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**PERFORMANCE AUDIT REPORT**

**MAURITIUS**

**SUGAR ENERGY DEVELOPMENT PROJECT  
(Loan 3458-MAS and GEF 28603)**

**June 23, 2000**

*Operations Evaluation Department  
Sector and Thematic Evaluations Group*

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## Currency Equivalents (annual averages)

*Currency Unit = Mauritian Rupee (MR)*

1991	US\$1.00	MR15.65
1992	US\$1.00	MR15.65
1993	US\$1.00	MR17.65
1994	US\$1.00	MR17.65
1995	US\$1.00	MR17.39
1996	US\$1.00	MR17.95

## Abbreviations and Acronyms

BEDP	Bagasse Energy Development Program
CEB	Central Electricity Board
DCCP	Dry Cane Cleaning Plant
EIA	Environmental Impact Assessment
EIB	European Investment Bank
EMC	Environmental Monitoring Cell
ESMAP	Energy Sector Management Assistance Program
GEF	Global Environment Facility
GHG	Greenhouse gases
GOM	Government of Mauritius
ICR	Implementation Completion Report
IPP	Independent power producers
MOE	Ministry of Environment
MSA	Mauritius Sugar Authority
MSRI	Mauritian Sugar Research Institute
NEAP	National Environmental Action Plan
OED	Operations Evaluation Department
PAR	Performance Audit Report
SAR	Staff Appraisal Report
UNDP	United Nations Development Program
UOM	University of Mauritius
UStA	Union St. Aubin

## Fiscal Year

Government: July 1 - June 30

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June 23, 2000

## MEMORANDUM TO THE EXECUTIVE DIRECTORS AND THE PRESIDENT

**SUBJECT: Performance Audit Report on Mauritius Sugar Energy Development Project (Loan 3458—MAS and GEF 28603)**

Attached is the Performance Audit Report (PAR) for the Mauritius Sugar Energy Development Project (Loan 3458-MAS) and the associated Sugar Bio-Energy Project (Trust Fund 28603), funded by the World Bank and the Global Environment Facility (GEF), respectively, and approved on December 28, 1991. The GEF grant of US\$3.3 million was fully disbursed. The Bank loan was for US\$15 million, of which US\$9 million was canceled.

The main objective of the Sugar Energy Development Project was to help the Government of Mauritius and the private sector implement the initial time slice of the 1992-95 Bagasse Energy Development Program (BEDP). The objectives of the associated Sugar Bio-Energy GEF Project were to develop and adapt technologies for utilizing sugar cane residues for energy purposes, and to strengthen BEDP management by fostering public-private collaboration.

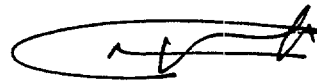
The *outcome* of the Bank/GEF project is *satisfactory*: the key strategy of the BEDP—that is, to set up the investment plan, the institutional framework, and the policies to encourage private investment in bagasse/coal power stations—was achieved under the project and continues to be pursued. Bagasse cogeneration now accounts for about 60% of firm capacity with all sugar factories operating bagasse units. The *institutional development* aspect of the project is *substantial*: the building-up of strong capacities for promoting private sector development (PSD) in the power sector was clearly positive. The technical knowledge base was strong, and there were regular multi-stakeholder consultations. The public-private partnerships showed a general willingness to experiment, tolerate mistakes, learn and improve. The project's *sustainability* is *likely*: the institutional and regulatory framework for PSD in power generation has been established, bagasse/coal generation has been mainstreamed as a possible alternative in the power expansion least-cost planning process, and private sugar plants are using bagasse for part of their power needs. The *Bank's performance* is *unsatisfactory* overall, based on the evident rush to lend and seriously deficient quality at entry, as well as weak supervision. It is important to note, however, that the project stakeholders attach high value to the Bank's advisory and catalytic role in forging the key public-private partnerships that helped launch the BEDP. The *borrower's performance* was *satisfactory* because the Mauritius Sugar Authority and other government agencies showed strong commitment and took important steps to set up the necessary institutional framework for the project.

The key lessons from the Bank/GEF project are:

- Government commitment is particularly critical where a complex and innovative project requires early actions on institutional development.
- The Bank can be highly valuable as a catalyst and honest broker in the early stages of promoting private involvement, when it is important to have effective consultation mechanisms that foster cooperation and trust among public and private stakeholders

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- Research, scientific data, reliable technical information, and monitoring and evaluation systems are critical to establishing the financial and economic viability of experimental projects, and to replicating positive results.
- The pressure to lend and the consequent short-cutting of preparation and appraisal can result, as they often do, in implementation failure. In this complex and innovative project, the technical assistance activities for institutional development and the physical components were pursued simultaneously instead of sequentially. This resulted in the bulk of the loan being cancelled due to lack of ownership and readiness for the investment portion.

A handwritten signature in black ink, consisting of several loops and a final flourish, positioned to the right of the main text.

Attachment

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This report was prepared by Mr. Fernando Manibog (Task Manager) and Mr. Kevin Warr (Consultant). Mr. Manibog visited Mauritius in January 2000. Mr. William Hurlbut edited the report.



## Principal Ratings

	<u>ICR</u>	<u>PAR</u>
	<u>Sugar Energy Development Project— Loan 3458</u>	<u>Sugar Energy Development Project—Loan 3458 and GEF 28603</u>
Outcome	Marginally Satisfactory	Satisfactory
Sustainability	Likely	Likely
Institutional Development Impact	Partial	Substantial
Borrower Performance	Marginally Satisfactory	Satisfactory
Bank Performance	Marginally Satisfactory	Unsatisfactory

## Key Staff Responsible

<u>Task Manager</u>	<u>Sector Division Chief</u>	<u>Country Director</u>	<u>Vice President</u>
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## **Preface**

This is the Performance Audit Report (PAR) for the Mauritius Sugar Energy Development Project (Loan 3458-MAS) and the associated Mauritius Sugar Bio-Energy Project (Trust Fund 28603), funded by the World Bank and the Global Environment Facility (GEF), respectively. The Bank loan and the GEF grant were approved on December 28, 1991. The GEF grant amounted to US\$3.3 million, all of which was disbursed. The Bank loan was for US\$15 million, of which US\$9 million was canceled.

