



Ref #: GEFSEC-N-2000-00080

PROJECT MANAGEMENT FOR GEFSEC

Incoming Correspondence Log

Official Use Only

Due Date:

04/11/2000

FOR ACTION: Frank Rittner

STATUS: Open

Project Name: Cogeneration of Electricity and Steam Using Sugar Cane Bagasse and Trash

VPU/Dept/Div: GEF	Date Logged: 03/08/2000 12:20:36 PM
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CORRESPONDENCE DESCRIPTION:

From:	Rafael Asenjo
Organization:	UNDP
Reference #:	
To:	Mr. Keneth King
Dated:	03/06/2000
Type:	OP6
Subject:	PDF C: Cuba: Cogeneration of Electricity and Steam Using Sugar Cane Bagasse and Trash

ACTION INSTRUCTIONS:

Please review and/or technical comments for bilateral meeting

Note: Please send comments to Frank prior to bilateral on April 11.

INFORMATION COPIES:

Alan Miller, Johan Wide, Michael Santio, Maria C. J. Cruz/Person/World Bank, Amanda J. Days

GLOBAL ENVIRONMENT FACILITY
PROPOSAL FOR PROJECT DEVELOPMENT FUNDS (PDF)
BLOCK C GRANT

Country:	Cuba
Project:	Co-generation of Electricity and Steam using Sugar Cane Bagasse and Trash
Requesting Agency:	UNDP
Amount of Funding Requested:	
GEF	US\$ 680,520
UNDP	US\$ 30,000
Total PDF C Costs:	US\$ 1,480,520
Project Cost:	US\$ 85.75 million
Financing Plan:	Private Sector US\$ 62.65 million Government US\$ 10.58 million GEF grant US\$ 12.52 million
Focal Area:	Climate Change
Recipient:	The Republic of Cuba
Convention Ratification:	Cuba ratified the Climate Change Convention in January 1994

BACKGROUND AND CONTEXT

1. Since 1989, Cuba has been in a critical period of national development caused by the sudden collapse of commercial and financial relations with the former COMECON economies along with the reinforcement of the economic, financial and trade embargo that the country is facing. In addition, the Cuban industry and energy sectors are built around imported fuel. Due to the abrupt fall of its Gross Domestic Product and the lack of hard currency, fuel imports have declined from 13 million tons in 1989 to slightly more than 6 million in 1998 (with an additional national production of nearly 2 million tons). This situation has provoked an intense energy deficit which has had a strong negative impact on the country's economic structure and population. The importance of fuel-oil for Cuba can be appreciated in Table I which presents 1998 estimates of the country's installed power capacity and generation.

Table I. Installed Capacity and Generation in National Electric System (NES) 1998

Source	Installed capacity, MW	Generation, MWh	Percentage of Total Generation
Fuel-Oil	3,124	12,671,564	92.5
Hydroelectric	60	86,364	0.6
Natural Gas + Independent producers	170	90,338	0.7
Biomass ¹	684	850,431	6.2
TOTAL	4,038	13,698,697	100.0%

2. Cuba's economy has traditionally relied on the production of approximately 7 million tons of sugar annually, most of which is destined for export. The production of this quantity of sugar requires the processing of around 70 million tons of sugarcane per year, resulting in the by-production of more than 17 million tons of bagasse and 4.2 million tons of sugarcane leaves (trash). The Cuban sugar industry thus holds an important potential for biomass power.²
3. This biomass energy potential is currently utilised only on-site in the sugar mills due to the existence of a number of barriers. Among these barriers are inexperience with power purchase agreements and independent electricity generation; limited experience of project finance utilizing joint venture companies in the sugar and electric power sectors; limited experience of internationally binding, production contracts for these projects; limited experience of harvesting and utilizing sugar-cane trash as a fuel; technological risks to investment associated with deploying this new technology in Cuba; a lack of experience operating sugar-cane cogeneration facilities; and the high capital costs associated with the adoption of renewable energy investments.

¹ This refers to co-generation in sugar mills for their own energy use. Few sugar mills are synchronized to the grid and able to sell electricity when they have surplus. Many sugar mills have to purchase additional power from the grid to satisfy their energy needs.

