ESMAP

Energy Sector Management Assistance Programme

MAY 1992

Republic of Mali

Household Energy Strategy

Report No. 147-92

JOINT UNDP / WORLD BANK
ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME (ESMAP)

PURPOSE

The Joint UNDP/World Bank Energy Sector Management Assistance Programme (ESMAP) was launched in 1983 to complement the Energy Assessment Programme, established three years earlier. ESMAP's original purpose was to implement key recommendations of the Energy Assessment reports and ensure that proposed investments in the energy sector represented the most efficient use of scarce domestic and external resources. In 1990, an international Commission addressed ESMAP's role for the 1990s and, noting the vital role of adequate and affordable energy in economic growth, concluded that the Programme should intensify its efforts to assist developing countries to manage their energy sectors more effectively. The Commission also recommended that ESMAP concentrate on making long-term efforts in a smaller number of countries. The Commission's report was endorsed at ESMAP's November 1990 Annual Meeting and prompted an extensive reorganization and reorientation of the Programme. Today, ESMAP is conducting Energy Assessments, performing preinvestment and prefeasibility work, and providing institutional and policy advice in selected developing countries. Through these efforts, ESMAP aims to assist governments, donors, and potential investors in identifying, funding, and implementing economically and environmentally sound energy strategies.

GOVERNANCE AND OPERATIONS

ESMAP is governed by a Consultative Group (ESMAP CG), composed of representatives of the UNDP and World Bank, the governments and institutions providing financial support, and representatives of the recipients of ESMAP's assistance. The ESMAP CG is chaired by the World Bank's Vice President, Operations and Sector Policy, and advised by a Technical Advisory Group (TAG) of independent energy experts that reviews the Programme's strategic agenda, its work program, and other issues. The Manager of ESMAP, who reports to the World Bank's Vice President, Operations and Sector Policy, administers the Programme. The Manager is assisted by a Secretariat, headed by an Executive Secretary, which supports the ESMAP CG and the TAG and is responsible for relations with the donors and for securing funding for the Programme's activities. The Manager directs ESMAP's two Divisions: The Strategy and Programs Division advises on selection of countries for assistance, carries out Energy Assessments, prepares relevant programs of technical assistance, and supports the Secretariat on funding issues. The Operations Division is responsible for formulation of subsectoral strategies, preinvestment work, institutional studies, technical assistance, and training within the framework of ESMAP's country assistance programs.

FUNDING

ESMAP is a cooperative effort supported by the World Bank, UNDP and other United Nations agencies, the European Community, Organization of American States (OAS), Latin American Energy Organization (OLADE), and countries including Australia, Belgium, Canada, Denmark, Germany, Finland, France, Iceland, Ireland, Italy, Japan, the Netherlands, New Zealand, Norway, Portugal, Sweden, Switzerland, the United Kingdom, and the United States.

FURTHER INFORMATION

For further information or copies of completed ESMAP reports, contact:

The Manager
ESMAP
The World Bank
1818 H Street N.W.
Washington, D.C. 20433
U.S.A.

or

The Executive Secretary
ESMAP Consultative Group
The World Bank
1818 H Street, N.W.
Washington, D.C. 20433
U.S.A.

REPUBLIC OF MALI

HOUSEHOLD ENERGY STRATEGY

MAY 1992

EXCHANGE RATE

November 1989

U.S. $1 = FCFA 300

CONVERSION FACTORS

Petroleum Products	tons/m3	MJ/kg	TOE/ton
LPG	0.56	45.7	1.09
Kerosene	0.80	43.5	1.04
Gasoil	0.84	43.3	1.03
Woodfuels			
Wood (airdry)	0.70	17	0.405
Charcoal		29	0.69

Electricity	TOE/GWh
Final Energy	86
Primary Energy	283

ACRONYMS

IDA	International Development Association
EEC	European Economic Community
SEMU	Solar Equipment Maintenance Unit
PICDCS	Permanent Inter-State Committee for Drought Control in Sahel
MCDTF	Malian Company for the Development of Textile Fibers
RCSE	Regional Center for Solar Energy
NWFD	National Waterways and Forest Development
NHED	National Hydraulics and Energy Department
NSDPD	National Statistics and Data Processing Department
EOM	Energy of Mali
ESMAP	Energy Sector Management Assistance Program
GPPIM	Group of Petroleum Product Importers of Mali
GPPM	Group of Petroleum Producers of Mali
GTZ	Gesellschaft fur Technische Zusammenarbeit (Germany)
SEL	Solar Energy Laboratory
MAHE	Ministry of Agriculture, Husbandry, and Environment
MMHE	Ministry of Mines, Hydraulics, and Energy
FMPO	Forestry Management and Production Operation
STMPO	Sikassa Tree Management and Planting Operation
OHREHN	Office for Hydraulic Resource Exploration in the Haut Niger
ODSR	Organization for Development of the Senegal River
NGO	Non-Governmental Organization
NTO	National Transportation Office
PSRO	Price Stabilization and Regulation Office
WRIP	Wood Resource Inventory Program
LRIP	Land Resource Inventory Project
NDCP	National Desertification Control Program
UNDP	United Nations Development Program
ESP	Energy Special Program
ARC	African Refining Company (Senegal)
IFC	Ivoirian Refining Company (Cote d'Ivoire)

TABLE OF CONTENTS

LIST OF ANNEXES

MAPS:

EXECUTIVE SUMMARY

Introduction

1. The Household Energy Strategy Study for Mali was carried out under the Joint UNDP/World Bank Energy Management Assistance Program (ESMAP), with financing provided by the Netherlands. Field work was conducted in close collaboration with the National Hydraulics and Energy Department (Direction Nationale de l'Hydraulique et de l'Energie - DNHE) and the National Waterways and Forests Department (Direction Nationale des Eaux et Forets - DNEF), as well as with other Malian institutions and organizations participating in the Advisory Committee responsible for supervising this study.

2. Various surveys and preliminary studies were conducted in preparation for the strategy, including: household surveys in Bamako and the main secondary cities; an informal sector survey in Bamako; measurements of woodfuel consumption levels and prices; testing and presentations of energy equipment; meetings of consumer test groups; and surveys of woodfuel production zones.

3. This report presents an appraisal of the supply and demand of household energy in urban areas, analyzes the potential evolution of this supply and demand, then identifies areas of intervention needed to resolve the problems identified in the sector. The final section of the report describes the eight components of the Strategy, complete with an evaluation of costs, benefits, risks and economic and environmental impacts. Potential financing is also discussed.

Importance of the Household Sector

4. The household sector dominates Mali's energy balance, accounting for nearly 91% of total energy consumption in 1987. Fuelwood alone represents 96% of final energy consumption in households. Use of modern fuels in rural areas is almost nonexistent, while in urban and semi-urban areas (where 20% of the total population reside), use is still quite limited. Per capita energy consumption is comparable in rural and urban areas, since rural dwellers make greater use of less efficient woodfuels. Wood and charcoal consumption in Bamako and other main cities has a greater environmental impact than woodfuel consumption in rural areas, where lower population densities coupled with relative abundance and variety of wood resources attentuates the impacts due to offtake for energy consumption.

5. Production and marketing of wood and charcoal in urban areas is a major economic activity, generating an estimated 10 billion CFAF in annual revenues (7 billion for wood and 3 billion for charcoal). This amount is comparable to the annual revenues generated in the electricity sector. Nevertheless, it should be noted that forestry taxes on these activities generate revenues equivalent to only 1% of the total revenues in the sector.

A Strategy for Household Energy

6. Because of its considerable weight in the national energy balance, and its impacts on the national economy and on the environment, Mali's household energy sector clearly is a sector of primary importance. The National Desertification Control Program (Plan National de Lutte Contre la Désertification - PNLCD) serves as a coordinator for many ongoing or projected activities for improving the conditions for the supply and use of energy resources, and for limit the dangers of overexploiting the national forest reserves. However, other activities have been launched independently. The conflicting objectives of these activities must be reconciled: reduce woodfuel consumption by encouraging use of substitution fuels without aggravating the balance of trade; protect threatened ecological zones without depriving local wood producers of an important source of income; have prices reflect the economic costs of standing wood without penalizing the poorest urban consumers; ensure better (less costly) access to electric service without upsetting the financial situation within the power sector, particularly for Energie du Mali (EdM).

7. The proposed Strategy defines a coordinated framework of medium and long term policies for the household sector, with the objective to manage more efficiently national and imported energy resources and to provide better energy service to the urban population. In addition, the Strategy will provide the means for a segment of the rural population to take over and properly manage forest resources in their areas and to increase the income generated by exploiting those resources. These objectives are to be accomplished by acknowledging and formalizing the indisputable link between the energy and forestry sectors. Large-scale substitution of wood and charcoal by new fuels is hardly feasible within the medium-term, and thus national forest reserves must be managed responsibly. Nevertheless, deliberate substitution efforts will be needed in areas where reserves already are severely degraded (in northern regions, especially).

8. The strategy incorporates recommendations presented by and/or discussed with the main participants of Mali's energy sector. It also reflects the concerns and recommendations of the households themselves, ascertained through surveys and group interviews. In addition, the strategy provides incentives for local and private initiatives: the national government relinquishes its role in activities which can be marketing wood or in rural land management for example, while strengthening its control of the woodfuel supply (which it currently supervises inadequately). Finally, the strategy aims to bring the prices of household fuels closer to their economic costs, without decreasing the total fiscal revenues generated by the sector for the State.

Main Characteristics and Issues in the Household Energy Sector

9. Chapter 2 presents a detailed discussion of the main characteristics and issues of Mali's household energy sector. They are as follows:

(a) the dominance of wood consumption and the gradual growth of charcoal use;

(b) the successful market penetration by improved stoves;

(c) the existing differentials between prices and the relative economic costs of household fuels;

(d) the relative markets for various fuels which could substitute for wood and their economic impacts;

(e) the threat of environmental damage;

(f) the options for improving the situation in regions with wood resource deficits;

(g) an institutional, regulatory and fiscal framework ill-adapted to managing wood resources;

(h) the deficiencies in access to energy services, especially in electricity.

Objectives, Components and Costs of the Strategy

10. The proposed strategy addresses two fundamental objectives for developing the household energy sector:

(a) at the demand level, improve access to and utilization of energy, especially "modern" fuels, and thereby improve the daily standard of living for the Malian people;

(b) at the supply level, revise the means of supplying woodfuels so as to generate economic development without substantial risk to the environment by establishing practices for rationally managing forestry resources among the rural communities.

11. The strategy is divided into two modules: demand and supply. The demand module is comprised of three components for improving access to modern household fuels and for improving the efficiency of their use. The supply module consists of five components for rational management of forest resources. Implementation of the strategy's eight components will be supervised and coordinated by the Household Energy Unit (Cellule Energie Domestique - CED; to be established within the NHED) for the demand module and by the Woodfuels Unit (Cellule Combustibles Ligneux - CCL, to be established within the NWFD) for the supply module. The CED and the CCL will be supervised by the Strategy Steering Committee, which will be composed

of senior officials from the MMHE and the MAEE. A Temporary Steering Unit (TSU) will be created to operate only during the first year of strategy implementation. The TSU will have the following main responsibilities: (a) identify and mobilize national and external financing, as needed; and (b) prepare a detailed action plan for each component which receives financing.

12. Three components are devoted to improving access to modern fuels. The first involves research of "popular energy products" (PEP) adapted to the Malian market (technical and consumer tests for kerosene and gas cookstoves, improved charcoal and firewood stoves, portable photovoltaic lamps, etc.) and their introduction onto the market. The objective of the second component is to promote and provide assistance for marketing these products (media support, assistance to existing promotion agents, creation of decentralized distribution networks). Under the third component, specific and innovative credit mechanisms will be established to benefit small and medium-sized producers and operators, as well as consumers.

13. The remaining five components are supply-side oriented: (i) preparation of Woodfuel Supply Master Plans for the main cities (identification of preferred exploitation zones, geographic re-location of wood drawdown, improved infrastructure and monitoring woodfuel entries in large cities); (ii) assistance to firewood professionals (establish a network of rural wood markets, assistance to organize and equip selected groups of producers, transporters and marketers who will operate around these markets, training and information for firewood professionals and rural community representatives); (iii) modernize the charcoal sector (rationalize and organize charcoal production, transport and marketing); (iv) recovery of dead wood reserves to supply the northern cities (evaluate potential, identify appropriate exploitation practices, assist the establishment of supply networks); (v) managed supervision of classified forests and sensitive village territories (defined by component (i)) near the southern cities (technical assistance to village collectives, monitoring compliance with management regulations).

14. The success of the Strategy will depend on implementation of specific policies and a permanent monitoring and evaluation system for the sector. The appropriate policies and programs will be defined the CCL and the CED and will include:

(a) Monitoring prices of household petroleum fuels after planned price decontrol and, if necessary, prepare specific proposals for revising existing tax policy ;

(b) Revise regulations and taxes for wood and charcoal (local collection of part of the woodfuel taxes; introducing tax differentials);

(c) Assistance in the preparation and enactment of legal texts granting temporary and conditional land management authority to local collectives in areas targeted by the Strategy;

(e) Implementation of a permanent evaluation and control system for the sector. As indicated in the previous chapter, this task will be conducted by NHED and the NWFD.

15. The strategy will cover a five year period (including one year for preparation), with a total estimated cost of US $9.1 million, allocated as follows:

	Million US$
DEMAND MODULE	
Household Energy Unit (MMHE)	376
Data Evaluation Service (MMHE)	120
Component 1: Development of PEP	365
Component 2: PEP Promotion	510
Component 3: Small Credit Facilities for PEP	840
Subtotal	2211
SUPPLY MODULE	
Woodfuels Unit (MAEE)	1142
Projects and Programs Division (MAEE)	120
Component 4: Fuel Supply Master Plans	948
Component 5: Assistance for Wood Professionals	712
Component 6: Modernizing the Charcoal Sector	515
Component 7: Dead Wood Recovery	429
Component 8: Management of Forested Village Lands	1866
Subtotal	5732
Temporary Steering Unit	335
Miscellaneous	828
TOTAL STRATEGY	9106

16. The Government's share is about 6% of total costs and comprises personnel costs for staff seconded from the MAEE and the MMHE. If the results obtained during strategy implementation are to be sustained over the long term, a recurrent sum of US$270,000 per year (average) will have to be committed for 1997 - 2001 (operating costs and reduced training/information activities by CED, CCL and two evaluation/statistical bureaus), with small sums in the subsequent years. It should be noted that these recurrent costs are much smaller than

the additional fiscal revenues generated by the strategy; thus the strategy will not have negative impacts on the national budget.

Expected Results

17. The expected results for the Strategy are presented below for the year 2001, approximately five years after the active implementation phase of the Strategy. In terms of substitution fuels, the diversification scenario of the Strategy projects the following results:

(a) 22,000 tons of gas, versus consumption of only 6000 tons in the base case (continuation of current trends).

(b) 12,000 tons of kerosene, versus only 200 tons in the base case.

(c) projected charcoal consumption in Bamako 40% less than base case projections.

18. With respect to the distribution of improved stoves, the following results are projected:

(a) nearly 900,000 portable metallic improved wood stoves, about two-thirds of these distributed in Bamako; and more than 120,000 improved charcoal stoves.

(b) 80,000 kerosene stoves and 225,000 gas stoves.

19. With respect to the small power consumers, implementation of the Strategy should provide access to electricity to about 12,000 additional households (in addition to those targeted by the Second Power Project). This includes both "simplified" electrification and intermediate household pre-electrification options. About 80% of these households will be in Bamako.

20. At the rural level, the Strategy will obtain the following results:

(a) about 1.5 million wooded hectares will be placed under controlled local management;

(b) about 300,000 wooded hectares, 25% of these classified forests, gradually will be placed under land use and development plans;

(c) approximately 100 associations for rural wood producers will be formed, organized around rural woodfuel markets;

(d) 85% of all woodfuels entering the cities will be subjected to Forest Service controls;

(e) nearly 300,000 tons of dead wood in the north will be harvested.

Costs and Benefits

21. The main benefit of the Strategy is the environmental protection it accords to the fragile forest reserves near Mali's cities through its activities for conservation, substitution and improving woodfuel supply. Distribution of improved stoves and cookstoves fueled by non-wood fuels, promotion of energy-efficient cooking techniques and dietary habits will yield wood savings of about 500,000 tons by 2001.

22. With regard to costs, the Strategy requires not only its direct investment costs (US$9.1 million total) but also increased imports due to incentives to encourage the use (however limited) of gas and kerosene. This additional import burden will reach nearly US$20 million by 2001 (22% for additional kerosene imports, 71% for additional LPG imports and 7% for additional imports of cooking equipment), equivalent to nearly 10% of petroleum imports in 2001 (1989 prices). The costs associated with improving access to electricity also must be taken into account; these have yet to be determined (the benefits of these activities also have not been taken into account in this report).

23. The economic analysis indicates an internal rate of return of 36% for the 1991-2000 period. The rate of return is sensitive primarily to the economic value of standing wood and to the relative proportion of endangered exploitation areas to managed exploitation areas. Conservative values for these factors were used in the analysis.

24. The Strategy's fiscal impacts are very positive for the Government. Assuming a gradual increase in and improve of woodfuel tax collection, with no changes to the current tax/subsidy policy for kerosene and LPG, the surplus fiscal revenues generated by the sector (sum of the fiscal earnings for wood and for the new kerosene consumers) would represent nearly US$ 30 million over the years 1992 to 2001. Under these assumptions, the financial internal rate of return is 63%. This figure is sensitive to the market penetration rate for kerosene as a household fuel (and the level of possible deregulation for this fuel), as well as (to a lesser degree) the effectiveness of tax collection and the tax levels on woodfuels. Nevertheless, even in scenarios with neither appreciable market penetration by kerosene nor deregulation, the recommended strategy still yields a financial rate of return of 11%.

25. For urban consumers, application of the tax differential for wood and improved monitoring of woodfuel influxes will cause an increase of 10 to 20% in the retail prices of wood and charcoal. However, for households which cannot afford to convert to a substitution fuel -- most of the lower-income households -- cooking fuel expenditures still will represent only a minor share of the household budget (less than 10%). In addition, use of improved wood stoves and adoption of energy-efficient cooking techniques and dietary habits should counter the negative price effect, especially in impoverished households.

26. For peasants in rural areas targeted under the Strategy (approximately 100 villages), implementation of the Strategy will generate an addition financial benefit by virtue of the planned remuneration for village forestry management activities (nearly equivalent to the total tax differential introduced by the Strategy). This financial benefit from urban consumers to rural producers is estimated at nearly 100 million CFAF/yr in 1996 and beyond.

27. Finally, the Strategy will have a positive, although difficult to quantify, impact on Malian women. By decreasing the time needed to search for wood supplies in rural areas (the result of land management activities), women will have more time to devote to other productive activities. Similarly, urban women will also fined themselves with more time to put to productive uses once they adopt use of new cooking equipment and techniques.

28. In summary, the Strategy can be justified from an ecological basis (natural resource protection and halting deforestation) and from a social basis (improved standard of living for average and modest households). Furthermore, land use problems associated with forested areas are addressed through gradual delegation of territorial management to local peasants; new economic dynamics thus will be introduced into rural areas, encouraging the development of practices which allow for continued, long-term harvesting of woodfuels.

29. The risks linked to strategy implementation are technical, social and institutional. They are, however, limited when compared to the environmental risks associated with not implementing the strategy. The risks can be minimized in part by taking into account the experiences of the Niger Household Energy Project, under implementation since 1989 with assistance from AID. In addition, the TSU's activities during the first year will be devoted partially to refining the definition of and possibly modifying the strategy components. Finally, supervision and coordination of strategy implementation will be the responsibility of small permanent organizations who will receive regular technical assistance (decreasing over time).

30. Approximately US$1 million in financing has been allocated to the Strategy under the Second Power Project to contribute to the costs of strategy implementation; part of these funds will be used to initiate the TSU in 1992. The TSU will mobilize the remaining required financing

and will prepare a detailed action plan for strategy implementation during 1993 to 1996. Disbursements under the Second Power Project exceeding the sum of US$ 335,000 for financing the strategy's preparatory year will be made available only if the Government obtains the additional required financing (estimated at US$ 8.2 million). It should be noted that the mere fact that the Malian Government has agreed to create the TSU indicates the Government's commitment to proper implementation the strategy and its success. This commitment will be viewed favorably by donors and assist the generation of needed financing. A presentation seminar should be organized to determine donor interest in financing strategy components. In additional, the strategy should be implemented in coordination with the AID's Natural Resource Management and Development Projects for the Private Sector, which could be a potential source of additional financing and/or technical assistance.

I. OVERVIEW

Introduction

1.1 The household energy strategy study for Mali was completed under the Energy Sector Management Assistance Program (ESMAP), a joint UNDP/World Bank/Bilateral Aid program, with financing from the Netherlands. ESMAP and its consultants worked with their main counterpart, the National Hydraulics and Energy Department (NHED), as well as with the National Waterways and Forests Department (NWFD), the Solar Energy Laboratory (SEL) and other Malian institutions and organizations participating in the Advisory Committee which was organized to supervise the study.

1.2 The following report was prepared by Philippe Durand and Chiara Tufarelli (ESMAP), based on the report drafted by Michel Matly (energy economist and consultant team leader) and Modibo Dicko (survey coordinator).[1/]

1.3 Various field surveys and inquiries were conducted in order to prepare this strategy: household surveys in Bamako, Ségou, Mopti, Koutiala and Gao; surveys in Bamako's informal sector; actual measurements of woodfuel prices and consumption; consumer testing and demonstrations of energy appliances; testimonial meetings with consumer groups; surveys in wood and charcoal production areas. The results of field surveys and studies were presented in the intermediary reports listed in Annex 1.

1.4 This report presents a thorough analysis of Mali's urban household energy supply and demand using analysis of future trends and identification of areas of intervention to address problems in the sector. The final section describes the nine components of the Strategy and provides an evaluation of costs, benefits, risks and impacts for both the economy and the environment.

1/ Field work conducted in Mali between April and November 1989 was led by Messrs. Matly and Dicko They were assisted by Ms. Joséphine Arpaillange (Energy Statistician, ESMAP); Ms. Mariama Gamatie (Specialist, Women and Energy); Ms. Fatim Guindo (Technician); Ms. Jocelyne Jakob-Durany (Sociologist); Ms. Carolyn Tager (Economist, Coordinator of ESMAP's Women and Energy Program); Ms. Aminata Traoré (Sociologist); and by Messrs. Hamidou Magassa (Sociologist); Henk Neuteboom (Forester); Ousmane Sankaré (Forester) and Piet Visser (Technician). Assistance also was provided by thirty facilitators and surveyors. The study was supervised by Philippe Durand (ESMAP) and Amadou Tandia (DNHE).

Economic and Demographic Context

Demographics

1.5 Mali is one of the largest countries in Africa, with a surface area of 1.24 million km^2. It is an underpopulated country: 7.6 million inhabitants were counted during the 1987 census and the 1991 estimate was about 8.5 million, with population expected to exceed the 10 million mark before the end of the century. Mali's population still is fundamentally rural (80% of total population). Population densities throughout the country are quite low: only 1 inhabitant per km^2 in the semi-desertified zones of the north and up to 30 inhabitants per km^2 near Ségou, the most populated area. Nonetheless, the urban population has grown much more rapidly than the rural population (annual rates estimated at 5.8 and 2.3% respectively from 1988 to 2000); the urban population is expected to represent 30% of the total population by the year 2000.

1.6 Of the eight main towns in Mali (see Annex 2), only the capital, Bamako, is a major urban center. Bamako's population of nearly 800,000 inhabitants (1990) alone accounts for 43% of the urban population. All economic, financial, administrative and political activities are centralized in the capital, thus stimulating the strong migratory influx which fuels Bamako's population growth. The urbanization rates in other regions remain modest: in the second largest town, Ségou, there are only 100,000 inhabitants. By contrast, the growth rate for most secondary towns is quite high. For example Gao and Koutiala both have population growth rates of about 10% per year. This rapid growth creates pressure on the infrastructure, which generally is not design to support concentrated population influxes. [2/]

The Economy

1.7 Mali is one of Africa's poorest countries, with per capita GDP of US$ 270 in 1989. The country is landlocked and has few mineral resources, with the exception of some gold. The economy is largely dependent on agriculture, which is the primary source of income for most of the population and accounts for the largest share of product exports (cotton, especially). Agricultural production levels have suffered during the last two decades due to droughts, depleted fertility of soils, and underdeveloped farming techniques. As a result, Mali's economic performance was somewhat stagnant in the 1970s. However, the 1980s marked a strong period of recovery, with

---

2/ Smaller growth rates were estimated by the DNSI for 1976-1987 based on provisional counts in the 1987 census. The census figures are being reviewed, since population growth rates thus obtained fall far below rates in other Sahelian countries. In light of this, this report retains a national population growth rate of 3% per annum for the 1988 to 2000 period (as given in the World Bank's World Development Report), and uses the distribution of inter-regional growth rates as estimated by the DNSI (See Table 1 in Annex 2).

average annual growth rates of 6% during the latter half of the decade (average growth of 4%/yr throughout the entire decade).

1.8 Mali's economy also is characterized by a large external debt, equivalent in size to the country's GNP. Annual debt service payments currently amount to nearly US$90 million. This large debt burden aggravates Mali's foreign trade position, generating heavy deficits in the balance of trade and a 14% deficit in 1990 GDP current accounts; even so, the latter figure is two times smaller than the deficits incurred in the middle 1980s.

1.9 The secondary formal sector is in disarray and underdeveloped. Traditionally, this sector has been dominated by the public sector, but its role has gradually decreased in recent years. Rehabilitation efforts are underway as part of an economic reform program to improve management of public sector resources and to create favorable conditions for re-stimulating the private sector. Even so, such efforts fail to note that urban economic activity in Mali is dominated by an unofficial sector composed of informal or semi-formal activities, incorporating nearly two-thirds of all urban assets. Examples of these types of activities include truck farming, which has sprung up all around the capital; numerous small craftsmen who produce goods and provide services; and very small-scale "micro" industrial companies. The wood and charcoal supply sector represents a prime example of the development of small businesses in the informal sector, with an annual turnover of about 10 billion CFAF. Another factor of note is the growing participation of women in economic activities. This is true in rural areas where, due to emigration to urban areas and foreign countries, the female population tends to increase. In addition, although women traditionally have worked the fields, they also are developing truck farming businesses, businesses for processing agricultural or forestry products, and small crafts and trade businesses. This is also the case in towns, where activities such as dyeing fabric, running small eating establishments or certain trader-type businesses (such as for wood) are carried out almost exclusively or in large part by women.

The Energy Sector

Energy Resources

1.10 Mali is rich in energy resources, especially hydro resources, forestry and agricultural biomass, and solar energy. The country possesses a large hydroelectric potential of nearly 1050 MW installable capacity, with guaranteed power of 800 MW. This potential, found mainly at the Manantali, Kénié, Gouina and Grand Félou sites, is much greater than the country's current power

needs. [3] Mali also has substantial wood resources which, in theory at least, would allow up to 70% of the population (in the Koulikoro, Ségou, Kayes and Sikasso regions) to be self-sufficient in energy supply for several decades. Finally, there also are renewable energy resources in the country: solar energy, agricultural biomass (some of which is only marginally usable, such as the rice husks leftover from the Office de Niger's rice processors (rizeries), peanut shells and cotton stems). However, Mali currently has no fossil fuels, and petroleum product consumption is entirely dependent on imports. In addition, hydroelectricity produced by the Sélingué and Sotuba dams cover only part of national electricity demand (75% in 1989); the costs of developing new dams are quite high.

Financial Constraints in the Sector

1.11 Development of Mali's energy resources, whether for processing, transport, or direct use, comes up against considerable financial constraints. Large dams require substantial investments (for example, Manantali costs nearly US$ 3000 per installed KW), which would be difficult for the country to shoulder under current economic and financial circumstances. Decentralized power production is a potential alternative; but most rural collectives are not in a position to purchase decentralized energy generators for their own use. Although the Government itself is unable to offer substantial assistance, its Electricity Code of 1989 gives authorization to private sector initiatives in this area. The costs of transporting woodfuels from forested regions to towns or under-served regions are quite expensive. As a result, wood frequently is cut along access routes by peasants (for their own consumption) and by forestry operators (for marketing in towns) in order to reduce these costs. This practice invites overexploitation of resources, further damaging the local forest resource potential.

1.12 The cost of petroleum product imports represents a substantial burden for the country, despite the relatively small volumes which are imported (less than 200,000 tons annually). Petroleum product imports represented between 14% and 17% of total imports during 1984-1987, and up to 46% of export earnings in 1985 (see Table 5 in Annex 2).

1.13 These financial constraints enforce the necessity of ensuring rational supply of petroleum products and electricity and to optimize their final consumption. Mali also must take steps to ensure rational management and exploitation of its largest energy reserve: wood. Widespread and intensive urban use of wood in the form of fuelwood or charcoal exerts increasing pressure on forest reserves, some of which are already dangerously degraded (peri-urban zones, northern regions).

---

[3] Compared to Mali's maximum power demand of only 50 MW in 1989.

Energy Consumption

1.14 Mali's energy consumption is relatively low, despite the abundance of indigenous energy resources. The energy balance for 1987 (Table 1.1) shows per capita energy consumption of only 200 kg of oil equivalent (kgoe) per year for all consuming sectors and fuels. Fuelwood is the most widely consumed energy source, even by urban households and by a non-negligible proportion of the productive sector: it represents 91% of total domestic energy consumption. The predominance of this fuel emphasizes the limited reach of modern energy (petroleum fuels and electricity) in Mali: consumption of modern energy is less than 20 kgoe per capita per year.

Table 1.1: SECTOR ENERGY BALANCE 1987
('000 toe)

	Firewood	Charcoal	Electricity	Petroleum Products	TOTAL	%
Transportation				123	123	6.6
Households	1597	37	5	14	1653	91.1
Agriculture				4	4	0.2
Industry, Other*	4	1	8	26	39	2.1
Total Final Energy	1601	38	13	167	1819	100.0
Percent	88.0	2.1	0.7	9.2	100.0	

*Other: Informal Sector, Commerce, Communities/Organizations
Source: ESMAP estimates, 1989.

Household Energy Sector

1.15 According to the energy balance, households comprise the largest energy consuming sector, representing more than 90% of total final energy demand -- one of the world's highest relative consumption rates for the household sector. Many factors contribute to the dominance of the household sector in national energy consumption data: the transportation fleet is small and inter-regional trade is limited; most modern economic sectors are underdeveloped; and most of the agricultural sector has very restricted access to petroleum fuels and/or electricity. Although nearly 90% of electricity consumption and 40% of petroleum product consumption is concentrated in the capital, in relative terms urban consumers are not the largest total consumers of final energy: in general, urban dwellers consume less wood than the inhabitants in rural areas and medium-sized towns, [4/] yet their access to modern energy services in many cases is restricted (see Table 1.2).

4/ The situation could change rapidly if charcoal use in Bamako continues to grow at current rates: in terms of primary energy, a charcoal user consumes three to four times more wood than a firewood user.

1.16 Wood consumption -- more especially, charcoal consumption -- in Bamako and the main cities has a greater impact on the environment than does woodfuel consumption in rural areas. In rural areas, the population density relative to available wood resources generally is low. Exploitation of these resources is dispersed and non-commercial. The sources of wood for fuel use and the techniques used to collect it by nature have limited impacts on the environment: pruning trees, clearing fields, collecting dead wood. Producers rarely chop down standing trees for use in fuelwood production, nor are agricultural residues and animal wastes used; consumption of the latter would reduce an important nutrient source for maintaining soil fertility. Commercial fuelwood networks which are springing up in smaller cities use production techniques with more detrimental environmental impacts, but the volumes of wood involved remain limited. In Bamako and the main cities, by contrast, commercial networks dominate the market. Commercial production often results in deforested belts along access routes. This is especially true in areas used for charcoal production, which is consumed by increasing numbers of urban dwellers. Thus it is important for these cities to limit and rationalize the production and use of woodfuels.

1.17 Beyond its status as the major consuming sector, the household energy sector also has major impacts on household budgets, rural sector income, and the environment. Energy expenditures represent on average 10% of household budgets; the percentage is certainly larger percentage in lower income households. Even so, residential energy problems often seem minor to Malian householders relative to other difficulties which frequently preoccupy them (access to water, jobs, health services, etc.). Production and marketing of woodfuels plays an important role in the national economy, with an annual estimated turnover of 10 billion CFAF. Peasants turn to wood and charcoal production as a means of complementing their farming income. Finally, as will be discussed in subsequent sections, the impact of woodfuel production on the environment is undeniable: northern regions, where production is substantial, already suffer wood shortages, and localized pockets of degraded forests are appearing in the South.

Table 1.2: Residential Energy Consumption in 1987

		Residential Energy Consumption (in thousand t.o.e.)					
	Population ('000)	Wood	Charcoal	Electricity	Petroleum Products	Total (kgoe/yr)	Per Capita
Bamako	646	75.3	14.8	5.1	5.4	100.6	156
Medium-sized Villages	387	73.3	14.4	0.6	3.2	91.5	236
Semi-urban Areas	516	100.0	7.5	0.1	3.5	111.0	215
Rural Areas	6071	1348.3	0.0		1.7	1350.5	222
Mali	7620	1596.8	36.7	5.7	13.8	1653.5	218

Source: ESMAP estimates, 1989.

Institutional Framework

1.18 Mali's institutional framework is relatively complex and disorganized, making it difficult to implement a systematic, coherent energy policy. Approximately twenty departments, agencies, organizations or project teams manage the important parts of the sector. In total, nearly fifty public or parastatal organizations are active to some extent within the energy sector. The dispersed nature of sector responsibilities has led to the creation of multiple coordinating or ad-hoc advisory committees.

1.19 Energy sector planning is the responsibility of the National Hydropower and Energy Department (NHED) within the Ministry for Mines, Hydropower, and Energy (MMHE). This department is mainly concerned with hydroelectric activities: of the 450 agents on the staff of the Energy and Dams Division, only 5 work on energy matters. The draft decree for reorganizing the DNHE will strengthen all planning, regulatory, and monitoring functions related to the energy sector within the Energy and Dams Division.

1.20 In its management of the energy sector, the NHED must collaborate with other departments and with numerous operators with activities in the sector. Within the electricity subsector -- the subsector most directly supervised by the NHED -- the major operators include Energie du Mali (EDM), the national power company, and the Bureau for Hydraulic Resource Exploitation in the Haut Niger (OERHN), which runs the Sélingué power station. The Organization for Development of the Senegal River (OMVS), a small regional organization, participates in activities related to the regional power project at the Manantali (under preparation). The NHED also is responsible for promoting the development of renewable energy in coordination with two organizations: the nationally oriented Solar Energy Laboratory (SEL), which is under the supervision of the MMHE, and the regionally oriented Center for Solar Energy Research (CSER). Two ongoing renewables projects are the Special Energy Program (SEP) and the Solar Equipment Maintenance Unit (SEMU). Finally, the secretariat of the National Committee for Butane Gas Promotion is part of the DNHE. This Committee was created in 1990 under a CILSS/EEC regional program for using LPG to substitute for woodfuels.

1.21 A project for institutional reform in the hydrocarbons subsector is under preparation with World Bank financing and assistance. The project's main objective is to bring together under the authority of a single organization subsector activities and responsibilities which currently are dispersed. This organization would serve as the planning, monitoring and legislative center for the subsector. The project also includes components for liberalizing petroleum product prices at the pump and for simplifying petroleum fiscal policy by adopting a single tax to be collected by customs and deposited directly into the national treasury. The subsector currently is somewhat notorious within the energy sector for its lack of coordination and dispersion of responsibilities: The supply and distribution of petroleum fuels falls under the jurisdiction of the MMHE, which heads a

National Hydrocarbons Commission composed of various ministries, agencies, and two professional organizations: the Petroleum Producers Group (PPG) and the Malian Importers of Petroleum Products (MIPP). The former represents the main petroleum distributors (Shell, Total-Texaco, and Mobil) and the latter is a newly created group representing independent Malian petroleum importers. The secretariat for the Commission is housed in the National Transportation Office. There are three agencies intervening in other aspects of the energy sector. Two agencies are within the Ministry of Finance: the Department of Economic Affairs regulates petroleum imports, and the Bureau for Price Regulation and Stabilization (OSRP) updates price structures and collects cross subsidies on petroleum products. The third is the National Geology and Mines Department, part of the MMHE, which oversees storage depots and retail outlets.

1.22 Among the priorities of the National Plan to Prevent Desertification (NPPD) are management and control of woodfuels supply, and improved use of woodfuels. Implementation of the Plan is being coordinated and supervised by an inter-ministerial organization, the Sectoral Group for Monitoring the NPPD, which is headed by the Ministry of Agriculture, Husbandry and Environment (MAEE). National Waterways and Forests Department (NWFD) within the MAEE is responsible for the forestry sector, including woodfuels. Its main functions are to monitor forest exploitation, manage classified forests, and verifying the flows of forestry products. The NWFD staff numbers 780 forestry agents and nearly 700 non-foresters organized into eight Regional Divisions and five "Operations". The latter are parastatal organizations and include the OAPF and OARS which, in addition to its main management tasks, produces and markets firewood and charcoal. The NWFD also is the headquarters for the National Advisory Committee for Improved Stoves, which coordinates all improved stoves projects.

1.23 Promotion and distribution of improved stoves is the objective of several projects; the main project is under the jurisdiction of the National Department for Social Affairs (NDSA). Also of note, in addition to programs administered by the Regional Divisions for Waterways and Forests, is assistance for stove distribution provided in the 1980s by the Mali National Women's Union (UNFM). Promotion of butane gas is mainly the province of petroleum distributors (Total and Shell), who have introduced portable butane cookstoves onto the market.

Justification for a Household Energy Strategy

1.24 Even in the context of the disorganized institutional structure described above, various programs for improving the production and use of energy resources are underway or in the planning stages in the energy, forestry and environmental sectors. Reducing the risks engendered by overexploitation of forestry resources is a primary objective of these programs. Some programs are coordinated with each other as part of the NPSD; others are being administered independently. Programs of this type frequently are confronted with contradictory objectives: how, for example,

can wood or charcoal consumption be reduced through promotion of substitute fuels without increasing foreign trade imbalances? How can endangered ecological zones be protected without depriving rural populations who produce woodfuels of a major source of income? How can greater value be given to standing wood without penalizing the poorest urban consumers? How can access to electricity be made less difficult without burdening Energie du Mali's financial and technical balances?

1.25 A series of coordinated action programs for the residential energy sector must be implemented which bring together the investments needed for improving access to energy and management of national resources, and which establish affiliated regulatory, tax and fiscal measures. This action program should not be developed within the restricted context of household energy problems. On the contrary, household energy problems should be placed in a larger socio-economic context and within the context of natural resource management. Mali's current economic difficulties should be taken into account, along with the economy's particularities and dynamics (strength of the informal sector, for example). The interdependence of forestry and agricultural activities also should be taken into account in order that specific programs for woodfuels can be defined to strengthen the Government's global strategy for natural resource management. Finally, the outcomes of this action framework should both simplify and improve of the public sector's interventions in the energy sector, and strengthen and develop the roles of the private sector and rural communities in the supply of household energy.

II. MAIN SECTOR CHARACTERISTICS AND ISSUES

2.1 Several issues dominate and characterize the use of energy in the household sector. A clear understanding of these issues is necessary in order to define a strategy for resolving the major problems in the sector. This chapter is based on the analysis presented in Annexes 3 and 4, which detail the characteristics of household energy supply and demand. Of these, the main features can be summarized as follows:

(a) the dominance of wood consumption and the gradual growth of charcoal use;

(b) the successful market penetration by improved stoves;

(c) the existing differentials between prices and the relative economic costs of household fuels;

(d) the relative markets for various fuels which could substitute for wood and their economic impacts;

(e) the threat of environmental damage;

(f) the options for improving the situation in regions with wood resource deficits;

(g) an institutional, regulatory and fiscal framework ill-adapted to managing wood resources;

(i) the deficiencies in access to energy services, especially in electricity.

Dominance of Wood Consumption and Growth in Charcoal Use

2.2 Wood currently the dominant energy resource, even in cities, and is likely to remain so in the medium term. It is consumed primarily for cooking and for secondary energy needs such as water heating, preparing tea, or informal productive activities. In rural areas, daily per capita firewood consumption varies between 0.7 and 2.4 kg for an average-sized family. This variation is linked to the availability of wood resources and thus to the time needed to collect wood (for the most part, firewood is not a commercial item in rural areas). With the exception of kerosene used for lighting, modern fuels are rarely used in rural areas. In urban areas, wood also dominates as the primary fuel, as shown in Table 2.1. In Bamako, nearly 9 out of 10 households use wood, and

the proportion is even higher in the cities of the interior. However, most families also use several "auxiliary" fuels, such as butane gas and charcoal.

Table 2.1: Urban Fuel Use

% of households	Bamako	Ségou	Koutiala	Mopti	Gao
Primary Fuel:					
Wood	87%	92%	100%	96%	100%
Charcoal	11%	8%	0%	4%	0%
Gas	1%	0%	0%	0%	0%
Secondary Fuels:					
Wood	2%	6%	0%	4%	0%
Charcoal	56%	78%	60%	63%	90%
Gas	17%	1%	3%	9%	7%
Kerosene	1%	1%	1%	3%	0%
Not using secondary fuels	34%	12%	38%	29%	10%

Source: ESMAP surveys, 1989

2.3 There also are major variations in urban firewood consumption levels, both in terms of average consumption in each city (see Table 2.2) -- consumption which is linked to the price of wood -- and in terms of the energy intensity of activities for which firewood is utilized. For example, average wood consumption in Koutiala (which is located in the Sudanese area where wood resources are abundant and where there are household activities consuming large quantities of wood, such as brewing beer) is four times higher than consumption in Gao (located in the Sahara-Sahelian area, with a firewood price three times higher than in Koutiala, and with few traditional uses of firewood other than for cooking). Furthermore, these averages hide major variations in per capita consumption based on household size. In Bamako and Ségou, for example, large households only consume 0.7 kg per capita, per day, whereas daily per capita consumption for small families is as high as 3 kg. Eating habits also contribute to major variations in consumption levels for firewood and charcoal. Traditional Malian cuisine (grains and long-simmered sauces) is very energy intensive. A number of recent modifications to traditional eating habits (coffee in the morning, eating tô and couscous for lunch, cold evening meals, less energy intensive recipes, reheating plates, etc.) -- mostly in younger, well-to-do small households -- have led to a decrease in consumption levels. Some of these modifications, which often happen simultaneously with the household switching its primary fuel, should be encouraged.

2.4 Despite the noted variations in consumption levels, the typical household expenditures for firewood are relatively constant from one city to another, although slightly higher in the capital (16 CFAF per capita/day, as opposed to 12 to 13 CFAF in other urban centers). Based on these figures, energy expenditures in a typical household (8 people, firewood consumed

as primary fuel, charcoal and kerosene used as auxiliary fuels) are about 6000 CFAF/month in the capital and 5000 CFAF in other cities. This represents a little less than 10% of total monthly household expenditures (considering the DNSI statistics given in Annex 2); the percentage is sightly higher for poorer households.

Table 2.2: Daily Fuel Consumption

(kg/person/day)	Bamako	Ségou	Koutiala	Mopti	Gao
Primary Fuel:					
Wood	0.9	0.8	2.4	0.9	0.6
Charcoal	0.33				
Auxiliary Fuel:					
Wood	0.3				
Charcoal	0.095	0.05	0.07	0.05	0.06
Gas	0.005				
Kerosene (lighting, kindling)	0.015	0.011	0.018	0.013	0.011

Source: ESMAP surveys and estimates, 1989.

2.5 Urban charcoal consumption has grown quite steadily: in Bamako, the percentage of households using charcoal as the primary cooking fuel went from 3% in 1978 to 11% in 1989. Use of charcoal appears to hold a certain "temptation", since the fuel is considered more commodious and adapted to modern life. Thus it is quite likely that it will gain prominence in households in the capital and in the northern cities. Charcoal production induces further environmental pressure because of low carbonization yields (approximately 8 tons of wood are needed to produce one ton of charcoal with a calorific value only twice that of wood, whereas efficiencies for charcoal cookstoves are similar to those for wood-burning metal cookstoves). Thus it will be important to check the pace of charcoal growth and to improve the efficiency of its use and production.

2.6 Use of butane gas (LPG) by the most affluent and innovative households and even by a small number of middle class households also has progressed. About 20% of households in the capital own single-burner gas cookstoves, 13% in Mopti and from 3% to 7% in the other main cities: this corresponds to more than 20,000 cookstoves distributed throughout a three-year period. This is a significant level of market penetration, given the obstacles linked to initial investments, the cost of gas, and problems related to users' apprehensions about appliance safety. However, hardly anyone cooks regularly with gas (1% of households surveyed in Bamako) and gas cookstoves are used almost exclusively on an auxiliary basis. The decision to switch to gas as a primary fuel is restrained by its current price, which is not taxed or subsidized. As will be seen in subsequent

sections, gas costs can be lowered by rationalizing supply arrangements and by taking advantage of the economies of scale possible if larger quantities are imported. In addition, existing cookstove models (Déméba and Guatéli) can be improved, both in terms of efficiency and adaptation to local cooking habits. Finally, use of kerosene for cooking is rather limited for two reasons: kerosene cookstoves are poorly adapted for use in Malian cuisine and retail prices for the fuel are heavily taxed.

2.7 There are other woodfuel consumers in addition to household consumers (industries, small craftsmen, informal service sector, communal food and beverage services) but their impact on total woodfuel consumption is relatively small. Altogether, they accounted for 4% of Bamako's total wood consumption and 10% of its charcoal consumption in 1989. In certain cities, these figures are probably higher since these fuels are used for traditional activities such as drying fish (Mopti) and brewing beer (Koutiala). Furthermore, informal sector producers are micro-consumers -- the largest among them, the iron masons, average a daily consumption of only 10 kg of charcoal. Still, expenditures for charcoal can represent a significant percentage of the turnover of small producers such as iron masons, jewelers or launderers, whereas expenditures for wood have a much smaller impact on the family businesses' accounts (see Table 2.3).

Table 2.3: Bamako - Energy Consumption in the Informal Sector

Activity	Number in Survey	Energy Expenditures	Energy as Percent of Costs	Energy as Percent of Business Revenues
Ironmason	42	750	66.7%	10.9%
Jeweler	63	650	39.5%	17.2%
Launderer	434	380	87.6%	21.9%
Dry Cleaner	197	480	1.5%	1.0%
Small Restaurants/Diners				
Dibiteries	84	500	5.7%	5.1%
Grilled/Fried Foods	4	na	na	na
Breakfast	32	285	5.1%	na
"Fast-food"	114	350	3.5%	1.7%
Roadside Vendors				
Dibiteries	59	550	26.2%	na
Grilled Foods	288	150	3.4%	2.7%
Deep Fried/Fried Foods	622	170	9.5%	7.1%
Breakfast	176	110	3.1%	2.7%
"Fast-food"	62	300	6.9%	5.4%
Total in Bamako	2177	310	3.8%	2.6%

Source: ESMAP Surveys, 1989

Successful Market Penetration by Improved Cookstoves

2.8 Mali's distribution rate for improved stoves is quite high relative to other Sahelian countries. For example, 71% of the households in Bamako using wood as the primary fuel own at least one improved cookstove; more than two-thirds of these are portable metal stoves (see Table 2.4). Real savings in wood consumption attributed to use of improved stoves amount to between 10 and 20%, depending on whether the household has one or several improved cookstoves (see Table 2.5). These figures are even more remarkable when it is noted that in Bamako only 40 to 35% of the main meals actually are prepared using the improved stoves.

Table 2.4: Urban Distribution of Improved Stoves
(% of households with at least one stove)

	Bamako	Ségou	Koutiala	Mopti	Gao
"Massif"	10%	9%	9%	0%	1%
Metallic	49%	42%	21%	21%	3%
Louga	12%	32%	45%	68%	57%

Source: ESMAP Surveys, 1989.

2.9 Successful market penetration by metal improved cookstoves has proved been achieved at all socio-economic levels of the urban population. There are several reasons for this success. Firstly, the price differential between the most popular model of improved stove and a traditional cookstove is only about 500 CFAF. This differential easily can be amortized in less than a month on average, assuming the stove is used efficiently (wood savings of about 25%). Promotional and educational activities sponsored by various institutional projects also have been influential. Of special note are the SEL/VITA project, the DNAS/GTZ project and the joint UNFM/DNEF program. These three projects were launched in response to a March 1986 law requiring the use of improved stoves. (However, according to information gathered during surveys conducted for this study, very few households are aware of this law.) Surveys record a high level of satisfaction among female consumers with regard to the marketing network, prices and performance of the stoves. The success of these formal improved cookstove programs has led to the creation of an autonomous, private-sector market for cookstove distribution, especially in Bamako, driven by the stove producers and informal sector marketers. Assistance for such private-sector initiatives and enhanced consumer information programs should be continued in Bamako and initiated or strengthened in the cities of the interior, especially in Gao, Tombouctou and Mopti.