This PAR is based on the Implementation Completion Report (ICR) for the Bank loan prepared by the Africa Region, GEF and Bank project documents, the Staff Appraisal Report (SAR), and interviews with Bank staff, as well as officials from the Government of Mauritius, the Mauritian Sugar Authority, and the Central Electricity Board. An OED mission visited Mauritius in January 2000 to discuss with the foregoing interlocutors the effectiveness of the whole operation. The ICR was a desk study that was prepared in Washington before completion of the GEF activities; it mainly covered the non-GEF components and did not benefit from field evidence either just before or after completion. Consequently, this PAR documents the successes of the GEF grant, which included technical studies, physical trials, and institutional development. These GEF components were key enabling activities that should have been carried out before the Bank provided funding for investment in a bagasse/coal-fired power plant. However, the GEF technical assistance activities and the loan-financed physical plant were pursued simultaneously instead of sequentially, with the result that the bulk of the loan had to be cancelled due to lack of ownership and readiness for the investment portion.

The cooperation of the Government of Mauritius, the Mauritius Sugar Authority, and the Central Electricity Board is greatly appreciated.

Following standard OED procedures, the draft of this PAR was sent to the borrower for comments before finalization. Comments received from the Borrower are included as Annex B.



## 1. Background

1. Since sugar was introduced in Mauritius in the seventeenth century, it has been the mainstay of the economy. The sugar industry is the economy's largest earner of net foreign exchange and, therefore, is essential to continued growth and social stability in Mauritius. Growth within the sugar sector must come increasingly from enhanced use of byproducts, such as the fibrous material separated during cane crushing, called bagasse. Bagasse can be processed into briquettes and used in the generation of electricity. The use of bagasse and other cane residues in electricity generation offers the sugar industry the opportunity to increase its value added and diversify revenue sources, reduce the country's dependence on imported fossil fuels, meet a rapidly expanding demand for electricity at low cost, and reduce overall greenhouse gas (GHG) emissions from the power sector by displacing fossil fuels.

2. In 1988, Mauritius adopted a National Environmental Action Plan (NEAP), and the Department of Environment was established within the Ministry of Environment and Quality of Life to support implementation of the plan. The Bank assisted the government in developing the plan's institutional and legislative framework. Implementation of the plan was supported under the Bank-financed Environmental Monitoring and Development Project (Loan 3277-MAS), which closed in June 1998, and under the UNDP-financed Institutions for Environmental Management (UNDP MAR 189/009).

3. In August 1991, the government adopted the Bagasse Energy Development Program (BEDP). The BEDP had three goals. First, it required investments in power production and sugar mill improvements of US\$80 million over an eight-year period. These investments were required to effectively capture available bagasse for the production of electricity (coal would be used as a supplementary, off-season fuel). The investments were coordinated within an overall least-cost energy capacity expansion plan.

4. Second, BEDP sought to establish a comprehensive institutional framework. This framework would define the principles and modalities for energy contracting by the public utility, the Central Electricity Board (CEB), from independent power suppliers. The policy stated that power was to be purchased by the public utility at the economically efficient energy price, based on the cost CEB would have incurred in producing power from its marginal unit (a 24 Megawatt diesel plant) were it not to have access to electricity produced at independent bagasse/coal-fired power plants.

5. Third, BEDP established priorities for technology development to promote efficient utilization of sugar biomass for energy production, emphasizing cane tops, leaves, and trash. The program was implemented through cooperation among industry, government, and local research organizations. The outcome of the program of trials and experiments was expected to guide industry investments in expanding biomass energy development into the next century.

6. The Government of Mauritius (GOM) requested GEF and IBRD assistance in launching the BEDP. In response, the Bank-financed Sugar Energy Development Project sought to: (a) expand bagasse-generated electricity production over a five-year period from 70 to 120 gigawatt hours by constructing a bagasse/coal-fired power plant at the Union St. Aubin Sugar Factory in southern Mauritius and improving the efficiency of sugar mills in generation and use of steam; (b) promote efficient use of biomass fuels from the sugar industry for energy production through technology development and training; and (c) strengthen the management and coordination of BEDP by fostering effective collaboration between the public sector and the sugar industry. All three objectives served the goal of expanding the use of low GHG-emitting sugar cane residues

for production of electricity in Mauritius, displacing high GHG-emitting fossil fuels. As such, they were directly related to the GEF's scientific objective of reducing global warming. GEF's support for achieving this climate change mitigation objective was provided under the Sugar Bio-Energy Technology Project.

## **2. Project Objectives, Components, and Costs**

### **Project Objectives**

7. The broad objective of the Sugar Energy Development Project was to help GOM and the private sector implement the initial time slice of the BEDP (1992–95). This first slice focused on establishing a power plant at the Union St. Aubin Sugar Mill (UStA), operating on bagasse and coal, as part of the least-cost program for electric power development in Mauritius. In support of this broad objective, the project had three complementary objectives: (a) expand electricity generation from 70 GWh to 120 GWh by using bagasse; (b) promote efficient use of biomass fuels from the sugar industry in order to generate surplus bagasse for energy production; and (c) strengthen the management and coordination of BEDP by providing training to the Mauritius Sugar Authority (MSA) and the Central Electricity Board (CEB) and establishing an environmental monitoring system for the sugar industry.

8. The general purpose of the GEF components was to support all of the objectives of the Bank's Sugar Energy Development Project. Specifically, the GEF involvement had two aims: First, it would develop, or locally adapt, technologies for handling and processing sugar cane residues, emphasizing cane tops, leaves, and trash. This component was expected to extend the production possibility frontier for sugar biomass energy and provide a base for planning a second generation of investments in sugar biomass energy.