² At present, the sugar production is considerably lower (35 million tons of sugarcane was harvested in 1998) but it is expected that about 70 million tons of sugarcane will be harvested annually within 5 to 10 years. The recovering of the sugarcane cultivation is related to the sugar industry recovery and diversification programme.

4. Given the general shortage of energy in the country and the fact that about 75% of Cuba's total fuel-oil consumed is imported, in addition to the positive implications of using renewable energy for the local and global environment, exploring this alternative source of energy has been given high priority. In 1993, the National Parliament approved the National Energy Sources Development Programme where the efficient use of the sugarcane biomass for the production of energy is given one of the top priorities in terms of development efforts.
5. The Cuban Government is promoting foreign investment in those areas in which capital and technological innovation are most needed. The electric power generation sector is among the targeted areas. Various forms of economic association, such as joint ventures, can be employed for this purpose. The legal conditions for foreign investment are established in the Law 77 on Foreign Investment published in September 1995. Furthermore, Article 23 of the Constitutional Reform Law approved in July 1992 states that the Government will respect the property of the joint ventures and other economic associations set up under the law.
6. In this context, a PDF B was approved by GEF in 1995 in order to undertake feasibility studies relating to the generation of electric power for export to the national grid using sugarcane bagasse and trash. This preliminary phase was conducted with a view towards presenting a full-sized project for GEF.
7. Through this process, the following were identified as major barriers to increased biomass use for power generation in Cuba:
 - Limited experience with PPA's and independent power generation using biomass;
 - Lack of experience with project finance investments and joint venture operations between the sugar and electric power sectors;
 - Limited experience in handling sugarcane trash for use in energy facilities;
 - Lack of experience operating high-pressure, efficient bagasse cogeneration facilities;
 - Difficult access to finance for a technology that is new to Cuba due to the unusually high perceived risks; and
 - High implementation and capital costs of these relatively new biomass-based renewable energy technologies.
8. To overcome these barriers, the project will establish a commercial demonstration of state-of-the-art biomass co-generation technology through development of a joint-venture company. As part of the PDF B, a feasibility study to implement a steam and power co-generation plant using sugarcane bagasse and trash as fuel was carried out. The designed plant will use high-pressure condensing-extraction steam turbine (CEST) technology to provide steam for both sugar milling and power generation.
9. The proposed investment project is designed to remove barriers to the sustainable replication of co-generation in Cuba based upon sugarcane biomass. The GEF will contribute towards the incremental costs of the project in order both to encourage the adoption of this technology and to establish a replicable framework for future projects in this sector.

Summary of Project Objectives, Description and Financing

10. The global objective of the proposed project is to reduce Cuba's energy-related CO₂ emissions by substituting biomass (sugarcane bagasse and trash) for fuel oil in power generation. This will be achieved by project activities designed to remove barriers to the nation-wide deployment of steam and power co-generation using sugarcane bagasse and trash as fuel. The project will develop the legal and financial instruments necessary to demonstrate the technical, economic, and financial feasibility of establishing joint enterprises to co-generate steam and electricity by using biomass-fired CEST technology. It will thereby remove the barriers to the large-scale replication of this technology in Cuba.
11. The development objective of the project is to increase the efficiency of biomass use for power generation, thus reducing Cuba's dependency on imported fuel oil. The project also aims at supporting the aforementioned sugar industry diversification programme and improving sugar industry's economic performance by providing it with reliable and inexpensive source of steam and electricity, reducing investment requirements and decreasing power-related operation and maintenance costs.
12. The objective of the PDF C phase is to eliminate the barrier associated with the high start-up transaction costs by preparing the necessary documents and agreements for the joint venture to be established and by assisting in the international bidding process. The framework developed for this project will then be available for application in future replications, thereby reducing the start-up costs for future installations.

Eligibility

13. Cuba ratified the Framework Convention on Climate Change in January 1994.

National Level Support

14. The government of Cuba, including key actors MINAZ, CITMA and MINBAS, is highly committed to the project. Exploring alternative sources of energy has been given high priority and in 1993, the National Parliament approved the National Energy Sources Development programme where the efficient use of sugar cane biomass for the production of energy is given one of the top priorities in terms of development efforts. Further, in 1999 the Ministry of Sugar approved a specific plan for the development of co-generation of electricity from sugar cane biomass. The development programme identified 42 of the country's 156 sugar mills as potential sites for installation of co-generation systems for them to become net exporters of electricity to the national grid. 34 of these are considered suitable for high-pressure condensing-extraction steam turbine (CEST) technology.