Wood shortages are felt more keenly in day-to-day life in these cities; thus the need for improved stoves programs here is more urgently and the programs are more likely to be successful.

Table 2.5: Improved Stoves and Wood Savings

Number of Improved Stoves in Households Using Wood	Per Capita Wood Consumption (bundles/day)		Per Capita Wood Expenditures (CFAF/day)	
None	0.30	100%	19.45	100%
One	0.25	83%	17.65	91%
Two or more	0.23	77%	16.99	87%
Average in Bamako	0.26	87%	18.55	95%

Source: ESMAP Surveys, 1989.

2.10 It also should be noted that these types of projects have a high economic rate of return. Under conservative hypotheses of performance and use (10% wood savings), a minimum annual savings of 15,000 to 20,000 tons of wood could be achieved by distributing about 50,000 improved stoves. This figure assumes both direct and "indirect" stove distribution -- the direct distribution under "official" programs and the indirect distribution arising from spontaneous actions by small entrepreneurs. The economic value of wood savings of this magnitude is estimated at US$ 500,000 per year (8 CFAF/kg). This amount is far greater than the total annual costs for the three projects mentioned in para.2.9 combined with the additional cost incurred when the consumer purchases an improved stove rather than a traditional stove (about US$2 per stove).

Price Differentials and Cost Comparisons for Household Fuels

2.11 Table 2.6 below summarizes theoretic 5/ and empirical 6/ financial costs of cooking fuels, including wood, charcoal, kerosene and gas (see also Table 2.7 in Annex 2 for detailed

5/ The theoretic financial cost is computed on the basis of a constant quantity of useful energy for all cooking fuels under comparison and the average efficiency of cooking equipment as measured during this study or in other Sahelian countries.

6/ These are the real costs of cooking, calculated on the basis of surveys conducted during this study. This method gives slightly different results from the previous method and yields a smaller differential between the costs of substitution fuels and those of wood.

cost calculations). In survey results using the current price structure, wood is the least expensive fuel; charcoal is 1.3 times more costly than wood, and the prices of gas and kerosene are about 1.6 times higher than charcoal. Gas purchases are only marginally more expensive for the consumer than purchasing kerosene. For most Malian households, the switch from wood to charcoal is considered a luxury, reserved for an elite group of small, relatively well-to-do households. Yet the actual cost differential is quite modest, making charcoal well within the reach of many households. Cooking with gas requires that the consumer breach a totally different cost threshold. For an average household, using gas as a primary cooking fuel would require expenditures of about 20% of the family budget (not including other energy requirements such as hot water heating, etc.), which represents a substantial financial burden. Thus the fuel is not readily accessible to most households.

Table 2.6: Prices and Economic Costs of Cooking Fuels in Bamako (1989)

	Wood	Charcoal	Kerosene	LPG
FUEL COSTS (CFAF/kg)				
Retail price	18	66	250	320
Price net of taxes	17	63	112	300
Theoretic economic cost	17(a)	63(a)	94	275(b)
COST OF USEFUL ENERGY				
in current prices (CFAF/MJ)	5.3	9.1	12.8	14.0
cost relative to wood	1.0	1.7	2.4	2.6
price net of taxes (CFAF/MJ)	5.0	8.7	5.7	13.1
cost relative to wood	1.0	1.7	1.1	2.6
theoretical economic cost (CFAF/MJ)	5.0	8.7	4.8	12.0
cost relative to wood	1.0	1.7	1.0	2.4
ANNUAL COOKING COSTS				
Total stove and fuel cost (CFAF)	38450	51900	76000	88600
cost relative to wood	1.0	1.7	1.0	2.4
cost relative to charcoal	0.7	1.0	1.5	1.7

Notes:

(a) Minimum cost (assuming area with sustainable wood and charcoal production)

(b) Assuming rationalization of the supply chain and not taking into account the possibility of substantial increases in consumption (which would induce a drop in supply and distribution costs).

(c) According to results of household surveys.

Source: ESMAP estimates, 1989.

2.12 Most urban households in the interior find it even more financially advantageous to use wood as the primary cooking fuel than do households in Bamako. The northern region, where the price of wood and charcoal are almost equivalent to prices in Bamako, is an exception. Retail prices for woodfuels vary significantly from one city to another, as shown in Table 2.7. The lowest average prices are found in Koutiala, where a kilogram of wood costs 6 CFAF and a kilogram of charcoal is sold for 40 CFAF. The highest prices are in Gao: 19 CFAF/kg for wood and 76 CFAF/kg for charcoal, almost identical to prices in the capital -- 19 CFAF and 66 CFAF, respectively. These prices are comparable with woodfuel prices in other Sahelian capitals. It should be noted that the price also vary from one neighborhood to another, with differentials of 20 to 30%, and that the wood prices vary seasonally (10 to 20% higher in the winter). The evolution of wood and charcoal prices generally have been stagnant throughout the 1980s; in real terms, prices actually have decreased since 1984, the year that Mali joined the group of West African countries using the CFA franc as common currency. Several factors contribute to this phenomenon, which although contradictory to the increasing scarcity of the resource, is common in most Sahelian countries: increased competition among producers and, to a lesser extent, among other parties acting throughout the supply network; decreased opportunity costs of peasant labor and the drop in the real price of petroleum products.

Table 2.7: Wood and Charcoal Prices

	Bamako	Ségou	Koutiala	Mopti	Gao
Average Price (CFAF/kg)					
Firewood	18.5	12.1	5.7	12.7	19.0
Charcoal	66.3	49.7	49.7	53.1	76.9
Firewood					
Minimum price (CFAF/kg)	16.0	9.3	5.0	11.8	16.7
Maximum price (CFAF/kg)	29.1	13.7	7.5	15.2	21.0
Charcoal					
Minimum price (CFAF/kg)	47.8	36.3	25.4	44.0	66.7
Maximum price (CFAF/kg)	83.3	62.5	62.5	64.5	80.0

Note: A total of 4200 observations in five cities (June 1989 in Bamako and August 1989 in other cities)

Source: ESMAP, 1989.

2.13 The price structure for wood and charcoal is determined by the structure of the supply network. In most cases, the network is so complex with its numerous transfers and arteries that it is only possible to describe the price structure in general terms. Producer costs can account for 30 to 60% of the retail price depending on the distance between the production zone and the

urban consumption center. For example, round wood purchased along the roadside at a distance of 30 km from Bamako sold for 13 to 14 CFAF/kg at the end of 1988, as compared to 6 CFAF/kg for wood sold 60 km away from the capital (along the Bamako-Ségou roadway). However, distance is only one factor affecting producer costs. Other factors include access to and type of transport employed, access to wood resources, inventory levels of woodfuel resources and availability of wood for purchase from roadside vendors. The price of standing wood fluctuates between 3 and 10 CFAF/kg (not including the opportunity cost of the land). Thus it would not be profitable under current circumstances, with wood prices stagnating, to plant trees specifically for supply fuelwood, even in peri-urban zones.

2.14 Margins for transporters and urban marketers also vary according to the number of parties involved and the type of sale (wholesale, discounters, retail). The relevant statistics suggest that urban retailers earn margins of about 30 to 50%, with transporters taking between 10% and 30% of the retail price. Although the transporter and wholesale margins thus represent a large share of the retail price, they probably reflect the real costs of supply since there is considerable competition in the sector. Similar margins have been noted in whre the markets for wood and charcoal are large and competitive. Likewise, the numerous small retailers (a majority of whom are women) generate large margins; however net revenues are low, hardly exceeding several thousand CFAF/week on average.

2.15 Comparison of the economic costs of using various cooking fuels yields different results from the comparison of financial costs, thus illustrating the distortions within the fuel market. Retail prices for petroleum fuels are higher than their economic costs -- significantly so in the case of kerosene, but only marginally in the case of gas (see Table 2.8). The prices of household fuels (in terms of useful energy) were compared under two hypothetical scenarios of market conditions: In the first scenario, the Government's current tax and subsidy policies are abandoned; in the second scenario, the policies are abandoned and subsequently the supply system is rationalized. Kerosene becomes almost competitive with wood in the first scenario. Gas becomes competitive with charcoal under the second scenario (see Table 2.6). Under both scenarios, the cost of butane is more than twice that of kerosene, in terms of useful energy. In summary, modifying the terms for fuel competition appears to be a question of pricing policy, rather than economics.

Table 2.8: Price Structure for LPG and Kerosene (1988)

	Gas (CFAF/ton) ex-Abidjan		ex-Dakar		Kerosene (CFAF/ton) ex-Abidjan	
Ex-Port	148700	41%	7863	39%	7359	37%
International Transport	33534	9%	2359	12%	3392	17%
Services	180749	50%	2529	13%	2509	13%
Taxes		0%	7249	36%	6741	34%
Total	362983	100%	20000	100%	20000	100%

Source: OSRP, Total-Texaco, 1988

2.16 As indicated in Table 2.7, the financial advantage of using wood is even stronger in most regions of the country than in Bamako. The retail price for wood in other areas is lower, while the costs of substitution fuels rise proportionately to distance. The economic differential is even more pronounced since wood resources are more abundant in southern regions (and thus the economic cost of wood is lower). By contrast, the financial comparison of costs in northern cities yields results almost equivalent to those in Bamako. In these cities, however standing wood has a economic value considerably higher than in other parts of the country (minimum estimates of 25 CFAF/kg). Thus the perspectives for substituting petroleum fuels for wood are more favorable in these areas.

Comparison of Markets for Substitution Fuels

2.17 Surveys of households' fuel choices identified two parameters which most influence the decision to use a substitute fuel: the availability of local wood supplies and the household's degree of urbanization. Women in Bamako, Mopti and Gao presented with a choice of cooking equipment displayed a strong and immediate interest in the use of charcoal, as well as a long-term preference for gas (see Table 2.9 for consumer preferences).

2.18 The potential market openings for substitution fuels in Bamako and the southern cities tend to differ from those in the northern cities. Substitution in the south is based on a desire for convenience and modernity. Households there and in Bamako are more likely to use gas cookstoves and use of gas as the primary cooking fuel us is on the rise in well-to-do households. Since woodfuel resources are relatively abundant in these urban areas, kerosene's holds only a minor market share, mainly among long-established middle-income households.

2.19 By contrast, substitution in northern cities has more of a forced nature since woodfuels are increasing scarce and expensive. In these cities, where 50 to 60% of the households expressed a willingness to switch fuels, kerosene is better positioned than gas to become the primary substitution fuel among well-to-do and middle income populations. This advantage is conditional, however: kerosene would have to be priced more closely to its economic cost.

Table 2.9: Preferred Fuels
(in % of households)

	Wood	Charcoal	Gas	Kerosene
TODAY				
Bamako	61	22	14	0
Ségou	51	36	12	0
Koutiala	77	12	11	0
Mopti	59	21	18	1
Gao	54	42	3	0
IN THE FUTURE				
Bamako	26	27	42	0
Ségou	20	16	42	9
Koutiala	42	23	35	0
Mopti	8	29	40	18
Gao	7	70	18	3
INTEND TO SWITCH SOON				
Bamako		13	18	5
Ségou		7	31	13
Koutiala			36	3
Mopti		12	38	5
Gao		25	28	0

Source: ESMAP Surveys 1989.

Potential Environmental Impacts

2.20 Drawdown of wood resources to supply urban consumption of fuelwood and charcoal is a major factor affecting Mali's environment. Other factors interact with wood offtake to exacerbate further its detrimental pressure on the environment: demographic growth, brush fires, clear-cutting for agricultural use, droughts, grazing by itinerant herds, and finance and credit problems in rural areas. It is difficult to distinguish the environmental impacts of individual factors and to measure their relative importance. Nonetheless, two distinct regions in the country can be identified based on the affects of wood offtake on the local environment: the southern area (Koulikoro, Sikasso, Ségou, and Kayes) and the northern region (Mopti, Gao and Tombouctou).

2.21 The Southern Region. Annual wood resource availability in the Sikasso and Koulikoro areas 7/ is estimated at more than 4 million tons (see Table 3.2 in Annex 4). Combined urban and rural wood demand in these two regions (including Bamako) only reached 2.5 million tons of wood in 1989 (360,000 tons for Bamako). In the area immediately surrounding Banamba, the available quantities of dead wood by themselves are sufficient to meet the capital's firewood demand for a period of nearly 5 years. Thus, on a global level, the southern region has no pressing problems with firewood availability, although some localized supply difficulties do exist.

2.22 Although there is currently is a general surplus in wood resources, the surplus is not expected to increase or even be sustained in the medium- to long-term. Large plantations for woodfuel supply are not profitable; less than 20,000 ha have been planted throughout the entire country, with only limited tree planting by rural inhabitants. The extent of the forest cover in southern areas also is not expected to retract to any significant degree. Although successive droughts have affected growth in these forests, they are not as vulnerable as the forests in the North. Thus the tree mortality rate has been considerably lower, estimated at 8% in the South-Sudanese zone and at less than 4% in the Sudanese-Guinéan zone. Furthermore, as a result of frequent brush fires, there is a steady re-supply of the stock of dead trees; the size and distribution of this inventory cannot be quantified.

2.23 Another factor with potentially detrimental impacts on the forestry cover is the expansion of agricultural lands. Certainly the combined pressure due to growth of the rural population and continued, extensive use of low-technology traditional farming methods results in gradual encroachment onto forested property. However, the annual increase in land area for agricultural use in Mali is quite modest: an additional 30,000 to 40,000 ha/yr are put into use, a growth rate of less than 2% annually. Studies carried out by the Land Resource Inventory Project (PIRT) show that active agriculture occupies only 10% of the land designated agricultural. Furthermore, cultivated or fallow agricultural lands remain wooded and contain almost as much wood on average as the so-called natural forests: 17 m^3/ha on cultivated and fallow lands and 18 m^3/ha in natural forests around Koulikoro, 24 and 27 m^3/ha respectively around Sikasso. It may be possible that deterioration of the forest cover is more extensive in agricultural areas with relatively small populations. Such is the case in the areas surrounding the Mailan Company for Developing Textiles (CMDT), where expansion of high density agricultural lands has resulted in to a decrease in woodfuel resources. More generally, wood availability is not likely to be affected by agricultural expansion, especially given agro-forestry plans for re-planting (the CMDT has begun a large program of linear planting (150,000 km) to introduce trees along the boundaries of its pastures). This strategy is an important means of maintaining and reconstituting forestry resources and for assuring rural self-supply in wood.

7/ That is, the portion of the annual production by natural formations which is accessible for offtake.

2.24 Increased demand for woodfuels linked to demographic growth appears to have only limited impacts on the supply-demand balance for the southern region (see Table 18 in Annex 6). Although no measures have been implemented to reduce consumption or to promote substitution, wood consumption in the Koulikoro and Sikasso regions remain well below the level of available supply. An estimated 4 million tons of wood will be consumed in these two regions by the year 2000; approximately the same quantity of wood could be supplied from annual production of natural formations in a surface area covering only half the Koulikoro region and 80% of the Sikasso region. Southern areas thus can be assured of sufficient wood energy supplies for at least the next 20 years (even without taking into account reserves of dead wood which should be put into use as soon as possible).

2.25 Development the charcoal market for use as a primary fuel, especially in the capital, is another factor which could increase pressure on forestry resources. In 1990, the quantities of wood carbonized for supplying charcoal to Bamako was already the same as the city's total firewood demand. A scenario for projected energy demand assuming large-scale market penetration by charcoal (see Table 19 in Annex 6) -- a scenario which is quite plausible in the next decade if a household energy strategy is not implemented -- shows 60% of Bamako's population using charcoal in 2017. This corresponds to a 50% growth in demand -relative to the scenario which assumes no change in the current demand structure (1,2 million tons versus 850,000 tons). However, Mali's forests could absorb this large growth potential for wood if woodfuels are produced using wood from the two regions cited, or if a rail market is developed for charcoal delivered from the western region of the country.

2.26 It is important to note that the positive forest balance in the southern region does not preclude the possibility of localized deforestation. Gradual overexploitation and degradation is marked in areas surrounding the cities, especially along the paved routes connecting to supply sources. Marketing and transport along these corridors is easier and the population density is lower (see maps in Annex 12). Measures are urgently needed to combat localized deforestation through proper supervision of commercial exploitation. Steps should be taken to make production sustainable, more efficient and less detrimental to the environment.

2.27 The Northern Region. By contrast with the situation in the south, foresters unanimously agree that forest reserves in the Mopti region already are being degraded and that other regions (Gao, Tombouctou) have distinct wood supply deficits. One quarter of Mali's population currently confronts deficiencies in woodfuel supply, which in the short-term could become full-blown local shortages.

2.28 The areas which have been hardest hit by drought are those most affected by resource deficiencies. Forest reserves in these areas are relatively fragile, and successive droughts

have transformed them into veritable cemeteries of dead wood. Estimates of tree mortality rates reach 30% in the south-Sahelian area and 20% in the north-Sahelian area. Large reserves of dead wood, such as the thousands of hectares in the Douentza and Youwarou forests, not far from Mopti, often are not exploited because they are not in the immediate proximity of commercial centers. This resource should be tapped before it is destroyed by damage from insects and humidity.

2.29 In the northern regions most affected by the woodfuel deficit (Gao and Tombouctou), the wood and charcoal prices are quite high. Wood prices in Gao, for example, are equivalent to those in Bamako, and charcoal prices are 15% higher than comparable prices in the capital. Unfortunately the petroleum fuels (gas and kerosene) which could be substituted for woodfuels also are subject to the high prices and limited supply. Therefore there is no pricing "threshold" provided by petroleum fuel prices, as is the case in other countries, where the relatively low cost of petroleum fuels allows for easier substitution and stabilization of woodfuel demand. Geographic wood shortages -- shortages which also could be a function of time -- also give rise to increasing use of animal and agricultural resources. These resources -- straw, agricultural residues or cow dung -- are of inferior quality relative to wood, but their "free" nature facilitates their use.

Options for Decreasing Wood Consumption in Areas with Deficits

2.30 Beyond the programs to promote substitution fuels or improved stoves, as described in the preceding paragraphs, there are two other options for improving wood supply in areas with resource deficits (mainly the northern regions): modify woodfuel prices or develop new sources of supply (plantations, tranporting wood and charcoal from the southern regions). However, these actions will have only a limited impact on the situation. Certainly, urban consumers are responsive to wood prices and tend to conserve the fuel when it becomes scarce and costly; this is evident from the differential between wood consumption levels in the northern cities and those in the south. However, heavy taxation of wood to reduce consumption has its limits. The price elasticity of wood demand is certainly less than one, and for lower income households a large price increase would substantially increase the relative share of wood expenditures in the total household budget. This could even lead to fewer hot meals for the family, and to less frequent sterilization of water, potentially with detrimental health consequences. Urban consumers also could be supplied using

wood transported from longer distances, if they are willing to pay higher fuel price 8/. Another option would be to use charcoal; since it is more economic to transport, this fuel already is making inroads against fuelwood in the northern cities. However, it is certain that forestry solutions alone (tree plantations, transporting woodfuels from southern regions) would not prove sufficient to stem the problems of the northern region. Thus emphasis must be given to developing infrastructure and programs to promote improved stoves and substitution by petroleum fuels.

2.31 Various types of plantation projects -- dry and irrigated, large-scale industrial and small landholders -- have been attempted in Mali (see Annex 4). These projects have met with disappointment, both in terms of economic viability and participation levels by local populations. Given current market prices and a cost of standing wood estimated between 11 and 13 CFAF/kg, it is not profitable for a peasant to plant trees to produce wood or charcoal. The orientation of recent projects has been towards agroforestry wood production or management of existing natural formations, such as classified forests (the Second Forestry Project, and the Forestry Management and Village Reforestation Project in Koulikoro). Land management allows the natural forests to be preserved and enriched at a more reasonable cost than plantations. The Koulikoro project estimates the cost of standing wood in managed forests at only 4 CFAF/kg.

2.32 Two outcomes are possible due to increased use of charcoal in Bamako and the northern cities (a trend seen in most urban areas of the Sahel), depending on whether or not development of the charcoal market is supervised by forestry authorities. Without supervision, development of charcoal use can only exacerbate forest problems: charcoal requires twice as much wood offtake and increased offtake in the meager resources in the north would have a strong negative environmental impact (pockets of deforestation). On the other hand, supervised development, partially oriented to use of dead wood cemeteries, could reduce pressure on forest reserves.

2.33 None of these options is are available to rural populations, who more or less must make do with the resources available. In the delta region and in the northern regions of the

---

8/ Back of the envelope calculations show that it is not financially viable to transport wood or even charcoal produced in the south to shortage areas in the north. In the case of Gao and Tombouctou. the associated distances are 1000 km, and transport costs (informal, that is the least expensive) would amount to 15 CFAF/kg for wood and 30 CFAF/kg for charcoal. The resulting retail price (after adding in production costs, marketing and taxes) would be considerable higher than current prices in the two cities. The economic costs of transporting wood produced in southern regions exceeds the economic value of standing wood in northern regions, and therefore the option also is not economically viable for wood, but would be viable in the case of charcoal. However, although there also are other associated advantages such as generating employment and savings in foreign exchange, charcoal transport from the south might provide an unwanted incentive for uncontrolled charcoal production in the northern areas (once the market has been created), with devastating environmental consequences for those areas. In the case of Mopti (and even for Gao and Tombouctou), the only option under which long distance transport is likely to be viable is for woodfuels produced from dead wood reserves along the Niger River.

country, the poorest households often resort to "emergency" fuels -- agricultural and animal residues, straws, etc. This is the case in other parts of the world where use of wood is a luxury reserved for the most affluent (e.g. certain regions of India and the Andean countries). Use of agricultural and animal wastes already is common in some areas as a complement to wood during certain times of the year. This traditionally has been the case in the delta region during high water season, where such use is based resource availability. Agricultural residues could be made into briquettes (easier to use and market than the raw material) for use in northern cities. An initial study of market potential would be needed (for example test trial to access the performance and user acceptance of briquettes produced in an craftsman's press). 9/

Poorly Adapted Institutional and Regulatory Framework

2.34 Faced with formalization of commercial wood production on a national scale and with the enforcement requirements of a very restrictive forestry code, the NDFW finds itself lacking in ability and resources to manage the approximately 10 million ha of forests which are under production. It is even less capable of protecting the forests from illegal incursions by wood producers. In fact, prohibiting access to classified forests for woodfuel production would be tantamount to, in the absence of means to enforce such a prohibition, an invitation for clandestine, uncontrolled and destructive offtake. Therefore the service needs to delegate partially management of protected forests, which in fact already are a major supply source for fuelwood sold in Mali's cities (e.g. Bamako and Ségou). In other protected land areas (the remaining wooded surfaces, including long-term fallow lands), woodfuel production occurs on an even larger scale and is poorly monitored. These so-called forested lands actually occur as the result of a dynamic equilibrium between agricultural and livestock activities, demographic pressures, climate and soil fertility. Management of these areas thus must occur within the larger context of natural resource management on village and inter-village territories. This would require implementaion of adapted contractual frameworks to give local collectives a certain level of control over granting production permits and guaranteeing exploitation rights. These arrangements are not possible under the current Land Use Code or the Forestry Codes, but most of staff of the NFWD agrees with this approach. An information study to consult the different protagonists -- livestock raisers, farmers and on-site forestry agents -- will be needed to help prepare the texts for such arrangements. This study could be initiated most effectively in the areas targeted by the the Natural Resource Management Project.

9/ However, several obstacles are likely to be encountered in developing the use of these briquettes: first, consumer acceptance (low calorific value, difficult to ignite, must be closely monitored while in use); then costs -- the cost price of briquettes used in a project implemented in Niger in the 1980s, for example, was 22 CFAF/kg (assuming that the opportunity costs for the residues was zero, which rarely is the case), whereas the price of wood during the same period was 15 CFAF/kg.

2.35 Under the new arrangements, the Forestry Services would adopt a new role as supervisor of actions implemented jointly by the forest service and the regional rural managers. Legislation for production permits and for fiscal policy related to the forests should be modified accordingly. In particular, the rural communities should be given the financial means required to manage the use of their forest lands. This would be provided through a local tax on woodfuels.

2.36 The current woodfuel fiscal policy, based on a uniform tax applied to the entire country, does not provide incentives for rational management of forest resources. In fact, under this system exploitation of the scarce resource is taxed at a lower relative rate. As shown in Table 3.8 in Annex 4, the relation between the relative tax rate and the value of standing wood varies inversely to the distance between the production center and the consumption center: the more intensively wood is exploited near consumption centers, the lower its relative tax rate. Furthermore, this relation varies directly with the retail price of wood; this means, for example, that a producer who supplies Gao, where resources are scarce, has a lower relative tax rate than a producer who supplies Koutiala, where resources are abundant. Thus in order to provide incentives for conserving forest resources, the woodfuel fiscal policies must be reformed.

2.37 Strategies for relocating forestry exploitation must be complemented by assistance for production and marketing wood. Although the Government need not manage wood transportation and marketing directly (as was the case for certain forestry activities), it should support and assist the modernization of these activities. Operation of woodfuel transport and marketing is effective at present but, with the exception of Bamako, these two operations remain traditional and informal. Initial results of the market study for forest products conducted as part of the Second Forestry Project (final results were not available during preparation of this report) confirm that the woodfuel supply systems for urban areas are relatively rigid and very informal. The sectors need to be organized and modernized through creating guarantee funds, improving transport methods and modifying the urban marketing structure. As a first step, sector participants with desired characteristics for this type of assistance -- demand and willingness to participate, relatively large-scale activities within the sector, high potential for improving their efficiency relative to the cost of provided assistance -- should be identified.

2.38 At the marketing level, the effectiveness of the program to geographically relocate wood offtake will require that the mechanisms for monitoring and controling woodfuel transport be strengthened. At present, the Forestry Services can only keep track of less than one-fourth of the wood and 10% of the charcoal entering Bamako, with no means of tracking its origin. There are no woodfuel monitoring stations in other cities. The effectiveness of existing stations must be strengthened and similar check stations installed in interior cities to monitor woodfuel entries. The check stations should be provided with adequate personnel (with training) and equipment. Mobile

teams could be used to minimize efforts to circumvent the check stations. Sanctions should be established which are sufficiently dissuasive to fraud.

Deficiencies in Access to Energy Supply, Particularly Electric Power

2.39 Mali's energy situation is closely interconnected with the general socio-economic situation. Access to modern fuels such as petroleum and electricity is an indicator of a country's level of development and wealth. Mali's present economic difficulties are similar to those of other countries in the Sahel, where expanding urban poverty is reflected in a deterioration in conditions for access to modern energy service. The electrification rate in Bamako, shown in Table 2.10, has declined in real terms, even though three-fourths of all household electric customers are located there. In addition, consumption levels for household customers remains low, as indicated in Table 2.11. The distribution systems for petroleum products are satisfactory in the main cities and distribution margins for small quantities seem reasonable, but unit consumption is low.

Table 2.10: Electrification Rates in Bamako

	1969	1977	1981	1985	1989
Connection Rate	41%	41%	36%	28%	24%

Source: DNHE, Enerdom.

Table 2.11: Electricity Expenditures and Consumption in Bamako

Electric bills (CFAF/month)	Percent of Households	Average Bill (CFAF/month)	Consumption (kWh/month)
Less than 4,000	20%	2.500	40
4,000 - 10,000	44%	7.000	100
10,000 - 40,000	27%	17.000	200
More than 40,000	9%	65.000	900
Average in Bamako	100%	14.000	180

Source: ESMAP Surveys, 1989

2.40 Development of alternative energy sources (solar and other) has been attempted, but has not proven successful. Although technically these energy sources provide somewhat original options for rural populations, the same barriers are encountered in their use as for conventional energy. Under current economic conditions, elevated investment, operating and maintenance costs render these fuels inaccessible to most of the population. Most rural areas will not have access to petroleum products for a long time to come, and thus will not have access to the variety of services which could be provided by using petroleum fuels. However, existing dynamics can be used to improve the rural energy situation. For example, greater use of small carts can be considered as an energy improvement, since it eases transport of wood and water, traditionally done by women. Relationships between rural inhabitants also are transformed by introducing monetized forms of exchange. The development of hand or foot pumps also represents important energy progress.

2.41 If trends continue, large numbers of lower income households in the urban areas will continue to have limited access to services provided by household energy, as will many in the urban middle class. For the latter group, energy choices often has been between all or nothing. For example, households choose between a four-burner cooker -- expensive and ill-adapted to national dietary habits -- or the three-stone stove for cooking. For lighting, the choice is between expensive (and sometimes impossible) connection to national electric grid or kerosene lamps. Experience with improved stoves and the recent move towards LPG use shows that intermediate energy materials could be distributed successfully to the middle class and eventually to part of the lower income classes.

2.42 Urban households without electricity are not necessarily those without financial resources. In Bamako an estimated 2 out of 5 households with average income and 1 out of 5 well-to-do households do not have electricity. Half of the low-income households also are not connected to the grid. These households typically own one or two kerosene lamps. Middle income households own three or more lamps and sound equipment (battery operated radio-cassette players). More affluent households (more than 10%) also own battery-operated television sets. Several thousand units of battery-operated equipment is owned in Bamako and Ségou. In Mopti and Kouiala, typical equipment owned by households not connected to the grid include sound equipment (half of these households) and two electric lamps (two-thirds of them) (see Table 9 in Annex 2). Several dozen small electric generators also can be found in medium- to high-income neighborhoods not connected to the grid (Kalaban, Magnanbougo, etc.) A few brave householders have even used solar lighting kits.

2.43 Pre-electrification: an Intermediate Solution. Certain types of solar lighting equipment could be used to provide lighting in households located in well-to-do periurban and rural zones not connected to the electric grid. Equipment was presented to representative consumer groups for comment during this study. (Main characteristics of the equipment are summarized in

Table 2.12.) Analysis of cost and performance leads to the conclusion that the best, most economic option is connection to the grid. Nevertheless, the financial conditions for connection must be made more accessible to consumer. Since lighting options using disposable batteries are excessively expensive, their continued use cannot be justified in the long term. This is not the case for gas lamps or lamps with rechargeable batteries, both of which provide much better lighting than competing kerosene lamps at a theoretically competitive price (assuming equivalent lighting levels); the lumen-hour provided by a gas lamp costs two times less on average (costs of battery-operated lamps are five times less) than one lumen-hour produced by a traditional kerosene lamp. However in many cases, consumers make do with the inferior lighting provided by the kerosene lamps.

2.44 Lamps were presented to consumer groups in neighborhoods without electricity in Bamako, Mopti and Gao, with positive results. Highest marks went to lamps operating on rechargeable batteries. Consumers favored electric lamps over gas lamps, portable lighting over stationary fixtures, and individual rather than collective options. Consumers are not put off by the large initial investments required, as long as credit plans are available.

2.45 The consumer choices observed during the study reflect consumer frustration with electric service (middle class consumers, in particular). They also reflect the quality of service provided by the lamps displayed in the presentation. Due to high initial costs for the lamps, distribution may have to be limited initially to only the most well-to-do households in non-electrified urban areas and to government officials or merchants in rural areas. There is definitely a market for these lamps, just as there is for battery-operated television sets. They have an advantage as original, intermediate options, between inaccessible electricity and the makeshift nature of the kerosene lamp. The former remains a lighting source for the masses, in the same way "popular" gas is used by many for cooking (however the single-burner gas cooker does not cost 12 times the price of an improved wood stove, a comparable relation to that which exists between the pre-electrification system and the kerosene lamp).

Table 2.12: Main Characteristics of Lamps

	Hours of Illumination	Duration	Investment	Cost per Hour Use (CFAF)	Lighting Cost (CFAF/ kmlh)
REFERENCE OPTIONS					
Classic Lightbulb	730		2000	4	6
Candle	12	5	50	10	833
Kerosene lamp	20	12	4000	5	230
GAS LAMPS					
with disposable refills	430	6	9000	59	132
BATTERY-OPERATED LAMPS					
with disposable batteries	240	8	16000	268	1116
with rechargeable batteries (a)	240	8	46000	7	31
STATIONARY OPTIONS					
bank of lights and generator	540	18	27000	11	20
PORTABLE PHOTOVOLTAIC LAMPS (b)					
Medium Lamp	95	3	35000	13	137
Large Lamp	450	8	43000	20	43

Observations:

(a) Costs per hour of illumination do not include refill costs.

(b) The costs of portable photovoltaic lamps are net of taxes.

Source: ESMAP estimates.

CHAPTER III: OPTIONS FOR INTERVENTION

Main Features of the Strategy

3.1 The main issues affecting Mali's household energy sector were presented in the preceding chapter. Despite some localized pockets of depletion, resource availability in Bamako and in southern cities is relatively satisfactory. In these areas, the objective will be to improve wood production, while simultaneously (i) limiting or improving charcoal use and production, (ii) regulating fuel substitution operations which are promoted by petroleum operators but have detrimental impacts on the balance of payments and (iii) improving general access to modern commercial fuels. In the northern cities, by contrast, actions to encourage economic substitution of wood and to arrest the growth of charcoal consumption are urgently needed. These actions should be accompanied by improved techniques for woodfuel production, and by improved access to modern commercial fuels.

3.2 The objective of the proposed strategy is to define and implement a coordinated framework of medium- and long-term policies (i) to improve management of national and imported energy resources and (ii) to provide better energy service to the Malian people. The strategy integrates energy and forestry policy, neither of which individually is capable of adequately addressing the existing problems. Since wood and charcoal will remain dominant fuels for several decades -- large-scale substitution is not likely in the medium term -- the national forest reserve must be managed rationally. However, forest management solutions by themselves cannot redress the deforestation problems associated with urban energy demand in some areas, especially in the northern regions. Targeted substitution interventions also will be required.

3.3 The recommendations found in the strategy bring together several options which have been presented to and discussed with representatives of the main ministries, public organizations and large enterprises within Mali's energy sector. Many of these institutions were represented in the Advisory Committee which supervised the strategy's preparatory work. The concerns and recommendations of households, as expressed through surveys and focus group interviews, are also reflected in the strategy. In fact, it is the decisions made within households, and more especially by the women in households, which will determine the strategy's success or failure. Therefore, household opinions about the current state of household energy use and production were solicited, and the various options recommended for the strategy were tested and discussed with household focus groups.

3.4 The strategy design incorporates current efforts to redefine the respective roles of the public and private sector:

(a) proposed solutions will strengthen and develop participation by private sector and local markets, whether it be for promotion and distribution of efficient energy equipment (manufacturers and NGOs) or for producing and marketing woodfuels 10/ (rural communities, fuel producers and wholesalers) or even partial responsibility for woodfuel marketing (local collectives); 11/

(b) the Government's role will be strengthened in areas such as integrated energy sector planning, consumer information, supervising the petroleum sector or monitoring the woodfuel supply network, and overseeing woodfuel production operations and providing technical assistance;

(c) the price of household fuels will be brought closer to the levels of their economic costs, without negatively affecting fiscal revenues generated by the household energy sector.

3.5 Definition and implementation of the strategy components will require close coordination between various public and private sector entities in the sector. The Advisory Committee provided an initial forum for coordinating and organizing work by the representatives of the various organizations involved in elaborating the sector strategy. Cooperation between these parties must be permanent, not only on an advisory level, but also on the operational level. This can be accomplished by creating a Energy and Forestry Unit composed of specialists in these fields and specialists in complementary sociological, economic and technical fields. This Unit should be established as rapidly as possible: its first responsibility will be to set the stage for the strategy by (i) mobilizing all relevant participants and necessary financing; (ii) defining the framework for cooperation between the Government, sector professionals and the consumers; (iii) implementing a permanent information and evaluation system; and (iv) initiating the most urgently needed strategy components.

3.6 The options presented in the proposed strategy were developed in response to two development objectives. The first is demand based: improve access to and use of household energy -- especially the modern, efficient fuels. 12/ Fulfilling this objective could substantially improve

---

10/ The Government should no longer participate in production and marketing of woodfuels, activities in which it currently engages under certain operations such as the OAPF and the OARS.

11/ In zones selected from supply master plans, these collectives should be authorized by the Government to deliver and verify woodfuel production and transport, as well as collection of taxes to finance part of the costs for managing existing wooded areas in their jurisdiction.

12/ These demand-side actions are targeted mainly for Bamako and the other main cities since woodfuel consumption in these cities presents a greater environmental risk than in rural areas. In addition, the urban areas are better potential markets for improved efficiency and substitution based energy equipment.

daily living conditions for urban households, its target group. The second objective is supply based: modify the mechanisms for supplying woodfuels so as to foster economic development which is not detrimental to the environment. This mainly will be accomplished by rational management of forestry resources. Women play a major role in the use and production of household energy, and their contribution to improving the standard of living within the household is significant. Thus particular attention has been given to ensure effective participation by women. Finally, an organized institutional and regulatory framework as well as adequate price and tax policy will be needed for effective implementation of the Strategy. These features of the Strategy are elaborated in the following sections.

Improving Access to Energy

Propose Adapted Equipment and Services

3.7 If access to energy is to be improved, the strategy must propose and develop specific, situation appropriate solutions, based on preferences or consumer means. Options available to households should include the full range of fuel supply and energy equipment so that each individual may purchase and use the cooking fuel, cookstove, and lighting system of his/her choice.

3.8 Energy options adapted to the social realities of Mali's rural and urban societies are not necessarily in conflict with economic criteria. For example, many urban dwellers can afford the price of electricity; the kerosene lighting which they currently is more costly. Likewise, battery-operated television sets found in affluent households are more expensive to operate than the electric-powered version. Ten years ago, the three-stone stove was practically the only cooking equipment used in Mali; today several tens of thousand women use improved stoves, not only because these stoves are fuel efficient, but also because they provide for easier and more rapid cooking. Almost no one had access to gas before portable single-burner gas stoves were introduced onto the market. Less than four years later, one in five families owns a gas stove, although it costs almost ten times more than a wood-burning stove.

3.9 Neither rural nor urban households display entrenched habits with regard to consumer behavior, lifestyle, and equipment owned. Kerosene lamps, carts, radios, charcoal, new cooking habits, and other "energy" innovations all have found their way into households. Households at a certain socio-economic level pay the market development costs for new products due to their willingness to be innovative. Middle-income groups in particularly are willing to modify habits or switch fuels if they feel it will lead to increased convenience and social standing. They also are willing to invest in a product which is appealing and adapted to their needs, if the price and terms of payment are reasonable.

Modify Existing Consumer Dynamics

3.10 Surveys and discussions with focus groups indicate a number of current and potential consumer dynamics which can be influenced by the strategy. Dietary habits, for example, typically are considered fixed. In fact the dietary habits of Mali's households are in rapid transition, and this transition often goes hand-in-hand with changes in the household's choice and use of cookstoves. The rapid spread of new fuels such as charcoal or gas is due largely to new dietary habits: introduction of coffee, pasta or vegetables (to replace millet) and taking light evening meals.

3.11 The dynamics of fuel and stove preferences were revealed in comment sought through surveys and focus group discussions. Gas and charcoal were judged almost unanimously most modern and efficient. A strong consumer preference for charcoal was expressed, and general data showing rapid growth in charcoal consumption confirms this preference. Consumers also found gas-fired cookstoves, quite appealing and they are purchasing and using these stoves in increasing numbers, despite the higher cost. By contrast, the appeal of kerosene is constrained by the inconveniences which accompany its use. In order for kerosene to regain credibility and popularity with urban consumers, these inconveniences will have to be addressed: new, better adapted ovens are needed (the Chinese ovens currently in use are too small) and the fuel's price must become more competitive with wood. Kerosene then could become the fuel of choice for average and lower income urban families and for higher-income rural families.

3.12 Although most women surveyed consider use of wood to be bothersome and incongruous with modern urban lifestyles, there has been widespread market penetration and acceptance of metallic improved wood stoves in Bamako. Initial marketing success was due to public sector initiatives, but now the market is driven almost exclusively by the private sector dynamics. Survey respondents living in the interior cities show stronger interest in the metallic improved wood stove, which presently are not widely distributed in those areas. Thus, markets for these wood stoves are likely to develop more rapidly in areas outside Bamako. In fact, improved wood stoves could conquer partially the market share presently held by Louga stoves, provided that an effective marketing network is created interweaving public sector promotion efforts with activities by stove manufacturers and merchants in the informal sector.

3.13 A final consumer dynamic worthy of note is the general frustration towards electric power service felt by the population at large. Households in the capital, in the interior cities and especially in rural areas complain of lack of access to electricity. High connection costs were cited as an obstacle by many, but in most cases, the power grid simply does not extend to the area in question. Many households expressed interest in "intermediate" solutions such as lamps with rechargeable batteries. The operating costs for such items can be accommodated by most households, yet the initial costs of purchasing equipment still represent major barriers to their use.

Main Areas for Intervention

3.14 The strategy's objective in addressing this issue is to expand the range of energy options and products available to the consumer. The range of available "popularized energy products" (PEP) would include improved stoves; gas and kerosene cookstoves; electric power for small consumers; portable lamps and -- if the concept were to be expanded even further -- individual or communally owned equipment in rural and peri-urban areas (carts, pumps, windmills, and cold storage compartments for preserving produce).

3.15 More specifically, assistance will include (i) introduction of adapted kerosene stoves in the high-priority urban areas to the north and in central rural areas; and (ii) introduction of high-efficiency charcoal cookstoves in areas where there its use for cooking is developing rapidly, such as Bamako. The range of existing products will be diversified by introducing multi-burner gas cookstoves and portable, metallic multi-burner models fueled by wood and charcoal.

3.16 The strategy also should assist the local sector with the distribution, marketing and, in some cases, manufacture of these products. Assistance would include: (i) aid to establish commercial networks in priority areas and to define and implement diversified marketing strategies; and (ii) promotion campaigns in support of distribution efforts. The public sector cannot and should not take part in the actual marketing, since Mali's private sector clearly is very capable in this regard. Nevertheless, the informal sector, craftsmen and small-scale merchants do not have the resources or expertise for certain activities -- product development and testing, publicity, consumer awareness programs. This is where public sector assistance would be both necessary and welcome.

3.17 Government action to facilitate introduction of priority PEPs should include: (i) establish appropriate fiscal measures; (ii) define new supply systems for fuels (import mechanisms for kerosene, for example); (iii) help formalize sales and distribution techniques; and (iv) finance promotion activities. The strategy also provides for a government role in consumer education programs for modifying consumer behavior (diet diversification and rational use of energy fuels).

3.18 Finally, the strategy should use economic and pricing policy where appropriate to increase households' access to different energy products. In the case of electricity, the price per kWh does not represent a major obstacle to the consumer. Thus lowering electricity prices would hardly make sense. On the other hand, the pricing mechanism could be utilized appropriately in the case of kerosene and gas. Optimizing supply arrangements with current suppliers or allowing competition for imports, coupled with reductions in Government surcharges on these fuels, would result in lower prices. At these lower levels, cooking with gas and kerosene would become an economically feasible option for a large portion of the population.

3.19 It would be neither realistic nor advantageous for the Government to regulate the retail price of energy products. Such controls would limit supplier margins, thereby weakening private sector interest. Nor would subsidies for stoves, lamps or connections to the grid be desireable; they simply are not feasible under current economic conditions, although short-term subsidies to assist initial marketing programs would be possible. Assistance for initial purchases could be provided by establishing small-scale, localized credit facilities. Previous efforts of this kind have been insufficient, and the modern banking sector is ill-equipped to handle it. Thus, the strategy should lead to the strengthening of existing small credit mechanisms provided by neighborhood organizations, small businesses or small-scale projects which support purchases of energy efficient equipment. In addition, the manufacturers and distributors of these appliances should be provided better access to the classical banking system.

3.20 In all cases, the strategy should grant an important role to women. Women generally are the primary beneficiaries of improvements provided by PEPs. They also play active roles in equipment distribution -- they currently are the principal distributors of improved stoves -- and in collective savings associations (tontines).

Forest Resource Management

Reconcile Objectives for Productive Natural Resource Development with Those for Preventing Desertification

3.21 In order to achieve its second main objective -- rational management of forestry resources -- the strategy should be incorporated into the National Program to Prevent Desertification (Programme National de Lutte contre la Desertification), which was adopted in 1987. In its summary documentation, the NPPD defined desertification prevention as a global approach to rational use of natural resources which results in more productive resource exploitation while safeguarding the environment. General use of woodfuels in Mali is a major factor in this approach; however, in order to effectively limit the impact of woodfuel use, other elements which contribute to corrosion or improvement of natural resources must be taken into account: grazing, crop production, climate, demographics, soil quality, etc. Thus strategy implementation should be coherent with and complementary to activities proposed under the National Resource Management Project (currently under preparation), especially in the areas targeted by this project.

3.22 Exploitation of forest reserves for woodfuel supply entails commercialization of a valuable national resource. Woodfuel supply is a major economic activity, generating revenues of more than 10 billion CFAF annually. Less than 50% of this revenue is recovered in producer margins accruing to rural dwellers. Yet this population derives other benefits from commercial

exploitation, since they can supply themselves with fuel directly from their own land. Thus thousands of peasants and workers in the informal urban sector benefit directly and indirectly from wood revenues.

3.23 When localized over-exploitation occurs in some areas, such as those close to urban centers, woodfuel supply presents a threat to the environment. Sustained forest exploitation in these areas loses the characteristics inherent to exploiting a renewable resource and takes on the character of mining exploitation. The damage which results is often irreversible.

3.24 Forest exploitation in Mali takes on both characteristics. In the south (Kayes, Bamako, Sikasso or Ségou), the renewable nature of the resource has not been damaged. Thus, priority should be given to rational development of the existing forest resource; forest land management in villages; and modernization of production, transport and marketing networks for wood and charcoal. For Bamako, special attention should be given to woodfuel production areas along rail corridors. Rail transport costs are low (between 20 and 50 CFAF/ton-km) and rail capacity is under-utilized at present.

3.25 In the north (Tombouctou, Gao and even Mopti), forest resources are severely degraded. Exploitation of forest reserves for woodfuel supply should be concentrated in preferred production zones (particularly in wood cemeteries). This action will complement demand-based actions proposed in the previous section (develop use of improved stoves; substitution by gas and petroleum).

Main Areas for Intervention

3.26 The national strategy must be conceived as a group of regional strategies adapted to the localized conditions for forest resources and woodfuel supply. Thus specific knowledge about resource availability, resource use, commercial urban supply and non-commercial wood use will be required for each major city and its environs. Only then can appropriate actions be defined for relocating exploitation to the relevant wood production zones. Actions will take one of two directions: improve exploitation (increase efficiency) of the resource, or relocate production to other areas in order to salvage damaged reserves.

3.27 Fuel Supply Master Plans (FSMP) developed by each city should be based on inventories conducted the PIRL, where available, on analyses conducted under the Second Forestry Project of the supply chains for wood and charcoal in the major cities, and on complementary on-site inquiries. The FSMPs will vary case by case, but most will lead gradually to a system of rural planning or to voluntary shifts of forest exploitation into safer preferred zones.

3.28 Several basic components of Mali's new forestry policy will provide the framework for implementing the FSMPs. The first component permits legalized, newly organized rational exploitation in classified forests. The new arrangements are both technically feasible and adapted to the economic reality of the peasants and local populations who currently exploit these forests. Priority should be given to managing production in the classified forests surrounding Bamako ("rail" forests, for example), Ségou and Koutiala, since these forests are already subject to considerable illegal exploitation.

3.29 Another component grants protected status to rural forests and transfers the responsibility for forestry management to local collectives. Local authorities thus become both trustees and beneficiaries of the resource: 100 hectares located along a principal transportation artery within 50 km of Bamako, with a density of 15 m^3/ha and productivity of 0.5 m^3/ha/year, represents a standing capital of 5 million CFAF and an annual rent of 170,000 CFAF.

3.30 Transfer of responsibility for protected forests to the local collectives should be gradual: initially (as a special exception to the current Land Use Codes), local authorities could be granted temporary authority over the protected forests in the areas targeted under the future Natural Resource Management project. The classified forests in these targeted areas also would be given priority when land management plans are established. In order for the local collectives to manage effectively the protected forests, they should be given authority to grant permits for commercial exploitation of wood subject to conditions negotiated with the national Forestry Service. Thus, there would be a two-tiered supervision of forest exploitation: the producers will answer to the local collective, who in turn will be supervised by the Forestry Service.

3.31 The national Forestry Service will have two areas of responsibility, one which it will exercise immediately and the other will be assumed gradually:

(a) In its "macro" supervision role, the Service will define the global potential of the various national forests and will assign corresponding cutting quotas to individual collectives. The Service will assure compliance with the quotas by strengthening its regulation of woodfuel entries into main cities. Periodic checks will be made to verify resource conditions in supply areas so that quotas can be modified, if necessary.