9. The second objective of the GEF-financed project was to strengthen the management and coordination of BEDP by fostering collaboration between the public and private sector in the management of program implementation. This component would ensure effective management of the technology development activities. Moreover, it would help integrate the private sector's plans to invest in power cogeneration with the plans of national energy planners and the load management requirements of the public utility. By emphasizing integration, the project sought to help the private sector in its investment decisions. This emphasis was essential since, historically, the absence of coordination and consultation between the public and private sectors on issues of planning, pricing, and energy contracting has been the key barrier, worldwide, to expanded generation of electricity from crop residues.

10. As one of the first GEF-cofinanced projects to be completed and audited, it is essential to explain GEF's role and its importance in evaluating the project's outcome. One of GEF's overall objectives was to demonstrate, in suitable contexts, the global significance of technologies, techniques, and policies for addressing potentially important global environmental problems, in this case, global warming. A central aim of GEF was to encourage project design with the greatest replication possibilities to maximize the impact on global environmental objectives. The potential savings in greenhouse gases from the Mauritian power sector alone were limited by overall demand and the size of the population. However, since Mauritius had an international reputation as an efficient sugar producer, it had provided an ideal laboratory for testing techniques for agronomically sustainable sugarcane harvesting and energy use. Replication of the Mauritius program for biomass energy development would enhance the impact on the global

warming objective. To this end, the project emphasized international dissemination of project results based on the demonstration of successful program implementation.

### **Summary of Project Components**

11. To achieve its objectives, the project consisted of four components: (a) construction of a bagasse/coal-fired plant at UStA, under private financing; (b) investments in equipment and processes to improve the efficiency of the satellite mills supporting the UStA plant and to free bagasse for electricity generation to the grid, under the Bank loan; (c) technology studies to improve the efficiency of bagasse transport from the satellite mills to the regional power plant and evaluate options for using other parts of the sugar cane for energy; and (d) institutional support to the BEDP for overall program coordination, project supervision, and environmental monitoring, and to CEB for building expertise in bagasse/coal plant operations and for contracting with suppliers of coal to meet the off-season needs of the power plant. The bagasse/coal plant at UStA was not built because private financing for component (a) failed to materialize, and most of the Bank loan for component (b) was cancelled.

12. The GEF grant supported components (c) and (d) of the project through the following activities: (i) studies and trials to develop and adapt technologies for biomass energy production; (ii) training of technical staff for bagasse/coal plants; and (iii) support for BEDP management and coordination, including environmental monitoring. Since this PAR finds that the GEF components were successful, their activities merit detailed description..

13. (i) **Development of Bio-Energy Technology.** Two studies were planned under this GEF activity. The first, the Biomass Energy Technology Study, was designed to determine the technical, financial and economic feasibility of utilizing cane tops, leaves, and trash for power production. The second study, the Bagasse Transport Technology Study, was designed to improve the cost effectiveness of bagasse transport through trials aimed at reducing capital costs, maximizing the load per trip, and increasing the efficiency of transport scheduling.

14. (ii) **Training.**<sup>1</sup> The project was to provide for 32 person-months of training for managers, engineers, chemists, fitters, welders, electricians, and boiler- and turbo-alternator operators from the Union St. Aubin Power Plant. The training program was to be planned, implemented, and evaluated by the management of the power plant, in coordination with the BEDP Coordination Unit, and was to be completed in time to commission the new plant in 1994.

15. (iii) **Environmental Monitoring and Strengthening of BEDP Management.** This component had two parts: (i) BEDP Coordination and Environmental Monitoring and (ii) Support to the Central Electricity Board.

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1. Cogeneration of power at sugar factories using sugar biomass fuels and more sophisticated boiler equipment required strengthening of managerial and technical skills for the power plant personnel.

## Project Costs

16. The total cost of the project was estimated at US\$55 million. The financing was to consist of a US\$15 million loan from the Bank for the foreign exchange costs of equipment and machinery for efficiency improvements; a grant of US\$3.3 million from the Global Environment Facility (GEF) for the technology studies and institutional development components<sup>2</sup>; US\$23 million from an unidentified foreign private source for financing the UStA power plant; and US\$13.7 million from local financial institutions, the sugar industry, and government.

## 3. Project Implementation and Outcome

### Bagasse/Coal-fired Power Plant Component

17. A significant portion of the project's cost (US\$23 million) was for the construction at the Union St. Aubin (UStA) sugar factory of a bagasse/coal-fired power plant to be financed by private funds. The cost of the proposed plant was based on a pre-feasibility study carried out by UStA at the appraisal stage. Given the importance of the UStA plant to the project, the Bank required the following effectiveness conditions: (i) a feasibility study for the construction of the plant; (ii) the establishment of an appropriate financing package for the plant; (iii) appointment of a coordinator for the BEDP; and (iv) a workable price and sale contract between the Central Electricity Board (CEB) and UStA for the purchase of electricity.<sup>3</sup>

18. In June 1993, the GOM submitted to the Bank a final feasibility study for the UStA power plant, which was carried out by an independent design firm hired by the UStA sugar mill. The study indicated that the plant would cost nearly twice the originally estimated amount. By October 1993, a workable financing plan for UStA remained elusive. Meanwhile, CEB and UStA had reached an agreement on the price and sale of electricity and a sugar technologist had been nominated as the coordinator of BEDP. The condition requiring a financing package for the construction of the UStA power plant remained unfulfilled, and was waived by the Bank in favor of a dated covenant. The loan was declared effective on December 28, 1993.

