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**Report No. 19027**

**PERFORMANCE AUDIT REPORT**

**MADAGASCAR**

**ENERGY I PROJECT  
(CREDIT 1787-MG)**

March 11, 1999

*Operations Evaluation Department  
Sector and Thematic Evaluations Group*

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## Currency Equivalents (annual averages)

*Currency Unit = Malagasy Franc (FMG)*

July 1986	US\$1.00	FMG 750
July 1987	US\$1.00	FMG 1,360
June 1993	US\$1.00	FMG 1,844
August 1995	US\$1.00	FMG 4,602

## Abbreviations and Acronyms

DE	Directorate of Energy
ESMAP	Energy Sector Management Assistance Program
FANALAMANGA	Malagasy Industrial Wood Plantation Authority
GOM	Government of Madagascar
JIRAMA	National Electricity and Water Company
LPG	Liquefied petroleum gas
OED	Operations Evaluation Department
PAR	Performance Audit Report
PIU	Project implementation unit
TOE	Tons of oil equivalent
UPED	Unité de planification des énergies domestiques [Household Energy Planning Unit, within the DE]

## Fiscal Year

Government: January 1 - December 31

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March 11, 1999

**MEMORANDUM TO THE EXECUTIVE DIRECTORS AND THE PRESIDENT**

**SUBJECT: Performance Audit Report on Madagascar  
Energy I Project (Credit 1787-MG)**

Attached is the Performance Audit Report (PAR) prepared by the Operations Evaluation Department (OED) on the above project, approved in FY87. The total amount of the Credit was SDR 19.8 million (US\$ 25 million equivalent), of which US\$1.6 million was canceled at closure in May 1995.

The objectives of the project were to: (a) help the Government strengthen energy policy formulation, planning and investment programming; (b) assist JIRAMA, the power utility in improving the efficiency of resource utilization in the power sector by strengthening financial management, planning, and manpower development and by rehabilitation of its facilities; and (c) help GOM expand the supply of electric power and other locally available household energy products.

The project was essentially a traditional power rehabilitation and expansion project to which small household energy and energy planning components were added on. The household energy component aimed to improve the design of charcoal stoves, to test them with users, train artisans to produce the new models and then to disseminate the best design to the general public. It was very successful and today about 100,000 households in the capital have an improved stove, representing about half of all charcoal stoves in use.

The Project's electricity sector issues are satisfactorily covered in the ICR and were not reexamined by this Audit. Contrary to the assessment of the ICR, the Audit concludes that the benefits from the institutional development (energy planning) component have been almost entirely lost because the skills acquired as a result of the project have not been utilized. The outcome of this component is rated as highly unsatisfactory, its institutional development negligible and its sustainability as unlikely, while both Borrower and Bank performance is rated as unsatisfactory.

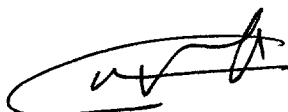
The Audit rates the overall outcome of the household energy component as highly satisfactory because the physical and institutional benefits directly attributable to it were both substantially greater than initially envisaged. This Audit considers this component of the project to have had a substantial institutional development impact and its sustainability to be likely. Bank performance was satisfactory while Borrower performance was highly satisfactory.

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Overall ratings for the whole Energy project remain those assigned at the time of OED's review of the ICR, given the prominence of the power component in the project and OED's judgement that these ratings are still valid: satisfactory outcome, modest institutional development impact, uncertain sustainability (due to the power utility's precarious financial situation) and satisfactory Borrower and Bank performance.

The significant lessons evidenced by this audit are: (a) the social, economic and environmental benefits from improved household woodstoves can be considerable; (b) the cost of such programs is quite low, yet they can have a wide impact on a large segment of the population and particularly the poor; and (c) the interactions between the energy sector, rural development and environmental protection are complex and often insufficiently analyzed and incorporated in project design.

Attachment

A handwritten signature in black ink, consisting of a large, sweeping loop followed by several smaller, connected strokes.

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This report was prepared by Messrs. Alain Barbu (Task Manager) and Sunil Mathrani (Consultant), who audited the project in July 1998. Mr. William Hurlbut edited the report. Ms. Soon-Won Pak provided administrative support.