(b) In its "micro" supervision role, the Service will work in cooperation with on-site NGOs, through its regional directorates, to assist (i) the local collectives in implementing master plans for rational development and exploitation of forest resources in their jurisdictions; and (ii) local producers in improving production techniques and acquiring associated equipment (cutting tools, carts).

3.32 Since access to wood is almost totally free, its standing value is close to zero, thus providing little incentive for conservation. In order to strengthen rural control of the forests, the power of the resource owner (the peasant) must be strengthened vis-a-vis the other links in the supply chain (wholesalers, transporters, marketers). The result will be increased weight given to producer prices and to the price of standing wood. In the short term this will allow the costs associated with resource development to be integrated into wood prices. In the medium term, peri-urban forest plantations may prove feasible due to this economic rent.

3.33 Implementation of the FSMP will strengthen, organize or modify existing networks at both the production level and the marketing level. The first step will be to identify those sector operators (transporters, marketers, producers) who potentially would be appropriate program participants, based on their willingness to participate, degree of organization, scope of activity, potential for improvement, areas of operation. These individuals could be identified from information collected for the forest products market study conducted in 1990-91 under the Second Forestry Project. Operators established in production areas sanctioned under the FSMP will be given first priority for assistance; these operators potentially could be organized into associations, as was done under the Household Energy Project in Niger. The program's effectiveness will depend on the establishment of viable rural wood markets in these areas. Participants in the supply chain serving these markets -- the producers upstream and the marketers and transporters downstream -- would receive assistance under the program. These markets will be developed from the spontaneous markets which already exist along the supply routes using incentives for merchants to relocate and concentrate their activities at selected sites. Coupons designating the wood's origin then could be granted by the local collectives to the marketers and/or transporters at these central market locations.

3.34 Finally, special assistance also is needed for operators in the supply chain for delivering charcoal to Bamako. This network is growing rapidly and is a high consumer of wood. Any interventions into the network would be facilitated by the fact that it already is quite professional and is concentrated in the hands of merchants with whom the Government could hold a more formal dialogue.

The Role of Women

3.35 Women play central, key roles in the production and consumption of household energy in both urban and rural settings. It is imperative that specific recommendations be formulated to ensure effective participation by women in the various components of the strategy, for two key reasons: Women's participation will (a) make the strategy as effective as possible by directly addressing the needs and concerns of the principal actors in the household energy sector;

and (b) ensure that women have access to the additional resources which will result from strategy implementation. This will lead to a more efficient distribution of the strategy's resources. Households' well-being will increase, since women's incomes are linked more closely than those of men to the well-being of the family in general and of the children in particular (quality of nourishment, schooling, etc.).

3.36 At the demand level, new energy equipment and substitution fuels should correspond with the needs and preferences of women, since they are the primary users. Existing women's associations and neighborhood groups should participate in developing and implementing the PEPs. This part of the strategy will support the development of income-generating activities in the informal sector, such as food vending, preserving produce (cold storage), and the like.

3.37 When addressing the need to improve the supply system for woodfuels, there is a greater likelihood that men -- due to their control over credit and means of production -- would become de facto partners in any dialogue with strategy planners., and that women would be shunted aside. This situation must be scrupulously avoided. A rural sociologist should work closely with forest specialists to determine on a localized basis the possibilities for and constraints to women's participation in firewood production and marketing. Interventions which benefit women, yet do not upset traditional social structures, should be defined for each case. Opportunities for women should be identified at the local level for managing rural markets, and assistance to the different participants in the woodfuel chain should include women, as well.

3.38 Development of forested land in villages requires that local collectives be given control over all forested areas. The rules for exploiting the lands should be discussed with the entire village. The strategy should assure that women are properly represented at the village council or, if that is not possible, that separate meetings be held for men and for women. Women's knowledge of the forest species and vegetation and their multiple uses should be consulted at all phases of forest exploitation, protection and restoration.

3.39 The strategy's Steering Committee will ensure a more effective design and coordination of surveys and market studies needed for the strategy. The presences of a sociologist on this committee will ensure better integration of women in the strategy (based on socio-cultural analysis). The Steering Committee also should ensure that women's preferences and advice are taken into consideration through regular consultation with groups representing the interests and knowledge of women.

Institutional Framework

Strategy Implementation and Administration

3.40 Implementation of the various strategy components requires a coordinated and cooperative framework which integrates energy sector and forestry sector, private and public sectors, project beneficiaries and ongoing projects. For example, definition and implementation of the Woodfuel Supply Master Plan for a particular city should take into account public and private sector efforts to distribute gas and kerosene equipment. The success of these master plans depends on the degree of participation by private sector operators, on the ability of the regional directorates of the NWFD to provide technical assistance to rural communities, and on the degree of organization and motivation within these communities for improving and monitoring wood exploitation on their lands. In order for new energy products (PEPs) to successfully penetrate the market, the private sector should be responsible for their manufacture and promotion, with active participation by existing consumer associations. Management of classified and protected forests should be included in the Malian Government's global strategy for managing natural resources, especially in targeted areas under the future natural resource management project.

3.41 The current institutional framework is characterized by complexity and dispersion, a structural dichotomy between energy and forestry activities, and insufficient resources (and even lack of technical expertise) within the public sector. Thus successful implementation of the strategy is contingent on the following conditions:

(a) The NEHD and the NWFD's planning and supervisory abilities must be strengthened (including regional directorates), without creating new structures or high recurring financial charges;

(b) Implementation of the strategy components should be delegated as much as possible to the private sector and to locally active organizations in the field, and participation by strategy beneficiaries (rural collectives, consumer organizations) should be secured through possible re-orientation of the strategy;

(c) Consistency between demand-side components (energy) and supply-side components (forestry) should be insured through high-level coordination between the two participating ministries (MAEE and MMHE).

3.42 Strategy implementation should be supervised by the organizations recommended in the ESMAP energy sector evaluation report: the Household Energy Unit (Cellule Energy Domestique - CED) within the NEHD, and the Woodfuel Unit (Cellule Combustible Ligneux -

CCL) within the NWFD, with assistance from the regional directorates. The CED should be comprised of the following personnel: an energy economist, an energy engineer, a sociologist, a statistician/data processor, and support staff. The CCL should be comprised of the following personnel: a forestry economist, a forestry engineer, a sociologist, a statistician/data processor, and support staff. The CED and the CCL should be provided with sufficient logistical resources to conduct their activities: vehicles, computers, operating costs (see budget in Annex 8).

3.43 Implementation of the strategy should begin with a preliminary phase during which the components are defined in detail and necessary financing is mobilized. A Temporary Steering Unit (TSU) was created in October 1991 for this purpose; it will begin operations in 1992 (see Annex 10 for May 1990 note describing the Unit). The TSU will be in place for one year. Its main objective will be to produce a detailed action plan for each of the strategy components for which financing should be obtained from donors. In 1993, the specialists seconded to the TSU by the MMHE and the MAEE will return to their respective ministries and take up posts in the CED and the CCL.

Mechanisms for Evaluation and Control

3.44 It is essential to include within the Strategy itself mechanisms for evaluation and control, because:

(a) the Strategy will bring together multiple participants, due to the diversity of components and actions which will have to be coordinated and followed-up;

(b) the Strategy is based on a dialogue with these participants: sector professionals (from small peasant wood choppers to directors of petroleum companies) and consumers;

(c) the CCL and the CED should brief the Government and project lenders on the progress of actions taken within the framework of the Strategy;

(d) finally, the MMEH and the MAEE must follow closely the evolution of the household energy sector, as well as the outcomes of implemented measures, in order to adjust strategy interventions if necessary.

3.45 Other bureaus within the NEHD and the NWFD (separate from the CED and the CCL) will evaluate the strategy results and input from the public and private sector operators affected by the projects. At the NWFD, the unit undertaking this responsibility will be the existing Projects and Programs Division. At the NEHD, the Information and Evaluation Service (to be

created upon recommendation of the ESMAP Energy Sector Evaluation Report) will be responsible for this activity.

3.46 The evaluation process must quantify the actions taken, the impact of these actions, and their effects on different groups, especially women. In the case of woodfuel supply, results which can be quantified include the number of rural markets in operation, the surface area of land used to supply these markets or the number of managed forests and their surface areas. The effectiveness of new arrangements also must be estimated; for example, the quantities of wood originating from rural markets, quantities of wood originating from managed forests, additional fiscal resources, the proportion of regulated supply among the woodfuels entering the city, and fiscal fraud.

3.47 The impact on the general organization of woodfuel supply also must be analyzed. Areas to be evaluated include the distribution of supply traffic by mode of transportation and by port of entry into the city; fuel prices in rural areas (market prices, producer prices, price of standing wood) and in cities. Attempts should be made to measure environmental impacts by comparing the evolution of the forest cover in depleted areas not under regulation, in supply areas for rural markets (referred to in the text as preferred exploitation areas, since these areas are not under regulation), and in managed forests.

3.48 Finally the effects of the strategy on the different groups affected by woodfuel supply should be measured. These groups include: village communities in areas where the strategy will try to limit forest exploitation, with the agreement of local collectives; village communities in areas where the strategy promotes forest exploitation (supply zones for rural markets, managed forests, wood cemeteries); and the various professionals in the sector, including producers, transporters and distributors.

3.49 in the case of energy demand, the distribution of stoves and other popularized energy products should be quantified. A principal measure will be the number of improved stoves, kerosene or gas cookstoves marketed during strategy implementation. In addition, other indicators will provide more permanent information regarding the market structure and distribution potential for kerosene and butane: quantities imported, origin and destination of the fuel, price structures.

3.50 Consumer behavior also must be monitored. The preceding information should be combined with the results of regular, direct observations of consumer behavior. Consumers should be categorized according to stove type and fuels used (primary and secondary); specific consumption; attitudes and preferences (satisfaction indexes, planning to buy). This information will be gathered using specific surveys and through dialogue with permanent consumer panels. The strategy should rely as much as possible on surveys which are already conducted regularly by the

DNSI, and should try to "institutionalize" collection of the important data needed for the strategy through use of these surveys.

Pricing Policies and Regulations

Wood Taxes and Regulation

3.51 Once systems for evaluation and control of the woodfuels sector have been established, it will be possible to implement a new tax structure and a new regulatory framework for woodfuel production and transport. The new fiscal and regulatory arrangements should provide incentives for the relocation of wood production to areas where it can be sustained, as well as incentives for rural populations to manage the settlements in forested areas.

3.52 New regulatory arrangements should take into account the Forestry Service's limited staff and resources. Direct intervention and control by the Service thus should be limited to truly pressing problems, with a portion of its activities delegated to authorities in local collectives. Specifically, implementation of regulations which cannot be enforced should be avoided. Enforcement of measures agreed to in discussions and negotiations with the Government and concerned local parties should be well within the abilities of the responsible party. A system should be implemented whereby each party (the Government, the local collective, the sector professionals) finds it in its own interest to comply with the laws and where non-compliance is penalized economically. For example, over-exploitation or exploitation in unregulated areas would be "acceptable" (i.e. no direct restrictions), but penalties would be paid in the form of a tax differential at the city gate (cutting permits would be used to monitor the origin of the wood).

3.53 Similarly, economic incentives should be provided to local governments so that they effectively assume control of natural resource management in their jurisdictions. Environmental degradation is always the result of local social consensus. A new consensus on resource management and protection can arise by developing the linkage between local economic conditions and the commercialization of wood. Therefore the local collectives must benefit directly from the sale of wood originating on their lands; the size of this profit will be proportional to the effort put into organizing rational, effective resource management.

3.54 Tax differentials can be used effectively as a policy tool for the forestry sector. A different tax regime should be applied to the three main types of wood exploitation: uncontrolled mining exploitation; exploitation controlled by local authorities; and preferred exploitation (wooded areas in villages or on managed property, dead wood cemeteries). The maximum tax should be applied in the case of uncontrolled mining type exploitation, where the origin of wood is not

regulated. Transporters will pay this duty at the city gate and the revenue will be used by the Government.

3.55 In the case of exploitation monitored by local authorities, a lower duty should be assessed. At least some part of the tax should be collected at the local level as revenues for the local treasury. Thus a financing facility will be available to the collectives, with repercussions for the exploiters and the transporters who supply themselves from these areas. The tax will only affect quantities of wood exceeding a threshold to be determined based on resource availability and potential. The progressive implementation of a system of annual production quotas will formalize this linkage between wood collection and resource potential. The annual quotas will be re-evaluated periodically and negotiated with the local population. They also will be reviewed when local authorities begin to manage development of wooded land in the villages.

3.56 The third type of taxation which is economically appealing should encourage transporters to seek their wood supplies from managed forests or preferred zones, and push the collectives to establish management plans for local wooded land. The tax rate would be lower, but the local collective's share of the revenues would be larger than under the previous two regimes.

3.57 Success of this particular tax structure will require authorities to: (i) implement a collection system for each mode of transportation which enters the city; (ii) negotiate and grant annual production quotas to local collectives, who gradually will take over local forest management duties in more and more areas; (iii) implement de facto quotas by granting preferential transport coupons for wood supplied from preferred zones; and (iv) implement effective reforms to the woodfuel taxing system.

3.58 Reform of the woofuel tax system thus comprises a general increase in tax levels, tax differentials based on the origin of the wood, and improved tax collection methods. For wood produced in managed, priority zones, the tax could remain (in real terms) at current levels (0.7 CFAF/kg), with a portion of this amount (to be determined) to be collected by the local rural community. For monitored exploitation, the tax would be higher and would increase even further for areas where exploitation in not monitored. The financial analysis of this strategy's impacts assumes that the average tax level across all exploitation areas will reach 1 CFAF/kg in real terms within five years after the strategy has been implemented. In any case, a first draft of the new tax system should be prepared by the TSU using the results of the market study for forestry products to be conducted under the Second Forestry Project. The draft can be further revised once the Woodfuel Supply Master Plans have been developed as part of the Strategy. In addition, the wood tax system should be adjusted periodically to take into account the following factors: inflation, modifications in the prices of substitution fuels, modifications in the attributions of priority/managed zones, monitored zones and unmonitored zones. The CCL should perform this activity.

Petroleum Product Taxes

3.59 The petroleum product price study conducted by the Malian Government in 1991 with assistance from IDA resulted in the following three main recommendations:

(a) liberalize all petroleum product prices in order to provide petroleum operators (majors as well as independents) with incentives for rationalizing and decreasing the costs of their supply and distribution systems;

(b) keep taxes at their current levels in real terms in order to ensure constant fiscal revenues for the State and to avoid unsuitable substitutions among fuels (relative tax levels were judged to be appropriate);

(c) establish a new Office to monitor and regulate petroleum subsector prices by consolidating the several organizations which currently have responsibilities in this area. This system, which is scheduled for implementation in 1992, should lead to a decrease in retail prices, especially for LPG and kerosene.

3.60 The new price policy for petroleum products will strengthen the substitution potential of LPG and kerosene in urban areas. The anticipated decrease in kerosene prices may be a sufficient incentive to induce a number of consumers in the northern cities and in Bamako to cook with kerosene, despite the consumer reticence noted during this study. This would be contingent upon availability of adapted, energy efficient cookstoves and upon major promotional campaigns and assistance to market these stoves. The financial analysis for the strategy's impact assumes that the tax levels for kerosene remain at current levels.

3.61 In any case, modifications to the fiscal regimes for wood, charcoal, gas and kerosene are not independent one of the other, and thus should be coordinated. This will ensure that overall fiscal revenues generated by woodfuel tax reforms could be used to decrease tax levels for kerosene by strengthening its market position as a substitute cooking fuel, while maintaining the overall level of revenues generated by the energy sector. The kerosene tax could be decreased so that kerosene prices are equivalent to diesel prices (which currently has fewer imposed taxes than kerosene) so that misuse of kerosene by the industrial and transport sectors is avoided. The TSU, during the strategy's preparatory year, and then the CED and the CCL, during the active phase of strategy implementation, should monitor the evolution of household fuel prices and associated fiscal revenues and propose reforms to the tax policy for LPG and kerosene, as needed.

3.62 Finally, the CED in collaboration with petroleum operators should define options for reducing costs related to LPG: supply (new supply sources such as Ghana, for example), storage and distribution (decrease depot charges and losses). It also is important that investments required

in transport, storage and distribution infrastructure be identified to support the Strategy's efforts to develop the LPG market. The CED should work closely with the National Committee for Promotion of Butane Gas, created within the MMHE in 1990.

CHAPTER IV: THE STRATEGY

Objectives for the Year 2001

4.1 The active implementation phase of the Household Energy Strategy will cover a five year period, including one year to prepare the detailed action plant and to mobilize necessary financing. The objectives, expected results, costs and benefits will be evaluated over a ten year period. The second timeframe corresponds more closely to the normal planning horizon for energy and represents a conservative approach, since the benefit/cost ratio increase with the length of the evaluation period. The strategy's objectives are based on analysis of the potential markets for the different household fuels, as identified in Chapter III and detailed in Annexes 6 and 7. The objectives can be summarized as follows:

(a) Reduce significantly (by at least 20% relative to projections of the current situation) the pressure exerted on Mali's forest resources due to wood and charcoal consumption in urban areas, specifically:

- reduce the percentage of households cooking with wood as primary fuel to 50% in northern cities, and to 70% in Bamako and the southern cities;
- eliminate all use of three-stone stoves in urban kitchens and ensure general use of metallic cookstoves;
- support efforts to distribute owner-built stoves (Louga) in northern rural areas.
- limit the percentage of urban consumers cooking with charcoal to a maximum of 20%, and ensure general use of improved charcoal stoves.

(b) Ensure general access to substitution fuels for urban dwellers in the north and those in Bamako. Specific objectives include:

- ownership of a gas and/or kerosene stove by approximately 5 to 6 of every ten households, with 20% of these using the equipment on a regular basis for cooking.
- ensure that kerosene is introduced successfully into middle-class and lower middle-class homes as a cooking fuel, especially in northern cities. The goal

is to have at least 30% of households owning kerosene cookers, with at least half of these using kerosene as the primary fuel.

(c) Ensure better access to modern energy service for the more affluent rural dwellers, especially in areas where wood is already marketed commercially, through developing the use of kerosene as a cooking fuel and promoting installation of communal equipment such as pumps and windmills.

(d) Develop micro-electrification projects in tandem with the Second Power Project, with the goal of providing access to more than 40% of Bamako households and 30% of households in other cities by 1996, either via the national grid or portable electric lighting. 13/

(e) Define long-term woodfuel supply policies (FSMP) for the main cities (Bamako, Ségou, Kayes, Mopti, Gao and Tombouctou) which accommodate the interests of producers and consumers while protecting the environment.

(f) Provide the conditions under which professional associations for woodfuel producers can blossom; organize rural wood markets.

(g) Formalize and modernize charcoal production for supplying the main cities, in particular the capital and northern cities.

(h) Place a larger percentage of village and national forests under controlled management. The goal is to place 50% of the areas which supply wood and charcoal to the capital and the main cities under direct local management; and 1 in every 10 villages should have detailed land-use plans for its wooded areas.14/

(i) Use reserves of dead wood in the three northern regions to supply up to 30% of woodfuel consumption in Gao and Mopti.

13/ These quantitative goals include results of projects already underway, such as the Second Power Project, which plans 15,000 new connections in Bamako between 1990 and 1995, for an electrification rated of 33% in 1995, and more than 3000 new connections in Koutiala, Mopti/Sévaré, Ségou/Markala and Sikasso, for an average electrification rate of 27%. Within the framework of the Strategy, new electric service customers would include additional new subscribers to EDM service (attracted by special facilities to assist the household in paying the initial costs of connection to the grid) and purchasers of pre-electrification equipment. The strategy component which encourages additional connections to the grid must take into account potential impacts on EDM's load curve.

14/ Over the next decade, approximately 2000 villages will participate in some exploitation of wood resources (see Annex 7.5). This figure is based on estimates of total urban consumption of wood, the density of woodfuels available for exploitation per hectare, and current statistics on surface areas under exploitation.

Expected Results

4.2 A general outcome will be diversification of the fuels used for cooking, and more importantly increased use of petroleum products. Projected consumption of petroleum fuels by the year 2000 are as follows:

(a) 22,000 tons of gas, versus consumption of only 6000 tons in the base case (continuation of current trends).

(b) 12,000 tons of kerosene, versus only 200 tons in the base case.

4.3 Part of the potential market for charcoal thus will be eliminated by steering potential consumers towards petroleum fuels. Projected charcoal consumption in Bamako will be 40% less than base case projections, which reflect continued strong market growth by charcoal.

4.4 Expected results for the stove distribution components are as follows:

(a) nearly 900,000 portable metallic improved wood stoves will be put into use between 1992 and 2001; the 100,000 mark will be surpassed by 1996. About two-thirds of the stoves will be distributed in Bamako.

(b) 20,000 improved charcoal stoves will be put into use between 1992 and 1996, with more than 120,000 entering the market in the succeeding five years.

(c) 20,000 kerosene stoves will be put into use between 1992 and 1996, and an additional 60,000 stoves distributed in the second half of the decade.

(d) 75,000 gas stoves will be put into use between 1992 and 1996, and nearly 140,000 stoves in the following five years.

4.5 Components affecting household lighting options will provide an additional 12,000 households 15/ with access to electricity or intermediate pre-electrification options.16/ About 80% of this number will be in the capital (equivalent to slightly more than 4% of households in Bamako and the main cities).

4.6 For components with impacts on woodfuel supply, the following results will be obtained:

(a) about 1.5 million wooded hectares will be placed under controlled local management between 1992 and 2001;

(b) about 300,000 wooded hectares, 25% of these classified forests, gradually will be affected by land use and development plans by the year 2001 (these areas are included in the total cited in part (a));

(c) approximately 100 associations for rural wood producers will be formed, organized around rural woodfuel markets;

(d) 85% of all woodfuels entering the cities will be subjected to Forest Service controls;

(e) nearly 100,000 tons of dead wood in the north will be harvested between 1992 and 1996, and more than 200,000 tons between 1996 and 2001.

Strategy Components

4.7 The Household Energy Strategy is divided into two modules: demand and supply. The demand module comprises three components for improving access to and use of modern household fuels. The supply module has five components for better management of forest resources. The components are as follows:

15/ In addition to those planned under the Second Power Project.

16/ The respective shares for pre-electrification and small-scale electrification are difficult to quantify and will depend on the way the market reacts to the two products during implementation of this component. The strategy will interface with EDM's development programs (especially the Second Power Project) by encouraging new connections along existing portions of the grid through innovative programs and incentives (for example: subcontract connections to the private sector, multiple-consumer supply points in certain suburbs (with lump-sum payments) small credit mechanisms, connection options with limited power, etc.)

Demand Module

Component 1:	Development of New Popularized Energy Products (PEP)
Component 2:	PEP Promotion
Component 3:	Small Credit Facilities to Finance PEP Equipment

Supply Module

Component 4:	Fuel Supply Master Plans for Mali's Main Cities
Component 5:	Assistance for Professionals in the Woodfuel Sector
Component 6:	Modernizing the Charcoal Sector
Component 7:	Use of Dead Wood to Supply Mopti and Gao
Component 8:	Management of Forested Village Lands Near Bamako, Ségou, Koutiala, Kikasso and Kayes

4.8 As described in the preceding chapter, implementation of the strategy's eight components will be supervised and coordinated by two sub-units created on the recommendation of the ESMAP Energy Sector Assessment Report for Mali (November 1991); the Household Energy Unit (CED), located in the NHED for the three components of the demand module and the Woodfuels Unit (CCL), located in the NFWD, for the five components of the supply module. All eight components will be implemented by groups of national and foreign technicians and experts supervised by the CED and the CCL; the CCL will be provided long-term technical assistance (an economist specializing in woodfuels, for three years). Personnel and budgets requirements for each component (see Annex 8) should be revised during the first year of strategy implementation. The Temporary Steering Unit created by the Government in October 1991 (see Annex 10) will be responsible for this task. The CED and The CCL will be supervised by the Strategy Steering Committee. This Steering Committee will be composed of high-ranking authorities from the MMHE and the MAEE and will meat twice a year to evaluate and provide direction for the strategy based on semi-annual reports produced by the CCL and the CED (see the Strategy implementation organigram in Annex 11.)

4.9 The success of the Strategy will depend on implementation of specific policies and a permanent monitoring and evaluation system for the sector. The appropriate policies and programs will be defined the CCL and the CED and will include:

(a) Monitoring prices of household petroleum fuels (kerosene and LPG) after planned price decontrol and, if necessary, prepare specific proposals for revising existing tax policy (for example, lowering the surcharges on kerosene and permanent decontrol of LPG) or rationalizing the price structure.

(b) In conjunction with (a), revised regulations and taxes for wood and charcoal (local collection of part of the woodfuel taxes; introducing tax differentials);

(c) Assistance in the preparation and enactment of legal texts granting temporary and conditional land management authority to local collectives in areas targeted by the Strategy, including the respective responsibilities of participants;

(d) Implementation of a permanent evaluation and control system for the sector. As indicated in the previous chapter, this task will be conducted by the Evaluation and Information Service of the Energy and Dams Division of the NHED for the demand module and by the Programs and Projects Division of the NWFD for the supply module.

4.10 The Temporary Steering Unit (TSU) will be in place during the first year of strategy implementation and will have the following main functions: (a) identify and mobilize the required national and foreign financing; (b) prepare a detailed action plan for each component which is financed. The TSU should also:

- propose mechanisms to simplify interministerial collaboration and consolidate the existing coordinating committees in the subsector;
- establish linkages with ongoing programs and projects related to the strategy;
- establish a network of private participants by identifying and/or organizing specialized professional groups in the informal sector (stove manufacturers and distributors; small-scale petroleum product distributors; wood and charcoal professionals);
- keep sector-related private and public organizations and institutions informed on the content and objectives of the Strategy;
- make specific proposals for regulatory and tax revisions.

4.11 The TSU will be placed under the supervision of the Ministry of Mines, Energy and Hydropower and the Ministry for Agriculture, Environment and Livestock and will be staffed by the following seconded personnel:

(a) a project director, with at least five years experience in the various aspects of Malian energy policy;

(b) an energy specialist, preferably with experience with improved stoves;

(c) a forestry specialist, with experience in woodfuels;

(d) an energy economist, specializing computerized energy data analysis;

(e) a sociologist with rural experience;

(f) support personnel.

4.12 The TSU will request occasional specialized assistance from foreign and local experts: for revising the detailed action plan; for organizing and implementing surveys; for data analysis; for socio-economic analyses of rural and urban centers. Annex 10 gives more details on the logistics of the organization of the Temporary Steering Unit.

Demand Module

Component 1: Development of New Popularized Energy Products

4.13 The objective of this component is to research, develop and test in the Malian market new and viable energy alternatives to replace inefficient traditional energy equipment. In the short term, this includes adapted kerosene cookstoves, multi-burner ovens fueled by charcoal, gas cookers based on a Nigerian model, and pre-electrification equipment.

4.14 New PEPs will be developed over a three year period (1993-1995). The group responsible for initiating new PEPs will:

(a) identify and purchase (in small quantities) equipment which could be adapted for use in Mali, either from neighboring countries or from other geographic areas;

(b) perform technical tests to modify the equipment as necessary, and present the adapted equipment to selected consumer panels; further adapt equipment after conducting technical and marketing surveys;

(c) be responsible for importing, adapting or manufacturing accepted products in larger quantities (several hundred units); identify distributors; initiate and monitor pilot sales programs;

(d) evaluate pilot sales to identify the most promising products; prepare promotional materials for these products, identify private Malian partners, assist preparation and signing of import and distribution agreements.

4.15 Staffing for the component will include specialists recruited from outside the Government. The group, which will request occasional assistance from other Malian and foreign experts, will comprise:

(a) a marketing expert, with specific experience with the marketing problems found in the Malian context;

(b) a technical assistant, preferably with experience in popularized energy products, to work on-site in neighborhoods in Bamako and the cities of the interior. This technician will be assisted by an on-call team of technicians who will provide technical support and maintenance.

(c) a head surveyor and product demonstrator, assisted by an on-call team to help with surveys and demonstrations of products.

(d) support personnel.

Component 2: PEP Promotion

4.16 The main objective of this component is to facilitate consumer acceptance of and increased use of PEPs (both existing products and those developed under Component 1) by various promotion and consumer education programs. The component will provide incentives to stimulate changes in dietary habits (more diversified and modern diet with lower specific energy consumption) and to promote energy conservation habits (proper, efficient use of cooking equipment). Three types of measures will be implemented over a three year period (1994-1996):

(a) media promotion, using conventional publicity to encourage use of targeted products,

(b) general promotion efforts to bring information to the general public through groups and associations or by institutional means (neighborhood associations, ongoing projects, etc.),

(c) assistance to develop and formalize private distribution networks.

4.17 Specialized assistance will be needed to ensure effective use of classical publicity channels (radio, television and, on a more limited basis, the press) to promote standardized (guaranteed quality and energy efficiency) products and energy conservation measures. The media in Mali has only a limited reach and publicity activities are not well developed. Therefore assistance must be well coordinated and should be handled by communication professionals: a specialized team of Malian experts to be assembled by the strategy and supported by assistance from foreign publicists with experience in similar markets (Ivorians or Senegalese, for example).

4.18 This component will provide assistance to the more general promoters (neighborhood unions, village associations, specialized institutions, urban or rural projects) for coordinating and organizing sessions to publicize and circulate equipment. Training sessions, educational brochures and specific demonstration materials can be provided by the team to these groups.

4.19 Finally, this component also will provide assistance to formal marketing and distribution circuits to develop decentralized distribution networks and to organize training course for PEP sales, as needed. The team will advise marketing and distribution professionals on the availability of specific support facilities (access to credit mechanisms in Component 3, for example).

4.20 The staffing for the component will include a team professionals recruited from outside the Government, who will request occasional assistance from other Malian and foreign communication and publicity specialists. The team will comprise:

(a) a professional publicist or advertizing expert, preferably with Malian experience;

(b) a marketing assistant, preferably with experience in large-scale product marketing in Mali;

(c) a nutritional specialist;

(d) a trainer, with an on-call team of assistant trainers;

(e) support personnel.

Component 3: Small Credit Facilities to Finance PEP Equipment

4.21 The objective of this component is to implement small-scale credit facilities to provide the financing needed to improve households' access to modern energy fuels. The component will make use of existing mechanisms for mobilizing savings at the neighborhood and village levels ("tontines" and "tons"), wherever possible, and link these with credit operations in the formal banking sector. (This will correct for the lack of such small-credit facilities in the formal

banking sector.) The facilities identified or defined under this component must be tailored to individual (village or neighborhood) circumstances. A small unit for promoting PEP small-credit facilities will be formed to accomplish this. This credit unit will champion the interests of both small and medium-sized producers and distributors (foresters, charcoal producers, wood transports, importers, stove manufacturers and distributors) and consumers. Assistance to woodfuel producers and distributors should be provided in close coordination with activities proposed in components 5 and 6.

4.22 The activities of this component will be implemented from 1994 to 1996. The objective will be to develop, test and implement small-credit facilities (manufacturing loans for equipment, marketing loans, consumer loans) adapted to the products themselves and the local conditions for distribution and purchase. The existing, informal financing mechanisms which are complementary with formal banking mechanisms should provide the basis for the new credit mechanisms. A guarantee fund (working capital for small, temporary loans) will be established to improve access to formal banking credit.

4.23 The existing informal financing mechanisms which can be used are: (i) credit granted to employees by companies, which could be extended to include PEPs through agreements with individual companies; and (ii) collective savings societies (tontines and tons) found in city neighborhoods and villages. Women play a major role in the neighborhood organizations, and thus they could be tapped to promote financing formulas. Other creative means of financing can be used: entire neighborhood blocks organize to acquire running water, generally through initial investments provided by the richest among them. The same is done for electricity.

4.24 Existing commercial credit mechanisms also will be used. More specifically, the small businesses in the sector must be given incentives to use financing mechanisms planned for private sector productive industries under the Private Sector Development Project (being prepared with AID assistance). Professional organizations should be created and supported (within the framework of sector organization in Components 5 and 6). Also efforts should be supported to bring a preference to the constitution and management of guarantee funds, administered by the professionals themselves.

4.25 The specialists staffing this group should be recruited from outside the Government. Staff will request occasional assistance from foreign experts, especially those in countries where similar financing mechanisms have been developed. The staff will comprise:

(a) a financial expert, preferably with Malian experience,

(b) a sociologist, preferably with experience in the informal sector and rural and urban associations;

(c) a financial analyst;

(d) support personnel.

Supply Module

Component 4: Fuel Supply Master Plans for Mali's Main Cities

4.26 The Fuel Supply Master Plans (FSMP) will be developed for each of Mali's main cities: Bamako, Ségou, Kayes, Koutiala, Mopti, Gao and Tombouctou. The objective is to geographically relocate wood offtake for urban firewood and charcoal consumption. Maps indicating both location of wood resources (PIRL Inventory for Mali's seven regions, PIRT data, results of the planned Natural Resource Management project) and methods of wood offtake (study of wood supply routes and markets for forestry products), as well as agro-socio-economic surveys will be used to identify two types of areas to be targeted under the FSMPs for priority intervention:

(a) preferential areas for exploitation (relative to existing exploitation zones) and the approximate quantity of wood which can be harvested annually;

(b) at-risk areas where current offtake poses a short-term or medium-term danger to the environment. These zones will be monitored and protected under agreements struck with the local collectives.

4.27 The FSMPs will define the terms and conditions for relocating offtake for woodfuel production to preferential areas:

(a) by establishing two complementary mappings: a mapping of the price of standing wood (calculated based on the retail price, minus costs of exploitation and marketing, and taxes 17/) and a mapping of territorial managers and their jurisdictions (Government managed lands, village domains, etc.)

(b) by determining the level of permissible exploitation in preferential areas and reorganizing supply networks; and

(c) by defining summary specifications for woodfuel exploitation in the selected areas.

17/ Taking into account their variation, as soon as a tax differential system is put into place.

4.28 The FSMPs will define the principal regional parameters for tax policies that provide incentives for directing exploitation towards specific zones through the progressive implementation of quotas. The geographic framework for action programs affecting woodfuel supply (assistance to woodfuel professionals, forestry management) will be provided by the Master Plans. A working team will be implemented to develop the FSMPs. The team must be capable of evaluating both the woodfuel potential (through cartographic analysis and on-site studies) and the socio-economic context of chosen areas.

4.29 The FSMPs also will set-up mechanisms to monitor geographic offtake by strengthening the checkpoints for woodfuels entering the cities. Check stations will be set up for the five main cities other than Bamako (one dozen stations in total), and operating conditions at the existing stations for Bamako will be improved.

4.30 The staffing for this component will include mainly staff seconded from the NWFD and recruited from outside the Government. This group will be supported by medium-term technical assistance and will request occasional specialized support from foreign and local specialists. The staff will comprise:

(a) a forestry expert specializing in forest exploitation;

(b) a "stationary" team composed on a forestry inventory specialist, a cartographer and an economist;

(c) a "mobile" team consisting of a forester, an agro-economist and a sociologist;

(d) additional personnel to man the new stationary and mobile check stations; and

(e) support personnel.

Component 5: Assistance for Professionals in the Woodfuel Sector

4.31 Geographic relocation of wood offtake, as defined under the FSMPs, will further transform the nature of wood exploitation and distribution. This sector already has been subjected to considerable change due to the rapid growth of urban demand. Therefore the objective of this component is to assist the sector professional who must adapt to these innovations and changes.

4.32 Assistance provided under this component will improve the organization and operation of supply networks. Three types of interventions are planned for implementation during 1993-1996:

(a) Implement a network of rural markets which will act as clearing houses for wood originating from specific areas. Once organized, management of the markets gradually will be transferred to local professionals as an incentive for complying with the FSMPs;

(b) provide the selected forest exploiters, transporters and merchants (wholesale and retail) affiliated with the rural wood markets with assistance to organize and equip themselves;

(c) organize regional workshops to provide training and information for firewood professionals, representatives of rural communities and forestry agents.

4.33 Staffing for this component will consist primarily of staff seconded from the Malian Government. Some staff will be recruited from outside the Government. The group will request occasional specialized assistance from foreign and local experts (sociologists, trainers in simplified communal management). The personnel will include:

(a) a forester specializing in forest exploitation;

(b) an economist with management experience;

(c) a team of on-site instructors;

(d) support personnel.

Component 6: Modernizing the Charcoal Sector

4.34 The objective of this component is to control and improve charcoal production and marketing, and to arrest the pace of expansion, which represents a serious threat to the environment. Specific action programs are needed for Bamako and the northern cities, where development of the charcoal supply chain has skyrocketed. The following subcomponents of the program, which encompass all links of the chain, are to be implemented during 1993-1996:

(a) rationalize and monitor charcoal production;

(b) improve carbonization techniques;

(c) organize charcoal transport and distribution.

4.35 Component objectives will be achieved by taking a global approach. For example, there will not be direct incentives to encourage use of efficient carbonization methods. Rather the conditions affecting access to the resource and remuneration for wood used in charcoal production will indirectly cause kiln efficiency to become an important factor in the profitability of charcoal exploitation. In fact, if rural communities control access to woodfuel resources and if the price of standing wood increases, the energy efficiency level for kilns should become an important criteria for charcoal makers.

4.36 The staffing for this component includes primarily staff seconded from the Malian Government. Some staff will be recruited from outside the Government. The group will request occasional specialized assistance from foreign and local experts (kiln technicians, improved stove technicians, pollsters, etc.). The staff will comprise:

(a) a forestry expert specializing in forest exploitation;

(b) an economist, preferably with management experience;

(c) a team of on-site instructors;

(d) support personnel.

Component 7: Recovering Dead Wood in the Fifth Region to Supply Mopti, Gao and Tombouctou

4.37 The objective of this component is to encourage short-term exploitation of wood cemeteries to supply firewood or charcoal to the cities of Mopti, Gao and possibly Tombouctou. These cemeteries, easily accessible in the north, constitute a perishable and non-renewable source of woodfuel.

4.38 Features of the component, to be implemented during the period 1993 to 1996, are to:

(a) define the areas concerned and perform an ecological analysis (state of the resource, possibilities for regeneration, impacts of extraction);

(b) analyze the economics of exploiting the available resources;

(c) define the modalities for exploiting and marketing woodfuels, and identify potential partners;

(d) assist the establishment of supply chains connecting areas of exploitation to the urban consumption centers;

(e) define the complementary work needed to regenerate vegetation in the affected areas and the modalities for implementation.

4.39 Staffing for this component will include staff seconded from the Malian Government. Some staff will be recruited from outside the Government. The group will request occasional specialized assistance from foreign and local experts (sociologists, cartographers, pollsters, etc.). The staff will comprise:

(a) a forestry expert specializing in forest exploitation;

(b) an environmental specialist;

(c) a team of on-site technicians;

(d) support personnel.

Component 8: Management of Forested Village Lands Near Bamako, Ségou, Koutiala, Kikasso and Kayes

4.40 Management plans meeting well defined criteria must be prepared to allow for the rational exploitation and management of wooded lands in classified and protected zones. This is the goal of the Master Plans, which will delineate preferred zones where commercial wood or charcoal production should be organized and rationalized in the short-term. Two criteria will be used to identify these zones:

- ecological criteria, i.e. current and potential environmental risks;
- economic criteria: nearby location and easy accessibility of resource; potential revenue generation for the local collectives.

4.41 Preferred exploitation areas will be subject to land management plans. The plans will not be capital intensive, as is necessary in other degraded areas (restorative reforestation), but instead will involve implementation of simple rules for exploitation, protection, maintenance and reconstitution of forest resources. These rules should be easily transferable to rural authorities.

4.42 In order to define these management rules, three cases will need to be distinguished: forested areas located on village lands; inter-village lands under joint control of several village authorities (necessitating inter-village agreements); and inter-village lands designated as Classified

National Forests (necessitating agreements between villages and states). A different form of management will be required in each case, but general organization principles and procedures for implementing land management plans will be identical. Agreements will be signed between the State (the current legal owner) and each village, granting the local villages management authority over forest resources and, if the village so desires, allowing the gradual transfer of the property to the village (exception to current land laws).

4.43 The agreements will permit commercialization of local forest domain, through a number of simple exploitation and management rules.18/ The villages agree to comply with these rules, to respect annual cutting quotas and to implement local patrols (garde-champêtre). In return, they will be given immediate authority to grant cutting permits and to collect woodfuel duties. Thus villages will be able to cover most of its management costs (with the exception of the cost of technical assistance by forest authorities.)19/

4.44 The Forestry Service will abandon its current forest patrol activities in the affected areas and concentrate on:

(a) providing technical assistance for establishing and implementing village land management plans;

(b) periodically monitoring the land management stipulations (initial check after the first year or two, then at longer intervals, such as when quotas are renegotiated).

4.45 The staffing for this component will include staff seconded from the Malian Government. Some staff will be recruited from outside the Government. The group will request occasional specialized assistance from foreign and local experts. The staff will comprise:

(a) a forestry expert, specializing in forest exploitation;

(b) a legal team, composed of a judge (preferably with experience in rural land problems), a sociologist, and an assistant;

18/ For example, control brush fires, restrict livestock grazing for 1 or 2 years to allow regeneration, selective cutting and pruning, selection and preservation of the best species, plantations to reinforce existing growth. When correctly applied, these measures can increase productivity of natural formations by more than 50%, as has been shown in countries such as Niger and Burkina Faso.

19/ The local costs of forest land management planning can be estimated for the Bamako region on the basis of ongoing activities (see Annex 5): about 1 CFAF/kg of wood, including patrol costs (garde-champetre).

(c) three "mobile" teams to provide on-site training and technical assistance, each directed by a forestry agent;

(d) support personnel.

Economic Aspects

Costs

4.46 The timeframe for the strategy is five years (including one year for preparation), with a total estimated cost of US $9.1 million (see Annex 8 for detailed budget) budgeted as follows:

	Million US$	Percent
DEMAND MODULE		
Household Energy Unit (MMHE)	376	4
Data Evaluation Service (MMHE)	120	1
Component 1: Development of New Popularized Energy Products (PEP)	365	4
Component 2: PEP Promotion	510	6
Component 3: Small Credit Facilities to Finance PEP Equipment	840	9
Subtotal	2211	24
SUPPLY MODULE		
Woodfuels Unit (MAEE)	1142	13
Projects and Programs Division (MAEE)	120	1
Component 4: Fuel Supply Master Plans for Mali's Main Cities	948	10
Component 5: Assistance for Professionals in the Woodfuel Sector	712	8
Component 6: Modernizing the Charcoal Sector	515	6
Component 7: Use of Dead Wood to Supply Mopti and Gao	429	4
Component 8: Management of Forested Village Lands	1866	20
Subtotal	5732	62
Temporary Steering Unit	335	4
Miscellaneous	828	10
TOTAL STRATEGY (Outside financing)	9106	100
Government financing (personnel)	585	6

4.47 The demand module represents 24% of the strategy's total cost and the supply module 62%. Preparation costs (TSU) represent 4% and miscellaneous costs are fixed at 10%. Two-thirds of the cost is for implementing the eight components, whereas less than 20% is for supervision/coordination (by the CED and the CCL) and data collection/evaluation (by the bureaus for the MMHE and MAEE) combined. The Government's share of the costs (6%) comprises personnel costs for staff seconded from the MAEE and the MMHE. An average annual sum of US$270,000 will have to be committed during the years immediately following implementation (1987-2001) to ensure that the strategy's initial results are maintained and developed. This sum includes operating costs and reduced training and information activities by the CED, the CCL and the two information/evaluation services -- staffing of these services will be half the staff levels maintained during Strategy implementation. Smaller sums will support these activities after 2001. It should be noted that these subsequent costs ar all well beneath the additional revenues generated by the Strategy (see the financial analysis in the following paragraphs); thus the Strategy will not impact negatively on the national budget.

Economic and Financial Impacts

4.48 The evaluation presented in the following paragraphs is based on a very simple procedure: the main costs and benefits are estimated in economic and financial terms, as well as the impacts on the various strategy participants, while taking into account the risks inherent to strategy implementation. the economic evaluation is made from the country perspective: the costs for the Strategy are added to the addition imports of substitution fuels and cookers are compared to the economic value of wood which is saved through substitution and conservation, managing part of the production area, and recovering dead wood. The financial evaluation is made from the Government's perspective and compares the costs of the Strategy to the additional tax revenues generated by wood and substitution fuels. Separate financial evaluations could also be applied to individual strategy components (for example, PEP promotion, dead wood recovery or land management for forested areas), from the perspective of the various strategy participants (consumers, forest exploiters, rural communities). These evaluations could be made by the TSU during the initial preparation year and modified as implementation of the components progresses.

4.49 Financial Analysis. As shown in the analysis in Table 4.1, the Strategy leads to a slight improvement in collection of forest duties, and thus has positive fiscal impact for the Government. Assuming no changes to the current tax policy for kerosene, a gradual increase in wood duties (1 CFAF/kg in real terms by the year 2001) and a tax collection rate rising to 80% by 2001 will generate a net gain in fiscal revenues (difference between the fiscal gains for wood and new kerosene consumers and losses for current kerosene consumers) of US$ 30 million over the 1992-2001 period. The financial internal rate of return under these conditions is 63%. The financial rate of return for the Strategy is sensitive mainly to the market penetration rate for kerosene as a household fuel (and to the potential level of deregulation for this fuel), as well as to

a lesser degree, the effectiveness of tax collection and the actual tax level. However, without market penetration by kerosene or deregulation of the fuel, the recommended Strategy still has a financial rate of return of 11%. In addition, if the objectives for market penetration by kerosene are attained (with current tax levels), the Strategy is still profitable even without improvements to the collection rate for woodfuel taxes.

4.50 As explained in the previous chapter, the tax policy for household fuels should be coordinated so that consumers are provided with incentives to use the least (economic) cost fuel. The policy must also correspond to more general objectives for generating government revenues. If price liberalization for petroleum fuels does not yield a retail price for LPG and kerosene which is sufficiently low enough to encourage substitution, part of the kerosene surcharge could be lifted without endangering revenue generation. Lowering the surcharge by 25 CFAF has neutral results at the fiscal level (additional revenues from wood and new kerosene customers makes up for the loss of revenues from current kerosene customers).

4.51 Economic Analysis. The main economic advantage of the Strategy is its environmental protection factor: conservation, substitution and improved woodfuel supply systems. Featured actions -- distribution of improved stoves, cookstoves using substitute fuels, promotion of energy-efficient cooking techniques and modification of dietary habits -- translate into savings of about 500,000 tons of wood by the year 2001. The average economic value of this wood is about 8.5 CFAF/kg 20/ Recovered dead wood is valued at 20 CFAF/kg, equivalent to the estimated costs of plantations in the north minus the indirect costs of recovery (environmental impacts). An economic value was calculated for the strategy's impacts on regulated forests (1.5 million hectares, including 300,000 has in areas under land management), under the hypothesis that without the strategy, the forest cover would be completely stripped in 10% of these areas. The economic value applied in this case is 14 CFAF/kg, the approximate costs of replacing the resource by establishing plantations in the southern region. The economic cost of wood is estimated conservatively, taking into account neither long term ecological advantages (indirect effects on agricultural production due to preservation of soil productivity, likely annual increases in land area placed under planned management) nor associated increases in the production of other forestry products (timber, forage). Certain benefits -- benefits due to increased electrification and pre-electrification, or those related to improved charcoal production -- cannot be quantified before the strategy is implemented, and hence they have not been included in this analysis. These include, for example, the benefits of improved charcoal production and also the benefits (and costs) of activities complementing investments to improve electrification of the periurban zone, as planned in the Second Power

---

20/ Wood savings are divided between the north (12%) and the south (88%). Assuming an economic value of 19 CFAF/kg in the north (the equivalent of kerosene) and 6 CFAF/kg in the south (average value of standing wood in that region), the average value is 8.5 CFAF/kg (see detailed assumptions for economic and financial analyses in Annex 7.5.)

Project. These benefits should be evaluated during the preparation phase of the detailed action plan for the Strategy.

4.52 In addition to the total investment cost of US $9.7 million, the strategy will require Mali to incur increased import expenditures. The limited substitution by gas and kerosene encouraged under the strategy will require additional import costs reaching nearly US $20 million by the year 2001 (22% for additional kerosene imports, 71% for additional LPG imports and 7% for additional imports of cooking equipment). This represents almost 10% of the petroleum import bill in 2001 (1989 constant prices).

4.53 Under the preceding hypotheses, and assuming an economic cost of 90 CFAF/liter for kerosene and 275 CFAF/kg for LPG, the economic internal rate of return for the strategy is 36%. The strategy's profitability is sensitive to the following factors: economic value of standing wood; the proportion of uncontrolled to regulated exploitation zones; and the level of kerosene deregulation. The strategy remains economically viable even when conservative values are used for these factors.