19. At the time of the feasibility study, the European Investment Bank (EIB) was considering investing in the UStA power plant, in partnership with the private sector. Eventually, however, the EIB withdrew from the project because: (i) the revised design and much higher cost of the plant significantly lowered the estimated financial rate of return;<sup>4</sup> (ii) negotiations for bagasse supply had broken down because of a failure to reach an agreement on an acceptable price; and (iii) EIB had concerns about the technical and financial capability of the promoter as well as the adequacy of guarantee arrangements. Consequently, with the collapse of discussions on the financial package, the bagasse/coal power plant was never built. However, with internal financing and the benefit of continued Bank advice under the project, private sugar mills pursued bagasse cogeneration and by 1996, almost 121 GWh of total electricity generation involved the use of

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2. The GEF Project Document for the Mauritius Sugar Bio-Energy Project estimated that the total cost of the GEF component would be US\$3.3 million. The Biomass Energy Technology Study would cost US\$1.4 million; the Bagasse Transport Technology Study would cost US\$0.2 million; the training component would cost US\$0.3 million; BEDP Coordination and Environmental Monitoring would cost US\$1.1 million and support to the Central Electricity Board would cost US\$0.3 million. All the funds were disbursed.

3. The Bank was not directly involved in the financing of the Union St. Aubin plant. Rather, the majority of its investment was for equipment and processes to improve the efficiency of the satellite mills which would provide the proposed UStA plant with bagasse.

4. From 13.3 percent at appraisal to 10 percent.

bagasse, which in fact met the 120 GWh target specified in the project objective. Bagasse cogeneration now accounts for about 60 percent of firm capacity with 10 out of 14 sugar factories operating bagasse units and contributing to the total.

### **Sugar Mill Efficiency Improvement Component**

20. The Bank's loan of US\$15 million was meant to improve the efficiency of sugar mill operations and thereby produce surplus bagasse that could be provided to the planned bagasse/coal-fired power plant at UStA. At appraisal, foreign exchange was a constraint and the Bank would have been the only viable source of funds for sugar mill improvements. However, GOM lifted foreign exchange restrictions before the loan became effective, thus decreasing the demand for Bank funds right from the start of implementation. Once it was apparent that the UStA bagasse/coal plant would not be built, it also became clear that the full amount of the Bank's loan would not be necessary for the sugar mill efficiency improvements. GOM therefore requested the Bank to cancel US\$9 million of its US\$15 million loan.

21. **Summary Results of Physical Components.** The Sugar Energy Development Project did not meet most of its physical objectives. The project was appraised before a detailed design was established for the proposed power plant, and the effectiveness condition for providing a viable financial plan for the plant was softened into a dated covenant. The appraisal and supervision teams did not include a power engineer to advise on design of the power plant. The plant's costs were grossly underestimated and the ultimate design proved to be too expensive to implement economically. Failing to mobilize a private financing package, the bagasse/coal power plant was never built. When the project was appraised, Bank financing was attractive to the private sector primarily because foreign exchange resources were unavailable through other channels. However, when the government lifted the restrictions, the private sector quickly discovered that commercial bank financing was easier to obtain, and the rationale for Bank financing disappeared. Private sector demand for funds to finance mill improvements was therefore below expectations, and only 40 percent of the funds allocated for this purpose were disbursed.

22. The project, however, did have one very significant achievement: the project coordination unit became a focal point for resolving independent power producer (IPP) development issues, and in designing a power purchase agreement. The non-financial, analytical and advisory activities throughout the project cycle led to substantial achievements in the area of facilitating increased power generation using bagasse fuel by the private sugar industry, in cooperative partnership with the concerned public and regulatory agencies.

### **Technology Studies and Institutional Development Component**

23. The GEF-funded activities had significant difficulties getting under way, most of which were due to the serious impediments posed by the slowness in meeting loan effectiveness and in starting the implementation of the Bank project to which the GEF project was tied. Until 1993, implementation was also hampered by the lack of a coordinator for the BEDP Management Committee, which was responsible for supervising the main studies supported by the project. The results under each of the GEF activities are presented below. This information was not contained in the ICR, which was prepared prior to the completion of the GEF portion of the project.

#### *Development of Bio-Energy Technology*

24. **Biomass Energy Technology Study.** The purpose of the study was to identify viable investment opportunities for the use of cane residues, other than bagasse, for the production of

electricity.<sup>5</sup> A whole cane processing trial was conducted and the results indicated that the present mill configuration could not handle it. This component of the project was discontinued. Instead, a dry cane cleaning plant (DCCP) was designed and piloted successfully. The plant separates the trash from the cane to be processed in the plant's respective sugar and energy production streams. For training purposes, students from the University of Mauritius (UOM) and the Mauritian Sugar Industry Research Institute (MSIRI) also participated in the trials and evaluation of the plant. Further trials are planned to assess the compatibility of the DCCP with other types of power plants, to address the technical issues related to the ash content of bagasse<sup>6</sup> and its calorific value.<sup>7</sup> The plant continues to operate and is the subject of visits and inquiries from abroad. The Mauritius Sugar Authority and UStA continued to finance the plant after the GEF grant was exhausted.

25. An international workshop on the study's results was to be held in 1994. However, because of the delays in the project's start-up, the workshop has been delayed until August/September 2000. The results of the DCCP project will be presented at the Workshop on Cogeneration, which will be sponsored by the International Society of Sugar Cane Technologies

26. **Bagasse Transport Technology Study.** The intent of the study was to determine the most cost-effective means of transporting bagasse from satellite plants to power plants. Trials using compaction equipment and a towing trailer were envisioned. However, this study was not implemented because of the subsequent plant centralization policy that was adopted by the government, which relied on existing sugar mills rather than the UStA plant and thus obviated the need to transport large quantities of bagasse. Moreover, the UStA plant, which would have been a central consumer of the surplus bagasse, was never built.

27. The funds for this component were used to prepare an environmental impact assessment (EIA) of the Belle Vue plant and conduct an environmental monitoring study in four sugar factories. The Belle Vue study was completed in March 1997. It concluded that the Belle Vue plant would be less environmentally harmful than alternative baseload thermal generation plants. The recommendations of the EIA were implemented at the plant.

