheme. Applicants will be informed of the exact amount of their required cost sharing, and will be informed that such cost sharing represents only 25 percent of the various systems' turnkey cost. Applicants will also be informed that O&M costs will pertain to them as cost sharing too, and will be told in advance how much such O&M costs are estimated to amount to. For the location selected by the GoB for Configurations C and D, a fraction of the savings achieved may be used to cover O&M costs.

Successful applicants will commit by paying the 25 percent turnkey cost sharing. The sums collected by beneficiaries will be allocated to pay the final installment to providers of equipment at the moment of installation. As all other systems installed under the BL&P pilot program, installations will be governed by a "Renewable Energy Interconnection Agreement" between the customer and BL&P.

e) Cost and beneficiary cost sharing. The SEF RE Pilot Program will provide significant incentives for participants, thus reducing the high upfront cost of RE systems and their long payback period. All program participants, as noted, will be required to provide cost sharing on the turnkey cost of systems, as well as O&M costs. The option of having the SEF RE Pilot Program cover O&M costs for one year was discarded, because it would be unsustainable: participants need to be involved from the very beginning in the systems' maintenance, or they will likely neglect it after it is not provided anymore. Also, O&M costs are minimal for small RE systems, particularly for residential PV installations.

Cost sharing provisions for the SEF RE Pilot Program are summarized as follows:

- Participants will provide cost sharing to cover 25 percent of the systems' turnkey costs, as well as O&M costs throughout the systems' lifetime (the participant for the location indicated by GoB for Configurations C and D may use a fraction of the savings to cover O&M costs). While this cost sharing percentage may seem low, it should be noted that it is for social considerations—the purpose is to ensure that the SEF RE Pilot Program does not only benefit higher-income customers, but also middle-income ones. The Pilot Program does not aim to install sophisticated systems for the benefit of the few, but to demonstrate to the public at large that these technologies are viable, like the country managed to do for Solar Water Heaters
- GEF resources will cover 75 percent of the turnkey cost of systems
- BL&P resources will cover the cost of purchasing bi-directional meters to be installed on all systems (unit cost USD200). BL&P will also provide (as an in-kind contribution) the inspection/supervision of all installations, and complete load and metering information for all other systems installed under its pilot program. BL&P and GoB will also explore options to provide telemetry for systems installed under the SEF RE Program.

Table 14 below summarizes the key cost assumptions for the systems proposed. Thanks to the 75 percent subsidy on turnkey cost, simple payback periods for private sector systems will be reduced to one-fourth of their normal unsubsidized value.

TABLE 14

	A. 2kW PV Thin Film (Fixed mounting)	B. 3kW PV High-efficiency (Fixed mounting)	C. 5kW LCPV (Single Axis Tracking)	D. 5kW HCPV (Dual Axis Tracking)	E. 10kW Wind (Horizontal Axis)
Turnkey total cost (USD)	14,000	24,000	33,750	42,250	52,000
25% cost sharing on turnkey cost, private sector only (USD)	3,500	6,000	8,438	10,563	13,000
Annual O&M costs (USD)	85	191	318	318	6,000
Lifetime total costs, turnkey installation + O&M for 20 yrs (USD)	15,697	27,819	40,115	48,615	172,000
Simple payback for systems, 25 percent of turnkey cost only (years)	4.3 years	5.5 years	4.6 years	5.8 years	2.6 years

Table 15 in the following page shows a detailed and complete budget for the SEF RE Pilot Program.

TABLE 15

System Type (Solar PV or Wind)		Solar PV System	Solar PV System	Solar PV System	Solar PV System		Wind System	
Technology Configuration		A: Thin Film Fixed Mounting (2kWp)	B: High Efficiency Fixed Mounting (3kWp)	C: Low Concentration PV (LCPV) Single Axis tracking (5kWp)	D: High-Concentration PV (HCPV) Dual Axis Tracking (5kWp)	Subtotal (all Solar PV Systems)	E: Horizontal Axis Grid-Connected (10kW)	Grand Total (all Solar PV and Wind Systems)
Peak Capacity, per system	kWp or kW	2	3	5	5		10	
Number of systems	No.	15	10	1	2	**28**	1	**29**
Total installed capacity	kW	30	30	5	10	**75**	10	**85**
Costs								
Turnkey cost per Watt	USD	7.0	8.0	6.8	8.5		NA	
Turnkey cost, per system	USD	14,000	24,000	33,750	42,250		52,000	
Turnkey cost sharing at 25%, per system	USD	3,500	6,000	8,438	10,563		13,000	
Turnkey cost, all GEF-funded systems	USD	210,000	240,000	33,750	84,500	**568,250**	52,000	**620,250**
GEF-funded systems turnkey cost sharing at 25%, all systems	USD	52,500	60,000	8,438	21,125	**142,063**	13,000	**155,063**
Turnkey cost covered by Pilot Program, all GEF-funded systems	USD	157,500	180,000	25,313	63,375	**426,188**	39,000	**465,188**
Annual Operating and Maintenance costs, per system	USD	85	191	318	318		6,000	
Lifetime Operation and Maintenance costs, per system	USD	1,697	3,819	6,365	6,365		120,000	
Lifetime Total Cost (Capital + O&M), per system	USD	15,697	27,819	40,115	48,615		172,000	
Lifetime effectiveness, per system	kWh/USD	4.5	3.5	4.0	3.3		2.5	
Pilot Program cost (turnkey + 0yr O&M), all GEF-funded systems	USD	157,500	180,000	25,313	63,375	**426,188**	39,000	**465,188**
Cost of bidirectional meters, USD200 each (funded by BL&P)	USD	3,000	2,000	200	400	**5,600**	200	**5,800**
Contingency for metering systems	USD							**4,200**
Monitoring and publishing of Pilot Program Results	USD							**11,604**
Program Management	USD							**11,604**
Contingencies	USD							**11,604**
GEF-funded systems turnkey cost sharing at 25%, all systems	USD	52,500	60,000	8,438	21,125	**142,063**	13,000	**155,063**
Total Pilot Program cost, all systems	USD	160,500	182,000	25,513	63,775	**431,788**	39,200	**665,063**