4.54 Impacts Applying differential taxes for wood and improving controls at the city gate will result in retail price increases of about 10% to 20% for urban consumers. For those who cannot switch to substitution fuels -- the vast majority of lower income households -- the increases will not have major impacts; expenditures for cooking fuels will still represent only a minor share of the household budget. In addition, higher woodfuel prices will be counterbalanced by increased use of improved stoves, use of more efficient cooking techniques and modifications in dietary habits.

4.55 For peasants in rural areas affected by land management (approximately 100 villages), the strategy will generate additional local revenues through the mechanisms designed to compensate village management (nearly equivalent to the tax differentials established by the strategy). These additional revenues are estimated at nearly 100 million CFAF annually by the 1996.

4.56 Finally, the strategy will have a positive, although non-quantifiable, impact on Malian women. Less time spent searching for wood supplies in rural areas (the fruits of land management) will free women for more productive activities. Likewise, urban women will spend less time cooking if they use new cooking equipment or adopt less energy-intensive dietary practices.

4.57 In summary, the strategy has both ecological (natural resource protection and prevention of deforestation) and social (improved standard of living in average households) benefits. Furthermore, delegating forestry management to the peasants themselves introduces a new economic dynamic into rural society and facilitates development of sustainable, rational woodfuel extraction.

Risks

4.58 Risks associated with strategy implementation can be found at several levels: technical, social and institutional (other than the economic and financial risks analyzed in the preceding paragraphs). At the technical level, successful market penetration of PEPs will hinge on the success of tactics used to: (i) encourage private sector interest for marketing; and (ii) disseminate information to consumers. Other risks include failure of forest management techniques to stimulate sufficiently development of rural wood markets or dead wood recovery; the system for monitoring and taxing woodfuels, which should gradually be extended to all woodfuel production areas, could give rise to illegal woodfuel marketing activities; and finally, the number of beneficiaries and participants of the Strategy (fuel consumers and producers; household equipment manufacturers could also prove an obstacle of which Strategy implementers should be wary. On the social level, fiscal reforms affecting wood will lead to an increased retail price for wood, although expenditures for wood will remain a small fraction of the household budget, even in the poorest households. Less wood exploitation in restricted areas means a reduction in income for the local rural populations. At the institutional level, the main risk will be the potential lack of coordination between the demand and supply modules of the Strategy, and insufficient participation by the private sector and the local rural communities during Strategy implementation.

4.59 The risks described above are rather limited relative to the environmental risks involved if the Strategy is not implemented. They can be minimalized by drawing on the experience of the Household Energy Project in Niger (see box); a project description and summary of its initial results (implementation of the Project began in 1989 with assistance from AID), are given in Annex 12; a mid-term evaluation of the Project planned for the beginning of 1992 will provide more detailed results which can be used to guide implementation of the present project. In addition, during the initial year when the TSU is in session, the Strategy components can be modified and/or elaborated based on a complete evaluation of the exiting risks and constraints (this potentially could be done during a presentation seminar for the Strategy). Finally, supervision and coordination of the implementation of Strategy components should be conducted by permanent, small organizations which would be given occasional technical assistance.

Financing

4.60 As stated above, the Second Power Project (project implementation began in 1990) includes a sum of US$1 million for implementation of the Strategy. Disbursements will be handled by the MMHE, via the NHED. Part of this sum could be used to cover the costs of the TSU during its year of operation, as well as the costs of the CED and the Evaluation and Information Service of the NHED from 1993 to 1996. These costs total US$915,000. Disbursements under the Second Power Project over the sum of US$335,000 for financing the first year of the strategy is contingent upon the Government's ability to obtain the additional financing needed for implementing the

strategy (estimated at US$8.2 million) as well as on preparation of a detailed action plan for 1993-1996.

The Household Energy Project in Niger

The objective of this project, which was a component of the Second Energy Project (implemented with technical assistance and financing from AID), is to promote rational exploitation and use of wood energy. The five-year Household Energy project was launched in 1989 with total financing of US$10.3 million provided under a grant from DANIDA. The project is divided into two modules: the demand module, with the objective to encourage substitution of wood by kerosene and butane gas as well as the use of improved wood stoves; and the supply module, with the objective to rationalize exploitation of wood energy and supply to Niger's main cities, as well as to stimulate the rural population's participation in the management of wood resources on their territory.

Although the project's approach and the expected ecological impacts are geared to the long term, the initial results of project implementation appear quite promising: more than 3000 kerosene stoves especially adapted to cooking practices and developed under the project had been sold by the end of 1991 (the stoves are marketed by the private sector with assistance in the form of a promotional and information campaign and decreasing subsidies); rural firewood markets and forest management cooperatives have been installed in part of the area which supplies wood to the main cities, and wood marketer associations have been established in five cities; a new regulatory framework defined and implemented in 1992 provides incentives for rational exploitation and marketing of wood energy; and finally, fiscal revenues from wood nearly tripled between 1987 and 1990 under the combined effect of improved monitoring and increased wood taxes.

Box 1.1: Household Energy Project in Niger

4.61 During 1992, the TSU's main task should be to find financing for the eight components and the costs of the CCL and the Project and Programs Division of the NWFD. It should be noted that the mere fact that the Malian Government has agreed to create the TSU indicates the Government's commitment to proper implementation the strategy and its success. This commitment will be viewed favorably by donors and assist the generation of needed financing. A presentation seminar should be organized to determine donor interest. Several donors already indicated their interest in financing the strategy while this study was being prepared: the Netherlands and France (demand module), the UNDP (technical assistance) and Germany (supply module). Donors could provide supervision to components which they finance, while strategy

coordination and consistency will continue to be the responsibility of the CED and the CCL. Donor interest should be verified and a financing plan prepared during ESMAP's presentation of this report to the Government. The financing plan would outline the source of funds (multilateral or bilateral donor, Government, other) and the application (by component and category of expenditures).

4.62 Finally, the Strategy should be implemented in coordination with the AID Private Development Sector Natural Resource Management Projects. Additional financial or technical assistance could be furnished through these projects: for example, credit could be extended to private sector participants in the woodfuel supply chain or to commercial PEP marketers. Similarly, in areas targeted by the Natural Resource Management Project (NRMP) which are also woodfuel supply zones (i.e. the outskirts of Bamako and three areas pre-selected by the NRMP near Mopti and Gao), the organizational structure at the village level (village council, local development committee, neighborhood development committees) could serve both the NRMP and the Strategy's components for managing wood resources and controlling rural wood markets.

LIST OF ANNEXES

MAPS

CONSULTANT REPORTS

The Study's consultants produced the following intermediate documents, which were used to prepare the final report:

(a) Survey and data processing methodologies (Modibo Dicko)

(b) Report on surveys and group discussions (Aminata Traoré)

(c) Report on group demonstrations of equipment (Mariama Gamatie)

(d) Socio-economic aspects of woodfuel supply (Hamidou Magassa)

(e) Role of women in the Mali household energy strategy (Jocelyne Jakob-Durany)

(f) Forestry resources and production systems (Ousmane Sankaré)

(g) Wood supply and rational management of wood resources (Henk Neuteboom)

(h) Stoves and lamps in Mali (Piet Visser)

(i) Test results for a sample of portable metallic improved woodstoves (Fatim Guindo)

FIELD WORK

The following surveys and field work have been conducted to define the strategy:

(a) a survey of 470 households in 5 cities: Bamako, Ségou, Mopti, Koutiala and Gao;

(b) a detailed survey of 90 households in Bamako over a period of one week, including weighing of wood consumptions;

(c) a price survey of household fuels (purchase and weighing of wood and charcoal, with around 4,200 measures in the above five cities);

(d) a census of small woodfuel-using activities in Bamako (2,200 activities recorded, out of a total estimated at 2,500);

(e) a survey of energy consumption for 95 small activities in Bamako;

(f) group meetings on the household energy strategy with 5 sample groups in Bamako (3 groups of women and 2 groups of men, from different socio-economic groups), at the beginning and at the end of the study;

(g) technical tests of different models of lamps and kerosene stoves;

(h) comparative tests of portable metallic improved woodstoves sold in Bamako;

(i) presentations of new household equipment to consumer groups in Bamako, Mopti and Gao (8 presentations of stoves and 6 presentations of lamps);

(j) surveys and inquiries in about 40 villages in the areas where wood and charcoal are produced to supply the above five cities.

Table 1: FORECAST POPULATION (in thousands of inhabitants)

		1987	Annual increment 1987-2000	2000	1990	1995
Kayes						
	Rural	923	2.7	1001	1146	1312
	Urban	136	4.5	155	192	238
	Total	1059	3.0	1156	1338	1550
Koulikouro						
	Rural	1066	3.6	1185	1413	1685
	Urban	115	3.9	129	155	187
	Bamako	646	6.7	784	1082	1494
	Total	1827	4.7	2097	2650	3365
Sikasso						
	Rural	1128	2.1	1202	1338	1488
	Urban	181	6.4	218	298	407
	Total	1309	2.8	1421	1636	1895
Ségou						
	Rural	1143	3.8	1280	1475	1700
	Urban	185	4.6	212	266	334
	Total	1328	4.0	1492	1741	2034
Mopti						
	Rural	1144	1.5	1197	1291	1393
	Urban	118	3.3	130	154	181
	Total	1262	1.7	1327	1455	1574
Tombouctou						
	Rural	369	(2.3)	344	305	271
	Urban	84	5.6	99	130	170
	Total	453		443	435	441
Gao						
	Rural	298	(1.2)	287	270	254
	Urban	85	9.0	110	171	264
	Total	383		398	441	519
MALI						
	Rural	6071	2.3	6497	7238	8103
	Urban	1550	5.8	1837	2447	3275
	Total	7621	3.0	8334	9686	11378
CITIES						
	Ségou	89	5.3	104	135	174
	Mopti	74	5.7	87	115	151
	Sikasso	73	7.9	92	135	197
	Gao	55	10.1	73	118	191
	Kayes	48	(0.4)	47	46	45
	Koutiala	48	10.1	64	103	167
	Tombouctou	32	3.6	41	62	94

Note: The urban population includes chief towns of departments' subdivisions and cities of more than 5,000 inhabitants.

Source: DNSI, ESMAP

Table 2: DENSITY OF RURAL POPULATION IN MALI

Region	Inhabitants (x1000)	Area (1000 km²)	District Density (inhab/km²) average	minimum	maximum
Kayes	923	120	8	6	15
Koulikoro	1066	88.5	12	5	19
Sikasso	1128	76.5	17	12	26
Ségou	1143	6	19	9	29
Mopti	1144	89	15	7	28
Tombouctou	369	485	1	-	26
Gao	298	383.5	1	-	3
Total	6071	1240	5	-	29

- : Less than 1 inhab/km²

Source: General census of population and households - DNSI Provisory results, April 1987.

Table 3: SOCIO-PROFESSIONAL CATEGORIES PER CITY (in percentage)

	Bamako	Ségou	Mopti	Koutiala	Gao
Manager/ High-scale Tradesman	17	20	10	1	13
Professional/ Middle-scale Tradesman/ Craftsman	34	28	40	35	47
Worker/employee/ Small-scale Tradesman	49	52	50	64	40
Total	100	100	100	100	100

Source: Household surveys - ESMAP

Table 4: URBAN POPULATION BY REGION OF MALI

Region	Urban population (1987) (en thousands)	Rate of urbanization %
Ségou	185	14
Mopti	118	9
Gao	85	22
Sikasso	181	14
Koulikoro (*)	761	42

(*) including Bamako

Source: DNSI

Table 5: IMPORTED ENERGY AND TRADE BALANCE

(Billions F CFA)		1984	1985	1986	1987
(1) Oil Imports		25.2	36.1	30.9	23.1
(2) Total Imports		122.0	171.1	148.3	159.2
(3) Total Exports		89.4	80.0	68.6	76.9
	(1)/(2)	21%	21%	21%	15%
	(1)/(3)	28%	45%	45%	30%

Source : Centre Malien du Commerce extérieur

Table 6: YEARLY HOUSEHOLD EXPENDITURES IN THE MAIN CITIES (1985)

	Keyes		Koulikoro		Sikasso		Segou	
Item	CFAF	%	CFAF	%	CFAF	%	CFAF	%
Food	361677	62.8	497233	50.2	343382	51.8	473861	50.6
Energy and Water	34765	6.0	56170	5.7	22102	3.3	48033	5.1
Other	179240	31.1	436371	44.1	297647	44.9	414776	44.3
Total	575682	100.0	989774	100.0	663131	100.0	936670	100.0

	Mopti		Tombouctou		Bao		Bamako	
Item	CFAF	%	CFAF	%	CFAF	%	CFAF	%
Food	370207	62.2	424746	75.1	572388	73.2	433500	48.2
Energy and Water	28900	4.9	28495	5.0	33900	4.3	43681	4.9
Other	196532	33.0	112258	19.9	175182	22.4	422906	47.0
Total	595639	100.0	565499	100.0	781470	100.0	900087	100.0

Source: Survey of urban household expenditure. DNSI. 1987.

Person per household

Keyes: 8.3 Mopti: 7.0 Sikasso: 6.0 Gao: 7.4
Koulikouro: 5.1 Tombouctou: 7.2 Segou: 6.9
Bamako: 7.0

Table 7: YEARLY ENERGY EXPENDITURE OF HOUSEHOLDS IN THE MAIN CITIES (1985)

	Keyes		Koulikoro		Sikasso		Segou	
Item	CFAF	%	CFAF	%	CFAF	%	CFAF	%
Electricity	4265	14.6	7483	15.3	1459	7.9	1236	2.9
Liquid Fuels	2015	6.9	11897	24.3	3959	21.6	14705	34.1
Solid Fuels	23058	78.6	29565	60.4	12938	70.5	27238	63.1
Total	29348	100.0	48945	100.0	18356	100.0	43179	100.0

	Mopti		Tombouctou		Bao		Bamako	
Item	CFAF	%	CFAF	%	CFAF	%	CFAF	%
Electricity	756	2.9	797	3.4	3306	13.8	9595	23.0
Liquid Fuels	2966	11.5	1181	5.1	2563	10.7	7560	18.1
Solid Fuels	22116	85.6	21132	91.4	18099	75.5	24580	58.9
Total	25838	100.0	23110	100.0	23968	100.0	41733	100.0

Source: Survey of urban household expenditure. DNSI. 1987.

FIGURE 1A: WOOD CONSUMPTION BY HOUSEHOLD SIZE
IN BAMAKO
(Wood Main Fuel)

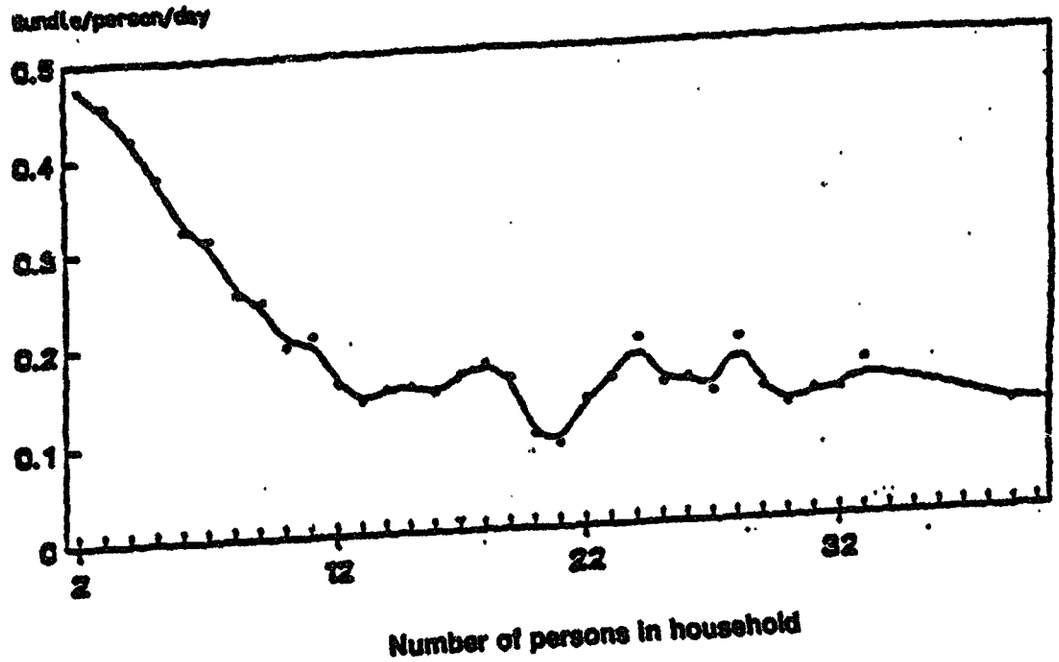


FIGURE 1B: WOOD EXPENDITURE BY HOUSEHOLD SIZE
IN BAMAKO
(Wood Main Fuel)

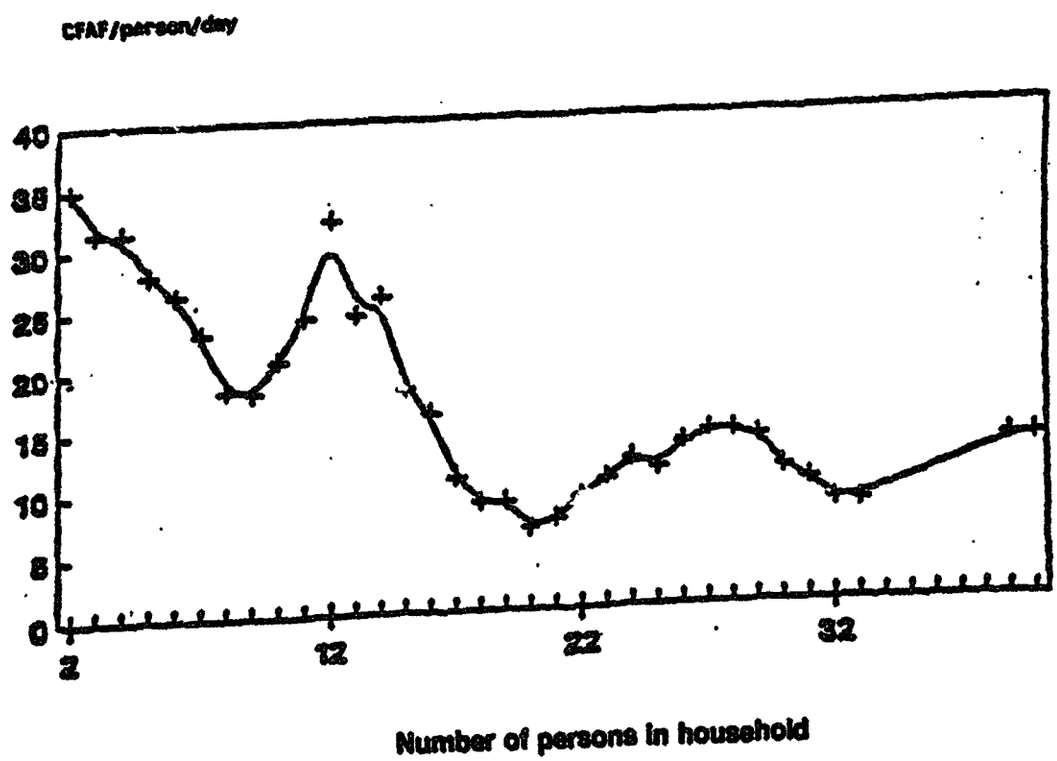


Figure 1A: WOOD CONSUMPTION BY HOUSEHOLD SIZE IN BAMAKO (Wood Main Fuel)

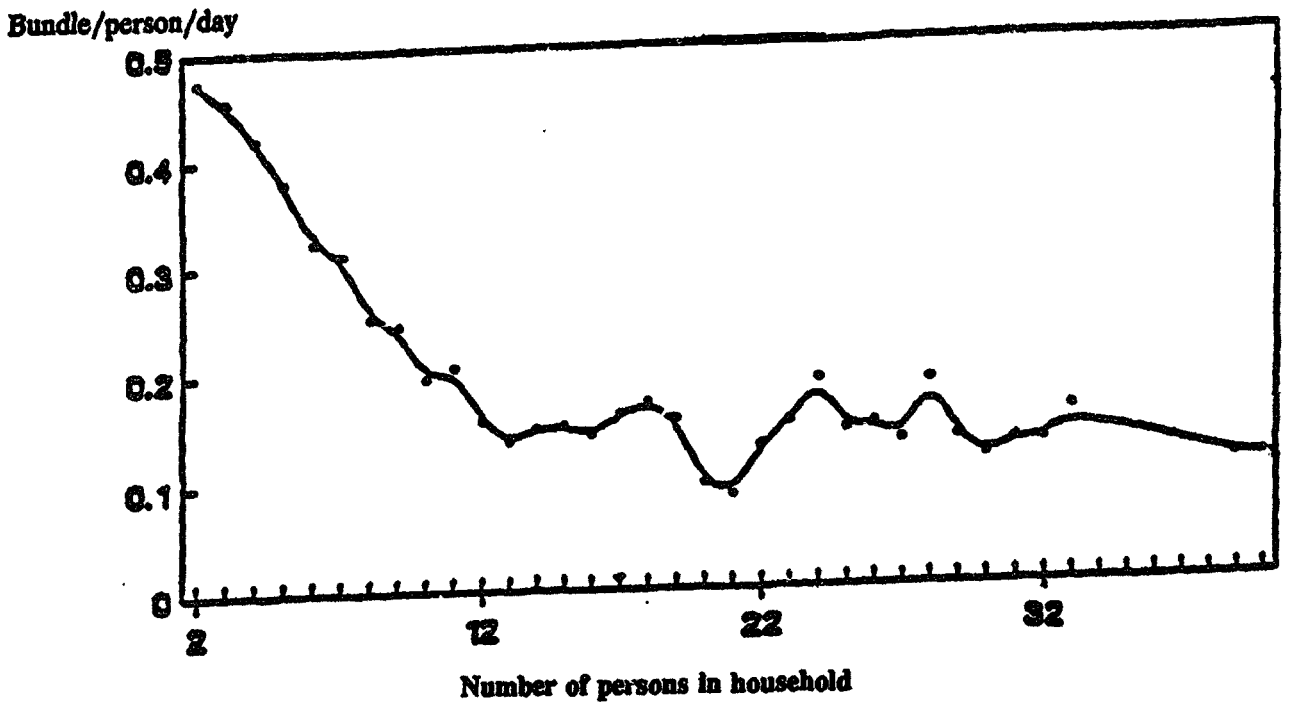


Figure 1B: WOOD EXPENDITURE BY HOUSEHOLD SIZE IN BAMAKO (Wood Main Fuel)

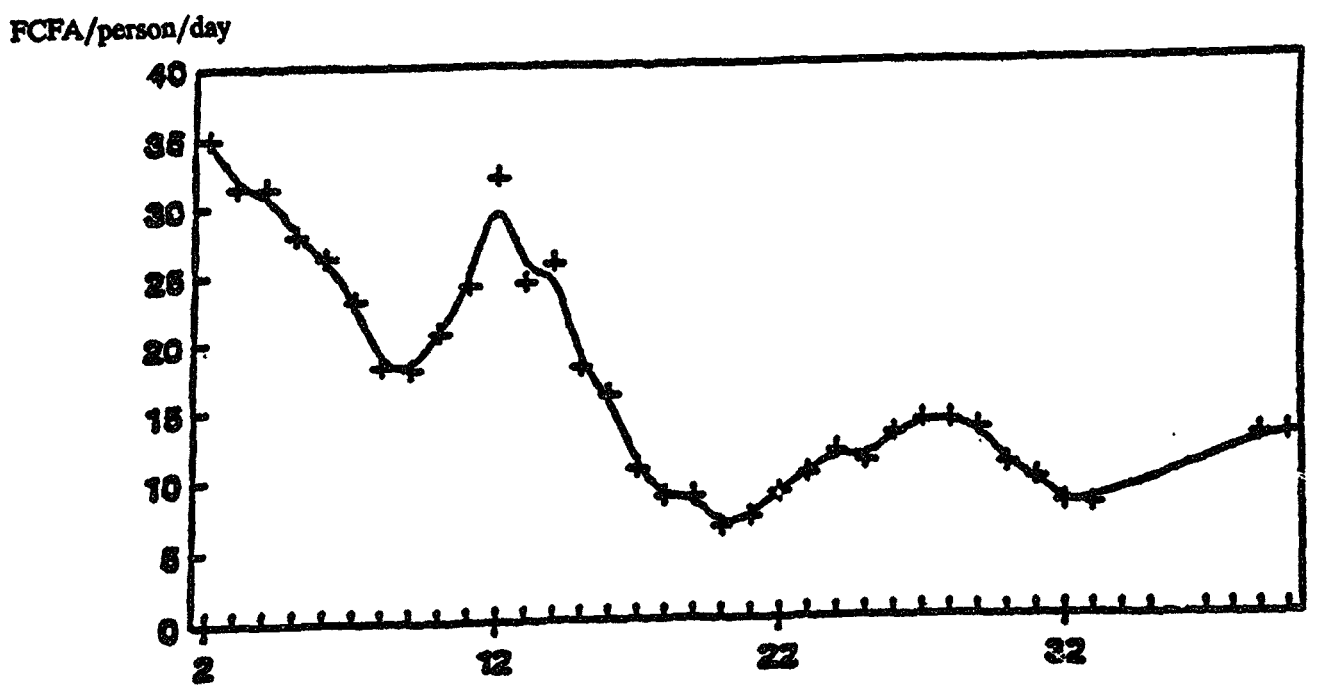


Table 8: ASSUMPTIONS OF WOOD UNIT CONSUMPTIONS

		kg/person/day
Kayes	Rural	1.4
	Urban	1.61
Koulikouro	Rural	2.05
	Urban	2.7
Sikasso	Rural	2.05
	Urban	3.08
Segou	Rural	1.4
	Urban	1.26
Mopti	Rural	1.05
	Urban	1.42
Tombouctou	Rural	0.8
	Urban	1.2
Gao	Rural	0.8
	Urban	1.2
Bamako		1.55

Source: Various surveys.

Table 9: HOUSEHOLD EQUIPMENT IN DRY CELLS AND CAR BATTERIES

HOUSEHOLDS NOT CONNECTED TO ELECTRICITY GRID

	Bamako	Ségou	Mopti	Koutiala
In % of households not connected				
Flash light	45	29	90	65
Battery-operated radio	62	62	60	43
Battery-operated cassette-radio	38	73	66	55
Battery-operated television	10	13	0	0
In % of total surveyed househols	56	63	67	66

HOUSEHOLDS CONNECTED TO ELECTRICITY GRID

	Bamako	Ségou	Mopti	Koutiala
In % of households connected				
Flash light	55	35	80	72
Battery-operated radio	65	50	84	60
Battery-operated cassette-radio	16	35	16	20
Battery-operated television	1	0	0	0
In % of total surveyed households	44	37	33	34

Source: ESMAP Surveys, 1989

Table 10a: PRICES OF 2.7 AND 6kg GAS STOVES
IN SENEGAL AND MALI (FCFA)
January 1990

2.7 kg. Stove	MALI	SENEGAL
TOTAL COST	14275	11297
2.7 kg. BOTTLE (sold)	6980	5700
GAS	845	325
BURNER	2685	2312
SUPPORT	3765	2960

The difference of cost is about 18% (without gas cost).

Source: DNHE

6 kg. Stove	MALI	SENEGAL
TOTAL COST	16185	10000
BOTTLE (deposit = 50% of price)	4000	3750
RECHARGE	1920	720
BURNER	4100	n/d
SUPPORT	6165	n/d

The difference of cost is about 35% (without gas cost).

Source: DNHE

Table 10B: PRICE STRUCTURE OF BUTANE GAS IN BAMAKO

	1988		1990 (*)	
	CFAF/ton	%	CFAF/ton	%
Sale Price at SIR Abijan	140,000	39%	110,000	37%
Miscellaneous	8,700	2%	13,690	5%
International Transport	33,534	9%	36,162	12%
Border Price	182,234	50%	159,852	53%
National Transport	31,773	9%	33,230	11%
Miscellaneous	20,047	6%	8,792	3%
Storage Bamako	37,940	10%	37,940	13%
Bottle depreciation/ maintenance	29,663	8%	20,143	7%
Losses	13,369	4%	4,796	2%
Importer margin	29,957	8%	17,972	6%
Distributor margin	18,000	5%	18,000	6%
Sub-total	180,749	50%	140,873	47%
Retail price in Bamako	362,983	100%	300,725	100%

(*) Structure recommended by the Committee for the promotion of butane gas, after consulting oil companies.

Source: DNHE, 1990

DETAILED DEMAND CHARACTERISTICS FOR HOUSEHOLDS AND THE INFORMAL SECTOR

Rural Households

Socio-Economic Characteristics

1. Rural Mali is a society in transition. The various phases of this transition correspond to the different historic and political stages in the country's overall evolution. Yet the stages in Mali's evolution do not necessarily reflect the outside forces which supposedly have influenced them. Thus, the nature of local governments and entrenched local practices, social linkages, and production systems have developed as much as in resistance to, as in response to, external influences. The socio-economic characteristics of rural households still are strongly shaped by tradition; because of this, they vary noticeably from one region to another. This section will attempt to underscore some of the features generally shared by rural households.

2. Mali's rural economy is basically a subsistence economy, although there have been some rare exceptions to this in recent times. Cash income levels for rural households are quite low, ranging from 7000 to 15,000 CFAF per capita per year, depending on the region. On average, about one third of household income is derived from "secondary" activities -- activities in addition to farming or raising livestock, such as processing agricultural products. Rural incomes and purchasing power are thought to have dropped during the past few years. A non-negligible portion of the rural population has been forced into debt due to droughts and economic difficulties throughout the country.

3. Migration is another phenomenon which has changed the face of the rural world. Movement towards cities in the interior, especially the capital, or towards more affluent rural areas in the south tends to be permanent. Rural Malians also emigrate temporarily to countries along the coast (mainly the Côte d'Ivoire) and to Europe. There is also seasonal emigration during drought seasons. Several statistics illustrate the extent of emigration from rural areas: an estimated 15% of the rural population, mostly men, is absent at any given time; between 60% and 75% of men in the 15 to 35 year age range are seasonal migrants. As a result, women remaining in the village increasingly are responsible for maintaining both agricultural production and some semblance of family structure.

The Role of Women in Rural Households

4. In rural areas, women shoulder heavy work loads: the average workday extends 14 to 17 hours in all seasons and includes both household and productive activities. Women plant and cultivate the fields during the rainy season; in the dry season they undertake numerous small-scale processing activities and market their agricultural products. Some of the household chores which women perform after returning from the fields, such as pumping water or collecting wood, also tend to be quite taxing.

5. Within the rural division of labor, women -- the primary users of woodfuels -- are responsible for ensuring the household's firewood supply. Thus they are involved at both the beginning and the end of the production cycle for a "free" fuel which is gradually becoming commercialized. Women collect wood in small teams. Wood usually is gathered within 5-km radius of the village. Both dead and green wood are cut, preferably during the dry season, and left to dry in the bush before it is collected and stored in the village. This process allows women to better manage their time. Three days spent collecting wood will net, on average, the equivalent of one cartload (two to three cubic meters). In more affluent areas, the proliferation of carts means women no longer must transport firewood (and other agricultural products), except during the rainy season when carts are used for farming.

6. Women also are responsible for supplementing the basic diet of grains with other nutrients, such as karite nut butter or the "soumbala" spice drawn from the néré plant. In areas where firewood is marketed, these condiments can be purchased with the income. In addition, such income serves to maintain the woman's role as economic provider for the family.

7. Despite the central role a woman plays in supporting the household and although the income which she generates has a substantial impact on improving the household's living conditions, she remains of low stature. Women have very limited participation in decision making in the rural society, which is largely patrilineal and polygamous. Access to property and other factors of production is restricted in priority to men. As a consequence, the activities performed by women tend to be underproductive and result in minimal remuneration.

Rural Energy Consumption

8. Rural households use wood almost exclusively for cooking and associated household needs (water heating or space heating in the cold season, lighting, etc.). Various bibliographic sources provide estimates of unit wood consumption ranging between 0.7 and 2.4 kg per person per day on average, depending on the area. Cooking grains (millet, sorghum, rice or corn) accounts for most of daily wood consumption. In fact, about 80% of the rural calorific intake consists of grains, normally in the form of a thin millet porridge eaten in the morning and evenings, and sauce and grains (to, fonio or rice) at noon and at night. In some areas (such as the Niger region), there also is wood consumption within the productive sector for uses such as drying fish.

9. The level of wood consumption is strongly dependent on its availability. As a result, consumption levels tend to decrease in the northern parts of the country, as shown in Table 2.1. In northern regions where wood supply is limited, the local population traditionally have used agricultural (straws) or animal wastes (cow dung) to supplement the use of fuelwood.

Table 2.1: ESTIMATED RURAL CONSUMPTION OF WOOD

Ecological Zone	Rural Population (% in area)	Wood Consumption (kg/inhab/day)
Desert and sub-desert zone	5	0.7 - 0.9
Sahelian and Soudano-Sahelian zone	14	1.4
Central Delta zone	14	0.9 - 1.2
Soudanian zone	57	1.7 - 2.4
Soudano-Guinean zone	9	1.4
Rural average	100	1.8

Source: Various references, 1984-1989.

10. Charcoal (often obtained from firewood) is the most noteworthy among other energy sources used in rural areas. Charcoal is consumed for small residential uses (mostly to make tea) and for some crafts or small-scale commercial activities. In the latter case, the charcoal producer traditionally has been the blacksmith, who uses the fuel to work metals. Use of kerosene also is widespread; rural uses are mainly for lighting, as well as for flashlights and dry battery-operated radios or cassette players. Finally, human energy is the primary resource used for gathering water, processing agricultural products, transportation, etc.

11. The highly inefficient three stone stove is widely used in rural areas. Various programs to distribute a locally-constructed improved model, the Louga or "improved three stone" stove, have met with relative success in regions where the programs are closely supervised. The NWFD estimates that about 200,000 Louga stoves were distributed between 1986 and 1988. Even though there is no question that quantifiable progress has made in the distribution of improved stoves in Mali's rural areas, these estimates are to be taken with a grain of salt. Various surveys by a consulting firm (IT Power) show that in reality, up to 40% of these stoves are abandoned immediately after they're constructed, and only a third are in regular use.

12. With the exception of kerosene, modern fuels are not found in rural areas. Rural zones generally are not serviced by power grids and butane gas is practically unknown. In addition, only a few rural communities -- often communities which have been targeted under comprehensive development programs -- have access to modern equipment powered by renewable energy. Existing equipment of this type includes more than 150 solar-powered water pumps, as well as several dozen refrigerators, lighting systems, televisions and radio-telephones. While this represents some advancement in the use of solar-powered equipment, there are considerable limits to further development. Only the few, most fortunate rural dwellers have means sufficient for acquiring solar equipment.

Urban Households

Socio-Economic Characteristics

13. The rapid expansions of urban society in Mali is a fairly recent phenomenon. Bamako, the main city with a population of 700,000 in 1987, had only 60,000 inhabitants in 1957. The inhabitants of other towns and cities are mostly former rural dwellers: 40% of the heads of household in Gao were born in villages. The urban infrastructure (asphalt roads, distribution networks for water, electricity, sewage and drainage) and urban services (public transportation, garbage collection) are rather limited in scope and often confined to the city center and a few residential neighborhoods.

14. Living quarters for most urban inhabitants are communal allotments shared by several households and individuals; less than 5% of the urban population lives in residential neighborhoods composed of villas and separate dwellings. The notion of "household" in Malian society is quite different from that of "family" (which refers to an extended family, not all living in one place): a household can be characterized as a group of people sharing the same living quarters and the same meals. Table 2.2 below, which distinguishes between organized households with more than one person and unmarried individuals, indicates the types of households found in the main towns. In the rest of this report, the survey results which are presented refer only to organized households of more than one person, excluding unmarried individuals, some of whom often share meals with neighbors in the allotment. The averages given in Table 2.2 may give an erroneous and overestimated impression with regard to household size: it should be noted that in Bamako, 25% of households have between 2 and 5 people, and only 25% have more than 12 people.

Table 2.2: URBAN HOUSEHOLDS

	Bamako	Ségou	Koutiala	Mopti	Gao
Household/plot	1.8	1.9	2.1	1.4	1.6
Average size (Inhab/household)	10.0	13.0	13.4	10.9	8.9
Bachelors/plot	1.2	1.3	0.5	0.7	0.3
Total household/plot	3.0	3.2	2.6	2.1	1.9
Average size (Inhab/household)	6.4	8.1	11.0	7.6	7.7

Source: ESMAP Surveys, 1989.

15. Three prominent social characteristics distinguish and stratify urban households: (i) length of time resident in the city, (ii) social and employment category, and (iii) income level. The social behavior of a household which has been urbanized for a while will differ from that of a household which has just arrived in the city. In the latter case, the household tends to remain strongly characterized by rural traditions. Households also will differ according to how the head of household is employed: the contrast between those employed as bureaucrats (usually the most modern and progressive) and those in the merchant class (more traditional) also is easy to spot.

16. Most importantly, household behavior can be distinguished according to income levels. The exact income of an individual household can be relatively difficult to ascertain. The household income frequently is the combination of individual incomes generated from multiple jobs, many of them informal, held more or less on a regular basis. 1/ The Urban Plan estimated that the average monthly household income in Bamako was about 60,000 CFAF in 1984, with per capita monthly income varying between 5,000 and 15,000 CFAF. Other surveys (National Statistics and Data Department, NSDD, 1985) put monthly income at a little less than 100,000 CFAF in Bamako, and between 60,000 and 90,000 CFAF in the towns of the interior.

17. These averages mask substantial disparities among households based on size and employment category. Surveys conducted for this study show that about 15% of Bamako's households are relatively well-to-do (head of household employed in upper management, as transporter or as large-scale merchant), 35% are classified as average (in middle management and average-sized merchants), and the rest -- almost half of all households -- are low-income. The distribution in the towns of the interior are more or less the same: between 5 and 15% of households are well-to-do, 35 to 45% have average incomes, and 50% are poor. (See Annex 2) In terms of absolute income levels, someone in Bamako's upper class is estimated to earn more than 50,000 CFAF monthly, whereas someone in the middle class earns between 25,000 and 50,000 CFAF.

18. However, these figures do not reflect the household's true financial standing. The basic household income is frequently supplemented by additional income from informal, occasional employment. Furthermore, a good income provides an incentive or frequently constrains the entertaining of an increased number of unemployed individuals.*** As in rural areas, urban areas have become poorer, which constrains the growth of income sources and mechanisms for mutual assistance.

Urban Women and the Family Budget

19. Compensation for work performed by women is a major source of additional income for urban households. In Bamako, for example, two thirds of all women work outside the home. In other towns, 50% to 60% of the women have income-generating employment (with the exception of Gao, where only one-in-five women work for monetary income). Some women are employed in the modern sector (an estimated 25% of staff in Bamako are female, generally employed in lower-level posts), but the majority are employed in the informal sector: small businesses, small-scale food and drink, crafts. For the most part, it now is necessary that women work in order to ensure sufficient income for the household. Contrary to other African societies, where women's incomes generally finance personal purchases for herself and her children (clothing and other items), in Mali's towns and cities women's incomes finance the majority share (about two-thirds in Bamako, and 50% to 60% in other towns) of the family's daily subsistence expenditures (food).

1/ The household survey's attempt to evaluate income levels also ran into difficulty due to classic reticence and because many of the women surveyed were not knowledgeable about their husband's income. Nevertheless, the survey's figures for household budgets, food purchases, equipment ownership, number of actively employed persons, etc. provided sufficient indicators of household income.

20. In most cases (more than 80% of households), the head of the household allocates a budget for daily expenditures which is managed by women. Households which budget their current expenditures on a weekly or monthly basis are rare. They generally are the more modern, well-to-do households, often with connections to government service. The daily budget, between 5000 and 1000 CFAF, finances the household's current expenditures --in priority, food ("condiments") and fuels which will be used during the day.

21. The status of urban women is clearly superior to that of rural women. Less harassed by work than their village sisters, urban women also find their households more open to discussion and compromise. Within the urban environment, women have greater participation in household expenses and new responsibilities (school education for children). These, along with the strengthening of the nuclear family to the detriment of the extended family, all give women a new margin for initiative, even a new power in decision-making. This is especially true regarding purchases of certain household equipment such as household appliances (but not for leisure items such as televisions).

Urban Fuel Consumption

Urban Eating Patterns

22. Urban eating habits until recently were similar to those in the countryside. Only gradually have they become more distinct. At breakfast, for example, many urban dwellers still eat millet porridge, but in increasing numbers they also have taken to drinking coffee. Coffee is a factor of social differentiation: more than half of the well-to-do households in Bamako drink coffee at breakfast, in contrast with 30% of middle class households and only 15% of the poorest households. Coffee drinking is a relatively new habit, already well established in affluent households, and gradually making its way into the middle strata. This is especially the case in the older neighborhoods of Bamako, where first the head of the family, then other adults, take up the habit. Coffee drinking also has spread into the towns of the interior, more so in those in the north (Mopti and especially Gao) than in those in the central region (Ségou and Koutiala).

23. By contrast, the meal eaten by all households at lunch is still the traditional midday meal. More than 83% of households in the capital eat the traditional rice with sauce on a regular basis. This meal is eaten by the affluent households as well as by a large majority of middle- and low-income households. Sometimes, tô or couscous are eaten at midday, but these dishes have tended to be replaced by rice in middle- and low-income families. In the more innovative and affluent households, the traditional meal has been modified with new sauces. Vegetable-based sauces (lettuce and spinach, for example) and sauces borrowed from neighboring countries (Yassa from Sénégal or Sakassaka from Guinée) have been brought into use. Although tô is no longer eaten in the capital except by the most disadvantaged households, it is still the main midday dish for towns in the interior. Nonetheless, here also rice is becoming the main midday food.

24. It should be noted that Malian cuisine -- based on simmered grains and sauces as in other Sahelian countries -- is highly energy intensive. The food is prepared in two parts, with grains and sauce cooked in separate pots and often even over two separate fires.

25. Dinner tends to be a diversified meal: the main dishes are tô and couscous, but with many variations according to family income and size. The larger the family, the less diversified the foodstuffs: the diet of 85% of large households (more than 12 persons) is based on couscous and tô, whereas only less than half of all households have less than 9 persons.

26. It also should be noted that more than one third (35%) of the poorest households in Bamako do not cook a separate meal in the evening; they reheat the midday meal. A small fraction (about 12%) of middle-income households do the same. Thus, approximately 20% of Bamako's households prepare only one major meal each day. This is also the case for comparable percentages of households in Koutiala and Gao (20% to 25%). In other cities of the interior, the percentage of households cooking only one principal meal daily is even higher (40% in Ségou).

27. At the other end of the social spectrum, dinner is the meal where women have introduced a certain diversity into the daily diet through preparation of "European" dishes (fried or grilled meats, salads, etc.). This tends to be the case in the more innovative and affluent households -- especially those in the capital, and more often than not those which are younger and smaller. Two sample meals and their costs are presented in Table 2.3. One meal is typical for a small affluent family, the other for an average family of more modest means. In the latter example, the traditional dishes are prepared in a more simple and less costly fashion. The table shows that the new dishes consume much less fuel and cost about the same for the small family as the traditional meal prepared in "quality" style (tô with double gombo and tomato sauce, for example). This is not the case for larger, moderate-income families: with preparation of traditional dishes, the household can enjoy economies of scale (or simple savings due to use of a simple sauce) which are greater than those possible when preparing modern dishes.

Table 2.3: TRADITIONAL AND MODERN COOKING
Costs in CFAF per meal

	Small Household (4 persons)			Average Household (10 persons)		
	Ingredients	Charcoal	Total	Ingredients	Wood	Total
Traditional cooking:						
Tot sauce	1380	150	1530	1195	150	1345
Millet couscous	1195	150	1345	850	150	1000
Modern cooking:						
Potato stew	1225	75	1300	2040	100	2140
Spaghetti/meat/salad	1100	75	1175	1830	100	1930

Source: ESMAP Surveys, 1989.

Types of Fuels in Use

28. Table 2.4 gives classifies the consumers in the five towns studied by fuel used. A distinction is made between the primary fuel, that used mainly for midday and evening meals and other everyday cooking, and secondary fuels used for "small cooking" (grills, small dishes) or for

associated needs such as hot water heating, heating baby bottles, preparing tea, and ironing. It was not possible to produce a reliable breakdown of fuel consumption by final usage (cooking versus other uses) based on the data collected from surveys and previous projects.

Table 2.4: URBAN FUEL USE

(% of households)	Bamako	Ségou	Koutiala	Mopti	Gao
Primary Fuel:					
Wood	87%	92%	100%	96%	100%
Charcoal	11%	8%	0%	4%	0%
LPG	1%	0%	0%	0%	0%
Secondary Fuels:					
Wood	2%	6%	0%	4%	0%
Charcoal	56%	78%	60%	63%	90%
LPG	17%	1%	3%	9%	7%
Kerosene	1%	1%	1%	3%	0%
No secondary fuel	34%	15%	38%	29%	10%

Source: ESMAP Surveys, 1989.

29. The table shows wood's dominance as a primary fuel in Mali's towns: 9 of every 10 households in Bamako and almost all urban households in the interior use wood. Those which do not tend to use charcoal. Gas as a primary fuel is found almost exclusively in expatriot, international households (diplomats, technical assistants) and in smaller, very affluent households.

30. The figures in the table also indicate the typical pattern of most households, where several different fuels are consumed for specific uses. For example, charcoal commonly is used from time to time in households which consume primarily wood -- perhaps more commonly than indicated by the estimates in the Table. In fact, women frequently recycle firewood coals for use in small ovens or irons (household charcoal). Some charcoal users still use firewood when preparing specific dishes. Part of the population also uses gas or kerosene on an auxilliary basis. A small fraction of households still use the latter for cooking; however, kerosene is primarily used for lighting and to kindle firewood during the rainy season.

Fuel Consumption Levels and Expenditures

31. Estimates of average consumption for each type of fuel are given in Table 2.5. These figures are based on surveys of fuel expenditures in different towns. Consumption levels were confirmed by actual measurements taken in nearly 100 Bamako households during a one week period, as well as by other previous studies. The surprisingly high level of household energy consumption in Koutiala can be explained in part by the relatively low price of wood in this area, and by energy requirements for preparing the traditional local beer (dolo). By contrast, in Gao, where wood prices are equivalent to those in the capital, consumption levels are one third lower than those in Bamako, Ségou or Mopti.

Table 2.5: DAILY FUEL CONSUMPTION

CFAF/person/day	Bamako	Ségou	Koutiala	Mopti	Gao
Primary Fuel:					
Wood	0.9	0.8	2.4	0.9	0.6
Charcoal	0.33				
Auxilliary Fuel:					
Wood	0.3				
Charcoal	0.095	0.05	0.07	0.05	0.06
Gas	0.005				
Kerosene (lighting; ignition)	0.015	0.011	0.018	0.013	0.011

Source: Surveys and Enerdom Estimates, 1989.

32. These figures are averages, and thus tend to mask important variations due to household size. In Bamako and Ségou, for example, the larger households only use 0.7 kg per person per day, whereas smaller families use up to 2 or 3 kg (see Figures 1 and 2 in Annex 2, which indicate fuel consumption levels and expenditures according to household size). Nonetheless, the overall average figures of 0.9 kg of wood and 330 g of charcoal consumed per person per day in the urban households that cook with these fuels are comparable to statistics in other neighboring countries such as Niger and Sénégal (which consume about 1 kg of wood and between 250 and 350 g of charcoal).

33. Despite variations in consumption levels, the expenditures for wood are relatively uniform throughout Mali, except in Bamako where they are a bit higher. Daily per capita averages are 16 CFAF in Bamako, but only 12 to 13 CFAF in other urban centers. (Fuel expenditures are compared in Table 2.6.) This phenomenon would tend to prove the existence of a certain price elasticity in demand; households, by choice or by force, adjust their level of consumption based on their financial means relative to the price of fuel. According to these figures, the energy expenditures of a median household (8 persons, wood consumer, auxiliary use of charcoal and kerosene) would be about 6000 CFAF in the capital and 5000 CFAF in other towns. This represents a little less than 10% of total monthly household expenditures (based on DNSI statistics), although the percentage most likely is considerably higher for poorer households.

Table 2.6: DAILY FUEL COSTS

CFAF/person/day	Bamako	Ségou	Koutiala	Mopti	Gao
Primary Fuel:					
Wood	16	12	13	12	12
Charcoal	22				
Auxiliary Fuel:					
Wood	5				
Charcoal	6	2	3	3	5
Gas	2				
Kerosene (lighting; ignition)	4	5	4	4	

Source: Surveys and Enerdom Estimates, 1989.