### *Training*

28. The training program was implemented, including visits to foreign countries with significant sugar industry sectors, and involved representatives from all the main sugar entities in Mauritius.

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5. Specifically, the study's goals were to (a) assess the available cane residue base; (b) determine the productivity of alternative systems for recovering residues and evaluate agronomic effects of removal of residues from the field; (c) assess the feasibility of alternative systems for handling and burning residues in the factory and the effects on the sucrose and energy balances; and (d) evaluate the impact of air emissions under alternative scenarios of cane burning in the field and biomass in the factory. The study was to be managed by a team of local experts drawn from four sugar factories scheduled to participate in the trials, the Ministry of Agriculture, the Mauritius Sugar Authority, the University of Mauritius and the Mauritius Sugar Research Institute. The team would be supplemented by consultants covering engineering design and technical specifications for a pilot factory and an agro-business evaluation of study results.

6. Coal has a higher ash content than bagasse.

7. The calorific value of bagasse is about 10 percent less when leaves and tops are used, since they are less lignified than the bagasse itself.



### *Coordination of Environmental Monitoring and BEDP Management*

29. **Environmental Monitoring.** An Environmental Monitoring Cell was to have been established within the Mauritius Sugar Authority (MSA). However, this was not carried out because the objectives of the *air quality* aspect of this component were met at lower cost and with more widespread benefits, through other institutional arrangements that did not involve expanding the public sector. This was accomplished by developing the capacities of the University of Mauritius (UOM) to monitor air emissions from the sugar industry. The arrangement has evolved into a sustainable institutional arrangement whereby UOM, for a fee, provides air quality monitoring services and independent, objective technical advice to both public and private entities.<sup>8</sup>

30. For the *water quality* monitoring aspect, the Ministry of Environment (MOE) has established a self-reporting system requiring all factories to disclose data on their water effluents. In lieu of creating a new public agency, MSA assigned its monitoring tasks to the MOE's Environment Cell, which is preparing a proposal delineating its tasks and responsibilities. The enforcement agency for water quality monitoring is the Ministry responsible for water resources. Its staff were trained under the GEF grant. When the GEF grant was entirely used, MSA financed the continuation of the training program.<sup>9</sup>

31. **Support to the Central Electricity Board.** This component was initially supposed to train CEB's personnel in fuel quality analysis, which would enable the laboratory to adequately meet the requirements for coal fuel quality analysis. However, this component was cancelled because costs were higher than originally anticipated. Moreover, the government was of the opinion that the private sector should handle fuel analysis.

## **4. Sustainability**

32. Although the bagasse/coal power plant under private financing was never built, and most of the Bank loan for sugar mill improvements to generate surplus bagasse for the plant was cancelled, the analytical and advisory work throughout the project cycle led to significant achievements in establishing an institutional and regulatory framework for private power generation in Mauritius. Moreover, the associated GEF project proved to be an effective vehicle in implementing the key technical studies and trials to support bagasse-based energy development, as well as to establish environmental monitoring systems for the sugar industry. The bagasse/coal alternative has been mainstreamed into the long-term planning exercises of CEB, subject to the same rigorous financial and economic criteria as those applied for conventional fuel sources, with due consideration to environmental benefits as well as the political importance of diversifying fuel sources in order to minimize the vulnerability of Mauritius to external supply constraints. In view of (i) the privately financed use of bagasse as boiler fuel in existing sugar plants to a level that meets original project targets, and (ii) GOM's

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8. UOM's mobile systems measure particulate matter, gaseous emissions, and ambient air quality and generate real-time, online data. In addition to a Technical Committee, the facility is supervised by a Management Committee comprised of the MSA, the Mauritian Sugar Research Institute (MSRI), the Mauritian Sugar Producers' Association, and the Ministry of Health. Based on the monitoring results, MSA is responsible for formulating policy proposals and advising the Ministry of Environment. The UOM facility is seeking accreditation from Mauritian Service Accreditation body.

9. The Mauritian Sugar Industry Research Institute also has a program to assist the sugar factories in developing water quality monitoring systems. New equipment for water quality measurements was not acquired in order to avoid duplication with Bank-financed equipment under an earlier project with the Central Water Authority

continuing ownership and commitment to the objectives of the Bagasse Energy Development Program, the *sustainability* of the project is rated as *likely*.

## 5. Bank Performance

33. The *Bank's performance* was *unsatisfactory*. During the preparation and appraisal stages, evidence from the documentation and field interviews indicates that the Bank loan was hastily put together in order to enable the processing of the GEF project, since at the time, it was not possible to approve free-standing GEF projects, in line with GEF procedures. The project was appraised after only one preparation mission, during which it became clear that key pre-requisites of the complex and innovative bagasse energy project were lacking (notably a detailed engineering design, a reliable cost estimate, and an agreed financing package) and that neither the borrower nor the Bank had much prior experience in dealing with issues related to independent power production (IPP), much less on bagasse/coal-based IPPs. This pressure to lend resulted in conditionality being successively weakened and up-front actions being postponed, to the point that the loan (and the grant) was declared effective based on anticipated, rather than actual, compliance with major agreed actions. It also resulted in the detailed cost estimate of the plant (obtained after project approval) that was significantly out of line with industry standards for thermal plant costs, i.e., almost double the initial estimate made prior to the rapid appraisal of the project. During supervision, there was inadequate attention to broader power sector development issues, which may have been a consequence of having assigned the management of this energy project to an agriculture division instead of an energy division. The Bank also acted as biased and arrogant at some points during supervision, by declining a government request to review the alternative generation proposed for baseload power units when an update showed that bagasse/coal power plants are no longer part of the least-cost power development program. In sum, it can be argued that the Bank lost interest and *de facto* abandoned project supervision when the physical components failed to materialize and a large part of the Bank loan was cancelled (the last supervision mission was June 1995, or 18 months before the project closing date, and a completion/ICR mission was not carried out; moreover, the responsibility for the task management of the project was unclear during the completion stage). With the Bank having abdicated, the borrower essentially took full implementation responsibility for the GEF components, which were implemented successfully.