## Principal Ratings

	<i>ICR</i>	<i>Audit*</i>
Outcome	Satisfactory	Satisfactory
Sustainability	Likely	Uncertain
Institutional Development	Substantial	Modest
Borrower Performance	Satisfactory	Satisfactory
Bank Performance	Satisfactory	Satisfactory

\*Ratings apply to whole project rather than just the two components reviewed by this audit (see preface for explanation)

## Key Staff Responsible

	<i>Task Manager</i>	<i>Division Chief</i>	<i>Country Director</i>
Appraisal	Ken Newcombe	Harold E. Wackman	Hans Wyss
Completion	Nourredine Bouzaher	Iain Christie	Andrew P. Rogerson





## **Preface**

The IDA approved the Energy I Project (Cr. 1787-MG) in Madagascar for a credit of SDR 19.8 million (US\$25 million equivalent) in April 1987. The credit closed in December 1994, about two years behind schedule.

This Performance Audit Report (PAR) on that project is based on the Implementation Completion Report (ICR) the Staff Appraisal Report, loan documents, project files, and discussions with Bank staff. An Operations Evaluation Department (OED) mission visited Madagascar in July 1998 for discussions with the government and the project implementing agency. Their cooperation and assistance are gratefully acknowledged.

Because household and biomass energy projects are relatively uncommon in the Bank's portfolio, and given the increased emphasis attached to them of late, they are the central focus of this PAR. The project's electricity sector issues are satisfactorily covered in the ICR and were not examined by this audit. Instead, this report examines the two areas not adequately addressed in the ICR, i.e. the institutional development component of the project at the governmental level and the initiatives to increase the supply and reduce the consumption of wood fuels by households.

Although the audit provides separate ratings for these non-power components, the overall ratings for the Energy Project as a whole remain those assigned at the time of OED's review of the ICR (December 1995) given the prominence of the power component in the project and OED's judgment that these original ratings are still valid: specifically, outcome was rated by OED as satisfactory, institutional impact as modest, sustainability as uncertain (due to the power utility's precarious financial situation), and both Borrower and Bank performance as satisfactory.

Following standard OED procedures, this draft PAR will be sent to the Borrower for comments before it is finalized. Comments received is included in Annex C.

## **BACKGROUND**

1. Madagascar, one of the world's poorest countries, has a population of about 14 million and a per capita GNP of about \$230. About three-quarters of the population lives below the poverty line. Per capita income has halved over the past 30 years. Commercial energy consumption per person is only about 36 kg of oil equivalent, on the low side even for sub-Saharan Africa. Wood fuels are the main energy source and account for over 85 percent of the total energy supply. More than 2 million tons of oil equivalent (TOE) of wood fuels are consumed annually in Madagascar, most of it by households. Nearly 80 percent of households in Antananarivo use charcoal for cooking. The use of liquefied petroleum gas (LPG) and electricity is extremely low and is limited to high-income families.

2. The Energy I project was essentially a traditional power rehabilitation and expansion project to which small biomass fuels and energy planning components were added. The problems and unresolved issues faced by the power sector are the main focus of the ICR<sup>1</sup> and are common to many other countries. This PAR does not reexamine those problems and issues.

## **PROJECT OBJECTIVES**

3. The project objectives as stated in the Staff Appraisal Report (SAR) were (a) to help the government strengthen energy policy formulation, planning, and investment programming; (b) to assist the National Electricity and Water Company (JIRAMA), the power utility, in improving the efficiency of resource utilization in the power sector by strengthening financial management, planning, and manpower development and by rehabilitation of its facilities; and (c) to help the Government of Madagascar (GOM) expand the supply of electric power and other locally available household energy products.

4. The objectives were derived from a sectoral review carried out by the UNDP/Bank Energy Assessment Program<sup>2</sup> in 1984/85 and were a broadly appropriate response to the issues highlighted by the review. Despite the seemingly direct link of household energy supply with the environmental issue of deforestation, which was a prominent theme of the Energy Assessment report, there was no explicit environmental objective stated for the project.

## **INSTITUTIONAL DEVELOPMENT COMPONENT**

### **Description and Implementation**

5. Following the identification of energy policy and planning weaknesses by the Energy Sector Management Assistance Program (ESMAP) Energy Assessment report, the project included a component to "develop within the Ministry of Energy the capability to prepare and evaluate energy sector policies, plans and investment programs for the sector as a whole and to

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1. Report #14638 dated June 14, 1995.

2. Issues and Options in the Energy Sector, Report No. 5700-MAG, January 1987. The fieldwork was carried out in 1984/85.

initiate household energy planning.”<sup>3</sup> This component of the project comprised a substantial amount of technical assistance over a three-year period (1988–91) and office equipment necessary to set up a new energy planning unit within the ministry. As in many other technical assistance projects or components of this type, the Bank financed the initial running costs of the unit as well.