Relative Fuel Costs

34. Table 2.7 compares the cooking costs of wood, charcoal, kerosene and gas on a theoretic basis (useful energy) and on the basis of survey results. This comparison is actually one of the principal measures available to the consumer for making fuel choices. In terms of price, wood currently is the cheapest fuel; charcoal is a little less than twice as expensive as wood, and gas and kerosene are about 1.5 times more expensive than charcoal. Gas, which on all counts is preferable to kerosene, is only slightly more costly. For Malian households, the switch to charcoal is already a luxury reserved for an elite class of small, relatively well-off households. To cook with gas would entail crossing a new cost threshold that is even less accessible: the average household would have to devote about 20% of the family budget to cooking (without taking into account other energy needs, such as water heating, etc.).

Table 2.7: COMPARISON OF COOKING COSTS IN BAMAKO

A. THEORETIC COSTS OF USEFUL ENERGY	Wood	Charcoal	Kerosene	LPG
Fuel price (CFAF/kg)	18	66	250	320
Calorific value (MJ/kg)	17	29	43.5	45.7
Equipment efficiency (%)	20	25	45	50
Cost of useful energy (CFAF/MJ)	5.3	9.1	12.8	14.0
Cost relative to wood costs	1.0	1.7	2.4	2.6
Cost relative to charcoal costs	0.6	1.0	1.4	1.5

ASSUMPTIONS
Cooking Equipment
Wood and Charcoal: portable metal cookers
Gas: portable cookstove (3 or 6-kg cannisters)
Kerosene: pressure cookstove

B. COOKING BUDGET FOR TYPICAL MEAL (ACCORDING TO HOUSEHOLD SURVEYS)				
Fuel Price	18	66	250	320
Quantity/Amount Needed	2.3	0.8	0.3	0.3
Meal Budget	41	55	80	96
Cost relative to wood costs	1.0	1.3	2.0	2.3
Cost relative to charcoal costs	0.7	1.0	1.5	1.7

C. ANNUAL COOKING COSTS (ACCORDING TO HOUSEHOLD SURVEYS)				
Fuel Costs	37800	51100	73000	86000
Number of stoves	2	2	2	1
Price per stove	1250	1500	7000	16000
Life of stove	2	2	4	5
Stove annuity	650	800	3000	2600
Total Cost	38450	51900	76000	88600
Cost relative to wood cost	1.0	1.3	2.0	2.3
Cost relative to charcoal cost	0.7	1.0	1.5	1.7

ASSUMPTIONS (Parts B and C)
Family of 8
Meal: rice with sauce; midday meal
Wood consumption: 0.9 kg per capita/day; 0.72 kg used for cooking, with 40% of cooking consumption used in the midday meal.
Charcoal consumption: 330 g per capita/day; 265 g for cooking, with 40% of cooking consumption used in the midday meal.
Kerosene consumption: 0.150 l per capita/day; 0.125 l for cooking, with 40% of cooking consumption used in the midday meal.
Gas consumption: 115 g per capita/day; 92 g for cooking, with 40% used in the midday meal.

35. The comparison in Table 2.7 is based on current market prices in Mali, not the economic costs of fuels. In fact, the prices of petroleum fuels are higher than their current theoretic economic costs (significantly in the case of kerosene, more modestly in the case of gas). Table 2.8 presents price comparisons for household fuels under the two hypotheses: in the first, the Government discards current levies (real taxes and cross-subsidies); in the second, the supply chain is nationalized and price controls are lifted. Under the first hypothesis, kerosene would be competitive with wood. Under the second hypothesis, gas would become competitive with charcoal (see Table 2.8). The results indicate that the current terms of competition between fuels are not economic, but rather are politically induced.

Table 2.8: FUELS PRICES AND COSTS IN BAMAKO

A. FUEL COSTS	Wood	Charcoal	Kerosene	LP6	(CFAF/kg)
Retail price	18	66	250	320	
Price net of taxes	17	63	112	320	
Economic cost	17(a)	63(a)	94	275(b)	
B. USEFUL ENERGY COSTS					
Retail price (CFAF/MJ)	5.3	9.1	12.8	14.0	
Cost relative to wood	1.0	1.7	2.4	2.6	
Cost relative to charcoal	0.6	1.0	1.4	1.5	
Price net of taxes (CFAF/MJ)	5.0	8.7	5.7	13.1	
Cost relative to wood	1.0	1.7	1.1	2.6	
Cost relative to charcoal	0.6	1.0	0.7	1.5	
Economic cost (CFAF/MJ)	5.0	8.7	4.8	12.0	
Cost relative to wood	1.0	1.7	1.0	2.4	
Cost relative to charcoal	0.6	1.0	0.5	1.4	

Notes: (a) minimum cost (in the case of an area with sustainable production of wood and charcoal)
(b)

Source: ESMAP estimates, 1989.

Traditional and Improved Wood Stoves

36. Traditional cookstoves, whether it be the three stone stove (in widespread use throughout the Sahel) or the tripodal metal stove used mainly in the north (Gao), are used extensively in Mali's towns and cities. Nearly 57% of Bamako's households still use a three-stone stove, and 20% use a tripodal stove.

37. Even so, an impressive number of improved stoves has been distributed, as verified by the statistics presented in Table 2.9. The Louga stove is the model most commonly distributed in the towns of the interior, whereas improved metal stoves are common to Bamako and, to a lesser extent, Ségou. Approximately 70% of the households in Bamako that cook with wood have at least one improved stove: the metal model, the Louga model in neighborhoods in the outskirts, or the

older, large model with a grate and smokestack. Half the owners of improved stove have at least one metal model; about 20% of these own two or more metal stoves.

Table 2.9: IMPROVED WOODSTOVE DISSEMINATION IN CITIES

(% of households with at least 1 improved stove)	Bamako	Segou	Koutiala	Mopti	Gao
Solid	10%	9%	9%	0%	1%
Metallic	49%	42%	21%	21%	3%
Louga	12%	32%	45%	68%	57%

Source: ESMAP Surveys, 1989.

38. Although the legislation effective in March 1986 requires only a small number of households to use improved stoves, dissemination of improved stoves has been a primary objective of intensive efforts/projects?, with neighborhood demonstrations? carried out by the National Women's Union in various towns and villages. Female consumers generally seem satisfied with the marketing network, the price and the efficiency of metal stoves. This alone results in a high level of market penetration in all socio-economic classes in Bamako, as shown in Table 2.10.

Table 2.10: IMPROVED METALLIC WOODSTOVES OWNERSHIP BY INCOME LEVEL IN BAMAKO

Income category of households cooking mainly with wood	% of total households in the category	% of households owning improved stoves
High	15	86
Medium	35	70
Low	50	63
Average Bamako	100	68

Source: ESMAP Surveys, 1989.

39. Household surveys in Bamako taken during this study were analyzed to compare consumption and expenditures in wood-consuming households based on the number of improved stoves within the household (none, one, more than one). The three sample groups polled each contained 60 persons with comparable sized households. Surveyed households presented energy savings of 5%-10% or 10%-20%, depending on whether the household owned one or more improved stonves. Table 2.11 below summarizes the average consumption (in bundles of firewood) and expenditures (in CFAF) for the three sample groups.

Table 2.11: IMPROVED WOODSTOVES AND WOOD SAVINGS

Improved woodstoves ownership in households cooking with wood	Wood consumption (Bundles/person/day)		Expenditure (CFAF/person/day)	
0	0.30	100%	19.45	100%
1	0.25	83%	17.65	91%
2 and more	0.23	77%	16.99	87%
Average Bamako	0.26	87%	18.55	95%

Source: ESMAP Surveys, 1989.

Note: Wood savings indicated in the table represent an average for each household category, with a rather large dispersion however.

40. The savings generated by improved stoves are considered substantial, especially in light of the fact that improved stoves often does not replace other stoves, but rather complement them -- and the household cooks uses them all when preparing meals. Only an estimated 40% to 45% of the main meals (lunch or dinner) are prepared improved stoves, about 25% using the metallic stoves. Table 2.12 below summarizes the use of improved stoves in the preparation of 1500 meals, as surveyed in 90 households in Bamako.

Table 2.12: IMPROVED WOODSTOVES UTILIZATION RATES

	Breakfast	Lunch	Dinner
Three-stone stove	50%	53%	49%
Metallic improved stove	23%	28%	27%
Louga improved stove	10%	10%	10%
Solid improved stove	3%	7%	4%
Total improved stoves	35%	44%	41%
Other stoves	15%	2%	9%

Source: ESMAP Surveys, 1989.

41. The metallic improved stoves in use in Bamako households were observed to be in very good condition (most had been recently purchased). In general, it appears that women have adjusted to using them with relative ease. However, a study carried out by the consulting firm IT-Power yielded contrary results for towns of the interior: there, the Louga stoves in use are poorly maintained, and they are used infrequently and in an inefficient manner.

Substitute Fuels to Replace Wood

42. The coexistence of several fuels is an indication of the transition underway in urban cooking practices. This transition affects primarily and most noticeably in the capital, but has not by-passed interior towns and cities. All indications show a gradual switch to charcoal as the primary fuel and gas as the secondary fuel. This movement toward "higher" fuels, highlighted in Table 2.13, occurs mainly in smaller, high income households living in the more established residential neighborhoods or in new housing developments. As for kerosene, it is used as a cooking fuel only in a few households, being reserved for lighting purposes in areas not served by electricity.

Table 2.13: CHARCOAL AND LPG PENETRATION RATES IN BAMAKO

Penetration rate by category	Charcoal as primary fuel	Secondary fuel Charcoal	LPG
Household size			
2 to 8	15%	55%	19%
9 to 12	10%	55%	18%
More than 12	4%	61%	12%
Income level			
High	33%	48%	57%
Medium	6%	69%	12%
Low	8%	48%	8%
Districts			
Old	19%	54%	23%
New	8%	75%	29%
Residential	12%	65%	18%
Belt	9%	52%	9%
Village-districts	0%	25%	8%
Average	11.5%	56%	17%

Source: ESMAP Surveys, 1989.

Charcoal

43. Use of charcoal as a primary fuel -- normally to fire "malgache" stoves -- can no longer be considered [marginale], given its growth in the past decade. In Bamako, 11.5% of households (7500 in total) now use it for cooking, as opposed to 3% in 1978 and 8% in 1987. The households which cook with charcoal still have a particular profile: in general, they are smaller and more affluent than average. But the different analyses conducted (recent or hoped for substitutions, opinions on fuels and stoves) reveal a certain "temptation" associated with using charcoal, which is considered very **comfortable and well adapted to modern life**. The foreseable growth of charcoal use is thus one of the fundamental parameters in the development of the household enregy sector, notably due to its potential impact on national forest ressources -- an impact which is greater than that due to direct use of firewood.

Gas

44. Gas has made considerable inroads in the richer, more innovative households, and a fraction of average households as well, due to several single-burner cookers promoted by distribution companies. These include the Déméba (6 kg) and the Guatéli (6 kg). These stoves, which only have been in distribution since 1986, have been very successful: more than 20,00 stoves have been purchased in a little less than three years. Approximately 20% of all households in the capital, 13% of those in Mopti and a non-negligible number in Ségou (7%), Koutiala (4%) and Gao (2.5%) are equipped to use "popular gas". This market penetration levelis quite significant, given the constraints associated with initital investment costs, the cost of gas and user apprehensions about the safety factor of using gas.

Table 2.14: BUTANE PENETRATION IN MALI

	1986	1987	1988	1989
Stove sales (units)	5500	6800	4900	5800
Stove stock (units)	5500	12300	17200	23000
Refill sales (units)	38000	62000	84000	86000
Gas sales (tons)	106	201	308	333
Gas sales/stove (Kg/year)	19.4	16.4	17.9	14.5

Source: Shell, Total-Texaco, 1989.

45. Gas rarely is used as a primary cooking fuel (only 1% of the survey respondents in Bamako). Gas stoves are used almost exclusively on an occasional basis, for preparing coffee and light dishes and for heating water. The average consumption of someone using a Déméba cooker is about 20 kg of gas per year -- less than one tenth the amount needed for cooking. Gas consumption when using the Guatéli stove is even lower, without doubt due to the larger "budgetary shock" required to replace its resevoir. The growing share of Guatéli models among stoves in circulation accounts for the gradual decrease in average gas consumption shown in Table 2.13. Gas consumption now averages about 15 kg per cookstove per year.

46. It is not atypical that first uses of gas are only auxilliary; this can be considered a normal phase in the first years of gas distribution. The switch to cooking principally with gas (which one could call the "second butanization", the first corresponding to the purchase of gas-fired appliances) could occur in Bamako and Mopti 2/ simultaneous with market penetration by gas-fired cookstoves, under certain favorable pricing conditions. Gradually, use of gas for cooking could then spread to other towns in Mali.

2/ Where a bottling plant was installed in 1990.

Kerosene

47. Kerosene has been distributed in Mali on a limited basis for several years, but its use is in decline. Some households continue to use it on an auxilliary basis (approximately 5% of the households in Bamako). Use of kerosene has been abandoned primarily because the cookstoves are too small and not adapted to the Malian cuisine 3/. They also are not easy to use (smelly, smoky, difficult to install the wick) and the fuel itself is costly. The latter makes kerosene accessible mainly to small, well-to-do families, the same customers who are likely to use charcoal or gas. Nevertheless, the fact that kerosene can be purchased in small quantities and in the immediate neighborhood gives it a certain advantage over the use of gas.

Market Potential for Substitution

48. Household Preferences. Table 2.15 summarizes the preferences of households polled during the survey with regard to selection of fuels. Two main parameters of substitution can be discerned in this data: the supply situation for wood and the degree of urbanization. ****The data also highlights the development of behavioral patterns to the extent that substitution fuels are known and available.***

49. At one end of the spectrum is a town such as Koutiala, where wood supply is sufficient for the most part, and where consumer habits are very traditional. Wood currently is the best fuel for 3/4 of the inhabitants and will remain thus in the future for almost half of them: less than 40% would be ready to change fuels. At the other end of the spectrum are towns in the north, especially Gao, where wood already has been replace by charcoal and other fuels. Between 50% and 60% of the inhabitants of these twons would be willing to switch fuels.

3/ The existing kerosene cookstoves in Mali are a small Chinese model with wicks, and the Primus pressure cooker.

Table 2.15: PREFERRED FUELS
In % of households

	Wood	Charcoal	LPG	Kerosene
Currently				
Bamako	61	22	14	0
Segou	51	36	12	0
Koutiala	77	12	11	0
Mopti	59	21	18	1
Gao	54	42	3	0
In the medium to long term				
Bamako	26	27	42	0
Segou	20	16	42	9
Koutiala	42	23	35	0
Mopti	8	29	40	8
Gao	7	70	18	3
Substitution planned in the short term				
Bamako		13	18	5
Segou		7	31	13
Koutiala			36	3
Mopti		12	38	5
Gao		25	28	0

Source: ESMAP Surveys, 1989.

50. Between the two extremes is Ségou, where 50% would be willing to change, its consumer habits being a bit closer to those of the northern towns (***that which translates its intermediary situation with regard to wood supply***]) and the capital. In the latter case, long-term use of wood will be abandoned by 3/4 of the inhabitants, but the push to switch to another fuel is less urgent and pronounced here than in the northern towns (only 35% willing to change).

51. Two fuels will be the primary beneficiaries of the desire for change: gas and charcoal. Between 7% (Ségou) and 25% (Gao) of households state a preference to switch to charcoal (for use as the primary fuel). In Bamako, 13% are considering a switch to 13%, with 3% to 4% intending to do so in the next few months. This is a tendency which should be taken into account when projecting future household energy consumption.

52. In addition, nearly 20% of households polled in Bamako intend to purchase gas-fired appliances (20% already own gas appliances); the percentages in other towns for intended purchases range from 30% to 40%. It would be reasonable to expect 40% to 50% of households to be equipped for gas use by the year 2000, at least in areas where there is an adequate distribution infrastructure -- above all in Bamako. By contrast, kerosene was not cited as a potential future fuel

by respondents in Bamako or Koutiala; it was mentioned only rarely by respondents in Ségou and in northern towns.

53. Household Preferences for Cookstoves. Various types of cookstoves fueled by charcoal, gas and kerosene were presented simultaneously to groups of women in Bamako, Mopti, Gao. The opinions gathered during these presentations indicate a strong immediate interest in charcoal, as well as a preference for gas over kerosene. These results are summarized in Table 2.16.

Table 2.16: PREFERRED STOVES

	Bamako	Mopti	Gao
	(in % of households)		
First choice			
Improved woodstove	0	38	17
Improved charcoal stove	35	27	28
Gas stove (Demeba)	0	2	11
Gas stove (Guateli)	4	2	4
Nigerien gas stove	49	11	28
Sub-total gas	53	15	43
Indonesian kerosene stove	7	7	9
Colombian kerosene stove	1	4	4
Sub-total kerosene	8	11	13
Second choice			
Improved woodstove	7	9	15
Improved charcoal stove	28	29	30
Gas stove (Demeba)	4	2	11
Gas stove (Guateli)	8	7	9
Nigerien gas stove	26	24	20
Sub-total gas	38	33	40
Indonesian kerosene stove	11	4	2
Colombian kerosene stove	8	4	7
Sub-total kerosene	19	8	9
Stove rating			
Improved woodstove	4	1	5
Improved charcoal stove	3	4	3
Gas stove (Demeba)	5	5	3
Gas stove (Guateli)	2	3	2
Nigerien gas stove	1	2	1
Indonesian kerosene stove	7	6	6
Colombian kerosene stove	6	7	6

Source: ESMAP Surveys, 1989.

54. The portable metallic wood stove has been very well received in towns where it has only minimally been in distribution, such as Mopti, proof that the product is very well adapted to local needs. However, considerable interest was shown in SEL's prototype stove, a multi-burner charcoal cooker which receive 30% of the first choice votes from presentation participants. Interest in the stove was generated not only because it can hold more than one cooking pot, but also because it uses charcoal.

55. The different gas cookstoves also generated strong interest, especially at Bamako and Gao, where the combined first and second choices votes for gas accounted for more than 80% of the total votes. It should be noted that among the different gas cookstoves presented, the 6 kg model clearly was preferred to the 3 kg model. The Nigerian multi-burner prototype -- which is distinguished from the 6 kg only by its supporting stand -- was ranked far superior to the competing models: it was ranked first among all cookstoves tested in Bamako and Gao, and second in Mopti, after the improved wood stove.

56. The kerosene cooker was only chosen by a limited number of women: it was the first choice of between 8% (Bamako) and 13% (Gao) of the respondents. Combined first and second choice votes ranged from 20% to 30%. These are not negligible percentages, despite the poor past performance using this fuel. Of the two cookers (both ranked nevertheless at the bottom) the Indonesian cooker appears to be better accepted than the Columbian model, which is a little too exotic in shape and usage.

57. In-depth interviews of approximately 100 women in Bamako underscored the nature of women's reticence towards kerosene. Between 20% and 30% of the respondents consider kerosene an acceptable fuel, whereas 30% reject it totally. Between these two extremes, a hesitant [fringe] is deterred by the kerosene prices (30%) while a lesser number are [turned off] by the stoves poor adaptation for use.

58. Potential Markets. In summary, there appear to be a number of potential markets for substitution distinguished firstly by the size of markets in each town: larger potential markets exist in Bamako and in the northern cities than in the south. There is also a difference in the impetus for substitution in Bamako and that in the northern cities. In Bamako, substitution is based on desire for comfort and modernization. Thus, gas is preferred to kerosene as a substitute, portable cookers are the sought-after household equipment, and a gradual switch to gas as the principal fuel is found among the most affluent households. Since woodfuels are relatively abundant, kerosene remains somewhat stuck between charcoal and gas, able to conquer only a minor market share -- "poor man's gas" used mainly by established urban middle class populations.

59. On the contrary, the populations in the northern cities are compelled to substitute due to increasing scarcity and expense of woodfuels. Under these circumstances, it is possible for kerosene to carve out a larger niche for itself. Observations in these cities show that 50% to 60% of households are ready to switch fuels (Table 2.15): this represents a large potential market for kerosene, since relative to gas, it can more easily gain influence as a principal fuel by substituting for wood among the well-to-do and middle class populations. However it will be necessary to mount a major drive to promote and distribute appropriate cookers in order to eradicate this fuel's poor current and past image.

Household Electricity Consumption

60. Access to Electric Service. An infinitesimal small number of households have access to electricity. As shown in Table 2.17, EDM's current low-voltage accounts number a little more than 35,000, of which 32,000 are households (90%). The balance is composed of accounts in the small-scale and residential productive sector. Thus Mali's national electrification rate is only about 3%.

Table 2.17: LOW VOLTAGE ELECTRICITY CUSTOMERS

	1980	1981	1982	1983	1984	1985	1986	1987
Interconnected Grip								
Bamako + Kati + Koulikoueo	15518	17115	18511	19818	21773	22223	23800	24978
Isolated Systems								
Bougouni	350	377	400	414	432	434	437	444
Fana	101	122	136	158	180	189	205	227
Gao	761	829	842	879	932	928	921	954
Kayes	1551	1639	1722	1722	1761	1734	1769	1888
Koutiala	537	563	579	579	614	633	673	676
Kita						59	126	167
Mopti-Sevare	1305	1311	1301	1346	1363	1339	1316	1422
Segou-Markala	2177	2309	2306	2395	2416	2425	2468	2492
Sikasso	751	832	862	889	942	960	989	1093
Tombouctou	640	728	747	809	867	882	894	860
Sub-total	8173	8710	8895	9191	9507	9583	9798	10163
Total	23691	25825	27406	29009	31280	31806	33598	35141

Source: EDM, 1989.

61. For all practical purposes, there is no access to electricity in rural areas, and the electrification rates for cities in the interior are limited. In 1985, only Ségou and Kayes had an electrication rate greater than 20%, with rates in other cities ranging between 15% and 20%. In addition, because of frequent breakdowns and [ruptures] in fuel supplies, load shedding and power cuts are common occurences. In Ségou or Mopti for example, only the administrative neighborhood is assured of continuous power; the other neighborhoods receive power on a rotational basis.

62. Nearly 70% of all electric customers are located in Bamako, accounting for about 90% of total low-voltage consumption. Yet the proportion of households served by electricity is relatively low here, also. Households within a common dwelling often share connections to the power grid : slightly more than 40% of these "joint" households receive electric service, or 24% of all households in Bamako when taking into account one person households (according to household surveys). The rate of electrification has decreased steadily in Bamako, as shown in Table 2.18. With only about 1000 new accounts each year, population growth has easily outpaced the number of connections.

Table 2.18: RATE OF ELECTRIFICATION IN BAMAKO

	1969	1977	1981	1985	1989
Connection rate	41%	41%	36%	28%	24%

Source: DNHE, ESMAP Surveys

Electric Consumption and Household Appliances

63. Electric consumption by household customers is quite low, averaging about 50 kWh/month/account in the cities of the interior (in Ségou the average is even less than 20 kWh/month) and a little less than 200 kWh/month/account in Bamako. The higher averages in Bamako are due mainly to the regularity of power service and to the existence of large household consumers (occupants of villas), rather than to higher consumption levels of individual consumers. In fact, more than half the electric customers in Bamako use less than 100 kWh/month.

64. Analysis of ownership rates for electric household appliances in Bamako yielded the following breakdown for households connected to the grid: Just over one-fourth of the households are micro-consumers who use electricity only for lighting. Another 60% have additional appliances or equipment, typically a television (the one piece of electric equipment owned by the greatest percentage of households), a refrigerator, a fan and a radio-cassette player. Finally, the affluent minority -- the larger power consumers -- own freezers, air conditioners, hot water heaters and irons. The bills for 70 household accounts were analyzed during surveys in the capital, yielding comparable information, as presented in Table 2.19.

Table 2.19: ELECTRICITY CONSUMPTION AND EXPENDITURE IN BAMAKO

Electricity bill (CFAF/month)	% of households	Average bill CFAF/month	Consumption (Kwh/month)
Less than 4,000	20%	2500	40
4,000 to 10,000	44%	7000	100
10,000 to 40,000	27%	17000	200
More than 40,000	9%	65000	900
Average Bamako	100%	14000	180

Source: ESMAP Surveys, 1989.

65. Ownership rates for electric household appliances varies markedly between Bamako and the cities of the interior, as shown in Table 2.20. The electric appliance owned by the greatest percentage of households is the television (in areas served by Mali's broadcast network), followed by refrigerators, which frequently double as a business [tool] for women (for selling ice or cold refreshments).

Table 2.20: APPLIANCES OF HOUSEHOLDS CONNECTED TO THE GRID

Appliance	Bamako	Segou	Kotiala	Mopti	Gao
Television	34	28	8	0	11
Ventilator	29	22	21	21	18
Refrigerator	28	20	15	18	17
Iron	7	5	3	7	5
Deep-freeze	5	5	4	9	11
Air-conditioning	5	4	1	1	9
High fidelity	2	9	0	3	7

Source: ESMAP Surveys, 1989.

Consumption in Households Without Electricity

66. The other category of households, those without electric power, is not a homogenous group, and it would be erroneous to assume that a lack of electricity in a household is necessarily synonomous with a lack of financial means. In Bamako, an estimated 2 of every 5 middle income households and 1 in 5 well-to-do households do not have electric power. Included among the households not connected to the power grid are half of low-income households, with one or two kerosene lamps; an almost equal proportion of households who comfortably satisfy their lighting needs (three lamps or more) and own sound equipment (battery-operated radios and cassette players); and finally more than 10% of well-to-do households, which own battery-operated televisions. There are several thousand battery-operated appliances of these types in Bamako. The distribution of non-electric equipment is roughly the same in Ségou. However, in Mopti and Koutiala equipment in households not connected to the power grid includes only battery-operated sound equipment in half the households and, on average, two kerosene lamps in two-thirds of them (see Table 9 in Annex 2). One also finds several dozen small electric generators in some middle- to high-income neighborhoods where households are not connected to the grid (Kalaban, Magnanbougou, etc.) In these same neighborhoods, solar-powered lighting kits [have made a timid appearance].

Wood and Charcoal Consumption in the Informal Sector

67. To analyze urban wood and charcoal consumption, it is necessary to determine a consumption for a series of uses other than household consumption: industries; small-scale crafts production; small-scale service sector (food and drink establishments; commercial dry cleaning, dyeing and steam pressing; blacksmiths and soapmakers, etc.); food services for health institutions, schools, military mess and prisons. The use of wood and charcoal for these activities constitutes a non-negligible share of total woodfuel consumption in Mali's cities.

68. A survey taken specifically for this study shows an estimated 2500 small trades or professions using wood or charcoal in Bamako 4/. Table 2.21 gives some information about these activities and their energy consumption levels. It indicates primarily that informal sector trades are

4/ A total of 2177 were surveyed.

all micro-consumers. For example, the larger consumers in this group are blacksmiths, who average 10 kg of charcoal per day, and dry cleaners and grilled meat vendors, with 25 kg of fuelwood (equivalent to the consumption of 2 or 3 charcoal-consuming families). Charcoal expenditures can comprise a non-negligible share of charcoal users' expenses and turnover (in the case of the blacksmiths, jewelers or laundries) but expenditures for wood generally have only a small impact on the accounts of family-owned businesses. Finally, it should be noted that roadside food vendors and dry-cleaning/fabric care businesses are run almost exclusively by women.

Table 2.21: ENERGY CONSUMPTION OF THE INFORMAL SECTOR IN BAMAKO

	Units	Energy expenditure (CFAF/day)	Energy/ operating costs (%)	Energy/ Turnover (%)
Ironmason	42	750	66.7%	10.9%
Jeweler	63	650	39.5%	17.2%
Launderer	434	380	87.6%	21.9%
Dry Cleaner	197	480	1.5%	1.0%
Small Restaurants/Diners				
Dibiteries	84	500	5.7%	5.1%
Grilled/Fried Foods	4	NA	NA	NA
Breakfast	32	285	5.1%	NA
"Fast-food"	114	350	3.5%	1.7%
Roadside Vendors				
Dibiteries	59	550	26.2%	NA
Grilled Foods	288	150	3.4%	2.7%
Deep Fried/Fried Foods	622	170	9.5%	7.1%
Breakfast	176	110	3.2%	2.7%
"Fast-food"	62	300	6.9%	5.4%
Total in Bamako	2177	310	3.8%	2.6%

Notes: 95 informal enterprises have been surveyed (including 17 launderers). The total number of these informal enterprises in Bamako is estimated at 2,500.

Source: ESMAP Surveys, 1989.

69. It is difficult to identify small informal sector businesses as they often are operated from homes and communal dwellings 5/. Thus, it is becomes difficult to a certain extent to obtain an accurate accounting of the number of small informal businesses and their contribution to urban energy consumption. In some cities, activities such as drying fish consume substantial quantities of wood. However, it is estimated that this type of woodfuel consumption for both informal or modern sector actitivies remains proportionally small. As shown Table 2.22, which summarizes wood and charcoal consumption in Bamako by category of consumer, the household consumers represent approximately 96% of wood consumption and nearly 90% of charcoal consumption in the capital.

5/ In this case, it is difficult to distinguish woodfuel consumed for small business purposes (especially for sales of food) from that reserved specifically for household needs.

Table 2.22: WOOD AND CHARCOAL CONSUMPTION BY SECTOR IN BAMAKO

	Wood (100 tons/year)	Wood %	Charcoal (100 tons/year)	Charcoal %
Households				
Primary fuel	184.0	94.5%	8.9	38.1%
Secondary fuel	2.0	1.0%	12.5	53.4%
Total	186.0	95.5%	21.5	91.5%
Public sector	1.1	0.6%	0.0	0.0%
Industry	2.3	1.2%	0.0	0.0%
Informal sector	5.3	2.7%	2.0	8.5%
Total Bamako	194.7	100.0%	23.5	100.0%

Source: ESMAP Surveys and estimates, 1989.

Demand-Based Strategies

Improved Wood and Charcoal Cookstoves

70. The most widespread cooking tradition, both in rural and urban settings, is use of the three-stone stove. An exception to this rule is the northern region (especially Gao): there metallic triped cookstoves from the Sahara are used. Initial introduction of improved cookstoves was through introducing an artifact, equipment to be used in Malian cooking.????

71. Improved cookstoves were first distributed in Mali in 1980, with introduction of cumbersome models, some of which are still in use. The pace of stove distribution accelerated in 1985 with the arrival of two models still in distribution, the Louga [en banco] and the metal portable cookstove. By 1989, approximately 300,000 improved cookstoves had been distributed in Mali, including 200,000 stoves [en banco] in rural areas and 100,000 improved stoves in urban areas, half of these metal portables (85% in Bamako).

72. Distribution of the Louga stove [en banco] is decentralized and carried out by a number of public or development assistance organizations who also train craftsmen in their construction. In some towns, individual private craftsmen now are promoting their services to construct a slightly different model. The Louga stove is a stationary cooker, with construction billed at about 250 CFAF, not including material, for a total cost of between 750 and 1000 CFAF. In rural areas, distribution efforts often are assigned to the Regional Departments for Waterways and Forests (an assignment more mandatory than [inactive]??, based on the Law of 1986 which requires use of these stoves).

73. Other programs to promote portable improved cookstoves constructed from metal have been launched in Mali. The two main institutional distribution projects are the following: the LESO/VITA project begun in 1985 in Bamako, with assistance from the UNFM, has effected the cumulative distribution of a little less than 10,00 stoves; and the DNAS/GTZ project, which

currently has been distributing about 1000 stoves each month since September 1988. The two projects promote the same stove model, although one is constructed from new sheet metal and the other from recycled materials (DNAS/GTZ). This particular model can only accommodate one cooking pot, and thus the household must purchase several stoves corresponding to the size of their pots. The price of the most commonly used cookstove of this model (the number 3 pot size) currently is about 1250 CFAF, but it can be found for about 900 CFAF. These prices are considerably less than those charged in the initial stages of the stove promotion (often more than 2000 CFAF per unit), but they still provide sufficient margin to encourage and develop participation by private sector distributors 6/.

74. Institutional projects have played a primordial role in the first phase of developing the production and marketing of improved metal stoves and they today obtain their objective, that of being overcome by the automatic logic of the market. Craftsmen not officially trained through these programs already have taken the initiative and constructed more than two-thirds of the improved metal cookstoves currently in use (15,000 to 20,000 stoves were distributed by these two institutional projects, whereas the total number of stoves in distribution is estimated to be about 50,000). The economic profitability of these activities is quite high. Under conservative hypotheses (wood savings of only 10%), the 50,000 improved cookstoves distributed both directly and indirectly (incentives for spontaneous construction by craftsmen) under these projects will generate annual savings of 15,000 to 20,000 tons of wood. The economic value of this quantity can be estimated at nearly US$ 500,000 (8 CFAF/kg), that is to say certainly much more than the total annual costs of the two projects combined with the additional cost of the improved stove to the consumer relative to the traditional stove [surcoût des foyer amélioré par rapport aux foyers traditionnels]. In addition, marketers have organized their own distribution networks (door-to-door sales, for example) and have cause the prices of these cookstoves to drop considerably.

75. The cookstove models distributed through spontaneous efforts by craftsmen are slightly different from those promoted through institutionalized projects (especially DNAS/GTZ), with a triangular bar to support the cooking pot. A test of 14 stoves undertaken for this study, some of which carried labels identifying them as part of the LESO-UNFM or DNAS-GTZ project, and others made by unaffiliated artisans, has shown that the stoves produced by unaffiliated artisans are at least as efficient as the models which received quality labels from the projects. The "three-bar" model also presents an advantage for women: they can use it with several cooking pots of different sizes, which makes things more practical for her, even if this is not optimal from an energy standpoint (in fact, the [***espace***] contact between stove and cooking pot should be constant for an ideal [***rendement***]). The SEL has developed a conical, multi-burner stove which is not yet in distribution.

6/ The successful market penetration by metal improved stoves also is due to their limited [surcoût] relative to traditional cookstoves (about 500 CFAF for the most frequently used model), which is amortized on average in less than a month if the stove is used efficiently, allowing an approximate 25% conservation of wood consumption; institutional projects to promote and educate consumers have contributed to making this conservation level obtainable in practice.

76. It also is important to note that most of these stoves are constructed from recycled metal drums, especially those use to hold pesticides. Although the risk of contamination is minimal for buyers of the final product, the same cannot be said for the blacksmiths who manipulate these drums, which often are still tainted by traces of chemical products.

77. Finally, because of the low usage rate for charcoal as a primary fuel, measures have yet to be taken concerning the distribution of charcoal stoves. In conjunction with projects for multi-burner wood cookstoves, SEL has developed an improved charcoal stove, for which the estimated price is 2250 CFAF, which is a reasonable price relative to the price of the traditional "malgache" stove, sold for between 1000 and 1500 CFAF.

Gas and Kerosene Cookstoves

78. The rapid distribution of gas cookstoves (more than 20,000 stoves since 1986) shows that the new single-burner stoves distributed by Shell (Déméba, the "useful model") and Total-Texaco (Guatéli, the "rapid model") are good products, better adapted to the traditional Malian cuisine than the classic four-burner gas cooker, which is inappropriate for the open-air cooking needed for current*** Malian dishes; it is better used for European style dishes.

79. The Déméba stove was introduced into the market more rapidly than its 6-kg counterpart and enjoyed immediate success. Sales have sagged, however, due to competition by the Guatéli model, which by 1988 had gained up to 80% of the market for cookstoves using popular gas. The 6-kg model effectively has proven itself more attractive to the Malian housewife than the 2.7-kg model because of its sturdiness and durability. Total-Texaco's marketing strategy, which concentrates especially in the [***petit credit-entreprise a la consmmation***] is paying off. In order to regain sales, Shell is planning to market a new stove model which is larger and more sturdy.

80. The sales price for these cookstoves (see Annex 2) are 14,000 CFAF for the Déméba model and 16,000 CFAF for the Guatéli and the newer model Déméba. Apparently consumers -- primarily members of the urban middle class -- do not view these prices as a major constraint. Initial barriers to investment do not exist, at least in the preliminary penetration phase for "innovative" households.

81. Presentations of different gas and kerosene cookstove models (see Illustration 4.1) were made during the course of this study to selected groups of consumers in Bamako, Mopti and Gao. Observations of consumer reactions and preferrences lead one to believe that still further technical improvements are possible. The women were seduced particularly by a Nigerian model using bottled gas (6-kg cannisters) with a conical support. Appreciation of this model was far superior to that for the two Malian models. Various women also suggested modifications to the Malian models, especially with regard to their burners, which often were considered difficult to regulate at lower cooking intensities (for simmering).

82. The kerosene cookstoves which are distributed in Mali at present are judged severely by the consumers. Consumers also were not particularly impressed by the foreign-made kerosene cookers, although these models are widely disseminated and used in countries in Asia (Indonesia,

India) and Latin America (Colombia). Only the Indonesian cookstove received a certain amount of interest and could potentially enjoy success in northern cities. This oven, which only costs 3000 CFAF in Indonesia, could be marketed for about 10,000 CFAF in Mali. 7/

Renewable Energy

83. Several research and development projects are being carried out under the auspices of the NHED. For example, experimental cultivation of "pourghère", an oil-yielding plant whose oil could be used as fuel in special motors, and research on charcoal from cotton stems -- as yet inconclusive -- are part of the SEP. Also of note is work carried out by the SEMU with solar pumps, as well as with pre-electrification using portable lamps and solar batteries. This project, which principally targets rural regions, experiments with various credit formulas for disseminating these materials.

84. However, given the preponderance of wood and charcoal in the household energy sector, most of the measures undertaken in the sector are related to forestry: forestry planting and management, taxation and monitoring forest exploitation and marketing woodfuels. These measures are presented in Annex 4, which covers the detailed characteristics of woodfuel supply.

7/ An Indonesian model of the improved kerosene cooker is being promoted and distributed in Niger, mainly in the eastern regions of the country, as part of the Household Energy component within the Energy II Project (with assistance from AID). Initial results are encouraging: demand for the cookers exceeds project projections.

ANNEX 4

DETAILED CHARACTERISTICS OF HOUSEHOLD ENERGY SUPPLY

Woodfuel Supply

Existing Wood Resources

1. Mali can be subdivided into six distinct agricultural and ecological zones (see Table 3.1). The country's ecological diversity is reflected in the variety of vegetation types which make up its wooded areas, from the scrub savannah found in the north (producing less than 10 m^3/ha) to tangled undergrowth covering 25% of the southern part of the country (production volumes of 20 to 40 m^3/ha) to the forests of the Sudanese-Guinean area (production volumes of 50 to 80 m^3/ha on average, with maximum levels rising to more than 100 m^3/ha in the great forests of the west.)

Table 3.1: AGRO-ECOLOGICAL ZONES

	Rainfall (mm) Min	Max	Area (Millions of km2)	%	Wood Stock m3/ha	Productivity m3/ha/year
Zone						
Desert/Sahelian		400	0.89	72	3.9 (a)	0.13 (a)
Soudano-Sahelian	400	600	0.09	7	5.4	0.18
North Soudanian	600	900	0.11	9	7.2	0.24
South Soudanian	900	1200	0.10	8	8.7	0.29
Soudano-Guinean	1200		0.05	4	10.5	0.35
Total			1.24	100		

(a) For the Sahelian zone
Source: MEE/DNEF

2. Several analyses 1/ have drawn attention to woodfuel deficiencies which are affecting large sections of Mali. A detailed inventory made as part of a summer 1987 project (Project to Inventory Wood Resources in Mali - PIRL) gives the most reliable overview of the potential of Mali's forests. According to the results of this inventory, the current situation is not as dramatic as previously thought, especially in the south. The Sikasso and Koulikoro regions, for example, are heavily forested: 60% to 80% of the surface area is covered in old growth timber (about 10 million hectares). Annual productivity of the accessible portions of these natural formations can furnish substantial quantities of wood, sufficient for assuring supply to rural and

1/ This report relies on the 1982 appraisals of wood availability by zone, as determined during a project supervised by FAO.

urban populations (see Table 3.2). Thus, the most populated regions in the south, Koulikoro (where the capital is located) or Sikasso, as well as the less populated Kayes are the regions with substantial wood surpluses; wood can be exploited over the long term as a renewable resource, whereas current exploitation methods encourage pockets or bands degradation along access roads or in the areas with high population density. In comparison, northern regions which were hard hit by the drought have woodfuel deficits; wood exploitation is conducting in the same fashion as mining exploitation which, if no other actions are taken, will lead eventually to resource exhaustion.

Table 3.2: Woodfuel Availability in the Koulikoro and Sikasso Regions

	Koulikouro (b)	Sikasso (a)	Total
Land Areas (1000 hectares)			
Natural forests	3719	4440	8159
Cultivated or fallow land	811	1042	1853
Density of standing wood (m^3/ha)			
Natural forests	18	27	23
Cultivated or fallow land	17	24	21
Volumes of standing wood (1000m^3)			
Natural forests	67507	118763	186270
National forests	6109	8763	14872
Cultivated or fallow land	13850	24550	38400
Natural growth (1000 T/year)			
Natural forests	1566	3727	5293
National forests	159	280	439
Cultivated or fallow land	330	716	1046
Woodfuel Availability (1000 T/yr)			
Natural forests	939	2236	3175
National forests	95	168	263
Cultivated or fallow land	99	215	314
Total	1133	2619	3752
Dead wood (1000 T)			
Standing wood (1000 m^3)	5400	3743	9143
Available (1000 T)	2268	1572	3840
Stocks on cultivated land (1000 T)	7373	32435	39808
Natural growth on uncultivated land	675	7373	8048

OBSERVATIONS:

(a) Sikasso Region: without the Sikasso circle (1.5 million ha)
(b) Koulikoro region: without the Nara and Dioila circles (3 million and 1.3 million ha, respectively)

ASSUMPTIONS:

Availability of natural forests and dead wood: 60%
Availability of wood on cultivated or fallow lands: 30%

Source: PIRL inventory; ESMAP estimates 1989.

Socio-economic Characteristics of Rural Woodfuel Supply

3. Landuse. On the basis of the very theoretical Land Code, Malian rural space is highly regulated: all territory has a nominal owner, and codified land practices, written or otherwise, organize village and inter-village territory ownership. The actual organization varies from region to region, even between neighboring regions, for various historic, ethnic, and other reasons: ownership is generally collective in the southern regions, with individual ownership most frequent in the Mopti region. Certain villages are established with full authority over their land; other more recently established villages have fewer land rights delegated by another collective. As fallow land disappears in the south, where land reserves are decreasing, their reduction in other zones leads to solidification of local land control. In certain areas near cities, large land areas are being lost to urban expansion: most notably near Bamako, and in particular along rivers.

4. Peasants manage use of these areas, while local authorities are responsible for guaranteeing local conformance to regulations. The village chief, chosen by the general village population (and sometimes by the administrative authority) and the village counsel -- four to eight persons selected by the villagers -- play this supervisory role. The village chief assigns land and supervises sales, regulates land disputes, problems between farmers and ranchers, controls outsiders, etc., and serves as intermediary between the villagers and administrative authorities. Forest exploitation, even if conducted by outsiders, is done under the supervision and with the support of the local authorities.

5. This presence of an effective local guardian and organization contrasts with the difficulties which the State encounters for regulating and managing rural areas. Contrary to what is written in the property and land code, it can be said that "the State's rights take precedence only when the population has no need for land upon which the said rights would be enforced": not only is the State incapable of overseeing but a small fraction of the lands over which it has rights, its laws are often denied in action. Classified forests, for example, become routes for the flocks or the purveyors who supply nearly all of the firewood for villages like Segou.

6. There is no specifically designated forest space: any section of land can be used for farming or grazing. The forest is the part left over, whatever grows in the space temporarily abandoned by farmers and ranchers. The tree therefore is one of the elements of the agrarian peasant system, itself a source of various products; the tree's exploitability competes with possible expansion of farm land. The manner in which trees are exploited for consumption by villagers is a reflection of the difficult conditions of rural life: in impoverished areas women must search for the wood wherever it can be found, often at a distance of several kilometers. Still, there has been a certain amount of progress -- carts are now used for agriculture in some locations are also used to transport wood. There remains a relatively complex relation between the means of production: men taken a role in the collection of wood, and rural monetary micro-circuits have been created.

7. The Importance of Woodfuel Extraction for the Rural Economy. Given the fragility of the agro-pastoral production system in the wake of the drought, commercial firewood and charcoal exploitation is a source of appreciable revenue for the localities situated near cities and major roads which are heavily trafficked. Rural surveys conducted within the framework of this

study show that the monthly income of an independent forester can be in the range of 6,000 to 8,000 CFAF. This indicates the importance of this activity in relation to other rural activities: it is not likely to replace agricultural work, the subsistence activity of peasants which occasionally even produces a minimal cash surplus, but it allows the peasant to double his monthly income and as such is completely indispensable.

8. Trees are "bonus" items for the peasants, who exploits it as an investor, not a professional forester, even though in the areas near cities, cutting wood can bring in profits up to four times greater than the wages to be earned as an agricultural day laborer. When the peasant intensifies his production, it is in fact often difficult for him to move his merchandize, since there are no established transport and marketing networks. In areas where wood is abundant, transporters are better off taking advantage of spot opportunities rather than establishing ongoing links with a production zone.

9. There is another dimension to forest exploitation: the dynamic element in rural migration. In the same way that the informal sector in the city is the place of entry for recent arrivals into the productive system and allows them to establish themselves and bring their families, forest exploitation serves as a small first step for a number of emigrants towards the south. The tentative initial step -- seasonal exploitation-- becomes more permanent as the producer moves to "wood villages" where, within an informal but permanent land rights situation, they and their families farm the land and exploit the forested areas.

10. Contrary to what one might think, the arrival of these newcomers is always viewed very positively by the indigenous population 2/ who benefit from the new labor provided by these arrivals and who often find ways of generating additional second income from the newcomers' forest exploitation activities (renting carts, for example). Rural areas are generally at a disadvantage due to the low population density (less than 30 inhabitants per km^2 in the most populated areas -- see Annex 2). Immigration to the cities deprives villages of young men and leaves some village on the verge of disappearance.

11. The possible gains for the urban population due to forest exploitation now gives incentive to a more systematic exploitation of the forest resources. This is the case for charcoal in Bamako, where manufacture has passed to professionals and is concentrated in the hands of a few commercial specialists who control the all of the supply chains from production to marketing in the city; these professionals have already been identified as strategy participants by the forest authority. Although firewood exploitation is extremely dispersed, the use of chainsaws by urban companies in certain zones is also a sign of professionalization and emerging systematization.

12. Sociological Characteristics of Woodfuel Extraction. In a number of areas, the women participate at all levels of firewood production and marketing; they themselves sometimes organize networks, hiring laborers to cut, carts for transport and going to sell the wood in secondary villages or under arrangements with retailers. Within the family production strategy, it is best to relieve women of their agricultural work so that they may devote themselves full-time, even during

---

2/ As is the case of the Guinean charcoal producers in Senegal.

agricultural season, to forestry activities. This relatively active participation by women helps situate forest exploitation into an intermediate position for the peasant: it is a sufficiently important as a secondary activity that it is worth releasing part of the agricultural labor to conduct it, but it is not yet an entire job unto itself.

13. In other areas, where production is intensifying, men have taken up commercial firewood exploitation -- especially the cutting and conditioning phase of production. Elsewhere, access to and use of mechanical means of transportation (bicycles, carts, trucks) is dominated by men, as is wholesale marketing of firewood and charcoal.

Production and Marketing

14. Sector Overview. Although the only important survey of the commercial firewood and charcoal sector way conducted more than 10 years ago (1978) 3/ information collected during in-field investigations and the results of some previous (recent) studies given an overview of the main sector characteristics. A first observation is that in general terms, the sector functions marvelously: with rather rudimentary means and minimum investments and financing, the system serves nearly 1.5 million consumers, delivering the daily fuel requirements practically to the door at a reasonable price which has not varied for years.

15. The second observation notes the economic importance of the production and marketing sectors for firewood and charcoal: the annual turnover is estimated at about 10 billion CFAF (see table 3.3). This figures is less than half the net-of-tax figures for the petroleum sector and about equivalent to EDM's total figures for all customers. For residential energy, it is the highest figure. By comparison, the residential sector represents a net-of-tax annual turnover of between 3 and 4 billion CFAF for the petroleum sector, and between 4 and 5 billion CFAF for EDM.

Table 3.3: TURNOVER OF THE WOOD AND CHARCOAL SECTOR

	Wood 1000 tons/year	Wood Millions CFAF/year	Charcoal 1000 tons/year	Charcoal Millions CFAF/year	Total Millions CFAF/year
Bamako	195	3600	23	1600	5200
Household consumption in Bamako	186	6700	21	2800	9500
Medium-sized cities	181	1700	21	1100	2800
Small cities	246	1600	11	300	1900
Total	622	6900	55	3000	9900

Source: ESMAP surveys, 1989

3/ A market study for forestry productions was conducted in 1990 under the Second Forestry Project; the results were to be used in the formulation of the household energy strategy. However, because of data analysis problems, definitive results from this study were not available when this report was under preparation.