34. On the positive side, however, there was a strong, general consensus among both private and public evaluation respondents that, although the Bank's contribution solely in financing terms was small and its involvement became minimal at completion, the Bank's advisory and "honest broker" role was critical and most valuable in facilitating the launching and implementation of the Bagasse Energy Development Program (BEDP). The Bank's proactive advice brought the (sometimes conflicting) parties together, catalyzed a negotiation process, and got the BEDP on its feet, after almost 30 years of discussions regarding the generation of electricity from sugar cane residues. The Bank's non-financial advice related to private sector development (PSD) for power generation, as well as the theory and best practices for energy pricing based on the avoided cost principle, were often cited as specific examples of the Bank's value-added under this project. Moreover, there was also general agreement that, without the technical knowledge and experience generated by the GEF-financed studies, coupled with the active contribution of the Technical Committee set up at the Ministry of Public Utilities and the results-oriented approach adopted by the BEDP Secretariat and Coordination Unit, the building of confidence and ownership among the public and private partners would not have occurred. In sum, although the documented evidence shows that the Bank's quality-at-entry and supervision approach from headquarters was unsatisfactory, the country clients gave highly positive responses regarding their professional

interactions with Bank staff in the field, and the concrete, sustainable results that were obtained from this dialogue.

## 6. Borrower Performance

35. Project preparation by the Government of Mauritius (the borrower) was satisfactory. The government showed strong commitment and took important steps to set up the necessary institutional framework for the project, notably the creation of the Management Committee for the Bagasse Energy Development Program, the designation of the Mauritius Sugar Authority (MSA) as the Secretariat, and the appointment of a senior sugar technologist to head the coordination unit within MSA. MSA produced a detailed review of bagasse energy development that occurred under the project. This helped considerably in filling information gaps resulting from the Bank's limited supervision reporting and the absence of a completion mission to prepare the Implementation Completion Report, which was a desk study done at headquarters. The partial or delayed compliance with some covenants (mainly related to reporting requirements) were a result of the cancellation of a portion of the loan, which obviated the need to complete the covenanted action, or situationally brought about by the problems that arose when the projected bagasse/coal power plant proved too costly to build. Overall, the *borrower's performance* was *satisfactory*.

## 7. Overall Assessment and Lessons Learned

36. The key strategy of the Bagasse Energy Development Program (BEDP)—that is, to set up the investment plan, the institutional framework, and the policies to encourage private investment in bagasse/coal power stations—was achieved under this Bank/GEF project and continues to be pursued. Although the project's hastily prepared bagasse/coal power plant component was not implemented due to the collapse of the private financing package, other private sugar mills are using the technology with their own internal financing. By 1996, almost 121 GWh of electricity generation was from bagasse, which meets the 120 GWh target specified in the project objective. Bagasse cogeneration now accounts for about 60 percent of firm capacity with 10 out of 14 sugar factories operating bagasse units and contributing to the total. The GEF grant provided the enabling technical studies and institutional development activities. Consequently, the *outcome* of the project is *satisfactory*. The building-up of strong capacities for promoting PSD in the power sector was clearly positive. The audit mission observed a general willingness during and after the project to experiment, tolerate mistakes, learn, and improve. There were also regular consultations and a multi-stakeholder approach involving public and private partnerships. Consequently, the *institutional development impact* of the projects is rated *substantial*. More broadly, there are strong prospects for Mauritius to evolve rapidly into a "knowledge-based economy," to the extent that the high efficiency of information flows and knowledge-sharing related to the GEF activities is a performance indicator that is being replicated in other sectors. The institutional and regulatory framework for PSD in power generation has been established, bagasse/coal generation has been mainstreamed as a possible alternative in the process of preparing least-cost power expansion plans, and private sugar plants are using bagasse for part of their power needs, hence the project's *sustainability* is *likely*. The *borrower's performance* is *satisfactory* as shown by its support for implementing the key institutional development prerequisites of the BEDP and its continuing commitment to the program. The *Bank's performance* is *unsatisfactory*, given the seriously deficient quality at entry, the evident pressure to lend, and the weaknesses in supervision and completion. With the exception of the Bank's performance, these OED ratings are higher than the ones from the ICR, which did not benefit

from a field mission and was prepared before the completion of the GEF components. Moreover, there were no more supervision missions before the December 1996 closing date (the last supervision mission was 18 months earlier in June 1995), whereas many of the project's achievements occurred during the 1997 and 1998 period, which the January 1998 ICR could not capture fully when it was prepared in Washington as a desk study.

37. The following are the principal lessons that can be derived from this audit:

- ***Government commitment is particularly critical where a complex and innovative project requires early actions on institutional development.*** The experience with this project shows that the government's strong commitment to the goals of its Bagasse Energy Development Program (BEDP) was a critical factor in achieving the project's goals of substituting bagasse for imported fuels. Despite the cancellation of the project's bagasse/coal power plant and the loan funds for generating surplus bagasse through mill improvements, the Mauritius Sugar Authority, the Central Electricity Board, and other government agencies continued to work with the Bank and private sugar mills. The eventual result is that project targets were nearly fully achieved through existing sugar mills and domestic private resources. As a further illustration of the importance of the borrower being in the "driver's seat", the GEF activities were also adapted to serve the relevant needs of the BEDP when it became clear that the bagasse/coal power plant was not going to be built.
- ***The Bank can be highly valuable as a catalyst and honest broker in the early stages of promoting private involvement, when it is important to have effective consultation mechanisms that foster cooperation and trust among public and private stakeholders.*** The participatory processes and transparent flow of information that sustained cooperation and trust in the stakeholders were key to the achievement of project objectives. The Bank played an important role in identifying the issues, setting priorities in the complex agenda, bringing in new knowledge, building linkages among traditionally isolated entities, and fostering a collaborative approach to resolving the difficult issues in which no one at the negotiating table had much experience.
- ***Research, scientific data, reliable technical information, and monitoring and evaluation systems are critical in establishing the financial and economic viability of experimental projects, and in replicating positive results.*** A sound and objective knowledge base enhanced the prospects for public-private partnerships from the start, and mainstreaming positive results. Solid research on sugar bio-energy and the necessary policy framework preceded project preparation, including an ESMAP study.<sup>10</sup> The appointment as BEDP Coordinator of a senior sugar technologist who knew the industry lent much credibility to the bagasse substitution program. Monitoring and evaluation systems were in place early on, thus allowing the Mauritius Sugar Authority to re-focus use of the GEF grant when results of initial trials on whole cane conversion proved unsuccessful and transport of large quantities of bagasse became less of a priority.