Project Rationale and Justification for GEF Funding

15. The project is fully consistent with GEF Operational Programme no. 6 (Promotion of Renewable Energy by Removing Barriers and Reducing Implementation Costs).
16. The feasibility study conducted under the PDF B identified the necessity of financial and legal advice for the negotiation of the joint-venture. The estimated cost of these activities is part of the incremental cost of the proposed investment project (full project).
17. Although sugarcane bagasse (and trash to some extent) is already widely used to generate electricity and steam in the Cuban sugar industry, this occurs with very low efficiency using low-pressure boilers and turbines. For instance, the *Hector Molina* sugar mill actually generates steam in eight boilers (pressures between 11 and 19 bar) and power using five turbo generators with total capacity of 6.5 MW. Even so, it still purchases between 1.0 – 1.5 MW of power from the national grid during the harvest season.
18. Introducing high-pressure condensing-extraction steam turbine (CEST) technology using sugarcane biomass would significantly improve the energy efficiency of the sugar industry. Establishing CEST power plants using trash and bagasse to generate steam and power would make it possible to satisfy the entire power needs of the sugar mills during the harvest season and also to sell a notable amount of electricity to the national grid. This would replace the use of fossil fuels (mainly fuel-oil) in power generation leading to significant global benefits by reducing greenhouse gas emissions.
19. There are presently 156 sugar mills in Cuba. In the first phase, 34 of these are considered suitable for high pressure CEST technology. These mills have a combined capacity to process about 230,000 tons of sugarcane per day. If the biomass derived from this cane were used for steam and power cogeneration, some 3,000 GWh of biomass-based power could be supplied to the grid, apart from satisfying the steam and power needs of the sugar mills. This amount of electricity is roughly equivalent to 1 GW of renewable electricity generation capacity during the *zafra* season. These projects have the potential to reduce the energy sector's carbon emissions by some 17 MtC over a 25-year lifetime of the power plants. In reality, the potential is much higher: energy efficiency improvements in other sugar mills and the collecting and storage of surplus bagasse and trash would make it possible to use biomass in the CEST plants during the non-harvest season. Once the identified barriers are removed and the demonstration plant is shown to operate as a successful commercial entity, Cuba can begin to tap this vast renewable energy potential.
20. For the rest of the world, the sugar industry processes over 1,200 million tons of sugarcane each year resulting in some 250 million tons of bagasse, roughly equivalent in thermal terms to 78 million tons of coal or 48 million tons of fuel-oil. While these technologies are slowly being adopted in the sugar producing world, they are by no

means universally deployed. If all of this bagasse were used to replace fuel oil, it would reduce global carbon emissions by almost 40 million tons annually. The proposed project has significant replication potential outside of Cuba as well.

21. In addition to bringing about global benefits, the project is consistent with Cuba's national development priorities. It will increase the use of national renewable fuels and reduce fuel imports. Likewise, it will have a positive impact on the local environment. The Government of Cuba is currently engaged in a programme to diversify the sugar industry. The proposed project will increase sugarcane-based power production and is hence in line with the objectives of the MINAZ energy development programme.

Description of PDF C Activities to be Undertaken

22. The technical and economic viability of the project was assessed using the GEF PDF-B funding. The feasibility study prepared by Cdf Ingenierie and SIDEC, both from France, is available upon request. The PDF-C activities will be based on the results of the feasibility study and include:

- (i) General Assessment. In the feasibility study, a preliminary financial framework was set up. It is based on mixed credit and equity financing, the equity assumed to reach 30% of the investment. The credit is envisaged to consist of a combination of export credits and near-commercial loans. The biggest expenditure item of the investment is the engineering, procurement and construction contract (EPC). The following aspects will be completed during the PDF C:
- General approach to project procurement, evaluation criteria for the bidding, legal and regulatory advice and support;
 - Modalities for providing GEF support; and
 - Financial structuring study and risk analysis covering completion, commercial, feedstock supply, off-take and *force majeure* risks. This will also involve the evaluation of the strategic use of contingent financing tools to mitigate against these risks and leverage better financial terms for the project.
- (ii) Preparation of the documents needed for the establishment of the Project Company. According to the Cuban Law No. 77, the joint venture between the foreign investor and the Cuban investor will need an authorisation and a concession from the Executive Committee of the Council of Ministers. The following documents will be prepared in close co-operation with the relevant Cuban authorities and the investors::
- Draft Joint Venture Contract (Convenio de Asociación Económica) to be signed between the shareholders;
 - Draft Statutes of the Joint Venture; and
 - The necessary documentation demonstrating the technical and economical viability of the project.