16. This figure is compared immediately to other statistics issued by the forestry sector: the revenues of the Forestry Management and Production Operation (Opération Aménagement et Production Forestière - OAPF) for example, which amounted to 50 million CFAF in 1987 for firewood alone, equivalent to 1% of the sector activity in Bamako. Also to be compared is the product of forestry taxes which are applicable to the sector: just under 100 million CFAF, or about 0.6% of the total revenues of the sector. If the public authorities successfully applied the same tax rate to wood and charcoal that it applies to kerosene (see discussion below), approximately 5 billion CFAF would be generated for the National Forestry Fund.

17. Production Methods. Wood fuel production is organized around the principal road axes serving the main cities and consists of both village and specialized producers. Village producers run independent, subsistence level operations to supplement their family budgets. Average productivity for these operators is one cartload per man per day over a maximum radius of 10 km. They normally work 7 hours per day during non-agricultural seasons according to their own weekly rhythm. The specialized producers generally are from outside the village. They have contractual arrangements with the cart owners, who they pay either in cash (7500 CFAF per month in Koutiala, for example) of in kind. Other specialized woodcutters are recruted by large companies (for example SONATAM near Bamako) which use wood for fuel. Organized in two man crews, they work 10 hours per day and can cut up to 10 tons in less than a week. Along the supply routes for Bamako, wholesalers generally recruit workers organized in two to five man crews who are paid about 10,000 CFAF per 15 ton-load in a truck.

18. Forestry exploitation, whether undertaken by outsiders or the villagers themselves, is left entirely to the initiative of the producers, who cut according to their means and their immediate interests. Trees are mutilated and damaged because of the rudimentary tools which are often used, and because of excessive trimming or improper cutting which does not allow for regrowth. High trunks to weak to exploit are abandoned and easily accessible areas are overexploited, although in other areas large reserves of dead wood remain unused.

19. Woodfuel Transport. The supply sector for firewood and charcoal has become increasingly diversified, rural and more formal. In the past, only urban dwellers were interested in marketing woodfuels; they would go into forested areas themselves to exploit wood or would hire cutters to fill their carts and trucks. New supply networks and organizational structures have appeared as rural dwellers recognize wood exploitation as a remunerative activity open to them also. Here and there, associations of rural wood exploiters are established, and village entrepreneurs monopolize the rural market. In numerous cases, women are key participants in production and form associations to exploit and sell the wood.

20. Several modes of transport are used to bring woodfuels to the cities. In locations where wood is available at a short distance from the consuming center (less than 20 to 30 km in general), carts are the pre[illegible]inant mode of transport: these areas include Faïra, Fanzana, Bougou or Doukoloma for suppl[illegible] Ségou, and Koba for supply to Koutiala -- all classified forests. However in other metropol[illegible] areas such as Bamako or the northern cities, carts are rarely used: wood transported by cart into the capital represents only 2% of total consumption. The percentage of wood supplied using various modes of transport presented in Table 3.4 should be viewed as purely representative, since the figures are based on data gathered by the forestry check stations

at city entrances; this data is far from exhaustive and has a tendency to underestimate informal modes of transport.

Table 3.4: MODES OF TRANSPORT FOR WOOD AND CHARCOAL IN PERCENT

	Bamako 1989	Kayes 1988	Sikasso 1985	Koutiala 1985	Bougouni 1985
Wood					
Freight trucks	83		32	21	3
Covered open bed trucks	9		21	7	5
Other vehicles	0		7	3	2
Subtotal	92	54	60	31	10
Train	6	6	0	0	0
Canoe	0	6	0	0	0
Subtotal	6	12	0	0	0
Carts	2	28	32	64	69
Small transport	0	5	8	5	21
Subtotal	2	33	40	69	90
Charcoal					
Freight trucks	74	0	0	0	0
Covered open bed trucks	25	0	9	0	0
Other vehicles	0	0	6	1	3
Subtotal	99	0	15	1	3
Train	1	6	0	0	0
Canoe	0	4	0	0	0
Subtotal	1	10	0	0	0
Carts	0	42	6	92	14
Small transport	0	49	79	7	83
Subtotal	0	91	85	99	97

Source: DNEF, UNSO, OARS.

21. Motorized transport is the major means of supply to the capital and the northern cities. Small covered open bed trucks and larger freight trucks are sent on ever longer distances in search of wood; Bamako is now supplied by large trucks or tractor trailers which bring wood from over 150 km by way of the Bamako-Ségou route. These trucks often load wood during a return trip, thus keeping their costs low. In addition, the costs of transporting charcoal by these means (informal transport) are very competitive and up to 30% lower than the costs of a "formal" modern transport company dedicated to charcoal transport (see Table 3.5). Some have cutting crews and occasionally modern equipment. Chainsaws are now used in rural Mali for general felling of timber. However in general terms, there are still no real large private entrepreneurs who specialize in forestry exploitation. Most entrepreneurs have come into the trade as a result of having occasionally marketed wood to fill empty trucks returning to the city, and now operate rather precarious operations of their own with aging equipment and little organization.

Table 3.5: COST PRICE FOR MOTORIZED TRANSPORT

Sector	PAVED Modern	PAVED Informal	PAVED Informal /Modern	UNPAVED Modern	UNPAVED Informal	UNPAVED Informal /modern
Transport:						
Covered open bed	160	134	84%			
Medium-load trucks	490	338	69%			
Large-load trucks	512	353	69%	707	465	66%
Tractor trailer	830	566	68%	1054	704	67%

Source: Transenerg, 1984

22. There are also other means of transport: canoes (pirogues) are still an important means of supply to Mopti, but no longer to Bamako; rail transport has taken on importance for supplying Kayes and the capital 4/ from the forests in the western part of the country. Rail transport is used mainly by women, who use it rather effectively to market wood and other products both locally and internationally (between Sénégal and Mali).

23. Production and Transport of Charcoal. Charcoal is produced in earthen kilns by traditional charcoal makers and occasionally by cast-iron craftsmen (although their numbers are decreasing; demand has provided incentives for more unaffiliated craftsmen to take up charcoal making). These rudimentary kilns have an efficiency of between 10% and 15%. Two types of charcoal producers are found in the supply chain: the small village charcoal maker and the professional charcoal producer. The first uses small kilns, usually located beside his or her home, which produce two or three bags of charcoal. The quantities of wood exploited for this operation are limited and do not infringe on resource productivity. These part-time charcoal makers are seeking additional income; many are women. Bags of charcoal (35 kg on average) are sold to distributors for about 250 CFAF (1989 data) and resold on the urban market for 750 CFAF. The professional charcoal producer is more specialized and well-integrated into the supply chain; they are mostly men. These producers are representative of the new type of rural entrepreneur who undertakes secondary business activities during non-agricultural seasons. A true lumberman, the professional uses only the species which produce the best charcoal -- the Burkea Africana (siri) the Prosopis Africana (guélé) and the Terminalia (wolo) -- and which are also important species for ecological balance. The trees are cut and transported by mule-drawn carts to the carbonization site located in the exploitation area. Charcoal is then transported by various means, depending on the level to which the market is developed in the destination city. For cities in the interior, the producer himself transports the product on foot, by bicycle or by cart. In Bamako, where craftsmen and household consumers require large quantities, charcoal is transported by large and small trucks.

4/ The tonnage of wood transported by rail to the capital quintupled between 1985 and 1988, yet represents only 6% of the 1988 total.

24. Urban Marketing and Distribution. The urban marketing system for wood is relatively diversified: it comprises wholesalers, who sometimes have means to transport wood and can store large quantities; distributors; and an extended network of neighborhood retailers. Retailer are sometimes even occasional workers, saving money to make a certain purchase. The conveyance from transporter to urban merchant can also take various forms: it is not rare for a large truck to spend several days in the capital to pass its production along to small retailers. The charcoal market in Bamako is more structured, with ten larger distributors who control most of the supply (originating mostly from the Banamba area) and who often sell by the bag to large consumers. There are also many small retailers who sell charcoal in small bundles.

Woodfuel Price Structure

25. Current Levels and Past Trends. The retail price for woodfuels varies widely from one city to another, as summarized in Table 3.6 below (also see TAble 11 in Annex 5). The lowest average prices were found in Koutiala, where wood sells for 6 CFAF/kg and charcoal for 40 CFAF/kg. The highest prices are in Gao, where the two fuels sell for 19 CFAF/kg and 76 CFAF/kg, respectively. Fuel prices in the capital approach those in Gao -- 19 CFAF/kg for wood and 66 CFAF/kg for charcoal -- and are comparable to prices recorded in other Sahelian capitals. It should be noted that fuel prices vary considerably from one neighborhood to another, with differentials of 20% to 30%, and that the price of firewood varies seasonally (increases of 10% to 20% in the winter).

Table 3.6: Firewood and Charcoal Prices

	Bamako	Segou	Koutiala	Mopti	Gao
Average Price (CFAF/kg)					
Firewood	18,5	12,1	5,7	12,7	19,0
Charcoal	66,3	49,7	49,7	53,1	76,9
Firewood					
Minimum price (CFAF/kg)	16,0	9,3	5,0	11,8	16,7
Maximum price (CFAF/kg)	29,1	13,7	7,5	15,2	21,0
Charcoal					
Minimum price (CFAF/kg)	47,8	36,3	25,4	44,0	66,7
Maximum price (CFAF/kg)	83,3	62,5	62,5	64,5	80,0

Note: 4200 total observations in the five cites (June 1989 in Bamako and August 1989 in the other cities).

Source: ESMAP Surveys, 1989

26. The past trends of firewood and charcoal prices are difficult to estimate, since data on woodfuel prices is scarce and unreliable. It is probable that, after a period of stagnation, fuel prices jumped in 1984 when Mali converted to CFAF currency, as was the case for numerous Malian products. The price has decreased gradually in real terms and now lies at levels comparable to or even less than those at the beginning of the 1980s. The contradiction between stagnating or decreasing prices and increasing scarcity of wood resources has been noted in many Sahelian countries. Several factor explain this phenomenon: the increased competition between producers and a decrease in the opportunity cost of peasant labor; and the significant decrease in the real price of petroleum products. The ratio between the price per kilogram of charcoal and that of wood has nonetheless remained fairly stable, between 3:1 and 4:1.

27. Price Structure. Given the complexity of the woodfuel network and the numerous transactions which take place before the fuel reaches the retail market, it is often difficult to make a detailed analysis of the price structure for wood and charcoal. The producer's component can vary between 30% and 60% of retail price, depending on the distance between the production zone and the urban center. Round wood delivered to roadside was selling in 1988 for 13 to 14 CFAF/kg at a distance of 30 km from Bamako and at 6 CFAF/kg 60 km from the capital (along roadways to Ségou). Distance is not the only parameter affecting producer price, however. The availability and mode of transportation, accessibility of the production zone (paved or unpaved roads), condition of the resource (quantity and density), proximity of the resource to the roadside also are determinants in the price, especially since woodfuel transport often is a secondary activity for most transporters.

28. Similarly, the margin between the transporter and the urban distributer varies according to the participants and the type of transaction (bulk, semi-bulk or retail). Available figures suggest margins of about 30% to 50% for urban wholesalers, with the transporter taking between 10% and 30% of the retail price. Margins and profits for transporters and wholesalers are high, but not unusually so: when a resource is scarce, the owner of capital (available cash, truck) will make a profit when the price is high and thus has a large margin for negotiation vis-a-vis the producer. It should be noted that these transporters and marketers provide the best service at the best price -- and attempts by the public sector in Mali to administer woodfuel marketing proves this point. Retail sales of wood and charcoal generate large margins but small absolute income for the retailers: the average retailer earns only several thousand CFAF per week.

29. Thus it is primarily the conditions for transporting woodfuels, especially the distance from the consumption center, which determine the price of standing wood (which is equal to the producer price minus his actual compensation). According to the estimates in Table 3.7, the price of standing wood ranges between 3 and 10 CFAF/kg around the capital, depending on the location from which the wood originates, equivalent to 20% to 50% of the retail price of firewood and 5% to 15% of the retail price of a bag of charcoal in Bamako. It is interesting to compare this price to the cost of planted wood, estimated at 11 to 14 CFAF/kg (without taking into account the fixed cost of the land). Given the present stagnation of woodfuel prices, it is not profitable to plant trees for fuel production, even in peri-urban zones.

Table 3.7: Price of Standing Wood Near Bamako

Wood	Data collected from road side			
Producer price (CFAF/kg)	5.0	7.5	10.0	12.5
Price of standing wood (CFAF/kg)	3.5	5.0	7.5	10.0
Charcoal				
Producer price (CFAF/kg)	20.0	30.0	40.0	50.0
Price of standing wood (CFAF/kg)	2.3	4.0	5.8	7.5

ASSUMPTIONS

Production rate - forest exploiter:	200 kg/day
Production rate - charcoal producer:	70 kg/day
Carbonization efficiency:	12%
Daily labor cost:	500 CFAF/day

Supply Side Strategies for Woodfuels

Tree Plantations and Forest Management

30. Various types of tree plantation projects -- dry and irrigated, large-scale industrial and small landholders -- have been attempted in Mali. Two major non-irrigated industrial plantations projects, designed to supply Bamako and Sikasso, accounted for three-quarters of forest investments under the last five-year plan: the OAPF of the Second Forestry Project, financed by AID (3400 hectares planted, 600 additional ha planted each year) and the Sikasso Management and Reforestation Operations (SMRO). Other activities have been attempted on a more modest scale: for example, attempts to use surrounding growths abandoned by the Office du Niger as industrial tree plantations, as well as village reforestation programs in various locations.

31. These projects have met with disappointment, both in terms of economic viability and participation levels by local populations. Tree plantations, whether they are irrigated or not, industrial or peasant, are very costly. The most expensive option is, without doubt, non-irrigated industrial plantations, with costs per hectare of about 13 CFAF/kg. Rural-based operations do not really cost much less; the costs are simply distributed differently, and the local smallholder is required to contribute in terms of land and labor. Still, the land and labor of the Malian peasant each has an opportunity cost: when a tree plantation is established on agricultural land, the cost of standing wood is about 11 CFAF/kg. Given current market prices, it is more profitable for the peasant to cultivate the land or even to let it lie fallow. Thus it would be advantageous to modify strategies to reflect an agro-forestry orientation, and various programs of this type, such as the Office du Niger program, have been introduced.

32. With the exception of projects to identify and protect classified forests (fire breaks, etc.), few management programs have targeted the natural forests. The costs of managed forests, while not insignificant, are still less than the costs of tree plantations. Thus it is somewhat surprising that this strategy has been attempted so rarely -- especially since some forested zones are

not exploited at all, while others are plundered in a chaotic manner. Land management is a means of preserving and enriching the forest at more reasonable costs than plantations: the cost of standing wood in managed forest if 4 CFAF/kg, or three times less than the cost of planted wood. Forests could be identified for management using the major inventory conducted by the PIRL, which has developed detailed forestry maps for the Koulikoro, Ségou, Sikasso and (soon) Kayes regions, as well as in other (non-desert) parts of the country.

33. The Second Forestry Project includes a component for managing classified forests located along rail lines, especially the Mont Mandingues forests. In order to obtain more information on classified forests, socio-economic studies and aerial photographic missions were conducted in 1990. The results of these studies were used to define preliminary forest management plans which have been used to implement pilot managed sites, where management mechanisms and strategies can be tested.

34. One project deserves special notice, given that it exemplifies the evolution of the forest sector towards new approaches: the Forestry Management and Village Reforestation Project for Koulikoro. This project will employ simplified land management and village supervision of local natural resources to implement systems for firewood production. Thus revenue generation for the local population is preserved, while simultaneously protecting the forest capital and its reproduction potential. After an initial stage during which the land affected by the project was delineated, the project entered its operational phase in 1990.

Forestry Regulation and Control

35. Regulation and control of Mali's forests constitutes a large part of NWFD activities and affects both rural communities and wood professionals. Forestry texts are based almost exclusively on protection of forested areas -- protection of classified forests, protection against forest fires, protection against excessive exploitation -- with the NWFD acting as a specialized police force. Revenues from collecting taxes and fines constitutes more than half of NWFD's financial resources. Fines levied against 3000 offenses charged in 1987 brought 160 million CFAF to the National Forestry Fund, a sum equivalent to revenues from forest tax collection. However, these fines did not have the full effect intended: prohibitions against exploitation generated revenues for the Forest Fund (2200 charges between 1986 and 1987), but had no effect on constraining illegal commercial exploitation.

36. The jurisdiction of the Government and the local rural populations with regard to possession and management of lands and forests has long been ambiguous. Use of poor forestry methods by the forest agents themselves has encouraged poor management and exploitation methods on the part of the locals: increasing use of brush fires for clearing land, a main culprit in the degradation of the forest cover (1500 cases recorded in 1987), is evidence of the ignorance of both locals and forestry agents with regard to proper forest management.

37. A permit must be obtained and a fee paid by those who exploit the forest for wood production and who produce charcoal. In 1987, 25,600 cutting permits and 8,600 carbonization permits were granted, giving the State control over only a fraction of the true woodfuel market: 122,000 tons of wood and 5,200 tons of charcoal, equivalent respectively to 12% and 5% of Mali's

urban consumption for the fuels. In order to strengthen control of woodfuels entering the capital, the Forestry has established six check stations along the principal roadways entering Bamako (see Annex 11). These check stations have lead to only a marginal improvement in control of woodfuel influxes: in 1989, quantities recorded in Bamako represented only 20% of the actual entries for wood and 10% of those for charcoal.

Woodfuel Tax Policy

38. Woodfuel taxes amount to 200 CFAF per stere of wood and 250 CFAF per 100 kg of charcoal (0.7 CFAF/kg and 2.5 CFAF/kg, respectively). These levies are constant and do not take into account the real value of wood in different production areas. As shown in Table 3.8, wood taxes represent from 5% to 20% of the value of standing wood, depending on the area; similarly, 4% to 12% of the retail price of wood and charcoal is attributable to taxes. The uniform tax leads to the following unfavorable conditions: (i) woodfuels produced in areas close to consumption centers, that is in areas where ecological risk is the greatest, have a lower relative tax; (ii) producers who supply Gao are taxed less (in relative terms) than those who supply Koutiala -- although the distance between production zone and consumption center is the same in both cases. In summary, the more scarce the resource, the lower the relative tax rate for its exploitation.

Table 3.8: Woodfuel Taxes

A. WOOD

Relative to retail price	Bamako		Segou	Koutiala
Retail Price (CFAF/kg)	18.5		12.1	5.7
% tax	4		6	12
Relative to producer price and price of standing wood				
Producer Price (CFAF/kg)	5.0	7.5	10.0	12.5
% tax	14	9	7	6
Price of Standing Wood (CFAF.kg)	3.5	5.0	7.5	10.0
% tax	20	14	9	7

B. CHARCOAL

Relative to retail price	Bamako	Segou	Koutiala	
Retail price	66.3	49.7	40.6	
% tax	4	5	6	
Relative to producer price and price of standing wood				
Producer Price (CFAF/kg)	20.0	30.0	40.0	50.0
% tax	13	8	6	5
Price of Standing Wood (CFAF.kg)	2.3	4.0	5.8	7.5
% tax	13	8	5	4

ASSUMPTIONS:

Wood Tax:	0.7 CFAF/kg
Charcoal Tax:	2.5 CFAF/kg
Carbonization efficiency:	12%

39. The tax often is paid as a lump sum, determined by the mode and frequency of transport and estimated transport expenses. It is often the transporters who obtain the exploitation permit, thereby carrying the expenses of the rural producer who supplies him. There are two consequences to this arrangement. On the one hand, the transporter armed with this permit could search for fuel wherever he pleases, without being monitored by the foresters. On the other hand, the permit gives the transporter a certain measure of authority and control vis-a-vis the rural producer: he has the authorization under State seal to legally cut wood, yet ultimately the peasant pays indirectly by forgoing part of his profit. Neither transformation to charcoal, nor transport nor marketing are required to pay this tax.

Limitations of Forestry Policy

40. The authority and regulations of the Forestry Service were defined to meet conditions of forest exploitation for woodfuel production which have since evolved: woodfuel production is no longer primarily a modest, small-scale operation undertaken by local craftsmen. The Forestry Service is ill-equipped and its authority poorly adapted to current conditions. Now that commercial exploitation has become relatively widespread throughout Mali, the NWFD no longer is able to manage adequately its 10 million ha of forests and protect them from illegal outside incursions -- despite the fact the NWFD is one of the oldest and best structured forestry services in West Africa. By continuing to claim the contrary, the service merely discourages efforts by others, collectives or individual organizations, who could more effectively take over some of its operations.

41. Prohibiting access to classified forests for woodfuel production would be tantamount to, in the absence of means to enforce such a prohibition, an invitation for clandestine, uncontrolled and destructive offtake. It would also deprive public coffers of the revenue which could be generated by better organized exploitation of forest resources.

42. By centralizing the system of granting permits for and taxing forest exploitation, a measure of control is exerted over an informal, fragmented sector which tends to naturally slip through regulatory cracks. The affect would also be to deprive the rural population of one of the few means at its disposal to raise production prices charged to transporters and wholesalers. Finally, due to the enormity of the task, effort would be frittered away on local territorial control issues instead of the more global and important issues of rational supply.

43. Based on these considerations, the NWFD currently is redefining its approach to commercial exploitation. It is elaborating mechanisms for the gradual transfer of responsibility for managing protected forests to local collectives. New regulatory arrangements and mechanisms for decentralized tax collection also are being developed. Finally, the NWFD plans to emphasize cooperative management of classified forests in partnership with the local inhabitants. The forestry strategy of this report is based on these modified approaches.

Petroleum Product Supply

General Aspects

44. Having declined markedly in the first half of the decade, the market for petroleum products underwent a recovery during the end of the 1980s, as shown in Table 3.9. The total market now stands at more than 170,000 tons. Imports of the two residential fuels, LPG and kerosene, totalled 536 and 13,150 tons respectively in 1987, representing less than 10% of Mali's total consumption of petroleum products.

Table 3.9: Consumption of Petroleum Products
(tons)

	1980	1981	1982	1983	1984	1985	1986	1987
All Products	167712	146539	136619	137114	147090	166796	166044	171100
LPG	199	238	231	219	240	266	422	536
Kerosene	12586	12285	12013	12181	12836	13020	13387	13150

Source: GPP, 1988

45. Mali is an enclosed country with no petroleum resources of its own, and thus must depend on the ports and access routes of its neighbors for its petroleum product supply. Traditionally, 90% of petroleum products are supplied from two sources: via rail from the SAR refinery in Dakar (Senegal) and by road from the SIR refinery in Abidjan (Côte d'Ivoire). Supply is assured by the four petroleum distribution companies operating in Mali, which are subsidiaries of BP, Mobil, Shell and Total. All four hold roughly equivalent shares in the two refineries, for a combined total of 47% in SAR and 38% in SIR. Since 1984, however, independent operators have been allowed to import and market petroleum products. The independents market primarily automobile fuels and hold 40% of the gasoline market and 26% of the gas oil market.

Liquified Petroleum Gas (LPG)

46. LPG sales were relatively stagnant at about 240 tons for several years, with consumption limited to a few residential users. 5/ LPG sales have grown considerably since 1985, tripling in the past four years due to the introduction of small cookstoves using "popular gas". In 1986, one year after introduction, sales of popular gas already represented 25% of total gas sales. By 1988, 45% of gas sales went to fuel the portable Déméba and Guatéli stoves.

47. LPG is distributed by three of the four large distribution companies: Shell, the main

5/ Mostly ex-patriots who used gas cookstoves fueled by 12.5 kg canisters.

47. LPG is distributed by three of the four large distribution companies: Shell, the main operator, distributes canisters sized in quantities of 2.7 kg. (popular gas), 12.5 kg (classic residential gas) and 30 kg (hotels, restaurants and small industry). Total-Texaco distributes 6 kg canisters (popular gas) and Mobil, which has recharge stations shared with Shell, distributes 12.5 kg and 38 kg canisters.

48. Shell and Total-Texaco import LPG from the Abidjan refinery. The two companies have their own storage and filling stations in Mali. Total-Texaco's facilities at Bamako have a storage capacity of 30 tons and Shell
has 62.5 tons capacity in Bamako and 25 tons capacity at Mopti. Shell's market position should be strengthened by implementation of a new filling center Mopti 6/ in association with Mobil.

49. The 12.5 kg and 2.7 kg canisters sold by Shell in 1990 cost 5600 and 880 CFAF, respectively. Total-Texaco's 6 kg canisters sell for 4000 CFAF, with recharge costs of 2200 CFAF. Investments for popular gas enjoy a five-year total exemption from taxes; after five years, the applicable tax structure is regressive (advantageous clauses of the tax code applied to filling centers). The price of LPG is 320 CFAF/kg for popular gas in 2.7 kg canisters (366 CFAF/kg in 6 kg canisters), versus 448 CFAF/kg for gas sold in 12.5 kg canisters.

50. The 1988 price structure for popular gas is presented in Table 3.10. (See also Table 10b in Annex 2). The CIF ex-refinery purchase price for LPG (at the SIR refinery) is 140,000 CFAF/ton, equivalent to US$500/ton in 1988. This is double the international market price. Since then, the purchase price has been renegotiated to 110,000 CFAF, or US$330/ton, which still is above international levels. Other potential supply sources have been explored by the distribution companies, such as supply from Ghana, where the purchase price would be US$250/ton. Under this supply option, the economic cost would be about 275 CFAF/kg and would decrease even further with planned development of the LPG market (diversification scenario described in Annex 6), to reach a level of 250 CFAF/kg.

6/ With capacity to charge 1300 - 3 kg canisters per 8 hour cycle, to be added to existing capacity of 1600 - 3 kg canister and 1400 - 12.5 kg canisters in Bamako.

Table 3.10: 1988 Price Structure for LPG and Kerosene

	LPG (CFAF/ton)				Kerosene (CFAF/hl)	
	Ex-Abidjan		Ex-Dakar		Ex-Abidjan	
Ex-Port	148700	41%	7863	39%	7359	37%
International transport	33534	9%	2359	12%	3392	17%
Services	180749	50%	2529	13%	2509	13%
Taxes		0%	7249	36%	6741	34%
Total	362983	100%	20000	100%	20000	100%

Source: OSRP, Total-Texaco, 1988

Kerosene

51. Kerosene also is imported by the large petroleum distribution companies from Abidjan and, to a lesser extent, from Dakar. Kerosene sales have grown very slowly but consistently at a rate of 1.8% since 1982: this rate parallels the growth rate for urban and rural populations not connected to the grid. Sector operators agree that sales are note likely to increase by more than 1% annually in coming years as long as kerosene is only used for lighting and other auxiliary uses (such as combustion fuel for cooking fires).

52. Kerosene sells at the pump for 200 CFAF/liter in Bamako and for 205 to 210 CFAF/liter in other cities. There also is a small neighborhood distribution system, which generally charges a reasonable margin of between 15 and 20 CFAF/liter. In Gao, kerosene shortages have lead to the use of "diesel lamps", kerosene lamps operated with gas oil, which is often imported clandestinely from Algeria.

53. The relative price of kerosene peaked in 1982 and has decreased steadily since then. Its share in the household budget currently is 1.5 times less than in 1979 and 2.5 times less than in 1982. Still, kerosene sells for well above its economic cost, for two main reasons. The first concerns the supply source chosen by Mali's petroleum product marketers: the ex-refinery prices at Abidjan and Dakar are twice the comparable CIF prices in the same ports: 39 CFAF/liter in 19878, versus 74 and 78 CFAF/liter respectively at the two refineries. Although prices were lowered drastically in April 1989 (50% reduction in the ex-depot price), they remain between US$20/ton (Abidjan) and US$40/ton (Dakar) above comparable international prices.

54. The second reason concerns the high fiscal surcharge placed on the product by the Malian Government. The average surcharge was 35% of retail price in 1988 and currently varies between 45% and 55% since the latest decreases in the acquisition prices. In fact, official taxes only represent about 5% of the retail price (slightly more than 10 CFAF/liter), but the Office of Stabilization (OSRP) collects a surcharge of between 40 and 50% depending on the supply source, nearly 100 CFAF/liter. Clearly if a liter of kerosene were purchased at the prevailing international market price and then sold to the public without surcharges, it would cost about 90 CFAF instead of the current 200 CFAF.

55. The fiscal surcharges on residential kerosene represents a considerable burden to the consumer, but little benefit to the Government. Only 1 billion CFAF were collected from this source in 1988, of which 75% was attributable to stabilization surcharges. Certainly this is not a non-negligible sum, as it represents about 7% of public revenues from the petroleum sector. However, when considering the possibility of abandoning fiscal surcharges, potential substitution effects should also be taken into account: diesel might be substituted by kerosene in certain sectors (industry, transportation) if the price of the kerosene becomes substantially less than the price of diesel.

Electricity Supply

General Aspects

56. For Energie de Mali (EDM), the problems associated with household demand for electricity -- which currently represent just over a third of total power sales -- are general operating and management problems: reliability of service, equipment and network maintenance, recovering customer delinquencies, maintaining financial balances, etc.

57. Household demand is not a determining factor in the utility's peak demand. Energy-intensive electric household appliances such as hot water heaters, air conditioners or electric cookstoves are used by only a fraction of households, and thus the peak period for household consumption (between 7 p.m and 11 p.m.) corresponds to a relatively limited power demand. In fact, the maximum system demand for the interconnected grid is actually in the warm season (in April, for example) during business hours -- between 9 a.m and 4 p.m.

58. A key problem in the development of electricity use in the residential sector is the difficulty of mobilizing the investments needed to expand generating and distribution facilities operated by the EDM. During the period 1985 to 1989, EDM invested 22 billion CFAF (more than US$70 million) and has projected investments levels for 1990-1994 of 83 billion CFAF (US$270 million, of which US$43 million is slated for expanding the distribution network). Thus the power utility itself will absorb 10% of public sector expenditures during that period.

59. Part of the planned investments will go towards renovating and restructuring Bamako's distribution system (totalling 600 km of lines, 400 of them low voltage), which has become obsolete and no longer is capable of meeting demand. Other investments will expand electrification to new neighborhoods (although the new connection rate does not keep pace with the population growth rate). Nine neighborhoods were targeted for electrification under the First Power and Water Project, and EDM plans to electrify an additional 12 neighborhoods on the right bank of the river, a project which will require laying nearly 120 km of new low voltage lines between 1990 and 1997. The costs of the distribution network are about 7 million CFAF/km (totalling nearly 1 billion CFAF); per customer costs are about 200,000 CFAF in areas which are more accessible and have a higher concentration of potential customers, and 1,200,000 CFAF in other areas (the average cost per customer is 450,000 CFAF).

Access to Electric Power

60. For current consumers, their are two main issues: the quality of service and the cost of power. The issues for those not connected to the grid come down to the mere opportunity to be connected (neighborhood served by the distribution system) and an affordable fee charged for that connection. Future investments for power generation and distribution should improve considerably the quality of electric service, which is still deficient despite the progress made, especially in the cities of the interior.

61. Current average costs per kWh are just over 60 CFAF. EDM has two residential tariffs: a uniform small-consumer tariff (single phase, 3 to 5 amperes) fixed at 59 CFAF/kWh including tax, and a regressive differential tariff (triple phase) corresponding to three consumption levels: 77, 69 and 50 CFAF. The social tariff applies to a substantial fraction of consumers: two-thirds of the consumers in Bamako, Ségou or Gao and more than 80% in other cities (Kayes, Mopti and Tombouctou).

62. Taking into account the subscribed power charge for each type of residential consumer (about 100 CFAF for the single phase tariff and 1000 CFAF for the triple phase tariff), lighting costs alone amount to more than 1500 CFAF per month, the average bill for EDM mini-consumers (based on 3 lighting sources with combined power of 200 W, used 5 hours per day). This figure is similar to lighting costs for kerosene users in households not connected to the grid: about 50 CFAF per day, totalling 1500 CFAF/month. 7/ Although the price differential is insignificant, electric lighting provides a clearly superior illumination with a greater degree of ease and comfort for the consumer: the cost of an hour of illumination is slightly more expensive for the electricity option, but the illumination provided is 30 times better in terms of luminosity).

63. There are two main constraints to developing use of electric power in households. The first concerns the limited rate at which urban networks are developed: many medium- to upper-income households who might otherwise prefer connection to the grid do not have this possibility as an option because their neighborhoods are poorly served by the network (or not at all). In Bamako, for example, the connection rate per neighborhood varies from 2% to 70%. Furthermore, in neighborhoods served by the power distribution network, constraints are found at a second level: prohibitive connection costs. Installation of a meter costs approximately 70,000 CFAF for single phase customers, if the line is already within close proximity to the residence. If a pole must be erected to bring the line up to the residence, costs rise to more than 150,000 CFAF. These costs exclude a large number of potential clients from receiving electric service. In addition, the high connection costs provide an incentive for customers to resell the power or install bootleg connections; the level of this type of activity could not be ascertained by household surveys.

7/ These expenses can amount to 4000 to 5000 CFAF per month in more affluent ares, such as the rural development area in Markala (according to a NHED survey).

Pre-electrification: an Intermediate Solution

64. For households not connected to the grid, the main alternative has been to use kerosene for lighting: use of kerosene lamps is widespread in rural areas, among urban households without electricity and even as emergency equipment in households connected to the grid. The other household appliances in use (radio, flashlights) are battery operated; otherwise, these households generally go without the amenities associated with electricity. More recently, new types of non-electric appliances have been put into circulation in Mali: televisions operating on direct current from automotive batteries (4000 to 5000 sets in use in Bamako); portable or stationary lamps (more powerful than kerosene lamps or flashlights) fueled by gas, regular batteries, or rechargeable batteries using normal current or photovoltaic panels (with recharging services offered by neighborhood merchants).

65. Equipment of this type, representing the new "pre-electrification" (access to amenities associated with electric service before the actual connection to the grid) generation, are already sold by Malian merchants. The direct current television sets have developed a relatively strong market, but the new lighting options are still not well known to the public. Different lighting models (see Annex 6) were tested for this study and compared with more traditional modes of lighting (regular electric lamps, kerosene lamps or candles) and presented in demonstrations to consumer groups.

66. The main characteristics of these new lighting options are summarized in Table 3.11. Analysis of the cost and performance efficiency of these options lead to a seeming obvious initial conclusion: the best, most economic lighting option is regular electric lighting. Still, access to the grid must be provided to the consumer under acceptable financial conditions. Lighting options using disposable batteries were prohibitively expensive; they are not likely to be put into continuous use. The same cannot be said for the gas lamps and lamps operating on rechargeable batteries. The lighting provided by these two options was far superior to that provided by kerosene lamps (based on theoretic relative prices for equal lighting levels). The cost of gas lamps per lumen-hour was two times less than that of kerosene lamps; the rechargeable battery-operated lamp costs five times less. However in many cases, consumers appear content with the inferior lighting provided by kerosene lamps.

67. The terms of competition are as follows. Initial investment for a kerosene lamp is about 4000 CFAF, with operating costs of 5 CFAF per hour of lighting. By comparison, the gas lamp requires twice the investment (9000 CFAF) and operating costs 10 times higher for lighting which is 20 times better. The rechargeable lighting option requires a substantially higher initial investment: about 40,000 CFAF for the lamp and 12,000 CFAF for the least expensive solar panels) with operating costs 2 to 3 times those of the kerosene lamp, to achieve an improved lighting level of 5 to 20 times. Still another option exists for certain households which have the possibility of becoming mini-demand customers of EDM: pay 80,000 to 150,000 CFAF for connection to the grid and obtain lighting which is 35 times better than the kerosene lamp for the same operating costs. These customers would have the short- to medium-term option of increasing their load by eventually using more lighting and other electric appliances, such as television sets and fans.

68. Demonstrations of the various lighting options to consumer groups in neighborhoods without electricity in Bamako, Mopti and Gao met with very positive results. The most popular

options were the rechargeable lamps. Consumers preferred electric lamps over gas lamps, portable rather than stationary lighting options, and individual recharge options rather than collective. When accompanied by appropriate credit facilities, initial investment costs were not viewed as obstacles by consumers.

Table 3.11: Main Characteristics of Lighting Options

	Power (W)	Illumination (lumens)	Illumination/ Kerosene Lamps	Hours of Operation	Investment (CFAF)	Cost per Hour of Illumination	Illumination Cost (F/klmh)
REFERENCE OPTIONS:							
Classic Light bulbs	60	730	37		2000	4	6
Candles		12	0.6	5	50	10	833
Kerosene lamps	200	20	1	12	4000	5	230
GAS LAMPS:							
Lumogaz	450	450	23	6	9000	59	132
BATTERY LAMPS							
Disposable	8	240	12	8	16000	268	1116
Rechargeable (a)	8	240	12	8	46000	7	31
STATIONARY LIGHTING							
Bank of lights and Automotive battery	18	540	27	18	27000	11	20
PHOTOVOLTAIC LIGHTING (b)							
Average lamp	3	95	5	3	35000	13	137
Large lamp	9	450	23	8	43000	20	43

OBSERVATIONS
(a) Investment costs do not include refill costs.
(b) The costs of portable photovoltaic lamps are net of taxes.

Sources: ESMAP estimates.

69. The consumer choices observed during the study reflect consumer frustration with electric service (middle class consumers, in particular). They also reflect the quality of service provided by the lamps displayed in the presentation. Due to high initial costs for the lamps, distribution may have to be limited initially to only the most well-to-do households in non-electrified urban areas and to government officials or merchants in rural areas. There is definitely a market for these lamps, just as there is for battery-operated television sets. They have an advantage as original, intermediate options, between inaccessible electricity and the makeshift nature of the kerosene lamp. The former remains a lighting source for the masses, in the same way "popular" gas is used by many for cooking (however the single-burner gas cooker does not cost 12 times the price of an improved wood stove, a comparable relation to that which exists between the pre-electrification system and the kerosene lamp).

70. This assessment is verified by data collected by the Solar Equipment Maintenance Unit (SEMU) within the NHED during a pilot program to distribute small solar lighting equipment in Bamako. Two main market segments were identified with short-term potential. The first comprises owners of television sets operated by 12V automotive batteries: switching to a 40W photovoltaic panel would allow them to operate simultaneously the television and one or several banks of lights. The second market, for portable lamps with individual panels, targets salaried employees in urban areas (government workers) or even in rural areas (teachers). The option of collective solar panels is not well received by potential customers, who value the autonomy provided by the other options. The various schemes tested for marketing these lighting options confirm that credit or leasing plans are indispensable for successful distribution of equipment.

Table 11: FUELWOOD PRICE STRUCTURES FOR SUPPLY BY TRUCK

	Bamako (1988)				Mopti (1988)		Sikasso (1985)	
	Truck hire		Return Empty		Truck hire		Truck hire	
	CFAF	%	CFAF	%	CFAF	%	CFAF	%
Felling permit (a)	0.6	4%	0.6	4%	0.6	4%	0.6	9%
Roadside price (b)	6.0	39%	6.0	39%	6.2	35%	3.1	43%
Transport cost (c)	4.5	29%	0.9	6%	3.6	20%	1.6	23%
Handling (d)	0.3	2%	0.3	2%	0.3	1%		0%
Costs	11.4	73%	7.8	50%	10.7	60%	5.3	74%
Mark-up (e)	4.1	27%	7.7	50%	7.1	40%	1.8	26%
Retail price	15.5	100%	15.5	100%	17.8	100%	7.1	100%

(a) Flat rate based on 30 steres per 10-t truck and 50 steres per tractor-trailer. Average actual quantities carried are 9.6 t and 18.8 t respectively.

(b) See Annex 7 for Bamako.

(c) Flat rate per journey for vehicle hire, estimated at 30% of official rates for transport of solid good (CFAF 25/t/km) per 100 km of "return empty" journey.

(d) Loading and unloading.

(e) Wholesale and retail mark-ups, incl. costs of wood chopping.

Sources: ESMAP estimates for Bamako and Mopti.
"Marchés urbains des produits forestiers," DNEF-CTFT and OARS for Sikasso.

Table 12: MAJOR URBAN AREA FUELWOOD SUPPLY SYSTEMS

Type of Transport	Firewood					Charcoal			
	Bamako (a)	Kayes (b)	Sikasso (c)	Koutiala (c)	Bougouni (c)	Kayes (b)	Sikasso (c)	Koutiala (c)	Bougouni (c)
Truck	64%		32%	21%	3%				
Pickup	14%		21%	7%	5%		9%		
Other (*)	3%		7%	3%	2%		6%	1%	3%
Subtotal	81%	54%	60%	31%	10%	0%	15%	1%	3%
Wagon	11%	28%	32%	64%	69%	42%	6%	92%	14%
Other (**)	0%	5%	8%	5%	21%	49%	79%	7%	83%
Subtotal	11%	33%	40%	69%	90%	90%	85%	99%	97%
Train	5%	6%				6%			
Pirogue	3%	6%				4%			

(*) Private vehicles
(**) Bicycle, moped, on head, etc.

Sources:

(a) Aug. 1987, "Propositions de mesures pour la réduction de la consommation de bois de chauffe à Bamako," DNEF, Jan. 1988.

(b) June-Aug. 1988, "Rapports d'enquêtes sur les filières d'approvisionnement en bois-énergie de la ville de Kayes," DREF/UNSO, Sep. 1988.

(c) April-May 1985, "Marchés urbains des produits forestiers," DNEF-CTFT, OARS June 1985.

Table 13: FOREST EXPLOITATION AND MANAGEMENT

	Total
Woodfuel consumption (1000t)	
Wood	718
Charcoal	65
Forest Exploitation (1000t)	
Fuelwood	718
Wood for charcoal	542
Total	1260
Areas (1000 ha)	
Areas under production	105
Total forest area	3149
Total rural land	15746
Villages involved (number)	
Each exploiting 500 ha	2033
Each producing 500t/year	2519
Management needs (1000 ha)	
State forests	100
Village forests	3049
Controlled areas for 1991-2000 (100 ha)	
State forests	100
Village forests	1500
Management areas for 1991-2000 (1000 ha)	
State forests	100
Village forests	300

ASSUMPTIONS

Standing wood: 12t/ha
Annual increment: 0.4t/ha/year
20% of village land under exploitation
500t/year: 50 producers at 10t/year
10% of forest reserves, i.e. 100,000ha under exploitation

Table 14: WOOD PRODUCTION COST

Labour efficiency (person-day/ton of wood)	
Exploitation	2
Transport (5 km)	2
Handling a preparation	1.3
Loading	0.7
Total	6
Production	
Daily Production (kg/person-day)	167
Working days per year	60
Yearly production (Ton/year)	10
Production costs	
Labour daily costs (CFAF/day	500
Total labour costs (CFAF 1000/year)	30
Depreciation equipment/miscellaneous (CFAF/year)	2
Wood production cost (CFAF/kg)	3.2
Village forest management	
Labour per exploited hectare (person-day/ha)	15
Standing wood (ton/ha)	12
Management cost (CFAF/kg wood)	0.6
Control by villages	
Number of producers	50
Village production (ton/year)	500
Rural ranger (CFAF 1000/year)	100
Local control cost (CFAF/kg of wood)	0.2

Source: Data on forest production and management from FAO, Koulikouro Project, and ESMAP estimates.

ANNEX 6: CONSUMPTION OF COOKING FUELS IN 2000

A. TREND SCENARIO (Charcoal penetration)

	Bamako	South. cities	North. cities	Small Cities	Rural	Total
Population (1000 inhabitants)	1494	583	342	856	8103	11378
% of population using wood as:						
Main fuel	65	89	79	95	100	95
Secondary fuel	2	2	2	0	0	0
Total	67	91	81	95	100	95
% of population using charcoal as:						
Main fuel	33	10	20	5	0	5
Secondary fuel	50	75	75	50	0	14
Total	83	85	95	55	0	19
% of population using gas as:						
Main fuel	2	1	1	0	0	0
Secondary fuel	30	15	15	5	0	5
Total	32	16	16	5	0	5
% of population using kerosene as:						
Main fuel	0	0	0	0	0	0
Secondary fuel	1	1	1	0	0	0
Total	1	1	1	0	0	C
Woodfuel final energy consumption						
Wood (1000T)	322	266	90	416	4141	5234
Charcoal (1000T)	85	17	14	15	0	130
Wood consumption						
Woodfuel (1000T)	322	266	90	416	4141	5234
Wood for charcoal (1000T)	711	138	115	121	0	1086
Total (1000T)	1033	405	205	537	4141	6320
Petroleum product consumption						
Gas (1000T)	4.5	0.9	0.5	0.3	0.0	6.2
Kerosene (1000T)	0.1	0.0	0.0	0.0	0.0	0.2

ASSUMPTION

Consumptions per person and per day	
Wood main fuel	0,9 kg/person/day in Bamako and in northern cities
Wood main fuel	1,4 Kg/person/day elsewhere
Wood secondary fuel	0,3 kg/person/day
Charcoal main fuel	330 g/person/day
Charcoal secondary fuel	95 g/person/day in Bamako
Charcoal secondary fuel	60 g/person/day elsewhere
Charcoaling efficiency	12%
Gas main fuel	115 g/person/day
Gas secondary fuel	20 g/person/day
Kerosene main fuel	120 g/person/day
Kerosene secondary fuel	20 g/person/day

CONSUMPTION OF COOKING FUELS IN 2000

B. DIVERSIFICATION SCENARIO

	Bamako	South. cities	North. cities	Small cities	Rural	Total
Population (1000 inhabitants)	1494	583	342	856	8103	11378
% of population using wood as:						
Main fuel	58%	75%	50%	89%	99%	92%
Secondary fuel	2%	2%	2%	0%	0%	0%
Total	60%	77%	52%	89%	99%	92%
% of population using charcoal as:						
Main fuel	20%	10%	20%	5%	0%	3%
Secondary fuel	30%	50%	50%	50%	0%	10%
Total	50%	60%	70%	55%	0%	13%
% of population using gas as:						
Main fuel	20%	10%	15%	1%	0%	3%
Secondary fuel	30%	15%	20%	4%	0%	5%
Total	50%	25%	35%	5%	0%	8%
% of population using kerosene as:						
Main fuel	2%	5%	15%	5%	1%	2%
Secondary fuel	3%	10%	15%	5%	0%	1%
Total	5%	15%	30%	10%	1%	3%
Woodfuel final energy consumption						
Wood (1000T)	288	209	51	361	4099	5008
Charcoal (1000T)	43	12	10	13	0	78
Wood consumption						
Fuelwood (1000T)	288	209	51	361	4099	5008
Wood for charcoal (1000T)	357	98	83	111	0	648
Total (1000T)	645	306	134	472	4099	5656
Petroleum product consumption						
Gas (1000T)	16	3	3	1	0	22
Kerosene (1000T)	2	2	3	2	4	12

ASSUMPTION

Consumption per person and per day:

Wood main fuel	0,9 kg/person/day in Bamako (improved stove ownership rate is constant)
Wood main fuel	0,8 kg/person/day in northern cities (improved stove ownership rate increasing by 25%)
Wood main fuel	1,3 kg/person/day elsewhere (improved stove ownership rate increasing by 20%)
Wood main fuel	1,4 kg/person/day in rurale zones
Wood secondary fuel	0,3 kg/peron/day
Charcoal main fuel	250 g/person/day (improved stoves in 100% of households)
Charcoal secondary fuel	95 g/person/day in Bamako
Charcoal secondary fuel	60 g/person/day elsewhere
Charcoaling efficiency:	12%
Gas main fuel	115 g/person/day
Gas secondary fuel	20 g/person/day
Kerosene main fuel	120 g/person/day
Kerosene secondary fuel	20 g/person/day

Table 17: SUMMARY OF HOUSEHOLD ENERGY CONSUMPTION

TREND AND DIVERSIFICATION SCENARIOS

Energy Source		1987	Thousands of tons per year 2000 Trend	2000 Diversification
Wood				
	Urban		614	1093	909
	Rural		3331	4141	4099
	Total		3945	5234	5008
Charcoal				
	Urban		53	130	78
	Rural				
	Total		53	130	78
Other biomasse				
	Urban				
	Rural		247	329	329
	Total		247	329	329
LPG				
	Urban		0.5	6.2	22
	Rural				
	Total		0.5	6.2	22
Kerosene				
	Urban		5.2	7.2	15.2
	Rural		7.3	8.8	12.8
	Total		12.5	16.0	28.0

Source: ESMAP estimates.