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10. Energy Sector Management Assistance Program. Mauritius: Energy Sector Review. World Bank, December 1994.

- ***The pressure to lend and the consequent short-cutting of preparation and appraisal can result, as they often do, in implementation failure.*** The absence, prior to effectiveness, of a detailed feasibility study, a credible cost estimate for the bagasse/coal plant, and an agreed financing plan with private investors, resulted in (i) postponing these key elements to the first years of the project; (ii) delaying overall project implementation, including the GEF activities which were in a much greater state of readiness than the other project components; and (iii) eventual implementation failure for the physical components, when the hasty original assumptions made at appraisal related to plant costs and the ease of mobilizing private financing proved to be inaccurate. The GEF technical assistance activities and the loan-financed physical plant were pursued simultaneously instead of sequentially, with the result that the bulk of the loan had to be cancelled due to lack of ownership and readiness for the investment portion.



## Basic Data Sheet<sup>a</sup>

### MAURITIUS SUGAR ENERGY DEVELOPMENT (Loan 3458--MAS)

#### Key Project Data (amounts in US\$ million)

	<u>Appraisal estimate</u>	<u>Actual or current estimate</u>	<u>Actual as % of appraisal estimate</u>
Total project costs	55.1	13.3	23%
Loan amount	15.0	6.0	40%
GEF Grant	3.3	3.3	100%
Cofinancing	23.1	0	0
Cancellation		9	
Date physical components completed	October 1994	Not Completed	
Economic rate of return		N/A	

<sup>a</sup> The GEF was a component of a larger Bank loan and was therefore appraised, prepared and supervised jointly. Therefore, this data sheet presents data for the larger Bank loan, of which the GEF was a part.

#### Cumulative Estimated and Actual Disbursements

	<i>FY93</i>	<i>FY94</i>	<i>FY95</i>	<i>FY96</i>	<i>FY97</i>
Appraisal estimate (US\$M)	2.0	4.2	7.2	11.1	15.0
Actual (US\$M)	0.0	0.0	1.4	6.0	6.0
Actual as % of appraisal	0	0	19	54	40

Date of final disbursement: 12/96

#### Project Dates

	<i>Original</i>	<i>Actual</i>
Identification	November 1990	November 1990
Preparation		April/May 1991
Appraisal		August 1991
Negotiations	November 1991	
Board approval	December 1991	March 31, 1992
Signing	March 1992	July 1 1992
Effectiveness	June 1992	December 28, 1993
Closing date	August 31, 1996	December 31, 1996

### Staff Inputs (staff weeks)

	Planned <sup>a</sup>		Actual	
	Weeks	US\$ ('000)	Weeks	US\$ ('000)
Preappraisal to Appraisal			5.5	16.0
Appraisal			10.6	27.5
Negotiations through Board Approval			7.1	18.9
Supervision			21.7	86.6
Other			4.7	10.0
Total			49.6	159.0

<sup>a</sup> figures on planned resource use in staff weeks and US\$ are not included in the table because they were not available consistently enough throughout the project cycle to provide a meaningful comparison with actual data.

### Mission Data

	Date (month/year)	No. of persons	Staff days in field	Specializations represented	Performance rating <sup>1</sup>	Types of problems <sup>2</sup>
<i>Through appraisal</i>						
Identification	Nov. 1990	2	23	FA, SE	-	-
Preparation and Pre-Appraisal	March/April 1991	6	33	EC, FA, EE, SI, FE	-	-
Appraisal	August 1991	5	14	EC, FA, EE, SI, FE	-	-
<i>Supervision</i>						
Supervision 1	Feb. 1992*	1	9	PO	-	-
Supervision 2	May/June 1992*	3	13	EC, AE, SIS, FA	-	-
Supervision 3	Sept./Oct. 1992	3	18	DC, AE, SIS	2/2	-
Supervision 4	Feb./March 1993	2	31	AE, SIS	2/2	-
Supervision 5	July 1993	1	7	AE	2/2	COV
Supervision 6	October 1993	1	15	SIS	2/2	COV, PR, TR
Supervision 7	December 1993	1	14	SIS	2/2	PR, TA, TR
Supervision 8	March/April 1994	2	29	AE, SIS	2/2	PR, TA, TR
Supervision 9	April 1995	1	10	AE	S/U	COV
Supervision 10	June 1995	2	14	AE, EE	S/U	COV
Completion <sup>11</sup>						

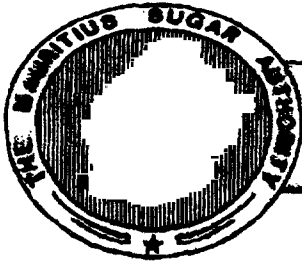
<sup>11</sup> There was no completion mission for this project.