The SEF RE Pilot Program will have an overall budget of USD665,063 broken down as follows:

- USD465,188 from GEF resources to fund 75 percent of the turnkey cost of private sector RE systems
- Up to USD10,000 from BL&P resources to fund bi-directional meters, including some contingency for possible telemetry systems (in addition to in-kind contribution for system installation/supervision, and provision of complete information on the systems' performance)
- USD34,813 from GEF resources for the monitoring and publishing of Pilot Program results, program management, and contingencies for RE systems (in consideration of possible even higher costs due to Barbados' location)
- USD155,063 from participants' cost sharing on turnkey cost sharing (25 percent), in addition to all O&M costs as shown in Table 15 above (O&M costs vary according to different technologies).

f) Pilot project expected output. Grid-connected Solar PV and Wind systems will sell excess electricity generated to BL&P. The interconnection agreement with BL&P will provide the specific terms of net billing and/or net metering. Renewable energy generated by the SEF RE Pilot Program systems will directly displace fossil fuel-generated electricity and therefore achieve (i) energy savings, (ii) carbon emission reductions, calculated with a grid emission factor of 0.88tCO_2/MWh, and (iii) economic savings, under an estimated rate for sale to the BL&P grid of USD23 cents, or 1.8 times an estimated Fuel Clause Adjustment of BBD 25 cents (equivalent to USD 15 cents including 15 percent VAT).

Table 16 summarizes each configurations' generation (energy savings), emissions reductions, and economic savings.

TABLE 16

	A. 2kW PV Thin Film (Fixed mounting)	**B. 3kW PV High-efficiency (Fixed mounting)**	**C. 5kW LCPV (Single Axis Tracking)**	**D. 5kW HCPV (Dual Axis Tracking)**	**E. 10kW Wind (Horizontal Axis)**
Annual generation per system (kWh/year)	3,564	4,811	8,019	8,019	21,900
Annual emissions reductions per system (tCO_2/year)	3.1	4.2	7.0	7.0	19.2
Annual economic savings per system (USD/year)	812	1,096	1,826	1,826	4,987

Table 17 provides a complete and detailed overview of the SEF RE Pilot Program's results. The overall expected outputs of the PV pilot project are the following:

- 29 new RE systems connected to the grid (28 Solar PV, 1 micro Wind)
- 85kW of new grid-connected installed capacity, of which:
  - 75kWp represented by Solar PV systems
  - 10kW represented by one micro Wind systems
- Estimated energy savings of 147.5MWh per year, and 2,950MWh over a 20-year system lifetime
- Estimated emissions reductions from displacement of fossil fuel-based, grid-generated electricity of 129tCO_2 per year, and 2,585tCO_2 over a 20-year lifetime
- Estimated economic savings of USD33,593 per year, and USD671,856 over a 20-year lifetime
- Availability of operational data from all systems installed, as well as from other systems installed under the BL&P pilot program.

TABLE 17

System Type (Solar PV or Wind)		Solar PV System	Solar PV System	Solar PV System	Solar PV System		Wind System	
Technology Configuration		A: Thin Film Fixed Mounting (2kWp)	B: High Efficiency Fixed Mounting (3kWp)	C: Low Concentration PV (LCPV) Single Axis tracking (5kWp)	D: High-Concentration PV (HCPV) Dual Axis Tracking (5kWp)	Subtotal (all Solar PV Systems)	E: Horizontal Axis Grid-Connected (10kW)	Grand Total (all Solar PV and Wind Systems)
Peak Capacity, per system	kWp or kW	2	3	5	5		10	
Number of systems	No.	15	10	1	2	**28**	1	**29**
Total installed capacity	kW	30	30	5	10	**75**	10	**85**
Generation and energy savings								
Average monthly generation, per system	kWh/mo	297	401	668	668		1,825	
Estimated annual generation, per system	kWh/yr	3,564	4,811	8,019	8,019		21,900	
Estimated lifetime generation, per system	kWh	71,280	96,228	160,380	160,380		438,000	
Estimated annual generation, all systems	kWh/yr	53,460	48,114	8,019	16,038	**125,631**	21,900	**147,531**
Estimated lifetime generation, all systems	kWh	1,069,200	962,280	160,380	320,760	**2,512,620**	438,000	**2,950,620**
Emissions Reductions								
Annual tCO2 displaced, per system	tCO2/yr	3.1	4.2	7.0	7.0		19.2	
Lifetime tCO2 displaced, per system	tCO2	62.4	84.3	140.5	140.5		383.7	
Annual tCO2 displaced, all systems	tCO2/yr	46.8	42.1	7.0	14.0	**110.1**	19.2	**129**
Lifetime tCO2 displaced, all systems	tCO2	936.7	843.0	140.5	281.0	**2,201.2**	383.7	**2,585**
Economic savings								
Annual value of energy generated, per system	USD	812	1,096	1,826	1,826		4,987	
Simple payback per system	yrs	4.3	5.5	4.6	5.8		2.6	
Annual value of energy generated, all systems	USD	12,173	10,956	1,826	3,652	**28,606**	4,987	**33,593**
Lifetime value of energy generated, all systems	USD	243,457	219,111	36,519	73,037	**572,124**	99,733	**671,856**