Table 18 : WOOD CONSUMPTION FORECAST
(1000 tons/year)

		1987	1990	1995	2000
Kayes					
	Rural	472	512	586	671
	Urban	80	91	113	140
	Total	552	602	698	810
Koulikouro					
	Rural	798	886	1057	1260
	Other Cities	113	127	153	184
	Bamako	366	444	613	847
	Total	1277	1458	1823	2291
Sikasso					
	Rural	844	900	1001	1113
	Urban	203	245	335	458
	Total	1048	1145	1336	1571
Ségou					
	Rural	584	654	754	869
	Urban	85	97	122	153
	Total	669	752	876	1022
Mopti					
	Rural	438	459	495	534
	Urban	61	68	80	94
	Total	500	526	574	628
Tombouctou					
	Rural	108	100	89	79
	Urban	37	43	57	75
	Total	145	144	146	154
Gao					
	Rural	87	84	79	74
	Urban	37	48	75	116
	Total	124	132	154	190
Mali					
	Rural	3331	3595	4060	4600
	Urban	983	1164	1548	2066
	Total	4314	4759	5608	6666

ASSUMPTIONS

1) Population growth rate: 3% per year
2) Consumption of wood (fuelwood and wood for charcoal) with current consumption patterns

Note:
Assumptions for unit consumptions of wood and charcoal are presented in Annex 2; these assumptions are based on: (a) results and extrapolations from surveys in several cities for the study; (b) estimates of rural fuel consumptions, as presented in Annex 3. Unit consumptions of wood and charcoal are considered consistent over the period 1987-2000 for the following reasons concerning parameter influencing these unit consumptions: (a) in real terms household purchasing ability will remain constant; (b) average household size will remain practically constant; (c) culinary habits of wood fuel-using households will change very slowly.

Table 19: FORECAST OF WOODFUEL CONSUMPTION IN BAMAKO

	1987	1990	1995	2000
Population (1000 inhab)	646	784	1082	1494
A. CURRENT CONSUMPTION PATTERNS				
% of household using wood as				
Main fuel	87.5%	87.5%	87.5%	87.5%
Secondary fuel	2.0%	2.0%	2.0%	2.0%
Total	89.5%	89.5%	89.5%	89.5%
% of households using charcoal as				
Main fuel	11.5%	11.0%	11.5%	11.5%
Secondary fuel	56.0%	56.0%	56.0%	56.0%
Total	67.5%	67.5%	67.5%	67.5%
Final energy consumption				
Wood (1000T)	187	227	313	433
Charcoal (1000T)	21	26	36	50
Primary energy consumption				
Fuel wood (1000T)	187	227	313	433
Wood for charcoal (1000T)	179	217	300	414
Total (1000T)	366	444	613	847
B. CHARCOAL PENETRATION AS PRIMARY FUEL				
% of households using wood as				
Main fuel	87.5%	84.0%	74.0%	65.0%
Secondary fuel	2.0%	2.0%	2.0%	2.0%
Total	89.5%	86.0%	76.0%	67.0%
% of households using charcoal as				
Main fuel	11.5%	15.0%	25.0%	33.0%
Secondary fuel	56.0%	55.0%	52.0%	50.0%
Total	67.5%	70.0%	77.0%	83.0%
Final energy consumption				
Wood	187	218	265	322
Charcoal	21	29	52	85
Primary energy consumption				
Wood	187	218	265	322
Charcoal	179	243	434	711
Total	366	461	699	1033

ASSUMPTIONS

Consumptions per person and per day :

Wood primary fuel	0.9 kg/person/day
Wood secondary fuel	0.3 kg/person/day
Charcoal primary fuel	330 g/person/day
Charcoal secondary fuel	95 g/person/day
Charcoaling efficiency	12 %

Annex 7: FORECAST PENETRATION OF IMPROVED METALLIC WOODSTOVES

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
Households (1000):											
Bamako	119	127	136	145	155	165	176	188	200	213	
Southern cities	35	37	39	41	43	45	48	50	53	55	
Northern cities	21	22	24	25	27	29	31	33	35	37	
Small cities	104	108	112	116	119	123	126	128	130	132	
Rural	1329	1359	1390	1422	1454	1487	1521	1556	1591	1628	
Equipment rates of improved metallic woodstoves:											
Bamako	50%	50%	50%	50%	50%	50%	50%	50%	50%	50%	
Southern cities	30%	32%	34%	36%	38%	40%	42%	44%	46%	50%	
Northern cities	15%	18%	20%	23%	26%	29%	31%	34%	37%	40%	
Small cities	0%	1%	3%	5%	8%	10%	13%	17%	21%	25%	
Rural	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%	
Stock of improved metallic woodstoves (1000 units)											
Bamako	60	64	68	73	78	83	88	94	100	107	
Southern cities	11	12	13	15	16	18	20	22	24	28	
Northern cities	3	4	5	6	7	8	10	11	13	15	
Small cities	0	1	3	6	10	12	16	22	27	33	
Rural	0	0	0	0	0	15	15	16	16	16	
Total	73	80	89	99	110	136	149	165	181	198	
Sales of improved metallic woodstoves (1000 units)											Total
Bamako	56	58	61	63	66	68	71	74	77	80	672
Southern cities	5	6	6	7	8	9	10	11	13	14	90
Northern cities	2	3	3	4	4	5	5	7	7	9	49
Small cities	0	1	2	3	6	6	10	12	16	17	74
Rural	0	0	0	0	0	15	0	15	1	16	47
Total	63	68	72	77	84	103	97	118	113	136	931

ASSUMPTIONS

Average number of persons per household:

Bamako	7
Southern cities	9
Northern cities	8
Small cities	6
Rural	5

Stove life span: 2 yrs

Annex 7 : FORECAST PENETRATION OF IMPROVED CHARCOAL STOVES

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
Households (1000):											
Bamako	119	127	136	145	155	165	176	188	200	213	
Southern cities	35	37	39	41	43	45	48	50	53	55	
Northern cities	21	22	24	25	27	29	31	33	35	37	
Small cities	104	108	112	116	119	123	126	128	130	132	
Rural	1329	1359	1390	1422	1454	1487	1521	1556	1591	1628	
Equipment rates of improved charcoal stoves:											
Bamako	0%	1%	2%	4%	7%	11%	14%	16%	18%	20%	
Southern cities	0%	1%	1%	2%	4%	6%	7%	8%	9%	10%	
Northern cities	0%	1%	2%	4%	7%	11%	14%	16%	18%	20%	
Small cities	0%	0%	1%	1%	2%	3%	4%	4%	5%	5%	
Rural	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Stock of improved charcoal stoves (1000 units)											
Bamako	0	1	3	6	11	18	25	30	36	43	
Southern cities	0	0	0	1	2	3	3	4	5	6	
Northern cities	0	0	0	1	2	3	4	5	6	7	
Small cities	0	0	1	1	2	4	5	5	7	7	
Rural	0	0	0	0	0	0	0	0	0	0	
Total	0	2	5	9	17	28	37	44	54	62	
Sales of improved charcoal stoves (1000 units)											Total
Bamako	0	1	1	4	7	11	13	17	19	23	97
Southern cities	0	0	0	0	1	1	2	2	2	3	12
Northern cities	0	0	0	1	1	2	2	3	3	4	16
Small cities	0	0	1	0	2	1	4	1	5	2	17
Rural	0	0	0	0	0	0	0	0	0	0	0
Total	0	1	3	5	11	16	21	23	30	32	141

ASSUMPTIONS

Average number of persons per household:

Bamako	7
Southern cities	9
Northern cities	8
Small cities	6
Rural	5

Stove life span: 2 years

Annex 7 : FORECAST PENETRATION OF GAS STOVES

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
Households (1000):											
Bamako	119	127	136	145	155	165	176	188	200	213	
Southern cities	35	37	39	41	43	45	48	50	53	55	
Northern cities	21	22	24	25	27	29	31	33	35	37	
Small cities	104	108	112	116	119	123	126	128	130	132	
Rural	1329	1359	1390	1422	1454	1487	1521	1556	1591	1628	
Equipment rates of gas stoves:											
Bamako	30%	34%	37%	39%	42%	44%	46%	48%	49%	50%	
Southern cities	5%	7%	9%	12%	14%	16%	18%	21%	23%	25%	
Northern cities	10%	13%	16%	18%	21%	24%	27%	29%	32%	35%	
Small cities	0%	1%	1%	1%	2%	2%	3%	3%	4%	5%	
Rural	0%	0%	0%	0%	0%	0%	0%	0%	0%	0%	
Stock of gas stoves (1000 units)											
Bamako	36	43	50	57	65	73	81	90	98	107	
Southern cities	2	3	4	5	6	7	9	11	12	14	
Northern cities	2	3	4	5	6	7	8	10	11	13	
Small cities	0	1	1	1	2	2	4	4	5	7	
Rural	0	0	0	0	0	0	0	0	0	0	
Total	40	50	59	67	79	89	102	114	127	140	
Sales of gas stoves (1000 units)											Total
Bamako	6	12	15	11	15	14	20	24	19	24	159
Southern cities	1	1	2	1	2	2	2	4	3	4	22
Northern cities	1	1	2	1	2	2	2	3	3	4	21
Small cities	0	1	1	0	1	0	2	1	1	2	11
Rural	0	0	0	0	0	0	0	0	0	0	0
Total	8	15	20	13	20	18	28	33	25	33	213

ASSUMPTIONS:

Average number of persons per household

Bamako	7
Southern cities	9
Northern cities	8
Small cities	6
Rural	5

Stove life span: 6 years

Annex 7 : FORECAST PENETRATION OF KEROSENE STOVES

	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	
Households (1000)											
Bamako	119	127	136	145	155	165	176	188	200	213	
Southern cities	35	37	39	41	43	45	48	50	53	55	
Northern cities	21	22	24	25	27	29	31	33	35	37	
Small cities	104	108	112	116	119	123	126	128	130	132	
Rural	1329	1359	1390	1422	1454	1487	1521	1556	1591	1628	
Equipment rates of kerosene stoves:											
Bamako	0%	1%	1%	2%	2%	3%	3%	4%	4%	5%	
Southern cities	0%	1%	2%	4%	5%	7%	9%	11%	13%	15%	
Northern cities	0%	3%	7%	10%	14%	17%	22%	26%	28%	30%	
Small cities	0%	0%	1%	2%	3%	4%	6%	7%	8%	10%	
Rural	0%	0%	0%	0%	0%	1%	1%	1%	1%	1%	
Stock of kerosene stoves (1000 units):											
Bamako	0	1	1	3	3	5	5	8	8	11	
Southern cities	0	0	1	2	2	3	4	6	7	8	
Northern cities	0	1	2	3	4	5	7	9	10	11	
Small cities	0	0	1	2	4	5	8	9	10	13	
Rural	0	1	3	4	6	7	9	11	13	16	
Total	0	4	8	14	18	25	33	41	48	59	
Sales of kerosene stoves:											Total
Bamako	0	1	1	1	1	2	2	4	1	4	17
Southern cities	0	0	0	1	1	1	2	1	2	3	11
Northern cities	0	1	1	1	1	1	3	3	2	2	15
Small cities	0	0	1	1	1	1	3	3	2	4	16
Rural	0	1	1	2	2	2	3	3	4	6	24
Total	0	4	4	6	6	7	11	13	13	18	83

ASSUMPTIONS:

Average number of persons per household:

Bamako	7
Southern cities	9
Northern cities	8
Small cities	6
Rural	5

Stove life span: 6 years

ANNEXE 8: DETAIL DES COUTS DE LA STRATEGIE (Financements externes et internes)

EN MILLIERS DE US$

COUT TOTAL

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Personnel detache	25	150	150	130	130	30	30	30	30	30
Personnel recrute	13	162	262	306	291	12	12	12	12	12
Infrastructure/Equipement	45	360	370	480	340	10	45	10	45	10
Fonds d'action/Formation	10	145	550	340	360	140	140	140	140	140
Assistance technique court terme	152	260	370	370	360	0	0	0	0	0
Assistance technique long terme	0	240	240	240	0	0	0	0	0	0
Fonctionnement	90	162	275	285	275	35	35	35	35	35
SOUS_TOTAL	335	1558	2237	2151	1996	227	262	227	262	227
Imprevus	34	156	224	215	200	23	26	23	26	23
TOTAL	369	1715	2461	2366	2196	250	288	250	288	250

ANNEXE 8 (Continuation): DETAIL DES COUTS DE LA STRATEGIE (Financements externes et internes)

	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
INITE PROVISOIRE DE PILOTAGE										
Personnel detache (5 cadres)	25									
Personnel recrute (7 appui)	13									
Formation	10									
Assistance technique court terme	152									
Fonctionnement	90									
Equipement/Materiel	45									
SOUS-TOTAL	335									
Imprevus	34									
TOTAL	369									
OLET DEMANDE										
ellule Energie Domestique										
Personnel detache (4 cadres)		20	20	20	20	10	10	10	10	10
Personnel recrute (5 appui)		9	9	9	9	5	5	5	5	5
Assistance technique court terme		30	30	30	30					
Fonctionnement		20	20	20	20	10	10	10	10	10
Equipement/Materiel			30		30		15		15	
SOUS-TOTAL		79	109	79	109	25	40	25	40	25
Imprevus		8	11	8	11	3	4	3	4	3
TOTAL		87	120	87	120	28	44	28	44	28
ervice Information/Evaluation										
Personnel detache (2 cadres)		10	10	10	10	5	5	5	5	5
Personnel recrute										
Assistance technique court terme		20			20					
Fonctionnement		10	10	10	10	5	5	5	5	5
Equipement/Materiel										
SOUS-TOTAL		40	20	20	40	10	10	10	10	10
Imprevus		4	2	2	4	1	1	1	1	1
TOTAL		44	22	22	44	11	11	11	11	11
omposante 1: Developpement des PEP										
Personnel detache										
Personnel recrute		15	15	15						
Infrastructure/Equipement		60	30	30						
Fonds d'action/promotion		20	20	10		10	10	10	10	10
Assistance technique court terme		40	40	40						
Fonctionnement		10	10	10						
SOUS_TOTAL		145	115	105		10	10	10	10	10
Imprevus		15	12	11		1	1	1	1	1
TOTAL		160	127	116		11	11	11	11	11
omposante 2: Promotion des PEP										
Personnel detache										
Personnel recrute			20	20	20					
Infrastructure/Equipement			60	30	30					
Fonds d'action/promotion			50	50	50	20	20	20	20	20
Assistance technique court terme			40	40	40					
Fonctionnement			20	20	20					
SOUS_TOTAL			190	160	160	20	20	20	20	20
Imprevus			19	16	16	2	2	2	2	2
TOTAL			209	176	176	22	22	22	22	22
omposante 3: Microcredit aux PEP										
Personnel detache										
Personnel recrute			30	30	30					
Infrastructure/Equipement			60		40					
Fonds d'action			250		250					
Assistance technique court terme			40	40	40					
Fonctionnement			10	10	10					
SOUS_TOTAL			390	80	370					
Imprevus			39	8	37					
TOTAL			429	88	407					
TOTAL VOLET DEMANDE		290	906	488	747	72	88	72	88	72

ANNEXE 8 (Continuation): DETAIL DES COUTS DE LA STRATEGIE (Financements externes et internes)

VOLET OFFRE	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
Cellule Combustibles Ligneux										
Personnel detache (5 cadres)	20	20	20	20	10	10	10	10	10	
Personnel recrute (7 appui)	13	13	13	13	7	7	7	7	7	
Assistance technique court terme	20	20	20	20						
Assistance technique long terme	240	240	240							
Fonctionnement	30	30	30	30	15	15	15	15	15	
Equipement/Materiel		40		40		20		20		
SOUS-TOTAL	323	363	323	133	32	52	32	52	32	
Imprevus	32	36	32	13	3	5	3	5	3	
TOTAL	355	399	355	146	35	57	35	57	35	
Division Programmes/Projets										
Personnel detache (2 cadres)	10	10	10	10	5	5	5	5	5	
Personnel recrute										
Assistance technique court terme	20			20						
Fonctionnement	10	10	10	10	5	5	5	5	5	
Equipement/Materiel										
SOUS-TOTAL	40	20	20	40	10	10	10	10	10	
Imprevus	4	2	2	4	1	1	1	1	1	
TOTAL	44	22	22	44	11	11	11	11	11	
Composante 4: Schemas Directeurs d'Approvisionnement en Combustibles Ligneux										
Personnel detache (5 cadres)	40	40	20	20						
Personnel recrute (2 c./4 appui)	37	37	37	37						
Infra/Equi. (postes contr/vehi.)	150	50	150	50	10	10	10	10	10	
Fonds d'action/promotion	20	20	20	20	10	10	10	10	10	
Assistance technique court terme	20	20	20	20						
Fonctionnement	40	40	20	20						
SOUS-TOTAL	307	207	267	167	20	20	20	20	20	
Imprevus	31	21	27	17	2	2	2	2	2	
TOTAL	338	228	294	184	22	22	22	22	22	
Composante 5: Appui aux professionnels du bois de feu										
Personnel detache (2 cadres)	10	10	10	10						
Perso. recr. (1 c/6 instr/4 ap)	26	52	52	52						
Infrastructure/Equipement	45		45							
Fonds d'action/formation	25	50	50	50	20	20	20	20	20	
Assistance technique court terme	30	30	30	30						
Fonctionnement	15	30	30	30						
SOUS-TOTAL	151	172	217	172	20	20	20	20	20	
Imprevus	15	17	22	17	2	2	2	2	2	
TOTAL	166	189	239	189	22	22	22	22	22	
Composante 6: Modernisation du secteur charbonnier										
Personnel detache (2 cadres)	10	10	10	10						
Perso. recr. (1 c/3 instr/4 ap)	37	37	37	37						
Infrastructure/Equipement	25		25							
Fonds d'action/formation	15	30	30	30	15	15	15	15	15	
Assistance technique court terme	30	30	30	30						
Fonctionnement	7	15	15	15						
SOUS-TOTAL	124	122	147	122	15	15	15	15	15	
Imprevus	12	12	15	12	2	2	2	2	2	
TOTAL	136	134	162	134	17	17	17	17	17	
Composante 7: Recuperation du bois mort										
Personnel detache (2 cadres)	10	10	10	10						
Personnel recrute (3 tech/3 ap.)	21	21	21	21						
Infrastructure/Equipement	25		25							
Fonds d'action	15	30	30	30	15	15	15	15	15	
Assistance technique court terme	20	20	20	20						
Fonctionnement	10	20	20	20						
SOUS-TOTAL	101	101	126	101	15	15	15	15	15	
Imprevus	10	10	13	10	2	2	2	2	2	
TOTAL	111	111	139	111	17	17	17	17	17	
Composante 8: Amenagement forestier										
Personnel detache (4 cadres)	20	20	20	20						
Perso. rec. (2 c./6 tech./6 ap.)	24	48	72	72						
Infra/Equi. (appui amenag./vehi)	75	100	175	150						
Fonds d'action/formation	50	100	150	150	50	50	50	50	50	
Assistance technique court terme	50	100	100	100						
Fonctionnement	30	60	90	90						
SOUS-TOTAL	249	428	607	582	50	50	50	50	50	
Imprevus	25	43	61	58	5	5	5	5	5	
TOTAL	274	471	668	640	55	55	55	55	55	
TOTAL VOLET OFFRE	1425	1554	1876	1449	176	200	176	200	176	

ANNEX 8: ASSUMPTIONS FOR THE ECONOMIC AND FINANCIAL EVALUATION

Kerosene tax :	110 F CFA/lt.	gain on new consumption
	0 F CFA/lt.	loss on existing consumption
Wood tax :	Collection rate of 80% in 2000 (versus 15% currently)	
Gas economic value:	275 F CFA/kg	(including investments to develop the market)
Kerosene economic value:	112 F CFA/kg	
Economic value of wood substitute:	8.4 F CFA/kg	
Economic value of dead wood:	20 F CFA/k	(est.cost= planting in northern areas - negative impact of recovery)
Economic value of wood in vulnrble areas	14 F CFA/kg	(cost of planting in the south)
Vulnerable areas/Controlled areas	10%	
New tax on wood (in 40% of contrld areas):	1 F CFA/kg	(gradual increase)
Dead wood recovery:	20% of consumption in Northern Cities in 2000	

Bases of calculation:

Progression	0.05	0.1	0.15	0.25	0.35	0.45	0.55	0.7	0.85	1	4
Gas imports	0.79	1.58	2.37	3.95	5.53	7.11	8.69	11.06	13.43	15.8	70
Kerosene 1 imports	0.59	1.18	1.77	2.95	4.13	5.31	6.49	8.26	10.03	11.8	53
Kerosene 2 imports	13.55	13.6	13.65	13.75	13.85	13.95	14.05	14.2	14.35	14.5	139
Wood savings	33	66	100	166	232	299	365	465	564	664	2955

(Kerosene 1: cooking; Kerosene 2: lighting)

Wood urban consum.(TREND)	1043	1103	1162	1282	1402	1521	1641	1820	2000	2179
Wood urban consm. (div.)	1012	1040	1069	1127	1184	1241	1299	1385	1471	1557
Trend Tax	15%	15%	15%	15%	15%	15%	15%	15%	15%	15%
Diversifivation tax	18%	22%	25%	31%	38%	44%	51%	61%	70%	80%
New tax	1 F CFA/kg									
Increase rate	0	0.5	0.5	0.5	1	1	1	1	1	1
Stove sales:										
Wood	0	0	4	4	10	24	16	32	25	43
Charcoal	0	1	3	5	11	16	21	23	30	32
Gas	8	15	20	13	20	18	28	33	25	33
Kerosene	0	4	4	6	6	7	11	13	13	18
Consump. of north. cities	93	100	107	115	122	129	136	143	150	157
% of consmp. from dead wd	0	0.05	0.1	0.15	0.2	0.2	0.2	0.2	0.2	0.2
Dead wood consumption	0	5	11	17	24	26	27	29	30	31
Controlled areas (x1000ha)	0	50	100	150	200	200	200	200	200	200
Production (kg/ha/yr)	300	300	300	300	300	300	300	300	300	300
Production (x1000t/an)	0	15	30	45	60	60	60	60	60	60
Controlled areas (1000ha)	0	300	900	1200	1500	1500	1500	1500	1500	1500
Production (kg/ha/yr)	300	300	300	300	300	300	300	300	300	300
Vuln. (% of control.areas)	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Produc. in vulner. areas (x1000t/yr)	0	9	27	36	45	45	45	45	45	45

Difference of cost between substitution stoves and improved metallic woodstoves

Kerosene: US$22 - US$2 = US$20

GPL: US$32 - US$2 = US$30

Table 24: RESUME OF TESTS RESULTS ON STOVES.

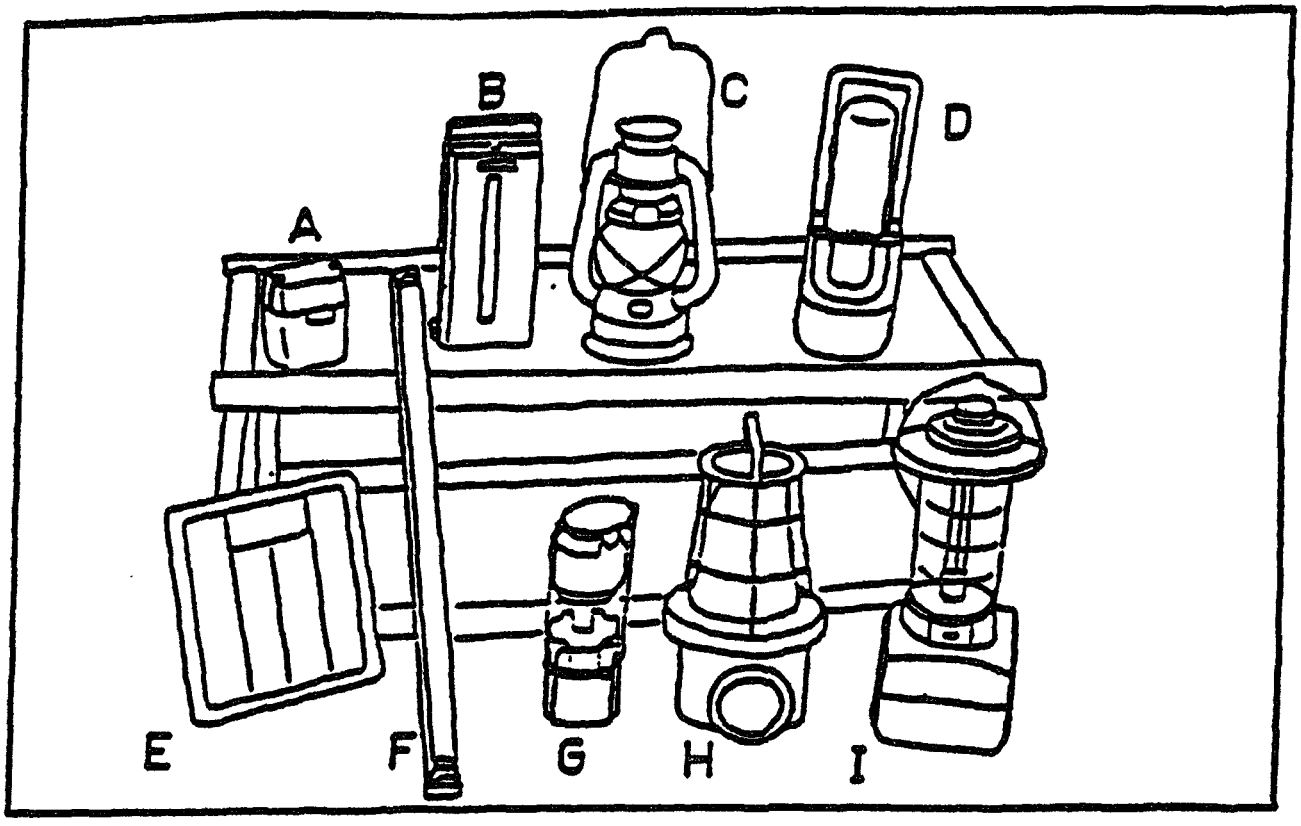
	Fuel	Cal. val. MJ/kg	Pmax kW	Emax %	Pmin kW	Emin %	Price FCFA	Max. Oper. hours	Reference
Imp. Charcoal	charcoal	30.0	3.5	25	1.7	40	2250		LESO,1989
Imp. Wood	wood	17.0	4.7	30	1.7	24	1250		LESO,1989
			5.0	30	1.6	30			Bussmann & Visser, 1986
	AVER:		4.9	30	1.7	27			
Thomas Cup 20	kerosene	43.5	2.7	40	0.6	40	8800	8	Bussmann & Visser, 1986
			3.1	49	2.1	44			Visser, 1988
	AVER:		2.9	45	1.4	42			
PET	kero.	43.5	3.3	37	1.8	32		9	Visser, 1988
Superior 1	petrol	44.1	1.8	47	0.8	32	10000	4	LESO, 1989
Superior 2/1	petrol	44.1	1.5	49	0.7	31	15000	6	LESO, 1989
Gaately (Total)	butane	45.7	7.0	40	1.5	57	16000	11	Bussmann & Visser, 1986
Demeba (Shell)	butane	45.7	3.5	45	2.0	55	14100	10	Bussmann & Visser, 1986
Dore (Niger)	butane	45.7	7.0	40	1.5	57	16000	11	Bussmann & Visser, 1986
Bleu (Niger)	butane	45.7	3.5	48	1.5	48	14000	10	Bussmann & Visser, 1986

Table 25: COOKING SIMULATION CALCULATIONS: STANDARD MEAL: RICE AND SAUCE.

Spec heat:	water	4.2	(kJ/kg.K)	Init. quant.:	oil	0.48	(kg)
	rice	1.8	(kJ/kg.K)		tom. puree	0.31	(kg)
	oil	1.7	(kJ/kg.K)		meat	1.25	(kg)
	tom.puree	3.6	(kJ/kg.K)		vegetables	1.00	(kg)
	meat	3.6	(kJ/kg.K)		rice	1.79	(kg)
	vegetables	3.6	(kJ/kg.K)		water	3.12	(kg)
					salt etc.	0.05	(kg)
Latent heat water:		2.26	(MJ/kg)		TOTAL	8.00	(kg)

	Fuel	Comb.v (MJ/kg)	Price (FCFA/kg)	(FCFA/MJ)	Pmax (kW)	Emax (%)	Pmin (kW)	Emin (%)	Tb (min)	Tc (min)	Tt (min)	Evap. (g)	Costs/meal (kg)	(MJ)	(FCFA)	Per day (kg)	(FCFA)	Savings 3-st (% MJ)
Imp. Charcoal	charcoal	30.0	75	2.5	3.5	25	1.7	40	44	60	104	922	0.60	18.0	45	1.5	112	28
Imp. Wood	wood	18.0	20	1.1	4.9	30	1.7	27	30	60	90	713	0.90	16.2	18	2.2	45	35
Thomas Cup 20	kerosene	43.5	250	5.7	2.9	45	1.4	42	93	60	33	946	0.31	13.7	79	0.8	197	45
PET	kerosene	43.5	250	5.7	3.3	37	1.8	32	34	60	94	908	0.36	15.8	91	0.9	227	36
Superior 1	petrol	44.1	375	8.5	1.8	47	0.8	32	45	60	105	497	0.23	10.2	87	0.6	217	59
Superior 2	petrol	44.1	375	8.5	1.5	49	0.7	31	51	60	111	426	0.21	9.2	78	0.5	196	63
Gately (Total)	butane	45.7	367	8.0	7.0	40	1.5	57	20	60	80	1228	0.26	11.8	95	0.6	236	53
Demeba (Shell)	butane	45.7	233	6.4	3.5	45	2.0	55	28	60	88	1523	0.34	15.4	99	0.8	247	38
Dr[illegible] (Niger)	butane	45.7	367	3.0	7.0	40	1.5	57	20	60	80	1228	0.26	11.8	35	0.6	88	53
Bl[illegible] (Niger)	butane	45.7	293	6.4	3.5	48	1.5	48	27	60	87	1148	0.31	14.0	90	0.8	224	44

FIGURE 3: LIGHTING EQUIPMENT TESTED



Conventional models

C.	Kerosene Lamp
F:	Fluorescent tube

LPG lamp

G:	Lumogaz N

Portable lamp on R20 batteries

A:	Instalux
B:	Lumotube

Portable lamp with rechargeable batteries

D:	Total/SAFT
H:	Zodiac
I:	Dynalight

Photovoltaic module: E

Note: These models are commercialized in Mali

ANNEX 10: DESCRIPTION OF A PROVISIONAL ENERGY STRATEGY STEERING UNIT

HOUSEHOLD ENERGY STRATEGY IN THE REPUBLIC OF MALI

PROVISIONAL ENERGY STRATEGY STEERING UNIT

Description

February 1990

Justification:

1. The establishment of a Provisional Steering Unit (Unité Provisoire de Pilotage -- UPP) is an important step in the implementation of the household energy strategy in Mali. In point of fact, the findings of the study carried out successfully under the ESMAP from April to October 1989 (presented in a final report now being finalized, which was discussed with a representative of the Government of Mali) need to be the basis of a detailed strategy action plan for the period of its implementation (1991-1995). This additional strategy preparation work will in particular make it possible to establish means of cooperation between the various institutions and organizations involved in the strategy, as well as support the research efforts and search for the financing required by the strategy, of which only a share has as yet been secured (SDR 750,000 under the Second Electricity Project).

Tasks:

2. The detailed work program for the UPP will be centered around the following main actions:

- carry out preparation studies for the implementation of the strategy, in particular: socioeconomic and forestry assessments in the main areas where fuelwood is now and will potentially be produced for the largest cities in Mali; the additional processing of files from surveys made under the strategy study; determination of the means of collecting data for monitoring and forecasting supply and demand of household energy; additional market studies for traditional fuels; incorporation of the findings of the market study on forestry products (carried out by DNEF [Direction Nationale des Eaux et Forêts] under the Second Forestry Project) into strategy components; evaluation of geographic variation in the economic cost of fuelwood; projected change in the economic cost of LPG in relation to the increase in demand; preliminary identification of the traditional fuels to be promoted under the strategy; review of possibilities and means of microcredit for the production and purchase of traditional fuels; evaluation of techniques for charcoal production to supply Bamako; etc.

- determine the means for streamlined concerted action between the Unit and the other projects and offices involved in household energy (projects to disseminate improved stoves, promote butane gas, inventory of fuelwood resources, forestry development, etc.);

- establishment of a network of private agents to act as catalysts for the strategy, identifying specialized trade groups in the business or informal sector (promoters of new equipment, manu-facturers and distributors of stoves, micro-distributors of petroleum fuels, dealers in wood and charcoal, etc.);

- prepare for the coordinated implementation of strategy components, through the identification and mobilization of the necessary local and external financing, pinpointing of action to be carried out and timetables for each of the components (detailed action plan);

- conduct an analysis of the necessary changes to regulations and taxation, submission of draft texts to the Government and assistance in their promulgation;

- provide the vital information needed for strategy oversight to the pertinent government authorities and public and private agencies;

- ensure the mobilization, information and exchanges of view with the other parties involved in the sector, through the holding of two seminars (the first to discuss the final results of the study on the household energy strategy and the second to submit the action plan for the domestic energy strategy prepared by the Unit);

- exchange experiences in the sector, in particular with the Sahelian countries.

Organization:

3. The Unit will be established within DNHE (Direction Nationale de l'Hydraulique et de l'Energie) by order of the Ministry of Industry, Water Resources and Energy (Ministère de l'Industrie, Hydraulique et de l'Energie -- MIHE). It will be supervised and overseen by a Managing Committee on which will sit the Director of DNHE, Director of DNEF, and any other person they deem necessary. The Managing Committee will take its decisions by consensus. Its decisions will be approved by the Minister of Industry, Water Resources and Energy, with MIHE having oversight for the strategy.

4. The Unit will be staffed by personnel from DNHE, DNEF and any other entity involved. The staff will be seconded for the duration of the Unit, which will be one year. The Unit will also have contractual personnel as follows for daily operations:

- A unit manager (project leader), with experience of at least five years in the energy sector in Mali, who will be responsible for administrative management, coordination, monitoring and evaluation of activities, and preparation of a six-monthly progress report to be submitted to the Managing Committee;

- an energy specialist;

- a specialist in fuelwood;

- a forestry economist;
- a data processing specialist;
- an accountant/administrative assistant, a secretary, three drivers, one messenger and one watchman.

5. The Unit will receive specialized support on a contractual basis from Malian experts:

- preparation and carrying out of surveys: energy specialist, two months;
- computer assistance; computer specialist, three months;
- urban and rural socioeconomic analyses and market studies on traditional fuels: two sociologists, of which one a woman, six months in total;
- analysis of aspects involving taxation of fuel and credit for traditional fuels: economist, two months.

6. The Unit will draw upon various specialized services, in particular for the surveys, cartography, technological assessment of traditional fuels and promotion of traditional fuels.

7. The Unit will also receive external support from an energy economist and a forestry economist (two months in total), plus funding to cover one month of one or two additional specialists to be determined, during two joint missions, the first, upon the establishment of the Unit, to help finalize its detailed activity program, and the second, 10 months later, for the finalization of the detailed strategy action plan.

8. The Unit will receive logistical support for the duration of the household energy strategy study in the form of two vehicles (sedan and all-terrain), a photocopier, two computers (office unit and portable) and the related software, and office furnishings. This will be supplemented by the acquisition of another all-terrain vehicle, an office computer, two mopeds and office furnishings. The purchase of demonstration equipment (e.g. burners and lamps) is also planned.

9. The salaries of the personnel assigned to the Unit will be paid by their seconding offices; this represents a contribution from the Government of Mali estimated at CFAF 4.3 million per year.

10. At the end of the Unit's duration of one year, if the necessary financing for the strategy has been secured, with firm agreements for more than 50% of the total cost of the strategy, and a detailed action plan has been formulated by the Unit and accepted by the Government and the World Bank, the Unit will be made a Strategy Steering Unit (Unité de Pilotage -- UP) by order of the Minister of Industry, Water Resources and Energy or, possibly, by joint interministerial order with the Minister of the Environment and Stockraising. With a view to continuity, to the extent possible, the Unit should retain the seconded personnel, plus additional staff. The UP will consist of two sections (*cellules*) and two offices under the supervision of the project manager, as indicated in the attached preliminary organization chart:

- the Household Energy Section, belonging to the DNHE Dams and Energy Division;
- the Fuelwood Section, belonging to the DNEF Forestry Development and Production Division;
- the Administrative and Finance Office and the Evaluation and Information Office, reporting to the project manager.

Budget:

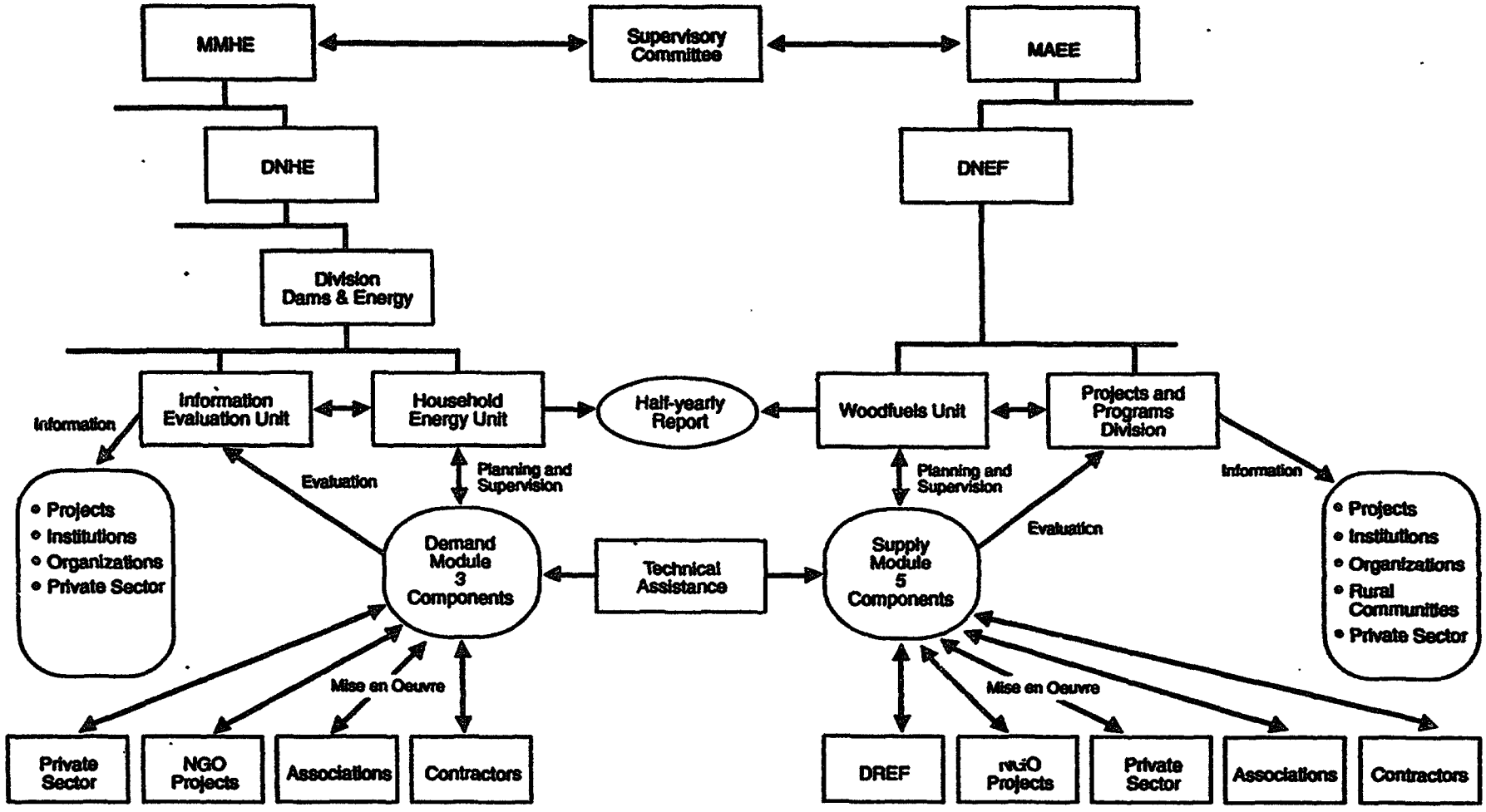
11. The budget of the UPP is estimated for its year of operation at CFAF 98 million (US$326,667 at the exchange rate of US$1 = CFAF 300), not including the contribution of the Government of Mali. The detailed final budget will be prepared by DNHE and DNEF prior to the establishment of the Unit. The preliminary budget is broken down as follows:

PSU BUDGET
APRIL 1990 - MARCH 1991

ITEM	Thousands of CFAF
1.1. Staff:	11.600
Detached staff	Non quantified
Salaries/overhead temporary staff	3.980
Accountant/Admin. Assistant	1.080
Secretary	650
Drivers (3)	1.500
Messenger	400
Guard	350
Field work per diem	7.620
Project Manager (36 days)	720
Energy Specialist (84 d)	1.260
Forestry Economist (84 d)	1.260
Forestry Engineer (168 d)	2.520
Drivers (372 d)	1.860
1.2. International travel (Project Manager):	2.100
2 trips	1.300
Per diem (14 d)	800
2.1 Local technical assistance:	19.500
Fees	17.700
Energy Specialist (2 months)	3.600
Sociologists (2x3 months)	7.800
Computer Specialist (3 months)	2.700
Economist (2 months)	3.600
Field per diem (90 d)	1.800
2.2. External technical assistance:	19.400
Fees (78 d)	11.700
International travel (6)	3.900
Per diem (90 d)	3.800
3. Additional equipment:	13.600
1 vehicle (4x4)	7.500
2 motorcycles	550
1 desk top computer	1.050
Furniture for 5 offices	3.000
1 fax machine	1.000
Demonstration equipment	500

4. Operational expenses:	**17.400**
Office space rental	3.600
Water and electricity	2.400
Telephone	2.400
Fuel/oil for vehicles	6.000
Insurance vehicles	500
Equipment and office maintenance	2.000
Expendable	500
5. Training and information:	**3.200**
Training	2.000
Seminars (2)	1.200
6. Services :	**6.500**
Surveys	2.500
Mapping	2.000
Technological evaluation	1.500
Promotion	500
SUB-TOTAL:	**93.300**
6. Miscellaneous and contigencies (5%):	**4.700**
TOTAL:	**98.000**

Implementation Chart



ANNEXE 12: Brève description du Projet Energie Domestique au Niger

1. Description. Le Projet Energie Domestique au Niger est une composante du Projet Energie II, qui comprend également une composante Electricité et une composante Recherche Pétrolière. La composante Energie Domestique vise à promouvoir l'exploitation et l'utilisation rationnelles du bois-énergie. Le Projet, qui a démarré en 1989, aura une durée de cinq ans et dispose d'un financement total de 10,3 millions de dollars US, y compris 0,6 milions pour un volet solaire. Le Projet est divisé en deux volets principaux: (i) le volet demande, dont l'objectif est d'encourager la substitution du bois par le kérosène et le gaz butane ainsi que l'utilisation d'équipements améliorés; (ii) le volet offre, dont l'objectif est la rationalisation de l'exploitation du bois-énergie et de l'approvisionnement des villes ainsi que la participation effective des populations rurales à la gestion des ressources ligneuses de leurs terroirs. Le Projet concentre son action sur les quatre principales villes du pays (Niamey, Maradi, Zinder et Tahoua) qui regroupent plus de 80% de la population urbaine. Le volet demande est mis en oeuvre par le Ministère des Mines et de l'Energie, qui s'appuie sur les fabricants et distributeurs d'équipements, les importateurs et distributeurs de produits pétroliers et les ONG. Le volet offre est mis en oeuvre par le Ministère de l'Hydraulique et de l'Environnement, qui s'appuie sur les Directions Départementales de l'Environnement et les ONG. Les deux volets sont mis en oeuvre en étroite coordination avec les activités des autres Projets intervenant sur le même thème.

2. Résultats attendus. Globalement, le Projet vise à stabiliser la consommation de bois-énergie des villes concernées, ce qui représenterait d'ici 1994 une économie de l'ordre de 100.000 tonnes de bois. Au niveau de la demande, le Projet vise à obtenir: la mise en place de réseaux privés de distribution d'équipements de cuisson améliorés ou de substitution; l'utilisation du kérosène pour la cuisson par environ 50.000 ménages; l'extension de l'utilisation du gaz butane jusqu'à atteindre en 1994 environ 12.000 ménages; et l'utilisation correcte d'un ou plusieurs foyers améliorés métalliques à bois par environ 60.000 ménages. Au niveau de l'offre, le Projet vise à obtenir: la réorganisation de l'exploitation et approvisionnement en bois-énergie des quatre villes concernées, y compris la création de marchés ruraux, la réforme de la taxation et le renforcement du système de contrôle; le contrôle effectif d'au moins 80% des quantités de bois entrant dans les quatre villes; la mise sous aménagement d'au moins 100.000 has de superficies boisées sur cinq zones; le renforcement de la capacité technique de la Direction de l'Environnement et des organisations rurales et professionnelles concernées.

3. La mise en oeuvre du Projet est confrontée à plusieurs risques bien identifiés, dont l'impact possible a cependant été pris en compte lors de l'évaluation technique, économique et financière initiale du Projet. Ces risques comprennent notamment: la connaissance insuffisante des ressources ligneuses existantes et de leur potentiel de production; la multiplicité et l'autonomie des acteurs (fabricants, distributeurs, consommateurs, exploitants, villageois); l'impact social de la hausse du prix au détail du bois, liée à la réforme de la taxation, et de la diminution des revenus de la production du bois dans les zones contrôlées; des retards éventuels dans les décisions politiques concernant la réforme fiscale et légale nécessaire; les incertitudes concernant l'acceptation des produits améliorés ou de substitution; le caractère innovateur des actions du Projet au niveau de l'offre; les variations de prix des combustibles pétroliers de substitution et le prix trop élevé des réchauds à kérosène.

4. Activités. Les principales activités du Projet sont les suivantes:

Au niveau du volet demande:

. Identifier un réchaud à kérosène performant et adapté à la cuisine sahélienne: tests et améliorations de réchauds, tests d'acceptabilité, labellisation.

. Réviser la structure des prix des combustibles de substitution, en parallèle avec la réforme de la fiscalité du bois-énergie.

. Réaliser des campagnes de promotion sur les produits énergétiques de substitution et améliorés: évaluation des différents vecteurs de promotion; élaboration et mise en oeuvre de campagnes publicitaires.

. Appuyer le secteur privé pour favoriser la diffusion des produits énergétiques: concertation avec des opérateurs économiques sélectionnés, mise en place de systèmes d'accès au crédit, organisation de ventes-pilotes, appui à la vente des équipements.

. Informer sur les activités et résultats du volet

Au niveau du volet offre:

. Evaluer les filières d'approvisionnement en bois des villes concernées.

. Créer et organiser des marchés ruraux de bois de feu.

. Elaborer des scémas directeurs d'approvisionnement en combustibles ligneux des quatre centres urbains.

. Promouvoir la création d'associations de professionnels du bois de feu.

. Réformer la fiscalité des combustibles ligneux.

. Mettre en place un système de contrôle efficace des flux de combustibles ligneux.

. Préparer, définir et mettre en oeuvre des plans d'aménagement dans des sites favorables de production de bois-énergie pour les quatre villes concernées.

. Définir les mécanismes de participation des populations rurales et les mesures incitatives nécessaires concernant la gestion des ressources ligneuses dans des zones prioritaires.

. Réaliser des sessions d'animation/formation dans les zones prioritaires.

. Evaluer le potentiel de régénération des peuplements forestiers naturels.

. Former les intervenants publics et privés.

. Informer sur les activités et résultats du volet.

5. Premiers résultats. Les résultats obtenus pendant les deux premières années de mise en oeuvre du Projet sont les suivants:

Au niveau du volet demande:

. Un réchaud à kérosène adéquat a été identifié et testé auprès des consommateurs. En juillet 1991, ce réchaud était commercialisé par le secteur privé, avec l'aide d'une subvention temporaire. Les ventes totales devraient atteindre 3.000 réchauds en décembre 1991. Un service après-vente autonome et privé ainsi que des facilités de crédit hors-projet ont également été mis en place.

. Une campagne d'information et de promotion (radio, TV et autres média) a été lancée; cette campagne met l'accent sur la nécessité d'économiser l'énergie et sur les possibilités de substitution du bois; elle inclut aussi la promotion des foyers améliorés à bois, qui sont commercialisés par des distributeurs privés.

. Le prix du kérosène reflète son coût économique. Cependant le GPL a été détaxé et est subventionné.

Au niveau du volet offre:

. Le plan d'approvisionnement et gestion des ressouirces ligneuses de Niamey a été finalisé, celui de Zinder est en cours d'achèvement et les travaux pour celui de Maradi commenceront en 1992. Des marchés ruraux de bois de feu ont été établis dans la zone d'approvisionnement de Niamey et de Zinder. Sept coopératives de gestion forestière ont été créées dans la zone d'approvisionnement de Niamey et Zinder, qui couvre une superficie totale de 100,000 hectares.

. Une association nationale des commerçants du bois-énergie a été créée, ainsi que des associations locales dans cinq villes; ces associations participent activement à la mise en oeuvre des plans directeurs d'approvisionnement.