6. With the help of resident foreign consultants, the unit created an energy database, prepared energy supply and demand balances, and developed energy demand forecasting models. Ministry staff were trained in the use of these tools. This component appears to have been initially successful, and ministry staff acquired new skills in these areas. A national energy plan was produced for the first time in Madagascar, with forecasts and a long-term investment program.

### **Achievements, Impact, and Sustainability**

7. The 1991 release of the national energy plan coincided with the start of an extended period of political unrest and with extensive staff changes at the top levels of the ministry. As a result, the plan was never formally issued. Worse, equipment acquired under the project and allocated to the energy planning unit was reassigned elsewhere. Once support from the IDA credit ceased, the operating budget of the unit was insufficient for it to carry out regular energy sector data collection or forecasting. These tasks have not been carried out since then.

8. Since the early 1990s, senior ministry officials have not seen the need for energy planning and analysis. Consequently, the staff trained by the project have been underused and are dispirited by the failure to use their capabilities. Today it is impossible to obtain from the Ministry of Energy basic data essential for any policy analysis such as a time series of energy prices or consumption in Madagascar since 1990. This is a serious weakness and clear evidence that the initial achievements of this project component were not sustained. The supervision reports and aide-memoires of Bank staff in charge of the project do not raise these issues, suggesting that the Bank was not concerned about ensuring the sustainability of the institutional development of the ministry.

### **Overall Assessment**

9. The benefits from the institutional development component have been almost entirely lost because the skills acquired as a result of the project have not been used. This contradicts the assessment of the ICR, which states that “the institutional and management capacity built under the project is likely to be sustained.” The outcome of this component is rated as highly unsatisfactory, its development impact as negligible, its sustainability as unlikely, and Borrower and Bank performance as unsatisfactory.

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3. SAR para. 5.05 (d)

## HOUSEHOLD ENERGY COMPONENT

### Environmental Context

10. The Energy Assessment report highlighted the growing shortage and rapidly increasing retail prices of wood fuels and the deforestation and environmental deterioration related partly to wood fuel extraction. In particular, the report indicated that the problem was most acute in the central highland provinces around the capital, Antananarivo, where 30 percent of the population was concentrated, but where forest reserves were minimal. As a result, for the capital the report predicted that "if no corrective action is taken, the gap between demand and supply is projected to increase to 680,000 toe/year."<sup>4</sup> The prices of wood fuels were observed to have increased significantly in real terms during the decade since the mid-1970s, and this trend was expected to accelerate as the imbalance between supply and demand grew.

### Design

11. Given the alarming picture drawn by the Energy Assessment report, the project correctly attempted to tackle both the supply and demand sides of the wood fuel problem. The project sought to take advantage of the large quantities of charcoal feedstock available in the 80,000-hectare Haut Mangoro pine plantation managed by the state-owned Malagasy Industrial Wood Plantation Authority (FANALAMANGA) located about 130 km from the capital. This plantation had been partly set up in the early 1970s by two previous Bank forestry projects.<sup>5</sup> The plantation was initially intended to provide feedstock for a paper pulp mill, but the latter never materialized and the quantity of wood available greatly exceeded sawmilling requirements. The Energy I project envisaged support for the production and marketing of at least 5,000 tons per year of charcoal from pine thinnings, with the goal of eventually supplying a quarter of Antananarivo's charcoal requirements. A second supply-enhancing component was for the production of experimental rice husk briquettes, using part of the 0.5 million tons of risk husks that were disposed of as waste from rice mills. On the demand side, the project envisaged a cooking efficiency program to design and disseminate efficient charcoal stoves.

12. The project prudently included a comprehensive review of the wood fuels supply business in the Antananarivo and Mahajanga regions, intending to improve the efficiency of supply and marketing arrangements. The study<sup>6</sup> was carried out in 1992 and revealed that the alarmist picture of ever-increasing deforestation around Antananarivo and inexorably rising wood fuel prices presented by the Energy Assessment report was *incorrect* (see paras. 13–16). This realization meant that the project as designed at appraisal was no longer appropriate. It was therefore jointly agreed to refocus this component to concentrate on demand-side issues. No formal restructuring of the project was necessary because demand-side management through the design and dissemination of efficient stoves had been included in the original project scope.

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4. Energy Assessment Report, para. 13.

5. Ln. 1065-MAG & Cr. 525-MAG, 1974 and Cr. 1161-MAG, 1982.

6. Approvisionnement en combustibles ligneux d'Antananarivo et Mahajanga, by Alain Bertrand, (Oct. 1992), for the Unité de planification des énergies domestiques, which was the implementing agency for this component of the project.