The SEF RE Pilot Program will also allow assessing the following key aspects:

- User willingness to invest in PV or Wind systems. The SEF RE Pilot Program will provide insight on the viability of a potential financial scheme involving consumer cost sharing, based on a mixed market-driven approach (25 percent consumer contribution to system turnkey cost, in addition to complete O&M costs)
- Estimated final cost of implementing PV and Wind systems in Barbados
- Estimated potential for large-scale implementation based on various possible penetration rates for the technology, within maximum levels estimated viable by BL&P
- Adequacy of the proposed Rider for Renewable Energy and need for other financial incentives
- Operational performance of small distributed generators selling electricity to the grid
- Technical capability building needs (particularly for BL&P, and for certified electricians and technicians)
- Institutional capability building needs for MFITE
- Potential issues in system integration in residential households, including any visual aspect
- Potential for enhancing awareness on sustainable energy in the residential sector.

The SEF RE Pilot Program will procure:

- Solar PV systems (four configurations)
- Mini-wind systems (one configuration).

The specifications of such systems are provided in the tables below.

A. Solar PV System: Thin Film PV, Fixed Mounting	**Specification**
Number of systems required	Fifteen (15)
Nominal PV capacity at STC	2 kWp
Type of module	Thin film photovoltaic technology including but not limited to: a-Si, CIGS, CdTe, $CuInSe_2$ etc.
Tracking/mounting system	Fixed mounting system rated for hurricane category 3 wind regime
Inverter Technology	Massively parallel, distributed micro-inverter or equivalent technology e.g.: Sustainable Energy Technologies SUNERGY5 Enphase Microinverters M190
Transformer	An isolation transformer must be supplied in addition to the inverter due to center tapping of single phase power in Barbados.
Space required for mounting	< 15 m2

B. Solar PV System: High Efficiency PV, Fixed Mounting	**Specification**
Number of systems required	Ten (10)
Nominal PV capacity at STC (DC output)	3 kWp
Type of module	Mono-crystalline photovoltaic panel with panel efficiencies > 20% (Hybrid technologies with panel efficiencies > 20% will also be accepted in this category e.g. Sanyo HIT technology)
Tracking/mounting system	Fixed mounting system rated for hurricane category 3 wind regime
Inverter Technology	Massively parallel, distributed micro-inverter or equivalent technology e.g.: Sustainable Energy Technologies SUNERGY5 Enphase Microinverters M190
Transformer	An isolation transformer must be supplied in addition to the inverter due to center tapping of single phase power in Barbados.
Space required for mounting	< 15 m2

C. Solar PV System: Low Concentration PV, Single Axis Tracking	Specification
Number of systems required	One (1)
Nominal PV capacity at STC (DC output)	5 kWp
Type of module	Low concentration (3-20 suns)
Tracking/mounting system	Single axis tracking suitable for hurricane category 3 wind regime
Inverter Technology	Massively parallel, distributed micro-inverter or equivalent technology e.g.: Sustainable Energy Technologies SUNERGY5 Enphase Microinverters M190
Transformer	An isolation transformer must be supplied in addition to the inverter due to center tapping of single phase power in Barbados.
Space required for mounting	< 25 m2

D. Solar PV System: High Concentration PV, Dual Axis Tracking	Specification
Number of systems required	Two (2)
Nominal PV capacity at STC	5 kWp
Type of module	High-concentration photovoltaic (HCPV) panel
Tracking/mounting system	Dual axis tracking system with < .1° error; rated for hurricane category 3 wind regime
Inverter	Massively parallel, distributed micro-inverter or equivalent technology e.g.: Sustainable Energy Technologies SUNERGY5 Enphase Microinverters M190
Transformer	An isolation transformer must be supplied in addition to the inverter due to center tapping of single phase power in Barbados.
Space required for mounting	< 15 m2

E. Mini-wind System: 10kW Horizontal Axis	Specification
Number of systems required	One (1)
Nominal capacity	10 kW
Axis	Horizontal
Inverter	Customizable power curve input to match specific wind turbine power curve.
Transformer	An isolation transformer must be supplied in addition to the inverter due to center tapping of single phase power in Barbados.
Tower	> 30m; rated for hurricane category 3 wind regime

ANNEX I: Total Budget SEF RE/EE Pilot Program[16]

Component		Number of Units	Cost per Unit (USD)	Total cost (USD)	BL&P	Consumer cost sharing	Cost covered by SEF RE/EE Pilot Program (GEF resources)
2.2 Implementation Support for Energy Efficiency (EE)	CFLs	15,000	5	75,000		-	75,000
	Power Monitors	3,000	75	225,000		-	225,000
	Implementation (application, installation, demonstration)			165,000		15,000	150,000
	Awareness campaign design and production of material			50,000			50,000
	Total Cost Component 2.2			**515,000**		**15,000**	**500,000**
3.3 Implementation Support for Renewable Energy (RE)[17]	PV Thin Film Fixed Mounting (2kWp)	15	14,000	210,000		52,500	157,500
	PV High Efficiency Fixed Mounting (3kWp)	10	24,000	240,000		60,000	180,000
	PV Low Concentration Single Axis tracking (5kWp)	1	33,751	33,713		8,400	25,313
	PV High Concentration Dual Axis Tracking (5kWp)	2	42,250	84,475		21,100	63,375
	Wind System Horizontal Access Grid Connected (10kw)	1	52,000	52,000		13,000	39,000
	Bidirectional meters	29	200	5,800	5,800		
	Contingency for metering systems			4,200	4,200		
	Data collection and processing			190,000	190,000		

[16] This table includes only the resources that will contribute directly to finance the SEF RE/EE Pilot program under this GEF operation.
[17] Total cost is based on turnkey costs.