1. AE = Agricultural Economist; DC = Division Chief; DO = Distribution Officer; EC = Economist; FA = Financial Analyst; FAC = Financial Analyst Consultant; FS = Financial Specialist; LE = Legal Staff; PO = Procurement Officer; SA = Secretarial Assistant; SE = Sugar Engineer; SIS = Sugar Industry Specialist.

2. 1 = No or minor problems; 2 = Moderate problems; 3 = Major problems; S = Satisfactory; U = Unsatisfactory.

3. I = Implementation delays; IN = Institutional problems; PR = procurement delays; COV = covenant problems;





## *The Mauritius Sugar Authority*

YOUR REF

MSAB 39/6/1

20th June 2000

OUR REF

DATE

Mr Ridley Nelson,  
Acting Group Manager,  
Operations Evaluation Department,  
The World Bank,  
Washington,  
USA.

Dear Mr Nelson,

I refer to the e-mail dated 13 June 2000 from Dr F. Manibog from the OED. Many thanks for the Draft PAR and we have the following comments to offer:

(i) Page 4, para 3.19, line 10, to delete existing sentence and replace by:

"almost 121 Gwh of total electricity generation involved the use of bagasse which in fact meet the 120 GWh target specified in the project objective."

(ii) Para 7.19, line 12 to delete "all" and replace by "10 out of 14".

(iii) Page 7, para 3.30, line 5, to delete "Ministry of Health" and to replace by "Ministry responsible for Water Resources".

(iv) Page 8, para 5.34, line 12 to add after "studies" the following words:

"coupled with the active contribution of the Technical Committee set up at the Ministry of Public Utilities and the result-oriented approach adopted by the BEDP Secretariat and Coordination Unit".

(v) Page 9, Para 7.36, line 6, same comment given at (i) and (ii) above would apply.

I hope that the above comments would enable you to finalise the PAR. We are as usual at your disposal for any additional clarification. A copy of the electricity generation (1988-1998) is annexed.

Regards to Dr Manibog.

Yours sincerely,

K. Deepchand  
for Executive Director

ELECTRICITY PRODUCTION (TWh) - crop 1988 - 1998

Power	Factory	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998 provide	
FUEL	Bagnasse	41,032,678	25,523,552	17,578,915	38,818,155	50,038,605	38,387,110	43,953,765	45,888,159	70,462,500	65,537,330	58,817,860	
	Coal	33,864,330	68,478,448	45,000,000	53,500,000	43,146,855	40,155,470	45,052,195	40,882,885	9,835,140	23,381,750	51,714,820	
	Bagnasse											54,990,900	
	Coal											10,678,500	
	Total	74,897,008	94,003,000	62,578,915	92,308,000	93,185,460	78,542,580	89,015,960	86,771,044	80,297,640	88,919,080	174,282,080	
	% Grand total	71	75	65	75	73	72	74	71	68	60	61	
	COWT	Madira	15,138,008	15,640,000	17,163,000	13,937,000	17,292,000	12,315,000	13,584,000	14,427,000	16,073,000	17,019,000	17,600,000
		Union St-Martin	4,338,000	4,624,000	6,368,000	7,224,000	7,488,000	6,788,000	6,408,000	6,868,000	7,486,000	7,510,000	13,016,000
		Reche En-Eau	-	-	-	3,496,240	3,325,600	3,226,000	3,119,200	3,227,200	3,294,800	16,567,360	18,056,800
		Union Desert Alma	-	-	-	-	-	4,845,720	4,908,600	5,835,660	6,210,240	7,536,540	13,518,716
Sarawach		-	-	-	-	-	-	-	-	-	4,620,080	16,226,384	
Mon Louiz		-	-	-	-	-	-	-	-	-	-	18,152,700	
Total		19,476,008	28,273,000	23,531,000	21,100,000	28,105,600	27,154,720	28,019,800	30,385,660	33,074,040	53,253,668	188,907,834	
% Grand total		18	16	24	17	22	25	23	25	27	36	38	
INTERMITTENT		Union St-Martin	608,128	217,440	587,280	1,742,400	1,551,600	-	-	-	-	-	-
		Reche En Eau	1,357,280	1,354,560	1,794,480	12,910	38,380	80,050	562,440	1,151,080	1,248,560	1,833,628	1,336,000
	Bahama	1,055,016	1,016,610	1,251,860	2,022,600	1,626,000	1,457,400	1,007,400	1,147,200	1,371,000	1,293,000	-	
	Sarawach	2,300,400	2,278,400	2,042,400	650,000	740,000	635,000	848,008	535,000	622,500	600,000	876,000	
	Belle Vie	788,000	814,500	821,000	332,500	527,500	508,000	204,500	197,000	346,000	238,000	-	
	Comstance	582,256	823,796	594,500	284,000	461,000	387,000	-	-	-	-	-	
	St-Anthone	433,808	739,000	495,000	284,000	461,000	387,000	-	-	-	-	-	
	Reche Chery	17,388	32,920	60,800	80	111,760	52,880	58,800	608,440	1,178,160	14,120	-	
	Union Desert Alma	1,670,488	1,078,200	55,800	0	746,900	622,800	865,100	368,000	1,107,600	634,900	-	
	Mon Louiz	1,094,188	1,186,800	1,973,900	971,500	186,500	87,000	127,500	548,400	362,100	-	-	
Bureau Plan	248,088	235,500	65,500	27,500	196,500	68,780	92,108	428,500	1,252,500	1,456,500	1,415,000		
Blivot	578,380	651,100	877,100	566,400	500,600	68,780	92,108	428,500	1,252,500	1,456,500	1,415,000		
Total	11,033,948	10,429,828	10,619,658	10,200,000	6,498,248	3,898,508	3,785,648	4,985,638	7,468,428	6,971,448	3,627,080		
% Grand total	11	8	11	8	5	4	3	4	6	4	1		
GRAND TOTAL		186,211,946	134,705,828	96,821,565	123,600,000	127,782,708	110,606,238	121,821,408	122,162,534	128,861,198	148,243,288	288,730,914	