. Un nouveau cadre règlementaire incitatif pour l'exploitation et la commercialisation du bois-énergie a été défini et sera mis en place en 1992. Ce nouveau système prévoit la cession du contrôle des ressources forestières aux populations locales et leur donne la responsabilité de prélever des redevances d'exploitation.

. L'efficacité du système existant de collecte de la taxe sur le bois a été augmentée; ainsi les revenus fiscaux du bois sont passés de 14,7 millions de FCFA en 1987 à 37,2 millions de FCFA en 1990, ce qui reflète l'effet combiné d'un meilleur contrôle et de l'augmentation de la taxe unitaire. Des services d'appui aux coopératives et à la gestion forestière sont en place, afin d'aider les populations locales à gérer de façon durable et communautaire les ressources forestières.

6. De plus, un système de suivi et d'évaluation a été mis en place pour les deux volets afin d'évaluer les résultats du Projet, qui sont publiés chaque semestre.

7. Compte tenu du caractère innovateur et du rôle clé du volet offre pour le succés de la stratégie, les objectifs, l'approche et les résultats attendus de celui-ci sont décrits en détail dans ce qui suit.

Objectifs, approche et résultats attendus du volet offre du Projet énergie domestique au Niger

Principes

8. Le système examiné ici est fondé sur l'hypothèse que la gestion des peuplements forestiers naturels devrait être confiée à des particuliers, aux communautés rurales et à l'administration locale. A cet effet, un cadre d'incitations et de règlements est proposé qui pénalise l'achat de bois exploité selon des méthodes ne protégeant pas la durabilité des ressources, tout en encourageant la gestion des ressources arbustives et forestières dans les zones désignées pour la production de bois pour les besoins en énergie et autres des ménages. Les négociants en bois devront payer une redevance d'abattage dégressive en fonction de la distance et du niveau de gestion de la zone forestière. Les communautés locales participant au projet assumeront la collecte de cette redevance et verseront à l'institution publique appropriée la part attribuée à l'Etat. Le rôle de l'Etat se limite : [a] à promulguer une loi portant création de ce cadre réglementaire transparent; [b] à veiller de façon non arbitraire à l'application de ces règlements; et [c] à fournir sur demande une assistance technique aux communautés locales.

Plan directeur pour l'approvisionnement de Niamey en bois de feu : objectifs et portée

9. Objectifs : L'un des principaux objectifs du projet vise à créer les conditions propices à l'approvisionnement durable de Niamey en bois de feu sans porter préjudice à l'environnement. Pour atteindre cet objectif, il est indispensable de gérer de façon rationnelle les ressources en bois de feu compte tenu des obstacles naturels et socio-économiques. Le Plan directeur a donc pour objectif d'établir les aspects géographiques, socio-économiques et techniques de cette nouvelle approche, et d'identifier les zones d'intervention prioritaires ainsi que leurs systèmes de gestion appropriés. Cette tâche exige un cadre transparent et logique pour permettre une planification adéquate des activités du projet, en particulier la création de marchés ruraux de bois de feu, avec ultérieurement la mise en gestion des zones de production. En résumé, le Plan directeur doit servir de guide à la planification, à l'exécution et au suivi des activités du projet, constituer la base de la gestion rationnelle des ressources en bois de feu dans la zone d'approvisionnement du centre de demande et orienter la réorganisation de la chaîne de commercialisation du bois de feu (coupe, transport et distribution) autour des marchés ruraux de bois de feu.

10. Marchés ruraux. Les marchés ruraux sont autant de points de vente pour le bois de feu, gérés par la population rurale locale, et dont les principaux objectifs sont les suivants :

- le transfert de la responsabilité de l'exploitation, de la gestion et du commerce des ressources forestières à la population locale;
- le renforcement du pouvoir de négociation de la population rurale vis-à-vis des négociants en combustibles ligneux, pour leur permettre d'améliorer le taux de rentabilité de leur travail et d'accroître la valeur de la production forestière;
- l'orientation de la production de bois de feu vers les zones prioritaires; et
- l'amélioration de l'aptitude du secteur public à contrôler et suivre le transport de bois de feu.

11. L'établissement de ces marchés ruraux constitue la première étape dans la restructuration du système de commercialisation du bois de feu. La deuxième étape vise le transfert de la couverture forestière naturelle et de sa gestion à la population locale. Il s'agit, grâce à de telles mesures, de rationaliser la gestion

de cet organisme et de renforcer la position de la population rurale à l'égard des négociants en bois basés dans les zones urbaines. Une gestion de type sylvopastoral ou agropastoral sera adoptée, selon la situation.

12. Méthodologie. La mise au point du Plan directeur s'articule autour de trois éléments : [i] évaluation de la base des ressources forestières; [ii] analyse de la chaîne de commercialisation du bois de feu; et [iii] identification des zones agro-socio-économiques dans la zone d'approvisionnement de Niamey. Cette approche a été choisie du fait que les données relatives à ces trois éléments, bien qu'indispensables, se sont avérées la plupart du temps incomplètes et non fiables.

13. L'évaluation des ressources forestières avait pour but d'établir avec le plus d'exactitude possible si les peuplements existant en 1990, compte tenu de la productivité annuelle, étaient suffisants pour répondre aux besoins en bois de feu sans avoir à toucher au capital forestier.

14. L'analyse de la chaîne de commercialisation du bois de feu visait à quantifier le volume annuel des approvisionnements en direction de Niamey, à identifier les principales sources de bois de feu et les axes d'approvisionnement, et à décrire la dynamique socio-économique de cette chaîne de commercialisation.

15. La délimitation des zones agro-socio-économiques dans la zone d'approvisionnement a pour objectif d'identifier les méthodes actuelles de gestion de la couverture forestière naturelle et d'établir la hiérarchie des facteurs environnementaux et socio-économiques qui déterminent l'exploitation du bois de feu et son exportation vers Niamey, et également d'identifier, avec leurs caractéristiques, les zones et/ou facteurs grâce auxquels les ressources forestières évoluent d'une façon relativement homogène et qui appelleraient un type d'intervention semblable.

Cadre réglementaire

16. Le cadre réglementaire proposé a pour principal objectif de remédier à l'absence actuelle de toute réglementation et d'encourager les intervenants dans la chaîne de commercialisation du bois de feu à respecter les objectifs de gestion forestière du Gouvernement. En conséquence, le nouveau cadre réglementaire vise à :

- encourager les transporteurs de bois de feu à s'approvisionner dans les zones placées sous gestion forestière, dans le cadre du Plan directeur de gestion du bois de feu établi par la municipalité, de préférence aux autres zones;

- attribuer la responsabilité du contrôle et de la gestion des ressources forestières, jusqu'ici confiée à l'Etat, à la population rurale locale;

- encourager les autorités locales (les arrondissements) à jouer un rôle consultatif et promotionnel vis-à-vis de la population rurale, en ce qui concerne la création de marchés ruraux de bois de feu et la gestion des ressources forestières, et à leur donner les moyens nécessaires à cet effet;

- réglementer véritablement les importations de bois de feu vers les zones urbaines afin de maintenir l'exploitation du bois de feu à des niveaux soutenables, de réduire la fraude fiscale et de se donner un instrument permettant de suivre la mise en oeuvre du Plan directeur de gestion du bois de feu;

- établir des prix à la production du bois de feu qui correspondent à une rémunération équitable de la main-d'oeuvre rurale, motivant ainsi les producteurs ruraux à gérer la couverture forestière existante;

- veiller à ce que les prix de détail pour le bois de feu reflètent son coût économique, afin d'établir une concurrence plus équitable entre les combustibles à usage domestique;

- dégager des revenus substantiels qui permettront l'autofinancement du fonctionnement du cadre réglementaire et, progressivement, déboucheront sur des investissements dans la gestion des ressources naturelles.

17. Le nouveau cadre réglementaire vise à réorganiser et rationaliser l'exploitation du bois dans les zones rurales en réduisant l'étendue des zones d'abattage ainsi que le nombre de transporteurs de bois autorisés, par l'intermédiaire de contingentements et grâce au renforcement du rôle joué par les autorités locales et les associations locales de gestion bien établies. D'autre part, ce nouveau cadre doit permettre d'établir des prix à la production du bois de feu qui correspondent à une rémunération équitable de la main-d'oeuvre rurale, ce qui augmentera les revenus et encouragera les producteurs ruraux à gérer la couverture forestière existante.

18. La gestion rationnelle des ressources forestières repose sur un principe élémentaire : s'assurer que le taux d'utilisation des ressources forestières ne dépasse pas le taux annuel de régénération naturelle. En conséquence, il est proposé que le Service forestier établisse un contingent pour chaque marché rural de combustibles ligneux et pour chaque zone de production forestière publique ou privée désireuse de participer au plan de gestion.

Renforcement du rôle des autorités locales

19. La décentralisation est un élément important des réformes en cours au Niger et pourrait avoir un effet très positif sur la gestion des ressources en bois de feu, dès qu'aura été renforcé le rôle des autorités locales, particulièrement des arrondissements. En effet, ce sont les arrondissements qui ont les contacts les plus fréquents et les plus réguliers avec la population locale. D'autre part, leur personnel est très proche de cette population et peut donc fournir une aide et des conseils en tant que de besoin.

20. Il est donc proposé que les arrondissements :

- participent d'une façon active à la création et à l'immatriculation d'associations locales de gestion qui seront responsables de gérer les marchés ruraux de bois de feu;

- fournissent formation et soutien réguliers à ces associations, en particulier en matière de comptabilité;

- fournissent une aide pour le suivi du commerce de combustibles ligneux et la mise en oeuvre des plans de gestion des ressources forestières;

- éliminent les opérateurs à temps partiel :

  - pour permettre exclusivement à ceux qui sont porteurs d'une carte professionnelle de membre de l'association des transporteurs de bois de s'adonner à des activités de transport et de vente de combustibles ligneux. Les

particuliers désireux d'acheter des combustibles ligneux pour leur propre usage pourront être autorisés à le faire si les quantités achetées sont petites (à concurrence de 10 fagots ou pièces de bois);

- en autorisant les associations professionnelles qui représentent les intérêts des transporteurs de bois à établir des cartes pour leurs membres, à condition que soient respectés des critères d'immatriculation et d'uniformité.

21. Jusqu'à ces derniers temps, la chaîne de commercialisation des combustibles ligneux n'était pratiquement pas réglementée, du fait qu'il n'existait pas de système de contrôle mais également parce que, les autorisations d'abattage étant délivrées sur une base mensuelle, il n'était pas possible de contrôler les quantités ni l'origine de chaque opération.

22. Pour remédier à cette situation, le nouveau cadre réglementaire exige de toute personne pénétrant dans la ville avec un chargement de bois de feu qu'elle soit munie d'un coupon de transport, valable uniquement pour ce chargement et qui sert également d'attestation de paiement de la redevance d'abattage, ainsi que de l'origine et de la quantité du bois transporté.

23. Pour assurer la souplesse et l'efficacité du système de contrôle, il est également recommandé que les unités de contrôle soient légères et mobiles. Leur principale fonction sera de s'assurer que les transporteurs de bois se présentent systématiquement aux postes de contrôle. Les unités mobiles, grâce à leur présence pratiquement constante à la périphérie de la ville, auront donc pour fonction de canaliser les véhicules chargés de bois circulant aux abords de la ville vers les postes de contrôle fixes. En particulier, elles contrôleront les pistes rurales.

24. Pour faciliter l'amélioration de la gestion de la couverture forestière naturelle, il est indispensable que le niveau de la redevance d'abattage motive réellement les transporteurs de bois à s'adresser pour leurs achats tout d'abord aux petits peuplements forestiers publics et privés, et ensuite aux marchés ruraux, en accordant leur préférence aux zones « contrôlées » et, en dernier ressort seulement, aux zones de transit. D'autre part, le niveau de la redevance devra également être de nature à décourager l'achat de bois en provenance de zones « non contrôlées ».

25. Toutefois, la différence entre les marchés ruraux et l'exploitation « incontrôlée » des ressources forestières devra être substantielle et, dans tous les cas, de nature à assurer qu'il soit plus profitable pour les transporteurs de bois d'acheter leurs approvisionnements sur un marché rural que dans les zones « non contrôlées », même si le prix de revient est plus faible dans ces dernières.

Redevance et éloignement de la zone urbaine

26. La gestion rationnelle de la couverture forestière naturelle doit également viser à réduire la pression exercée sur les peuplements forestiers proches des centres de demande urbains et qui sont exploités en raison de leur proximité, laquelle permet des économies de temps et d'argent.

27. Pour atteindre cet objectif, il est donc nécessaire d'encourager les transporteurs à acheter leur bois sur les marchés plus éloignés des centres urbains; pour cela, le niveau de la redevance d'abattage devra être inversement proportionnel à la distance qui sépare le marché rural du centre urbain. C'est pourquoi, il est recommandé :

- de regrouper un petit nombre de marchés ruraux situés dans un certain rayon d'un centre urbain, pour éviter de créer un système trop compliqué. Ce rayon pourra être

différent selon la zone de production mais, dans tous les cas, les groupements devront être constitués sur la base de la distance effectivement parcourue à l'heure actuelle par les transporteurs de bois, ce qui exige une bonne connaissance du circuit actuel de commercialisation;

- d'appliquer le niveau de base de la redevance d'abattage à la catégorie qui comprend les marchés les plus proches du centre urbain de demande, et de déterminer les réductions qui seront utilisées pour calculer les tarifs les plus faibles pour les catégories de marchés les plus éloignés du centre urbain. Ces réductions devront être substantielles par comparaison avec les coûts de transport supplémentaires des approvisionnements provenant de ces marchés. Elles pourront prendre la forme soit d'une réduction du pourcentage de redevance applicable, soit de la déduction d'un montant fixe;

- de revoir périodiquement la définition des catégories aussi bien que les réductions applicables pour tenir compte des changements survenus dans le taux de base de la redevance d'abattage, le prix de gros du bois de feu et la chaîne de commercialisation de ce dernier.

28. Dans le cas de Niamey, trois catégories ont déjà été établies, sur la base des distances parcourues à l'heure actuelle par les transporteurs de bois : [a] moins de 40 km; [b] 40-80 km; et [c] plus de 80 km.

29. La nouvelle redevance d'abattage, outre la réorientation des approvisionnements en bois de feu et son effet sur les prix des combustibles utilisés par les ménages, a également pour objectif de stimuler les partenaires ruraux locaux, qu'ils soient privés ou institutionnels, pour les encourager à participer à la gestion de la couverture forestière naturelle, à générer des revenus importants et, ultérieurement, à assurer l'autofinancement des activités de gestion forestière.

30. Pour créer un cadre réglementaire capable :

- d'assurer la viabilité économique des coopératives existantes et des nouvelles associations villageoises (lesquelles seront plus indépendantes que les coopératives et comporteront moins de membres); et

- d'assurer aux paysans une rémunération de nature à encourager la gestion des ressources forestières,

31. Il est nécessaire :

- de veiller à ce que les membres de la coopérative reçoivent une rémunération au moins équivalente à celle du vendeur installé au bord de la route (910 francs CFA/stère); et

- de faire en sorte que l'association locale de gestion et les autorités locales reçoivent, globalement, un revenu qui soit au moins égal à celui des coopératives actuelles, c'est-à-dire 612-650 francs CFA/stère (ce qui implique une réduction des frais généraux de gestion des coopératives existantes).

Résultats attendus du système proposé

32. Le nouveau système devrait permettre d'atteindre plusieurs objectifs. Premièrement, et surtout, son but est d'assurer la gestion et la protection de la couverture forestière naturelle. Toutefois, il s'agit là d'un objectif à long terme, et les effets du nouveau système ne seront pas visibles avant au moins 10 à 15 ans. Le deuxième objectif est, à moyen terme, de créer des marchés ruraux de combustibles ligneux et des unités de gestion des ressources forestières rurales. Il s'agit là d'une condition nécessaire pour imposer la gestion des ressources forestières, mais qui n'est pas suffisante. Il faudra également du temps pour établir ces marchés et ces unités de gestion, pour leur permettre de devenir totalement opérationnels. Le troisième objectif vise à dégager les fonds nécessaires pour financer la gestion et la protection des ressources forestières et superviser étroitement le fonctionnement de la chaîne de commercialisation du bois de feu. Cet objectif à court terme devrait pouvoir produire des résultats presque immédiats.

ENERGY SECTOR MANAGEMENT ASSISTANCE PROGRAMME

COMPLETED ACTIVITIES

Country	*Activity*	*Date*	*Number*
	SUB-SAHARAN AFRICA (AFR)		
Africa Regional	Anglophone Africa Household Energy Workshop (English)	07/88	085/88
	Regional Power Seminar on Reducing Electric Power System Losses in Africa (English)	08/88	087/88
	Institutional Evaluation of EGL (English)	02/89	098/89
	Biomass Mapping Regional Workshops (English - Out of Print)	05/89	--
	Francophone Household Energy Workshop (French)	08/89	103/89
	Interafrican Electrical Engineering College: Proposals for Short- and Long-Term Development (English)	03/90	112/90
	Biomass Assessment and Mapping (English - Out of Print)	03/90	--
Angola	Energy Assessment (English and Portuguese)	05/89	4708-ANG
	Power Rehabilitation and Technical Assistance (English)	10/91	142/91
Benin	Energy Assessment (English and French)	06/85	5222-BEN
Botswana	Energy Assessment (English)	09/84	4998-BT
	Pump Electrification Prefeasibility Study (English)	01/86	047/86
	Review of Electricity Service Connection Policy (English)	07/87	071/87
	Tuli Block Farms Electrification Study (English)	07/87	072/87
	Household Energy Issues Study (English - Out of Print)	02/88	--
	Urban Household Energy Strategy Study (English)	05/91	132/91
Burkina Faso	Energy Assessment (English and French)	01/86	5730-BUR
	Technical Assistance Program (English)	03/86	052/86
	Urban Household Energy Strategy Study (English and French)	06/91	134/91
Burundi	Energy Assessment (English)	06/82	3778-BU
	Petroleum Supply Management (English)	01/84	012/84
	Status Report (English and French)	02/84	011/84
	Presentation of Energy Projects for the Fourth Five-Year Plan (1983-1987) (English and French)	05/85	036/85
	Improved Charcoal Cookstove Strategy (English and French)	09/85	042/85
	Peat Utilization Project (English)	11/85	046/85
	Energy Assessment (English and French)	01/92	9215-BU
Cape Verde	Energy Assessment (English and Portuguese)	08/84	5073-CV
	Household Energy Strategy Study (English)	02/90	110/90
Comoros	Energy Assessment (English and French)	01/88	7104-COM
Congo	Energy Assessment (English)	01/88	6420-COB
	Power Development Plan (English and French)	03/90	106/90
Côte d'Ivoire	Energy Assessment (English and French)	04/85	5250-IVC
	Improved Biomass Utilization (English and French)	04/87	069/87
	Power System Efficiency Study (Out of Print)	12/87	--
	Power Sector Efficiency Study (French)	02/92	140/91
Ethiopia	Energy Assessment (English)	07/84	4741-ET
	Power System Efficiency Study (English)	10/85	045/85
	Agricultural Residue Briquetting Pilot Project (English)	12/86	062/86
	Bagasse Study (English)	12/86	063/86
	Cooking Efficiency Project (English)	12/87	--

Country	*Activity*	*Date*	*Number*
Gabon	Energy Assessment (English)	07/88	6915-GA
The Gambia	Energy Assessment (English)	11/83	4743-GM
	Solar Water Heating Retrofit Project (English)	02/85	030/85
	Solar Photovoltaic Applications (English)	03/85	032/85
	Petroleum Supply Management Assistance (English)	04/85	035/85
Ghana	Energy Assessment (English)	11/86	6234-GH
	Energy Rationalization in the Industrial Sector (English)	06/88	084/88
	Sawmill Residues Utilization Study (English)	11/88	074/87
Guinea	Energy Assessment (Out of Print)	11/86	6137-GUI
Guinea-Bissau	Energy Assessment (English and Portuguese)	08/84	5083-GUB
	Recommended Technical Assistance Projects (English & Portuguese)	04/85	033/85
	Management Options for the Electric Power and Water Supply Subsectors (English)	02/90	100/90
	Power and Water Institutional Restructuring (French)	04/91	[illegible]8/91
Kenya	Energy Assessment (English)	05/82	3800-KE
	Power System Efficiency Study (English)	03/84	014/84
	Status Report (English)	05/84	016/84
	Coal Conversion Action Plan (English - Out of Print)	02/87	--
	Solar Water Heating Study (English)	02/87	066/87
	Peri-Urban Woodfuel Development (English)	10/87	076/87
	Power Master Plan (English - Out of Print)	11/87	--
Lesotho	Energy Assessment (English)	01/84	4676-LSO
Liberia	Energy Assessment (English)	12/84	5279-LBR
	Recommended Technical Assistance Projects (English)	06/85	038/85
	Power System Efficiency Study (English)	12/87	081/87
Madagascar	Energy Assessment (English)	01/87	5700-MAG
	Power System Efficiency Study (English and French)	12/87	075/87
Malawi	Energy Assessment (English)	08/82	3903-MAL
	Technical Assistance to Improve the Efficiency of Fuelwood Use in the Tobacco Industry (English)	11/83	009/83
	Status Report (English)	01/84	013/84
Mali	Energy Assessment (English and French)	11/91	8423-MLI
	Household Energy Strategy (English and French)	03/92	147/92
Islamic Republic of Mauritania	Energy Assessment (English and French)	04/85	5224-MAU
	Household Energy Strategy Study (English and French)	07/90	123/90
Mauritius	Energy Assessment (English)	12/81	3510-MAS
	Status Report (English)	10/83	008/83
	Power System Efficiency Audit (English)	05/87	070/87
	Bagasse Power Potential (English)	10/87	077/87
Mozambique	Energy Assessment (English)	01/87	6128-MOZ
	Household Electricity Utilization Study (English)	03/90	113/90
Niger	Energy Assessment (French)	05/84	4642-NIR
	Status Report (English and French)	02/86	051/86
	Improved Stoves Project (English and French)	12/87	080/87
	Household Energy Conservation and Substitution (English and French)	01/88	082/88
Nigeria	Energy Assessment (English)	08/83	4440-UNI

Country	*Activity*	*Date*	*Number*
Rwanda	Energy Assessment (English)	06/82	3779-RW
	Energy Assessment (English and French)	07/91	8017-RW
	Status Report (English and French)	05/84	017/84
	Improved Charcoal Cookstove Strategy (English and French)	08/86	059/86
	Improved Charcoal Production Techniques (English and French)	02/87	065/87
	Commercialization of Improved Charcoal Stoves and Carbonization Techniques Mid-Term Progress Report (English and French)	12/91	141/91
SADCC	SADCC Regional Sector: Regional Capacity-Building Program for Energy Surveys and Policy Analysis (English)	11/91	--
Sao Tome and Principe	Energy Assessment (English)	10/85	5803-STP
Senegal	Energy Assessment (English)	07/83	4182-SE
	Status Report (English and French)	10/84	025/84
	Industrial Energy Conservation Study (English)	05/85	037/85
	Preparatory Assistance for Donor Meeting (English and French)	04/86	056/86
	Urban Household Energy Strategy (English)	02/89	096/89
Seychelles	Energy Assessment (English)	01/84	4693-SEY
	Electric Power System Efficiency Study (English)	08/84	021/84
Sierra Leone	Energy Assessment (English)	10/87	6597-SL
Somalia	Energy Assessment (English)	12/85	5796-SO
Sudan	Management Assistance to the Ministry of Energy and Mining	05/83	003/83
	Energy Assessment (English)	07/83	4511-SU
	Power System Efficiency Study (English)	06/84	018/84
	Status Report (English)	11/84	026/84
	Wood Energy/Forestry Feasibility (English - Out of Print)	07/87	073/87
Swaziland	Energy Assessment (English)	02/87	6262-SW
Tanzania	Energy Assessment (English)	11/84	4969-TA
	Peri-Urban Woodfuels Feasibility Study (English)	08/88	086/88
	Tobacco Curing Efficiency Study (English)	05/89	102/89
	Remote Sensing and Mapping of Woodlands (English)	06/90	--
	Industrial Energy Efficiency Technical Assistance (English - Out of Print)	08/90	122/90
Togo	Energy Assessment (English)	06/85	5221-TO
	Wood Recovery in the Nangbeto Lake (English and French)	04/86	055/86
	Power Efficiency Improvement (English and French)	12/87	078/87
Uganda	Energy Assessment (English)	07/83	4453-UG
	Status Report (English)	08/84	020/84
	Institutional Review of the Energy Sector (English)	01/85	029/85
	Energy Efficiency in Tobacco Curing Industry (English)	02/86	049/86
	Fuelwood/Forestry Feasibility Study (English)	03/86	053/86
	Power System Efficiency Study (English)	12/88	092/88
	Energy Efficiency Improvement in the Brick and Tile Industry (English)	02/89	097/89
	Tobacco Curing Pilot Project (English - Out of Print)	03/89	UNDP Terminal Report
Zaire	Energy Assessment (English)	05/86	5837-ZR
Zambia	Energy Assessment (English)	01/83	4110-ZA
	Status Report (English)	08/85	039/85
	Energy Sector Institutional Review (English)	11/86	060/86

Country	*Activity*	*Date*	*Number*
Zambia	Power Subsector Efficiency Study (English)	02/89	093/88
	Energy Strategy Study (English)	02/89	094/88
	Urban Household Energy Strategy Study (English)	08/90	121/90
Zimbabwe	Energy Assessment (English)	06/82	3765-ZIM
	Power System Efficiency Study (English)	06/83	005/83
	Status Report (English)	08/84	019/84
	Power Sector Management Assistance Project (English)	04/85	034/85
	Petroleum Management Assistance (English)	12/89	109/89
	Power Sector Management Institution Building (English - Out of Print)	09/89	--
	Charcoal Utilization Prefeasibility Study (English)	06/90	119/90
	Integrated Energy Strategy Evaluation (English)	01/92	8768-ZIM

EAST ASIA AND PACIFIC (EAP)

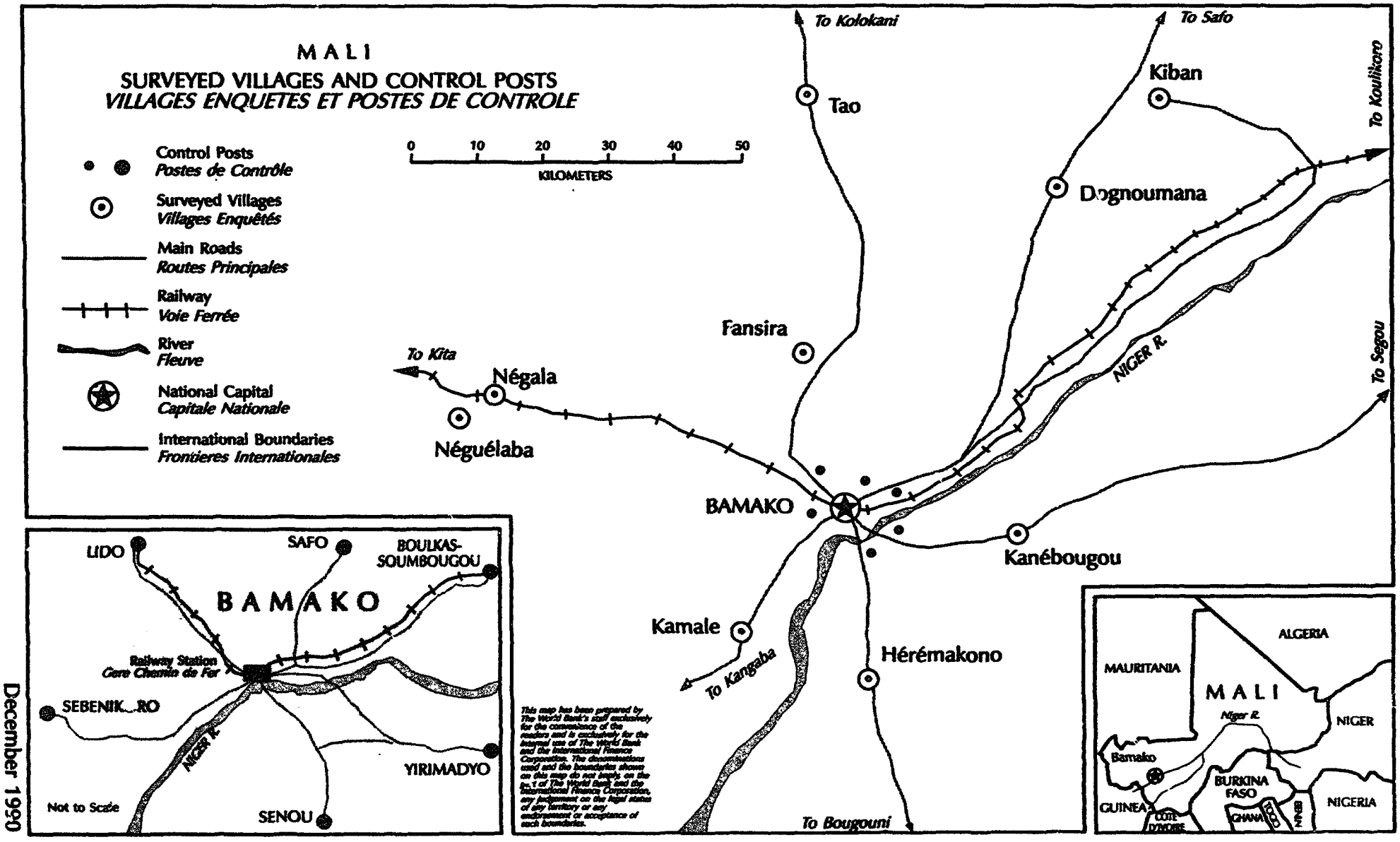
Asia Regional	Pacific Household and Rural Energy Seminar (English)	11/90	--
China	County-Level Rural Energy Assessments (English)	05/89	101/89
	Fuelwood Forestry Preinvestment Study (English)	12/89	105/89
Fiji	Energy Assessment (English)	06/83	4462-FIJ
Indonesia	Energy Assessment (English)	11/81	3543-IND
	Status Report (English)	09/84	022/84
	Power Generation Efficiency Study (English)	02/86	050/86
	Energy Efficiency in the Brick, Tile and Lime Industries (English)	04/87	067/87
	Diesel Generating Plant Efficiency Study (English)	12/88	095/88
	Urban Household Energy Strategy Study (English)	02/90	107/90
	Biomass Gasifier Preinvestment Study Vols. I & II (English)	12/90	124/90
Malaysia	Sabah Power System Efficiency Study (English)	03/87	068/87
	Gas Utilization Study (English)	09/91	9645-MA
Myanmar	Energy Assessment (English)	06/85	5416-BA
Papua New Guinea	Energy Assessment (English)	06/82	3882-PNG
	Status Report (English)	07/83	006/83
	Energy Strategy Paper (English - Out of Print)	--	--
	Institutional Review in the Energy Sector (English)	10/84	023/84
	Power Tariff Study (English)	10/84	024/84
Solomon Islands	Energy Assessment (English)	06/83	4404-SOL
South Pacific	Petroleum Transport in the South Pacific (English-Out of Print)	05/86	--
Thailand	Energy Assessment (English)	09/85	5793-TH
	Rural Energy Issues and Options (English - Out of Print)	09/85	044/85
	Accelerated Dissemination of Improved Stoves and Charcoal Kilns (English - Out of Print)	09/87	079/87
	Northeast Region Village Forestry and Woodfuels Preinvestment Study (English)	02/88	083/88
Thailand	Impact of Lower Oil Prices (English)	08/88	--
	Coal Development and Utilization Study (English)	10/89	--
Tonga	Energy Assessment (English)	06/85	5498-TON

Country	*Activity*	*Date*	*Number*
Vanuatu	Energy Assessment (English)	06/85	5577-VA
Western Samoa	Energy Assessment (English)	06/85	5497-WSO
	SOUTH ASIA (SAS)		
Bangladesh	Energy Assessment (English)	10/82	3873-BD
	Priority Investment Program	05/83	002/83
	Status Report (English)	04/84	015/84
	Power System Efficiency Study (English)	02/85	031/85
	Small Scale Uses of Gas Prefeasibility Study (English - (Out of Print)	12/88	--
India	Opportunities for Commercialization of Nonconventional Energy Systems (English)	11/88	091/88
	Maharashtra Bagasse Energy Efficiency Project (English)	05/91	120/91
	Mini-Hydro Development on Irrigation Dams and Canal Drops Vols. I, II and III (English)	07/91	139/91
Nepal	Energy Assessment (English)	08/83	4474-NEP
	Status Report (English)	01/85	028/84
Pakistan	Household Energy Assessment (English - Out of Print)	05/88	--
	Assessment of Photovoltaic Programs, Applications, and Markets (English)	10/89	103/89
Sri Lanka	Energy Assessment (English)	05/82	3792-CE
	Power System Loss Reduction Study (English)	07/83	007/83
	Status Report (English)	01/84	010/84
	Industrial Energy Conservation Study (English)	03/86	054/86
	EUROPE AND CENTRAL ASIA (ECA)		
Portugal	Energy Assessment (English)	04/84	4824-PO
Turkey	Energy Assessment (English)	03/83	3877-TU
	MIDDLE EAST AND NORTH AFRICA (MNA)		
Morocco	Energy Assessment (English and French)	03/84	4157-MOR
	Status Report (English and French)	01/86	048/86
Syria	Energy Assessment (English)	05/86	5822-SYR
	Electric Power Efficiency Study (English)	09/88	089/88
	Energy Efficiency Improvement in the Cement Sector (English)	04/89	099/89
	Energy Efficiency Improvement in the Fertilizer Sector(English)	06/90	115/90
Tunisia	Fuel Substitution (English and French)	03/90	--
	Power Efficiency Study (English and French)	02/92	136/91
	Energy Management Strategy in the Residential and Tertiary Sectors (English)	04/92	146/92
Yemen	Energy Assessment (English)	12/84	4892-YAR
	Energy Investment Priorities (English - Out of Print)	02/87	6376-YAR
	Household Energy Strategy Study Phase I (English)	03/91	126/91

Country	*Activity*	*Date*	*Number*
	LATIN AMERICA AND THE CARIBBEAN (LAC)		
LAC Regional	Regional Seminar on Electric Power System Loss Reduction in the Caribbean (English)	07/89	--
Bolivia	Energy Assessment (English)	04/83	4213-BO
	National Energy Plan (English)	12/87	--
	National Energy Plan (Spanish)	08/91	131/91
	La Paz Private Power Technical Assistance (English)	11/90	111/90
	Natural Gas Distribution: Economics and Regulation (English)	03/92	125/92
	Prefeasibility Evaluation Rural Electrification and Demand Assessment (English and Spanish)	04/91	129/91
	Private Power Generation and Transmission (English)	01/92	137/91
Chile	Energy Sector Review (English - Out of Print)	08/88	7129-CH
Colombia	Energy Strategy Paper (English)	12/86	--
Costa Rica	Energy Assessment (English and Spanish)	01/84	4655-CR
	Recommended Technical Assistance Projects (English)	11/84	027/84
	Forest Residues Utilization Study (English and Spanish)	02/90	108/90
Dominican Republic	Energy Assessment (English)	05/91	8234-DO
Ecuador	Energy Assessment (Spanish)	12/85	5865-EC
	Energy Strategy Phase I (Spanish)	07/88	--
	Energy Strategy (English)	04/91	--
Haiti	Energy Assessment (English and French)	06/82	3672-HA
	Status Report (English and French)	08/85	041/85
	Household Energy Strategy (English and French)	12/91	143/91
Honduras	Energy Assessment (English)	08/87	6476-HO
	Petroleum Supply Management (English)	03/91	128/91
Jamaica	Energy Assessment (English)	04/85	5466-JM
	Petroleum Procurement, Refining, and Distribution Study (English)	11/86	061/86
	Energy Efficiency Building Code Phase I (English-Out of Print)	03/88	--
	Energy Efficiency Standards and Labels Phase I (English - Out of Print)	03/88	--
	Management Information System Phase I (English - Out of PRint)	03/88	--
	Charcoal Production Project (English)	09/88	090/88
	FIDCO Sawmill Residues Utilization Study (English)	09/88	088/88
Mexico	Improved Charcoal Production Within Forest Management for the State of Veracruz (English and Spanish)	08/91	138/91
Panama	Power System Efficiency Study (English - Out of Print)	06/83	004/83
Paraguay	Energy Assessment (English)	10/84	5145-PA
	Recommended Technical Assistance Projects (English-(Out of Print)	09/85	--
	Status Report (English and Spanish)	09/85	043/85
Peru	Energy Assessment (English)	01/84	4677-PE
	Status Report (English - Out of Print)	08/85	040/85
	Proposal for a Stove Dissemination Program in the Sierra (English and Spanish)	02/87	064/87
	Energy Strategy (Spanish)	12/90	--

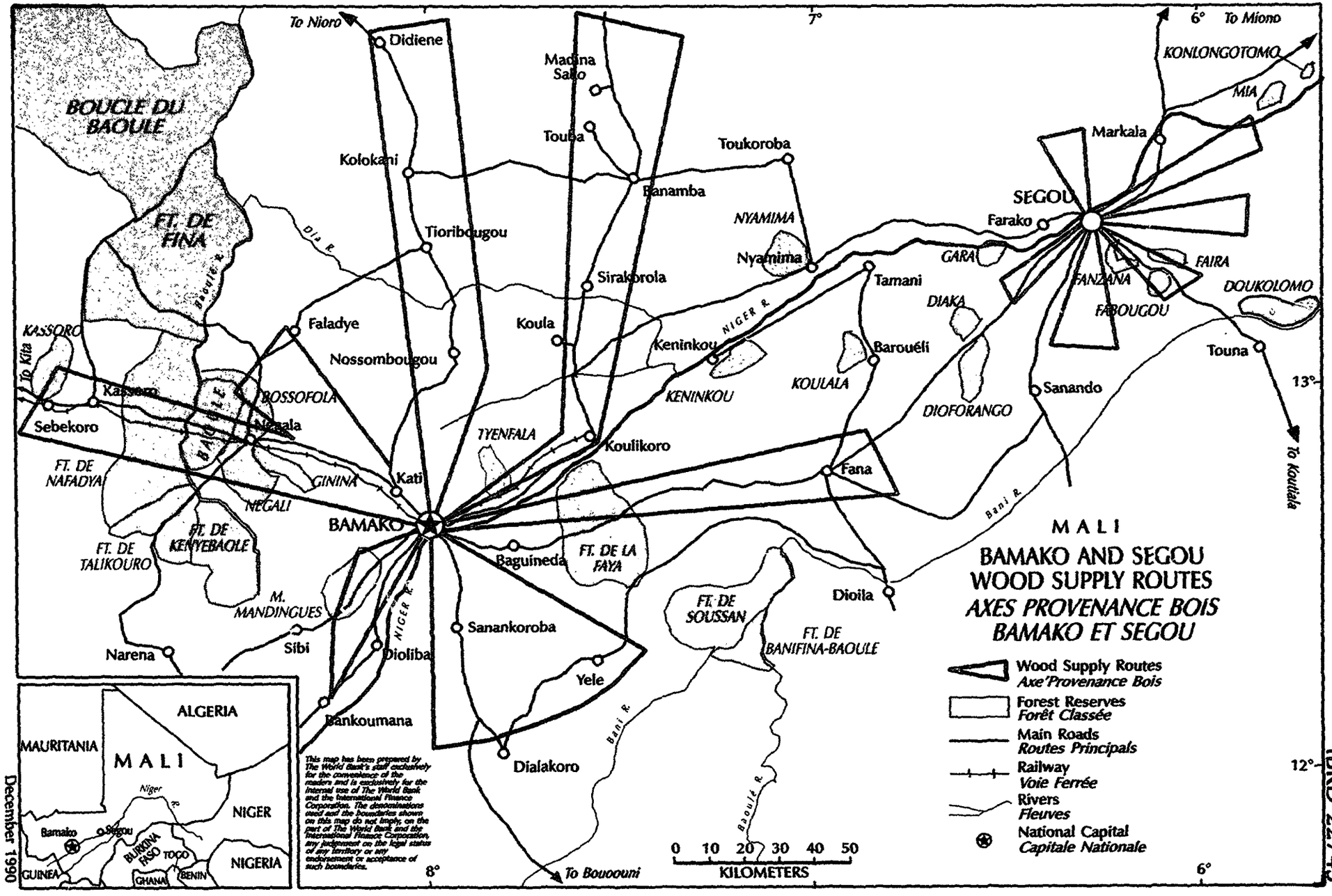
Country	*Activity*	*Date*	*Number*
Saint Lucia	Energy Assessment (English)	09/84	5111-SLU
St. Vincent and the Grenadines	Energy Assessment (English)	09/84	5103-STV
Trinidad and Tobago	Energy Assessment (English - Out of Print)	12/85	5930-TR
	GLOBAL		
	Energy End Use Efficiency: Research and Strategy (English - Out of Print)	11/89	--
	Guidelines for Utility Customer Management and Metering (English and Spanish)	07/91	--
	Women and Energy--A Resource Guide The International Network: Policies and Experience (English)	04/90	--
	Assessment of Personal Computer Models for Energy Planning in Developing Countries (English)	10/91	--

073192



December 1990

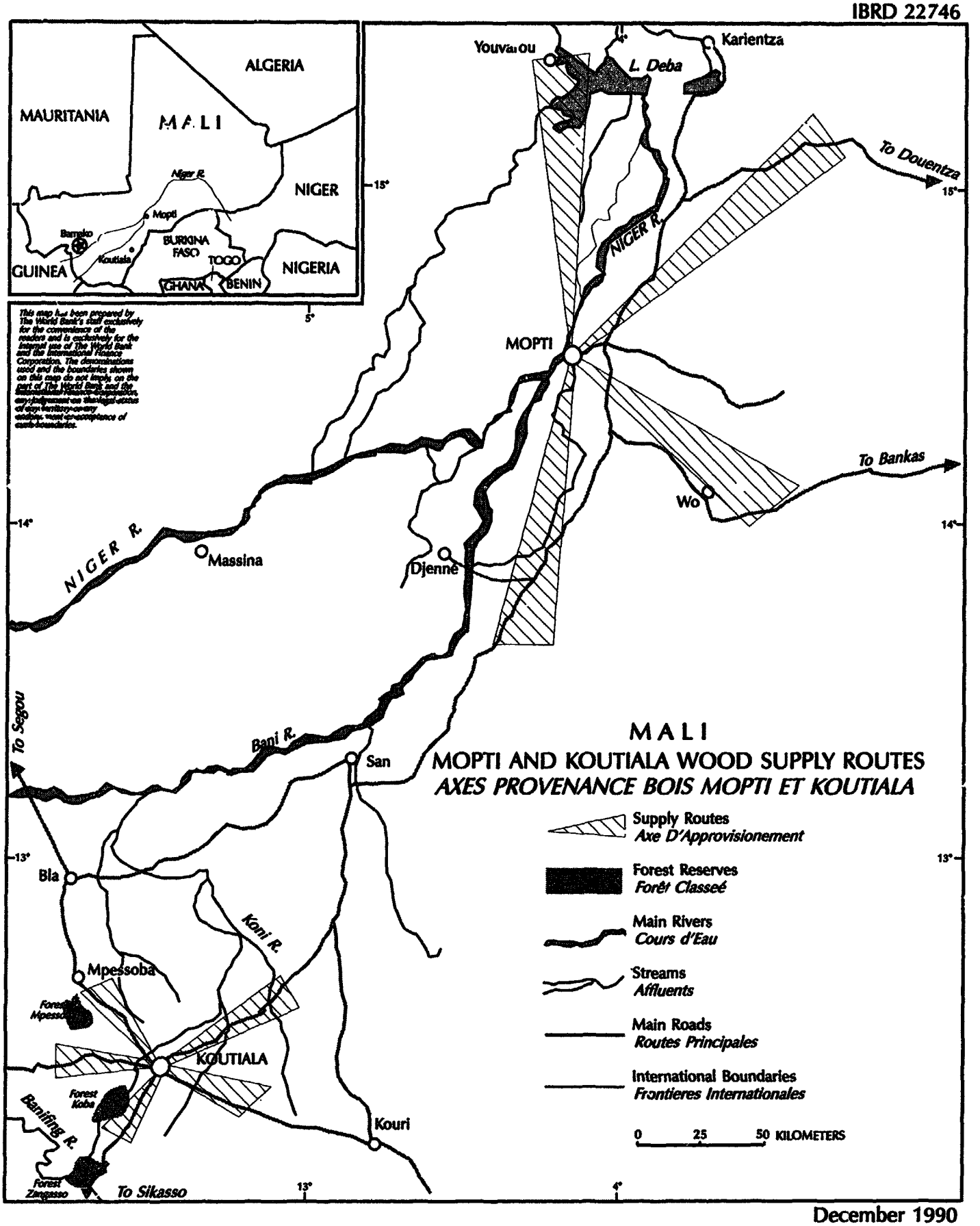
IBRD 22743



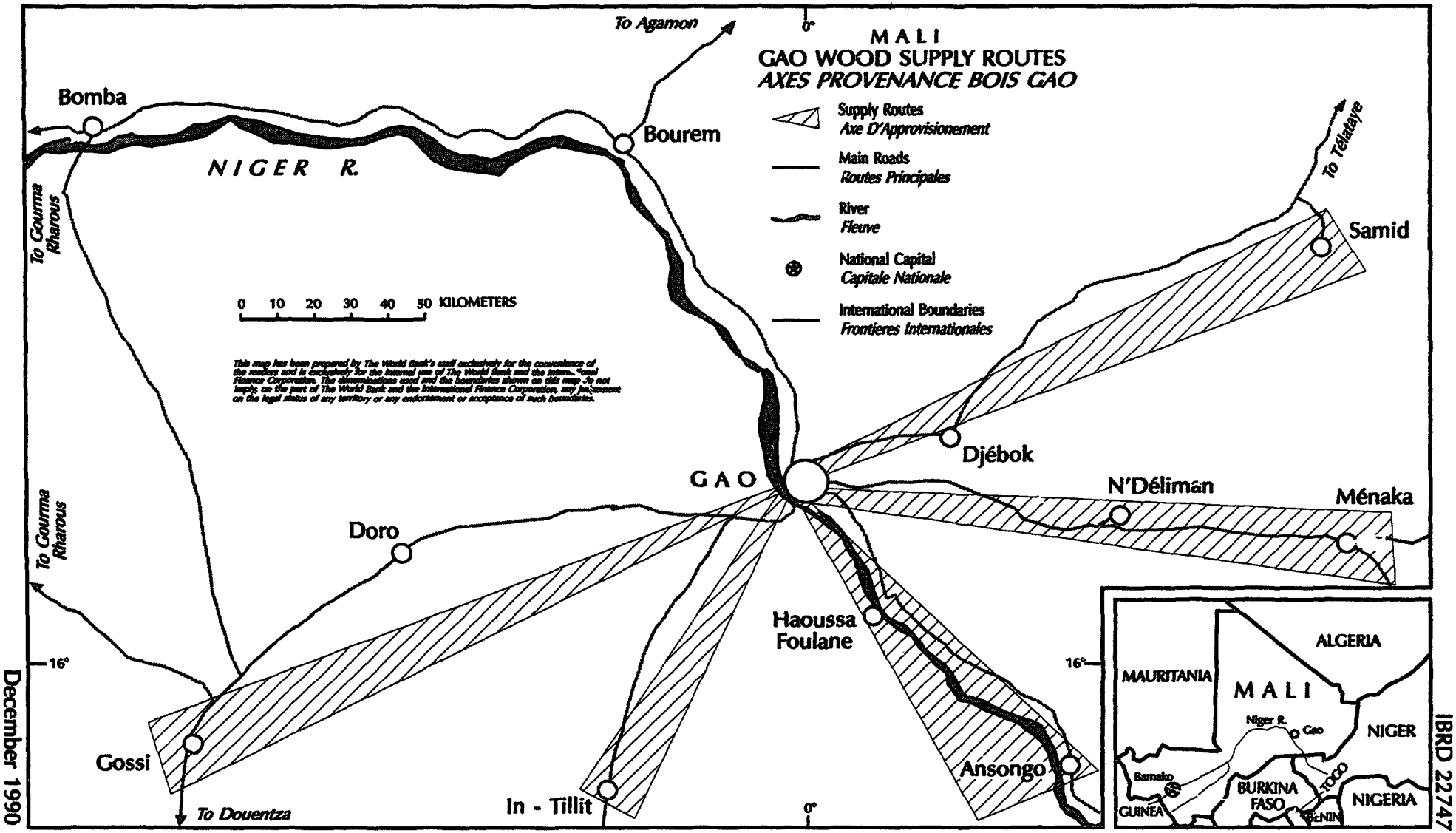
December 1990

IBRD 22745

IBRD 22746



December 1990



December 1990

IBRD 22747