	Monitoring and publishing of Pilot Program Results			11,604			11,604
	Program management			11,604			11,604
	Contingencies			11,604			11,604
	Total Cost Component 3.2			**855,000**	**200,000**	**155,000**	**500,000**
TOTAL Components 2.2 and 3.2				**1,370,000**	**200,000**	**170,000**	**1,000,000**

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BARBADOS

SUPPORT TO THE SUSTAINABLE ENERGY FRAMEWORK FOR BARBADOS (BA-X1001)

Non-Reimbursable Operation Financed with GEF Resources

PLAN OF OPERATIONS

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Annexes

ANNEX I	Logical Framework
ANNEX II	Procurement Plan

Basic socioeconomic data

For basic socioeconomic data, including public debt information, please refer to the following address:
http://www.iadb.org/RES/index.cfm?fuseaction=externallinks.countrydata

Electronic Links	
1.	GEF Full Document approved by CEO
	http://idbdocs.iadb.org/wsdocs/getDocument.aspx?DOCNUM=2268661
2.	GEF CEO Approval
	http://idbdocs.iadb.org/wsdocs/getDocument.aspx?DOCNUM=2268947
3.	Project Identification Form (PIF) approved by CEO
	http://idbdocs.iadb.org/wsdocs/getDocument.aspx?DOCNUM=1938986
4	Environmental Assessment
	http://idbdocs.iadb.org/wsdocs/getDocument.aspx?DOCNUM=2268960

Abbreviations

AP	Action Plan
AWPS	Annual Work Plans
BL&P	Barbados Light & Power
CARILEC	Caribbean Electric Utility Service Corporation
CCB/CBA	IDB Country Office in Barbados
CDM	Clean Development Mechanism
CERS	Carbon Emission Reductions
CFL	Compact Fluorescent Lamps
CHENACT	Caribbean Hotel Energy Efficiency Action Program
DSM	Demand Side Management
EE	Energy Efficiency
ESR	Environmental and Social Review
FCA	Fuel Clause Adjustment
FTC	Fair Trading Commission
GEF	Global Environment Facility
GHG	Greenhouse Gases
GOB	Government of Barbados
IDB	Inter-American Development Bank
INE/ENE	Energy Division of the Infrastructure and Environment Department
LAC	Latin America and Caribbean
M&E	Monitoring and Evaluation
MFIE	Ministry of Finance, Investment, Telecommunications and Energy
O&M	Operation and maintenance
OTEC	Ocean Thermal Energy Conversion
PIF	Project Identification Form
PM	Project Manager
PV	Photovoltaic
RE	Renewable Energy
SECCI	Sustainable Energy Climate Change Initiative
SEFB	Sustainable Energy Framework for Barbados
TC	Technical Cooperation
TOR	Terms of Reference
VPC/GCM	Grants and Cofinancing Management Unit
WE	Waste to Energy

I. Executive Summary

Beneficiary Country:	The Government of Barbados		
Executing agency:	Ministry of Finance, Investment, Telecommunications and Energy (MFIE) – Energy Division		
Target Beneficiaries:	The main beneficiaries are the Government of Barbados (GoB), the MFIE and Barbados Light & Power (BL&P).		
Financing:	IDB/GEF (Global Environment Facility) nonreimbursable:	US$	1,000,000
	Total[1]:	US$	1,000,000
Paralell Financing	IDB (SECCI) (ATN/OC-11473-BA):	US$	1,000,000
	BL&P:	US$	200,000
	IDB loan (BA-L1020):	US$	10,000,000
	Private Sector:	US$	170,000
	Local Counterpart (ATN/OC-11473-BA):	US$	435,000
	Total	US$	11,805,000
Objectives:	The **general objective** of this project is to promote renewable energy (RE) and energy efficiency (EE) in Barbados, thus reducing the country's dependency from imported fossil fuels, enhancing security and stability in energy supply, and improving overall environmental sustainability in the country		
Execution timetable:	Execution: 24 months		
	Disbursement: 24 months		
Special contractual conditions:	None		
Exceptions to Bank Policies and Procedures:	None		
Environmental and social review:	The ESR Secretariat reviewed the Project Identification Form (PIF) on February 13th, 2009. The PIF has been classified as a "C" according to the Safeguard Classification Tool.		
Coordination with Other Donors:	Not applicable		

II. Background and Justification

2.1 Barbados, a small island country of 431 square kilometers and a population of about 272,000, ranks high among Latin America and Caribbean (LAC) countries in terms of

[1] The only financing proposed for approval by means of this Plan of Operations is the Global Environment Facility (GEF) contribution of US$1,000,000.

economic and social indicators: for example, the country ranks 37th in the United Nation's Human Development Index, which corresponds to a high human development.

2.2 However, Barbados' high dependence on fossil fuels risks jeopardizing the sustainability of its economic and social development, as well as the country's competitiveness. The entirety of the country's electricity is fossil-fuel generated, including heavy fuel oil (82 percent, of which 19 percent with steam plants, and 63 percent with low-speed diesel plants), and diesel fuel (18 percent), and according to the 2008 report of the Barbados Light & Power Company (BL&P), the national electricity utility.