- (iii) Preparation of the Draft Agreements the Project Company needs to sign with different parties:
- Power Purchase Agreement (PPA) between the Project Company and the offtaker (Unión Nacional Eléctrica, UNE) denominated in a freely convertible currency (eg., dollars or euros) including i.a.:
 - Start-up and related penalties;
 - Prudent utility practises and network operation;
 - Annual electricity offtake on a take-or-pay basis;
 - Power available, allowed outages and respective penalties;
 - Purchase price and price escalation; and
 - Clauses for force majeure, change in law and cancellation.
 - Fuel Oil Supply Agreement between the Project Company and UNE denominated in a freely convertible currency (e.g., dollars or euros), including the following:
 - Price and price escalation;
 - Technical specifications of the fuel oil to be supplied; and
 - Guaranteed quantity, quality and related penalties.
 - Biomass (sugarcane trash) Supply Agreement between the Project Company and the Ministry of Sugar (MINAZ) denominated in a freely convertible currency (eg., dollars or euros) including i.a.:
 - Price and price escalation; and
 - Guaranteed quantity, quality and related penalties
 - Product Exchange Agreement between the Project Company and the Héctor Molina Sugar Mill denominated in a freely convertible currency (eg., dollars or euros) considering:
 - Bagasse and water supply to the Project Company;
 - Electricity and steam supply to the Sugar Mill;
 - Boiler ash disposal;
 - Prices and price escalation for all of the above-mentioned exchanges; and
 - Incentives and penalty clauses
- (iv) Environmental Impact Assessment:
- Incremental activities: environment studies for major technological variants, comparative studies between baseline and the project option (covering e.g. CO₂, SO₂, NO_x, particulate emissions, cooling water requirements and impact on ecosystems);
 - Recommendation of mitigating measures to reduce any adverse impacts; and
 - Environmental Monitoring and Evaluation Program, including project's global environmental impacts.
- (v) Preparation of the bidding documents:
- Pre-qualification criteria based on financial, institutional and operational merits; and

- Request for Proposals (RFP) including instructions to bidders on technical requirements and financial conditions. Determination of specific evaluation criteria.
- (vi) Preparation of the UNDP project document:
- A project document for the implementation of the full project will be prepared by a UNDP/GEF consultant.

Items to be Financed by GEF PDF C

23. The proposed grant will be used to pay for:
- Contracts of national and international consultants to conduct the studies and prepare the documents mentioned above; and
 - The preparation of the full UNDP/GEF project document by a GEF consultant.

Cost Table: Project Preparation Financing Requirements

24. The proposed project cost and financing is detailed in the following table:

ITEM	GEF Block C	UNDP	Gov. of Cuba (In kind)	Investors	TOTAL
General Assessment	90,000	-	10,000	90,000	190,000
Preparation of the Documents	50,000	-	10,000	50,000	110,000
Preparation of the Agreements	300,000	-	30,000	300,000	630,000
Environmental Impact Assessment	-	30,000	10,000	100,000	140,000
Bidding Documents	150,000	-	10,000	150,000	310,000
Project Document	10,000	-	10,000	-	20,000
Contingencies	42,000	-	-	-	42,000
Subtotal	642,000	30,000	80,000	690,000	1,442,000
UN Agency Fees (6%)	38,520	-	-	-	38,520
TOTAL	680,520	30,000	80,000	690,000	1,480,520

Outputs of the PDF C

25. The PDF C outputs will be:
- Draft documents for establishing the joint venture;
 - Draft agreements for power purchase, fuel supply and product exchange;
 - Environmental Impact Assessment;
 - Necessary documents for the competitive international bidding for the EPC contract; and
 - UNDP/GEF Project Document for the project.