

Mali

Key Indicators

Population 1998 (million)	10.6 million
Population Growth (1998)	2.8%
GDP 1998 (US\$ million)	2.600
GDP Growth 1992-8 (%) / 1998 (%)	3.5% / 5.3%
Inflation Rate (1999)	1% ¹
GDP/capita 1998 (US\$)	250 ²
GDP/capita 1998 (US\$) ppp	790
Foreign direct Investment (US\$ million)	
African Competitiveness ranking	
Human Development Index 1995 (%)	
Local Currency Exchange Rate (Jan. 1999)	1US\$ = 568CFA
Stock Exchange	no
Access to electricity (% of population)	10

Overview

Mali has some good potential opportunities for using renewable and environmentally sound energy technologies for energy service provision in rural areas. A low overall level of electrification, established renewable energy sector and reforming government are all factors which favor such an approach. The threats to successful deployment include a still shaky economy and the limited ability of rural populations to pay for improved energy services.

The energy sector is mostly based on traditional fuels, with a low per capita consumption (0.3 tons oil equivalent). 90% of energy consumed comes from the unsustainable use of fuel-wood. Biomass producing surface has been disappearing at a rate of 9,000ha per year, leading to soil erosion and desertification, and making this the predominant environmental issue linked to energy consumption.

A number of RET programmes, mostly photovoltaic (PV), have been deployed in the country to date. Current efforts focus on promoting promising PV applications whilst continuing development of other technologies such as solar dryers, micro hydro, wind power, small scale gasifiers and biogas digesters. Meanwhile, the government is encouraging private enterprises to take the lead on renewable energy commercialization issues such as distribution, installation, and maintenance of installed systems.

Institutional Profile

¹ Economist Intelligence Unit country Report Mali, 1st quarter 2000

² World Bank World Development Indicators 1999

The National Water and Energy Directorate (DNHE) is Mali's primary governmental institution for implementing national energy policy, regulating the energy sector and the planning of large energy and water projects. It oversees various projects such as the National Program for the Promotion of Butane Gas, the Special Energy Program (PSE) and the Domestic Energy Project, and supervises the operations of a number of entities, included some of those listed in the following table (regional or national research and development organizations are listed in the [organizations](#) section).

Government Energy Organisations

Organisation	Activity
National Water and Energy directorate (DNHE), (National Energy Directorate, energy board within the DNHE)	Implementation and regulation of national energy policy and planning of energy/water projects
Energy Mali (EDM) – national electricity company	Production of electricity and its distribution, support for development of new energy generation projects
National Center for Solar and Renewable Energies (CNESOLER)	R&D and promotion of RE
National Advisory Committee for Improved Stoves (CNCFA)	
National Directorate for Rivers and Forests (DNEF), part of the Ministry of Rural Development and the Environment	Controls exploitation of forest resources, including the production of wood-fuel and charcoal
National directorate of Agriculture (DNA), part of the Ministry of Rural Development and the Environment	Biogas research and production
Planned: creation of a National Energy Committee (CNE)	Facilitate knowledge exchange between global experts and Malian interests

After a stagnant period in Mali's efforts to integrate renewable energy technologies into the energy sector, the government has undertaken a series of reforms to create a more favorable climate for growth. In February 1999, Mali established the **National Energy Directorate**, an energy board within the DNHE that is designed to strengthen coherence and rationality of national energy policy. Other reforms or government-run initiatives that have or are taking place are:

- the extension of the existing electrical grid to new rural and semi-urban sectors close to the interconnected subregion and as well as an intensification of the distribution of electricity in districts already reached. In 2000, EDM plans to have 95,000 subscribers on the grid and in 2005, 143,000;
- the implementation of training and human resource programs for the electric sector. To this end, the government created the **Temporary Management Delegation** and the **National Energy Committee (CNE)** that help inform government officials about modern energy issues to facilitate knowledge exchange between global experts and Malian interests;
- the creation of "solar villages" with a particular emphasis on environmentally-friendly management practices;
- encouraging private enterprises to take the lead on renewable energy commercialization issues such as distribution, installation, and maintenance of systems (see [Business Environment](#)).