2.3 Power generation represents the main use of fuels in the country (50%), followed by transport (33%). Barbados has some oil production, but domestic demand (about 10,000 bbl/d) greatly exceeds local supply (about 1,000 bbl/d). This results in imports in excess of 9,000 bbl/d, which represent a significant expenditure and drain on Barbados' foreign reserves, particularly considering a recent high degree of volatility in international oil markets. Oil prices reached record levels in July 2008 (US$147 per barrel), dropped to US$32 per barrel by February 2009 in association with the global economic downturn, have rebounded to levels around US$70 per barrel as of November 2009, and are expected to increase further if the brighter economic outlook is proven.

2.4 The Government of Barbados (GoB) is committed to promoting sustainable energy practices both on the supply (renewable energy sources) and on the demand side (energy efficiency and conservation) as a means to reduce the country's dependency on fossil fuels, enhance security and stability in energy supply, improve the economy's competitiveness, and achieve greater environmental sustainability.

2.5 To achieve such objectives, Government entities have conducted several efforts to date to promote sustainable energy in Barbados. For example, the GoB set a general target for 10 percent of electricity generation to come from renewable sources by 2012 and 20 percent by 2026, and launched a Public Sector EE program in 2007. The BL&P conducted a Demand Side Management (DSM) study in 1999, and in May 2009 submitted to the Fair Trading Commission (FTC) its first application for a tariff review in 26 years. Residential base tariffs in Barbados were among the lowest in the Caribbean Electric Utility Service Corporation (CARILEC) in 2008. However, a full pass-through of fuel costs through the Fuel Clause Adjustment (FCA) makes final electricity prices in Barbados very high. The BL&P expects the new rate structure to provide more correct signals on the actual price of electricity, encouraging EE and RE investments.

2.6 In spite of such efforts, however, actual implementation of sustainable energy measures is still limited due to various types of barriers that thwart their viability, as presented in more detail below.

2.7 IDBs Technical Assistance in Barbados: As a response to these challenges the GoB is being benefited by a number of technical cooperations (TC) that seek to address the afore mentioned issues.

i. **BA-T10007, ATN/OC-11473-BA. Sustainable Energy Framework for Barbados (SEFB) (US$1,000,000)**: The SEFB is assessing the energy matrix and analyzing the potential of RE, EE and Bioenergy for the island. The SEFB will provide recommendations for a sustainable energy framework and all the technical tools and options available to the GoB to design a road map for the configuration of realistic and achievable sustainable energy objectives. The results withdrawn from the TC activities will help GoB choose the best way to attain the objectives for the sector, by providing baseline information, technological alternatives and technical knowledge that will be transferred to policy makers, as well as by reviewing the GoB's sector objectives and the viability of the current policy targets.

ii. **RG-T1431, ATN/OC-11465-RG. Caribbean Hotel Energy Efficiency Action Program (CHENACT) (US$1,000,000)**: The CHENACT's objective is to encourage the implementation of energy efficiency (EE) practices and micro generation (MG) with renewable energy in the Caribbean hotel sector, hence improving the competitiveness of small, medium and large hotels through improved use of energy. Almost half of the CHENACT funds for this project will be directed to a case study that will take place in Barbados to show the potential benefits of implementing EE measures in the hotel industry. The ultimate goal of the project is to expand EE at the regional level so that economic and environmental benefits can be obtained at a larger scale, within an industry whose role is critical for the region's economy.

2.8 The proposed GEF project is complementary to the TCs BA-T1007 and RG-T1431 (both approved), because GEF resources (BA-X1001) will be used to implement pilot projects in EE and RE. The GEF project will provide to the GoB tools and information required for decision making, in particular through design and implementation of demonstration programs in EE and RE. Additionally, at present two loan operations are being prepared in an effort to scale up the findings of the TCs and the GEF operation: (i) the "Support for Sustainable Energy Framework for Barbados (SEFB) first phase (I)" Policy Based Loan operation (BA-L1022) to support the implementation of an adequate regulatory framework for the development of sustainable energy; and (ii) the "Sustainable Energy Investment Program" (BA-L1020) to create a fund that finances RE and EE projects thus complementing and expanding the efforts being made through this GEF operation.

2.9 The IDBs Country and Sector Strategies: The project is fully coherent with the IDB's 2009- 2013 Barbados Country Strategy (GN-2539), and specifically with the goals set forth for the energy sector. The project provides technical and financial support to expand the use of RE and EE, hence contributing to the reduction of Barbados' dependency on fossil fuels, the promotion of clean energy and a more efficient use of energy. The indicators used to monitor this project are basically the same indicators that will measure part of the progress of the IDB's energy sector strategy in Barbados: (i) expanded demand-driven funding for EE and RE initiatives; and (ii) financial benefits obtained in the form of energy savings and CO2 emissions reductions as a way of obtaining tangible environmental benefits.

III. Program Description

A. Program goal and purpose

3.1 The **general objective** of this project is to promote RE and EE in Barbados, thus reducing the country's dependency from imported fossil fuels, enhancing security and stability in energy supply, and improving overall environmental sustainability in the country.

3.2 The **specific objectives** of this project, related to the respective project Components described below, are to help de GoB: (i) develop a Sustainable Energy Framework for Barbados, and achieve institutional strengthening in the areas of RE and EE (see Component I); (ii) achieve EE in the country's key sectors, and to implement energy efficiency pilot projects (see Component II); (iii) identify and promote the most effective alternatives for RE generation, and to implement renewable energy pilot projects (see Component III); and (iv) ensure wide dissemination of all project activities and results, thus contributing to spreading sustainable energy practices in Barbados (see Component IV).