## Wood Fuel Supply Chain

13. Antananarivo is almost entirely supplied with charcoal produced from long-established private eucalyptus plantations, some of them dating from the early years of this century. They were originally established to stake land tenure claims to the plots and to supply fuelwood to the steam railway. The latter market for fuelwood was replaced by supply to city households as steam trains disappeared. Today there is no shortage of wood or charcoal supply in Antananarivo, and the area planted with eucalyptus has increased in line with demand growth. The extraction rates are sustainable and the entire supply chain works efficiently. These private eucalyptus plantations have also helped to prevent erosion on the upper mountain slopes, which would otherwise have badly damaged the rice cultivation areas in the lowlands.

14. The wood supply study was a major contributor to a correct understanding of the supply chain for wood fuel and showed that the highly aggregated approach of the Energy Assessment and the Project was incorrect. The interaction between household energy consumption and the environment has to be looked at on a regional level in Madagascar if appropriate local action is to be taken.

15. Contrary to the expectation of the Energy Assessment report that charcoal prices would rise in real terms, they appear to have remained stagnant or even to have declined gradually. Between 1991 and 1997 nominal charcoal prices in Antananarivo rose threefold while the national consumer price index rose by a factor of 3.3.<sup>7</sup> The wood supply study argues that (a) given the declining per capita incomes in real terms and (b) that charcoal supply to Antananarivo can expand in line with rising demand (driven by demographic factors), there is no pressure that would drive up real charcoal prices. Since rural families rely on charcoal sales to supplement their income, downward pressure on real charcoal prices seems to have had the effect of increasing the supply as producers sought to make up the lost real income by increasing the volumes sold.

16. In sharp contrast to the favorable situation in Antananarivo, in most other regions, including Mahajanga (which was part of the study), the bulk of wood fuel supply comes from the unsustainable depletion of natural forests and mangroves, with grave ecological consequences. The pressure on supply is reflected in charcoal prices in the other urban centers, which are significantly higher than in the capital.<sup>8</sup> The Bank's recent follow-on project<sup>9</sup> was designed to partially address the fuelwood supply problems of 16 other urban centers.

## Pine Charcoal Component

17. The initial design of the project envisaged a substantial increase in the supply of charcoal to Antananarivo by introducing a new, lower-priced<sup>10</sup> source of supply—the pine-based charcoal

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7. Between 1994 and 1997 charcoal prices rose only 1.5 times while the consumer price index increased 1.9 times, suggesting that prices are declining significantly in real terms.

8. For example, in 1997 charcoal bought in 40 kg sacks in Mahajanga cost about FMG 410/kg, while the price in Antananarivo averaged about FMG 320/kg.

9. Energy Sector Development Project, March 1996.

10. Since users strongly prefer charcoal made from eucalyptus because it burns more slowly than pine and has less resinous/aromatic emissions, it is necessary to price pine charcoal at a lower level than its competitor.

from the FANALAMANGA plantation at Haut Mangoro. However, this would have destabilized the smooth functioning of the supply system for eucalyptus charcoal as well as hurt the incomes of the rural charcoal producers. Following the Bank's recommendation, the project implementing unit (PIU) wisely dropped this component of the original design and concentrated its efforts on improving the efficiency of charcoal production and consumption, as described in paras. 21–23.

18. Without support from the project, FANALAMANGA has nevertheless supplied small quantities of charcoal to Antananarivo over the past decade, but has never succeeded in overcoming consumer reluctance to use it, despite a significantly lower price. Its sales are concentrated in the rainy and harvest seasons when there are temporary shortages of eucalyptus charcoal in Antananarivo because production is halted by the rain or because peasants are too busy to produce sufficient charcoal to meet the city's needs.

19. FANALAMANGA's peak sales were only about 1,000 tons in 1993/94, and have since fallen steadily to just over 100 tons in 1997/98, which is insignificant in comparison with Antananarivo's annual charcoal consumption of about 150,000 tons. The decline is mainly due to the poor returns on the activity and the deteriorating condition of its trucks. Other potential urban markets are even farther away. Attempts to find industrial users and export markets for the charcoal have also failed. The physical/combustion characteristics of the product and a high volume-to-weight ratio, which dramatically raises transport costs, are major handicaps. These efforts to find alternative users were supported by the project, because the Bank was understandably keen to see some use made of this resource. In recent years, FANALAMANGA has given greater emphasis to the sale of logs and it appears that this will be its principal activity for the foreseeable future.