B. Activities

3.3 **Component I, Preparation of a Sustainable Energy Framework for Barbados (SEFB) and capacity building (not funded by this project)**: this component, funded entirely by BA-T1007 using IDB SECCI resources, will review the existing energy framework, analyze energy related regulatory and policy issues, identify barriers to the promotion of sustainable energy and provide recommendations to overcome these barriers. Based on the energy needs of the country and the possibilities for adopting renewable energies, including energy conservation and energy efficiency, this component will support the preparation of a SEFB. Additionally, this component will provide technical assistance to support the preparation of legislation on EE and RE and institutional strengthening, capacity building and training to the energy government units for RE, EE and BE.

3.4 **Component II, Policy and implementation support for EE** this component will consist of three subcomponents:

i. ***Subcomponent II 1, Technical assistance to promote EE practices in Barbados***. This subcomponent—funded with resources provided by the IDB as well as by the GoB, in addition to in-kind resources by BL&P—will start by assessing the EE potential in Barbados, and analyzing such potential by user group. Energy efficiency audits will be conducted based on a protocol and standardized reporting model defined under this subcomponent. This subcomponent will provide recommendations on: (i) expansion and improvement of any existing EE programs for key sectors (public, residential, and commercial, excluding tourism); and (ii) financial instruments and potential funding resources to support EE project implementation. Finally, this subcomponent will involve an environmental

assessment of the EE measures proposed for the EE Pilot Program under subcomponent II.2. The assessment will cover the disposal of incandescent lights, and the installation of Compact Fluorescent Lights (CFL) containing small amounts of mercury.

ii. ***Subcomponent II.2*** **(funded by GEF):** ***SEF EE Pilot Program: promotion of CFLs and energy conservation in low- and middle-income households in Barbados***. The SEF EE Pilot Program will be funded with resources provided by the GEF, with co-financing from participating households. The SEF EE Pilot Program will target a representative sample of three thousand (3,000) low- and middle-income households in Barbados. For each household involved, the EE Pilot Program will: (i) replace five incandescent light bulbs (estimated average installed capacity 60W) with five 15W compact fluorescent lights (CFLs); and (ii) promote energy conservation by introducing a power monitor for residential meters (a power monitor is a device that is easily installed on a meter, shows real-time electricity consumption and expenditure on a handheld monitor, and induces behavioral changes that can lead to savings of up to 15-20 percent). An awareness campaign in the residential sector will accompany and strengthen the introduction of CFLs and power monitors[2].

3.5 **Component III, Policy and implementation support for RE.** This Component will consist of three subcomponents:

i. ***Subcomponent III.1, Technical assistance to assess alternatives and recommend support for RE in Barbados***. this subcomponent, funded with IDB SECCI, will assess the potential for deployment of RE technologies in Barbados, in particular solar power, wind power, ocean thermal energy conversion (OTEC), and non-electric RE applications (geo-exchange, ocean exchange, solar thermal, thermally driven cooling processes, and industrial process waste heat recovery). Recommendations will be made regarding tariff arrangements, financial requirements and funding for RE projects and power purchase schemes. Finally, this component will provide an environmental assessment of the RE systems, small Solar PV and a wind system, installed under the SEF RE Pilot Program under Subcomponent III.2.

ii. ***Subcomponent III. 2*** **(funded by GEF),** ***SEF RE Pilot Program: promotion of small grid-connected RE generation systems with bidirectional metering***. this subcomponent will promote the installation of twenty-nine (29) small grid-connected RE generation systems (28 Solar PV systems, and 1 micro Wind system). The systems will have a total combined installed capacity of 85kW, and will be implemented under one same Sustainable Energy Framework Pilot Program/Renewable Energy component (SEF RE Pilot Program). The SEF RE Pilot Program will join the efforts of various stakeholders. GEF resources will cover 75 percent of the turnkey cost of RE systems. Cost sharing will be required

[2] Details of the implementation details of this subcomponent can be found in the GEF full document presented as electronic link in this document

from Pilot Program participants, and will include: (i) 25 percent of the RE systems' turnkey cost, and (ii) operation and maintenance (O&M) costs throughout the systems' lifetime. The BL&P will provide bi-directional meters for all systems, supervision and inspection of all installations, and information on the systems' performance[3].

3.6 **Component IV, Dissemination of findings:** this Component, financed entirely with IDB SECCI, will provide for at least two workshops to validate and disseminate the findings of the project's technical assistance and Pilot Program activities. Several thematic meetings will also be held under this Component, to discuss the progress and findings of activities with interested parties, and steer subsequent activities in the most effective direction. Results of this Component will help MFIE, in coordination with BL&P, in planning and implementing a long-term public education and awareness strategy for sustainable energy in Barbados.

IV. Cost and Financing

3.1 The cost of the Project is US$1,000,000[4]; IDB/GEF will finance US$1,000,000 on a non-reimbursable recovery basis. In addition, the project will have paralell financing for US$11,805,000 comprised of: (i) US$1,000,000 from TC ATN/OC-11473-BA [5] and US$435,000 local counterpart for the same TC; (ii) a potential IDB loan, BA-L1020, for approximately US$10,000,000[6]; (iii) US$200,000 from BL&P; and (iv) US$170,000 from end users [7].