20. More efficient charcoaling techniques using improved kilns were devised and training of peasant charcoal producers was carried out by FANALAMANGA under the project, but served little purpose because of the "oversupply" of the pine resource and the difficulty of selling the final product. A parallel FAO technical assistance credit funded the training of trainers to disseminate the new techniques in other parts of Madagascar where deforestation is rampant. However, efforts to do so have had limited success because of resistance from the Forestry Service, which has a "policing mentality" and would like to stamp out illegal charcoaling in natural forest reserves rather than improve its efficiency.

### **Improved Charcoal Stoves Program**

21. Unlike in Sahelian countries, where a great deal of work was done on improved woodstove programs during the 1980s, only a few models of improved stoves had been introduced on a modest scale in Madagascar before the project implementation unit for the household energy component of the project, the Unité de planification des énergies domestiques (UPED), was set up in 1991. UPED had access to equipment, foreign technical assistance, and an adequate operating budget and was directly funded from the IDA credit. Although formally part of the Ministry of Energy, and staffed by some of its personnel, UPED had a great deal of autonomy, which enabled it to function effectively at a time when the normal operations of government were seriously disrupted by political unrest. Its accomplishments are remarkable in the political context of the time, when much normal activity was in a state of semi-paralysis.

22. A \$2.6 million program to improve the design of charcoal stoves, to test them with users, train artisans to produce the new models, and then to disseminate the best design was the

principal activity of UPED during its three-year life from mid-1991 to its abrupt closure in 1994.<sup>11</sup> The UPED-approved models<sup>12</sup> of stoves gave an average reduction in charcoal consumption of over 35 percent. More than 115,000 improved charcoal stoves were sold between 1992 and 1994, and the pace of substitution appears to have continued since then, although reliable sales data were no longer collected after UPED was closed. The traditional, less efficient stove is still available, but in Antananarivo markets it now accounts for a small minority of charcoal stoves available for sale. Today about 100,000 households in the capital have an improved stove; they account for about half of all charcoal stoves in use (see Annex B). Such high penetration rates in a relatively short period are unusual and the underlying success factors are analyzed in detail in the next section of this PAR.

23. The UPED improved charcoal stove program had a very significant impact on household income, particularly of the poorest families. In the context of urban poverty in Madagascar, a 25 to 30 percent cut in the fuel budget made a considerable difference. UPED's surveys after the introduction of the improved stoves showed that the charcoal savings were sufficient to allow the poorest families the means to prepare an additional cooked meal per day. The improved stoves program is a rare example of an energy project having a direct and significant impact on disposable income. The project had a minimal beneficial environmental impact, but a noteworthy anti-poverty one. A saving of US\$15–20 per year on energy expenditures is significant in a country with a per capita income of only US\$230. The economic returns to the project from charcoal savings were used as a narrow estimate of project benefits in the rate of return calculation given in Annex B. Only charcoal savings in Antananarivo have been estimated, even though many stoves can now be found in other cities as well. On this basis, the internal economic rate of return to the project was at least 17 percent.

### **Factors of performance**

24. Many factors contributed to the success of the woodstove program. Some are specific to the prevailing context in Madagascar at the time, but others are of a more general nature and are relevant to other countries.

25. Madagascar's prolonged economic crisis is characterized by continuously falling real per capita incomes,<sup>13</sup> which gives households a strong incentive to economize on energy consumption. The state of the economy also meant that there was an ample supply of unemployed skilled workers who were keen to be retrained to make improved stoves.

26. UPED proceeded on the basis that the standard measure of stove efficiency—the percentage of utilized heat—was not a relevant indicator for most stove users. Much more significant is the amount of charcoal required to cook a meal. Hence UPED put great importance on ensuring that the type of stove was adapted to the specific needs of preparing Malgache food.

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11. UPED was originally intended to become a permanent unit of the ministry and continue its activities under the Bank's follow-on project.

12. Some are entirely of metal and others are mixed metal/fired-clay models. Both types come in several sizes. The "traditional" stove was entirely metal.

13. Average yearly economic growth for the last 25 years has been 0.5 percent, well below the increase in population.

They correctly considered that it was pointless to improve the energy efficiency of stoves if the extra calories gained are not required.

27. UPED carried out exhaustive scientific tests of more than 30 stove models and studied household cooking practices to identify type of design features required to minimize charcoal consumption.<sup>14</sup> There was extensive participation in the testing process by both end-users (cooks) and producers (artisans).

28. The models of improved stove were unequivocally better than the existing ones. On average, households gained a 35 percent reduction in their charcoal usage. The fuel savings in about one week of cooking was sufficient to cover the cost increment over a traditional stove. The new stoves were also longer lasting by over 25 percent and so needed replacing less frequently. Hence the improved stove could sell itself on its own merits, even with a price premium.

29. The active involvement of the artisans and stove vendors in UPED's work helped to ensure the sustainability of the switch to the new stoves. No subsidies were given to stove producers, who only received training in production techniques. That the profit margin for the new stove was higher than for a traditional stove also helped persuade producers to make more improved stoves and reduce the production of traditional ones.

30. UPED had a very effective media campaign in the press to promote consumer awareness of the issue and the advantages of using the improved stoves. The project made use of specialists in marketing and communications. They created a "brand" image for the new stoves to distinguish them from the old ones and held public demonstrations of the use of the improved stoves in marketplaces. The participation of more than 30 non-governmental organizations working mainly with women was another effective way to disseminate information on the advantages of the new stoves and to arrange bulk orders for stoves with the producers.

31. Finally, the project was undoubtedly aided by the high quality of the technical assistance personnel who worked on it and by the commitment of UPED staff (both local and expatriate) to the goals of the project. It should be noted that the initial technical assistance contract did not include the stove dissemination program, but only the design, testing, and training phases; good initial results, staff commitment, and the availability of adequate funds in the credit meant that extending the contract scope was fully justified.

### **Overall Assessment**

32. This audit considers the household energy component of the project to have had a substantial institutional development impact and its sustainability to be likely. Four years after the end of the project, the audit mission found that the improved stoves continue to be produced and sold in large quantities in Antananarivo. They are also transported for sale in other towns where they command significantly higher prices. The local project staff gained skills and experience that were to have been applied to extending the stove dissemination program to other cities under

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14. UPED's applied research also revealed that cooking techniques can be modified to further reduce charcoal consumption by as much as 25 percent, without any adverse impact on cooking time or food taste. This information was also extensively disseminated during the ensuing publicity campaigns.



the subsequent Bank project. Bank performance under this component is rated as satisfactory and Borrower performance as highly satisfactory. Given that the results of the project far exceeded initial expectations, that the project had a valuable poverty reduction impact, and that the penetration rate of improved stoves (over 40 percent of household in Antananarivo possess one) is now among the highest achieved anywhere, the overall outcome of this component is rated as highly satisfactory.

## CONCLUSIONS

33. Several of the reasons for the success of the Malgache stoves dissemination program, such as the active participation of producers and users, the purely commercial, private (unsubsidized) production and sale of stoves, and the limiting of external support to design, testing, surveys, and publicity, have wider applicability and have been identified as important factors elsewhere.<sup>15</sup>

34. Better stoves only result in a one-time reduction in fuel consumption, so they are not a long-term remedy to deforestation. As the rate of penetration of improved stoves goes up, charcoal use drops temporarily, but total wood fuel consumption eventually rises again to unsustainable levels due to demographic factors. However, by delaying or slowing the increase in wood fuel consumption, a successful improved stoves program provides a window of opportunity in which other fuels like kerosene, electricity and LPG should be promoted. Such fuels have a longer lasting and greater impact on wood fuel use, provided major inter-fuel substitution can be effected. For example in Addis Ababa, Ethiopia, there has been a dramatic change in the pattern of household energy consumption since the mid-1980s. The program of improved charcoal stoves was accompanied by a major switch to kerosene and electricity as cooking fuels.

35. In Madagascar, there has been no such effort to promote the use of alternative household fuels. While the environmental consequences of inactivity may be benign for Antananarivo, due to its unique charcoal supply arrangements, other cities are far less well placed in this regard. Charcoal prices are higher and there is a direct link with shrinking natural forest cover, causing serious environmental damage. Much remains to be done in this area.

36. Furthermore, other urban centers in Madagascar have yet to benefit from a concerted improved stoves campaign because of a major delay in implementing the Bank's ongoing Energy project. This delay is highly regrettable because the expertise and public awareness built up by UPED has been partly dissipated. The household energy component of the Bank's ongoing project would have benefited considerably if it had followed on directly from its predecessor and UPED and not been closed. Part of the reason for the delay can be attributed to the perceived low status of and low priority given to household energy problems, both within the government and the Bank, where other forms of energy such as electricity tend to consume most of resources.

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15. What makes people cook with improved stoves, Barnes, Openshaw, Smith & Van der Plas, Energy Series Working Paper, # 60, World Bank, 1993.