Table IV-1 – Summary Cost (in US$)

Component	Financing		
	GEF	Paralell Financing	Total US$
	(US$)	(US$)	(US$)
Component I, Preparation of a SEFB and capacity building	**--**	**170,000**	**170,000**
Component II, Policy and implementation support for EE	**500,000**	**5,455,000**	**5,955,000**
EE Technical Assessment	--	440,000	240,000
EE Pilot Project	500,000	5,015,000	5,615,000

[3] Idem

[4] The only financing proposed for approval by means of this Plan of Operations is the GEF contribution of US$1,000,000. Other contributions from IDB funds have already been approved (ATC/OC-11473-BA).

[5] Sustainable Energy Framework for Barbados (BA-T1007 in execution ATC/OC-11473-BA) - the cost of this TC approved in December 2008 is US$1,435,000, of which the IDB would finance up to US$1,000,000

[6] Sustainable Energy Investment Program US$10,000,000 (BA-L1020 under preparation and possible approval in 2010)

[7] End user co-financing: US$15k for the SEF EE Pilot Program (cost sharing of US$5/household for CFLs and Power Monitors), and US$155k for the SEF RE Pilot Program (cost sharing for Solar PV and Wind systems, 25 percent of system turnkey cost)

Component III, Policy and implementation support for EE	**500,000**	**6,030,000**	**6,530,000**
RE Technical Assessment	--	675,000	440,000
RE Pilot Project	500,000	5,355,000	5,855,000
Component IV - Dissemination of findings	**--**	**25,000**	**25,000**
Project Management, Supervision, Audits and Contingencies	**--**	**125,000**	**125,000**
TOTAL	**1,000,000**	**11,805,000**	**12,805,000**

V. Executing Agency and Mechanism

5.1 Executing Agency: MFIE will be the Executing Agency of this GEF project. The selection and contracting of consulting services financed with GEF resources will be a responsibility of the MFIE.

5.2 Executing mechanism: The Energy Division of the MFIE will execute the proposed project with the support of the project manager (PM) hired by IDB for the execution of BA-T1007.

5.3 The project will be executed under the coordination of the Energy Division of the Infrastructure and Environment Department (INE/ENE) and the IDB Country Office in the Barbados (CCB/CBA). A mid-term evaluation will be carried out at the end of the first year of implementation, funded by IDB.

5.4 The PM based at the MFIE facilities in Barbados, will (among others): (i) prepare Annual Work Plans (AWPs); (ii) prepare Terms of Reference (TOR) and bidding documents; (iii) provide technical monitoring and evaluate performance of the activities, objectives, and targets established in the AWP; (iv) conduct processes related to the procurement of goods and services and contracting of consultants following IDB procurement policies; (v) supervise the provision, use, maintenance, and care of the goods, equipment, and material purchased for the project; (vi) prepare semiannual reports; (vii) maintain an effective record-keeping system for supporting documentation on eligible expenditures; (viii) keep separate records for project operations, including accounting and financial management of the GEF grant proceeds and the co-financing resources; (ix) prepare disbursement requests and supporting documentation; (x) prepare financial and accounting statements for audits; and (xi) establish operational and contracting controls for external audits.

5.5 In order to secure the involvement of relevant stakeholders, periodic coordination meetings among the government, the utility, the regulator and other relevant parties will take place during the execution of the project.

5.6 Execution period and disbursement schedule: The execution period for this GEF project will be 24 months, and the disbursement period 24 months running from the effective date of the relevant agreement. The disbursements are linked to the

procurement plan given that this operation will mainly finance the purchase of goods and works.

5.7 Procurement and program implementation readiness: The contracting of consulting services and the acquisition of goods required for the implementation of this GEF project will be conducted in accordance with the Policies for Procurement of Works and Goods Financed by the IDB (document GN-2349-7) and the Policies for the Selection and Contracting of Consultants Financed by the IDB (document GN-2350-7), (see also Annex II with the Procurement Plan). The MFIE will procure the goods and services following IDB procurement policies.

VI. Monitoring and Evaluation

6.1 Monitoring: The work of the consulting firm(s)/individual consultants and its compliance with the Terms of Reference (TOR) for this project will be monitored by MFIE in close coordination with INE/ENE and CCB/CBA.

6.2 The Monitoring and Evaluation (M&E) of the outputs and outcomes presented in the Logical Framework (Annex I), as well as, the monitoring of the day-to-day activities of the project will be responsibility of the MFIE through its Energy Division. The MFIE through its Energy Division will monitor the progress in achieving outputs and outcomes based on the Logical Framework.

6.3 The MFIE through its Energy Division in collaboration with the IDB will prepare an annual Project Implementation Review (PIR) in accordance with GEF requirements to be submitted to the GEF Secretariat including progress in achieving global environmental benefits, and the sustainability and replicability of project results.

6.4 A mid-term evaluation, carried out by the MFIE through its Energy Division in collaboration with the IDB, will be carried out when 50% of the GEF resources have been disbursed or 12 months after the project contract goes into effect, whichever comes first. This review will determine if the project strategy is performing according to the established objectives, or if adjustments are necessary. The findings and conclusions of the evaluation will be presented and consulted with key stakeholders and beneficiaries. In case adjustments are needed in the project implementation strategy, an Action Plan (AP) will be agreed between the IDB and the MFIE, establishing responsibilities and dates for completion of corrective actions.

6.5 Technical and basic responsibility: Technical and basic responsibility for the project rests with MFIE. CCB/CBA and INE/ENE will also conduct technical supervision and provide additional support. This includes supervision to procurement of studies commissioned with contribution resources, technical supervision of the TOR, the performance of consulting engagements, and review of the technical quality of all studies financed under this project, regardless of the source of financing.