## LESSONS

37. Although the household energy component accounted for only a small proportion of this US\$25 million Energy credit, its implementation yielded valuable lessons:

- The case of Antananarivo shows that the link between household consumption of wood fuels and environmental degradation is not always direct and self-evident. Local conditions vary enormously and measures to combat deforestation must be location-specific to be effective.
- The social, economic, and environmental benefits from improved stoves can be considerable.
- The cost of such programs is quite low, yet they can have a wide impact on a large segment of the population, particularly the poor. By contrast, the much costlier electricity component of the same project only led to an increase of 14,000 residential connections in the same period, while the stoves program brought benefits to nearly 10 times as many households.
- Training producers to use more efficient charcoaling techniques in natural forests is hindered by the policing mentality of many forest service employees who see their role as preventing such illegal activities. Since prevention is both impossible and undesirable—because of the adverse impact on both charcoal producers and users—charcoaling needs to be legalized, controlled, and improved with the collaboration of forestry personnel.
- The interactions between the energy sector, rural development, and environmental protection are complex and often insufficiently analyzed and incorporated in project design. Few energy/environmental/rural development sector specialists responsible for project design have the breadth of expertise in all these three areas to adequately incorporate these interactions in their projects.



## Basic Data Sheet

### ENERGY I PROJECT (CREDIT 1787-MG)

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

	<i>Appraisal estimate</i>	<i>Actual or current estimate</i>	<i>Actual as % of appraisal estimate</i>
Total project costs <sup>1</sup>	59.81	54.70	91%
Loan amount	25.00	25.18	
Cofinancing			
Cancellation	-	1.60	
Date physical components completed			
Economic rate of return <sup>2</sup>	n.a.	17%	

1. Total project.

2. Woodstove component only.

#### Cumulative Estimated and Actual Disbursements

	<i>FY88</i>	<i>FY89</i>	<i>FY90</i>	<i>FY91</i>	<i>FY92</i>	<i>FY93</i>	<i>FY94</i>	<i>FY95</i>
Appraisal estimate (US\$M)	1	5.00	12.50	19.50	25.00			
Actual (US\$M)		3.52	5.03	7.75	12.30	18.71	22.16	25.18
Actual as % of appraisal		70.40	40.20	39.70	49.20			

Date of final disbursement: 05/17/95

#### Project Dates

	<i>Original</i>	<i>Actual</i>
Identification	August 1983	August 1983
Preparation	June 1984	February 1986
Appraisal	May 29, 1986	June 2, 1986
Negotiations	-	February 24, 1987
Board approval	February 1987	April 28, 1987
Signing	-	August 20, 1987
Effectiveness	July 1987	July 19, 1988
Closing date	December 31, 1992	December 31, 1994

**Staff Inputs (staff weeks)**

	<i>Planned</i>	<i>Actual</i>
Through appraisal	n.a.	91.7
Appraisal through Board approval	n.a.	7.6
Board approval through effectiveness	n.a.	2.8
Supervision	n.a.	142.9
Completion	n.a.	5.0
Total		250.0

**Mission Data**

	<i>Date (month/year)</i>	<i>No. of persons</i>	<i>Staff days in field</i>	<i>Specializations represented</i>	<i>Implementation status</i>	<i>Development objectives</i>	<i>Types of problems</i>
Through appraisal	08/85 to 06/86	16	60	Energy Planner Power Engineer Financial Analyst			
Appraisal through Board approval	06/86 to 04/87	0	0				
Board approval through effectiveness	04/87 to 07/88	7	51	Energy Planner Financial Analyst			
Supervision	08/88 to 05/94	40	247	Energy Planner Power Engineer Financial Analyst	2	1	
Completion	06/94 to 07/94	1	19	Financial Analyst	1	1	

**Other Project Data**

Borrower/Executing Agency:

<i>FOLLOW-ON OPERATIONS</i>			
<i>Operation</i>	<i>Credit no.</i>	<i>Amount (US\$ million)</i>	<i>Board date</i>
Energy Sector Development Project	2844	31.8	4/16/1996