6.6 Progress and final reports: A final report will be prepared by the MFIE through its Energy Division at the end of the project, to be submitted to the IDB and the GEF for

evaluation by external reviewers. These reports will include all technical and non-technical results, as well as a compendium of the main lessons learned. A final, independent evaluation will also be carried out, financed by IDB.

VII. Program Benefits and Risks

A. Benefits and beneficiaries

7.1 This project contributes to the sustainable development process of Barbados, mainly in two areas, energy and environment, with an overall positive effect on the economy. On the energy sector side, it helps diversify the energy matrix introducing an appropriate regulatory and technical framework for the adoption of RE and EE practices that foster the efficient use of energy resources. On the environmental side, the use of RE and EE practices will help reduce GHG emissions. At the same time some revenues could be earned from emission reduction transactions in the international carbon finance markets. The net impact of these measures on the economy will be reflected on the energy bill that is highly dependent on oil and gas international prices and fluctuating supply.

7.2 The beneficiaries are set to be the GoB, MFIE, and BL&P.

B. Risks

7.3 RE and energy conservation in general are strongly correlated to the price of oil. If the price drops so does the interest to adopt EE measures or implement RE technologies. Given the volatility of the oil price, the GoB has decided to go ahead with the proposed project even if the price of oil is low to reduce dependency of foreign oil, diversify the energy matrix and prepare the country for a future scenario with high oil prices.

7.4 Since Barbados is in the tropical cyclone belt, the installed equipment for the SEF Pilot Program purchased with GEF funds could be damaged or destroyed. Minimizing the risk to damage or destroy the equipment will require examining multiple sites and developing contingency measures with the local project team.

7.5 The current electricity regulatory framework does not adequately provide for the sale of renewable energy to the grid. This, however, is expected to change thanks to the current application for a rate review of BL&P to the FTC, as well as to recommendations on regulatory measures under the SEFB Technical Assistance.

7.6 There is a coordination risk since the project has several parties and beneficiaries and the communication channels could intertwine at some point. This risk is mitigated with the presence of a PM who will centralize the communication among agencies, all the procurement processes and the influx of information, both from the consulting firms and the government agencies. The fiduciary risk, which resides on the capability of the MFIE to hire the consulting services under IDB’s policies, is also mitigated with the presence of the PM.

VIII. Environmental and Social Review

8.1 The proposed project will directly and indirectly contribute to the achievement of local and global environment benefits, by reducing energy consumption which translates directly into carbon emission reductions as Barbados' energy matrix is mainly fossil fuel-based. The allocation of GEF Financing of US$ 1 million will result in an estimated direct GHG emissions reduction of 23,904 tCO2e, as well as an indirect GHG (bottom up approach) emissions reduction of 239,042 tCO2e (see details in table VIII-I) . The abatement cost of the total carbon emission reduced is US$ 3.80/tCO2e.

Table VIII-I: Expected Global Environmental Benefits to be delivered by the project[8]

Technology	Direct	Indirect (bottom-up)	Indirect (top-down)
Subcomponent II2			
CFLs	4,731	47,306	74,463
Power Monitors	16,589	165,887	46,963
Sub-total EE technologies	21,319	213,194	121,426
Subcomponent III2			
Solar PV systems	2,201	22,012	52,976
Wind systems	384	3,837	33,950
Sub-total RE technologies	2,585	25,849	86,926
Grand total	**23,904**	**239,042**	**208,352**

Refer to the electronic links to see the detail for the calculation of the GHG benefits for each pilot project.

8.2 The direct emissions reductions consider the avoided CO2 emissions from thermoelectric generation (representing approximately 100% of the energy matrix, based on diesel oil) as a consequence of energy savings from reduction in electricity consumption.

8.3 The cost of the proposed interventions under this project is considered cost effective for achieving the expected energy, institutional, environmental and social benefits. The way in which this project has been designed is considered to be the most efficient alternative to achieve positive results in the short and medium term, as this project paves the way for more EE and RE project that would contribute to reduce CO2 emissions and diversify the Barbados´ energy matrix.

8.4 The project will contribute to generate Global Environmental Benefits in the form of carbon emission reductions. The mitigation of GHG emissions derives from the implementation of the SEF Pilot Program in its EE and RE components: (i) the SEF EE Pilot Program will reduce GHG emissions by implementing two types of EE technologies—CFLs and power monitors—that will reduce the demand of energy generated by grid-connected thermal plants; and (ii) the SEF RE Pilot Program will reduce GHG emissions by implementing two types of RE technologies—solar PV

[8]Each estimate was done over the corresponding lifetime for each project.

and wind systems—that will displace energy generated by grid-connected thermal plants.

8.5 Based on the IDBs Environmental and Safeguard Compliance Policy (OP-703), and taking into account the objectives, impacts and risks of this TC, this operation is a Category "C". The ESR Secretariat reviewed the PIF on February 13th, 2009 and the proposed environmental and social strategy was approved.

IX. Certification

9.1 The Grants and Cofinancing Management Unit (VPC/GCM) certifies that the amount of US$1,000,000 from the Global Environmental Facility – GEF (FMM) are available for the financing of the proposed program budget of the current Plan of Operations.

_____ Date: _____
Marguerite S. Berger
Chief VPC/GCM

X. Approval

Vo.Bo.: _____ Date: _____
Leandro Alves
Chief INE/ENE

Approved: _____ Date: _____
José Agustín Aguerre
Manager a.i. INE/INE