## Economic Evaluation of Improved Woodstove Dissemination Program in Antananarivo

	1991	1992	1993	1994	1995	1996	1997	1998
Population	1,227,056	1,261,168	1,296,229	1,332,264	1,369,301	1,407,367	1,446,492	1,486,705
Growth rate	2.78%	2.78%	2.78%	2.78%	2.78%	2.78%	2.78%	2.78%
Av. household size	5.1	5.1	5.1	5.1	5.1	5.1	5.1	5.1
Total no. of households	240,599	247,288	254,162	261,228	268,490	275,954	283,626	291,511
% households using charcoal	76%	76%	76%	76%	76%	76%	76%	76%
No. h/holds using charcoal	183,914	189,027	194,282	199,683	205,234	210,940	216,804	222,831
Av. h/hold consumption of charcoal (kg/month/household)	56	56	56	56	56	56	56	56
No. of UPED stoves sold								
mixed model		237	23,725	30,000	37,500	45,000	45,000	45,000
metal only		1,068	9,000	5,000	6,250	7,500	7,500	7,500
No. of stoves/household	1.9	1.9	1.9	1.9	1.9	1.9	1.9	1.9
Share of replacement stoves in sales		0%	0%	20%	33%	33%	33%	33%
No. of households using UPED stoves		676	16,956	31,464	46,652	64,877	83,102	101,328
Penetration rate of UPED stoves		0%	9%	16%	23%	31%	38%	45%
Charcoal consumption w/o UPED stoves(kg)		127,525,075	131,070,272	134,714,025	138,459,075	142,308,237	146,264,406	150,330,557
Av. charcoal savings rate, UPED stoves		30%	30%	30%	30%	30%	30%	30%
Charcoal savings due to UPED stoves (kg)		136,851	3,431,750	6,368,007	9,441,901	13,130,574	16,819,247	20,507,920
Price, traditional stove (av. US\$)	0.54	0.54	0.54	0.54	0.54	0.54	0.54	0.54
Price, improved metal stove (US\$)	1.63	1.63	1.63	1.63	1.63	1.63	1.63	1.63
Price, imprvd mixed model (US\$)	2.45	2.45	2.45	2.45	2.45	2.45	2.45	2.45
Av. charcoal price (US\$/kg)	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Benefits (in US\$)		10,441	261,823	485,843	720,363	1,001,788	1,283,212	1,564,637
Costs (in US\$)								
UPED Project Costs	642,170	808,755	713,786	390,447				
Extra cost to h/holds of improved stoves		1,616	55,061	62,670	78,338	94,005	94,005	94,005
Net benefits (US\$)	- 642,170	- 799,930	- 507,025	32,726	642,025	907,782	1,189,207	1,470,631
NPV	603,904 US\$							
IRR	17%							

### Notes:

Discount rate 10%

Stove sales data 1992-94 are actuals.

Estimated stove sales growth: 1995 - 25%, 1996 - 20% & 1997 - 15%.

Benefits to artisans from increased sales and profits not included.

All UPED project costs included but stove sales outside Antananarivo not included.

Sources: UPED documents, Direction de l'Energie and Mission estimates.



## Comments from the Borrower

MINISTRE DE L'ENERGIE  
ET DES MINES  
                      
DIRECTION DE L'ENERGIE  
                    

Antananarivo, le 12 Février 1999

FAX N° 023 /MEM/SG/DG/DEN.1

**DESTINATAIRE :** BANQUE MONDIALE  
( à l'attention de M.Alain BARBU , Chef par intérim- Groupe des évaluations  
sectorielles et thématiques- Département de l'évaluation des opérations-)  
WASHINGTON D.C

**EXPEDITEUR :** Monsieur le MINISTRE DE L'ENERGIE ET DES MINES

**N° TELECOPIE DESTINATAIRE :** (202) 522-3123

**N° TELECOPIE EXPEDITEUR :** 00 261 20 22 325 54

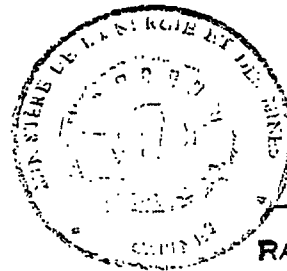
**OBJET :** EVALUATION RETROSPECTIVE - PROJET ENERGIE I (Crédit 1787 MAG ) MAGAGASCAR

**REFERENCE :** V.L du 7 Janvier 1999

Monsieur,

Suite à votre lettre mentionnée en référence, j'ai l'honneur de vous faire connaître que mon département n'a pas d'observation quant au rapport provisoire établi après la mission de Juillet 1998 sur l'évaluation retrospective de deux composantes du projet en objet, à savoir « Renforcement Institutionnel » et « Energie Domestique ».

Veuillez agréer, Monsieur, l'expression de ma considération distinguée.



*Charles Rasoza*  
RASOZA Charles





## **Unofficial Translation**

**Ministry of Energy and Mines  
Energy Directorate**

Antananarivo, February 12, 1999

Mr. Alain Barbu  
Acting Manager  
Sector and Evaluations Group  
Operations Evaluation Department  
World Bank  
Washington, D. C.

### **Performance of First Energy Project (Credit 1787-MAG)**

**Ref: Your letter of January 7, 1999**

Dear Sirs:

In answer to your referred letter, I am pleased to inform you that my Department does not have any comments on the draft report prepared after the July 1998 mission for the performance audit of two components of the above mentioned project, namely institutional development and household energy.

Regards,

Signed by  
Charles Rasoza