Decentralization:

Within the Departments of Health, Education, Rural and Environmental Development, and the Interior, power is being transferred to local levels. [Village associations](#) can therefore now play an increased role in rural energy service provision. Whereas their participation is currently rather limited, they could be particularly useful in providing technical and commercial assistance, as well as in managing credit financing schemes on the ground. '[Associations de ressortissants](#)' (loose organizations of former residents of rural areas who have migrated to urban centers or abroad) are well positioned to take part in rural development programmes, serving as a bridge between private or public energy service or technology providers and the

rural populations. Some, NGO's are already active in the renewable energy field, these often having the capacity for information dissemination and assistance with financing and credit; the Committee for the Coordination of NGO's (CAA-ONG) has been instrumental in implementing over 100 renewable energy projects.

Investment Climate

Macroeconomic Situation:

In 1997, the government continued its successful implementation of an IMF-recommended structural adjustment program that is helping the economy grow, diversify, and attract foreign investment. Economic forecasts look positive for Mali, mostly due to strong performance in agriculture. Annual growth of around 5% is predicted for 1999 and 2000 and inflation expected to remain below 5%.³ Nevertheless, Mali is still heavily indebted, has a significant trade deficit and low per capita GDP.

Economic activity is largely confined to the riverine area irrigated by the Niger, where 80% of the labor force is engaged in either farming or fishing. Industrial activity is largely concentrated on the processing of agricultural products.

Business Environment:

Mali's adherence to economic reform, and the 50% devaluation of the African franc (FCFA) in January 1994, has pushed up economic growth. Several multinational corporations increased gold mining operations in 1996-98, and the government anticipates that Mali will become a major Sub-Saharan gold exporter in the next few years.

The Government has been encouraging private enterprises to take the lead on renewable energy commercialisation issues such as distribution, installation, and maintenance of systems. In 1996, DNHE (National Water and Energy Directorate) signed contracts with 15 private companies for the distribution, installation, and maintenance of solar energy units. As of early 1999, there were more than 20 companies in direct co-operation with the government. The potential exists for more public private partnerships⁴.

Privatisation/Regulation:

The government is pushing to speed up privatisation but the issue remains contentious amongst trade unions.

Power Sector:

In the electricity sector, Mali produced 288 million kWh in 1996 (nothing more recent?), of which fossil fuel constituted 22% and hydro 78%. Only 10% of the population has access to electricity, although imported petrochemicals still constituted 11% of Mali's total imports for 1998.

Price Index (1998 estimates)

Energy source	Cost
Petroleum products	\$/litre
Electricity tariffs	96 FCFA / kWh (\$__)
PV Panels Costs	8,000 to 10,000 FCFA/W _p
SWH Costs	\$/m ²
Water pumped by PV	200 to 250 FCFA/m ³ water

³ Youba Sokona, Enda-Tm, Mali report, p.2

Taxes and Duties

The Economic and Monetary Union of West Africa (UEMOA) recently applied an across-the-board 6% tax to all photovoltaic-related equipment imported from outside the union after January 1. However, the Permanent Interstate Committee for Drought Control in the Sahel (CILSS) has from January 1, 1999 been applying a temporary tax to all photovoltaic equipment of at least 10%.

Renewable Energy Market and Applications

Photovoltaic systems

- Resource Availability

5-7 kWh/m²/day of solar irradiation

- Applications

Rural water access, lighting, battery charging, television and radio, air strips.

- Existing Market Opportunities

PV powered water pumps: 300 sites were equipped with solar powered water pumps between 1978 and 1997. They are used to extract water from underground wells and for irrigation. Costs of the equipment amount to 200 to 250 FCFA/m³ water.

PV lighting: Roughly 2,000 individual and 50 public lighting units are currently installed across Mali, while a cooperative agreement between Mali and India has helped to install 350 individual kits, 15 pumps, and 150 public lamps. Currently, the number of private enterprises dealing with the commercialisation of photovoltaic equipment is over 10; Cost: 8,000 to 10,000 FCFA/Wc.

In addition several large public and private corporations and social community centres use photovoltaics, the former for communications systems, and the latter for refrigeration (cost of which is between 15.000 to 20.000 FCFA/Wc).

More than 80% of all installed systems are reported to be still operable. The following PV market study was carried out by AFRITEC Consulting Engineers:

POTENTIAL AND REALIZABLE MARKETS

	Size of Potential market	Size of realizable market
kWp	41,000	1,000
number of kits	820,000	20,000

For this study, the upper income households represent 30% of the realizable market, middle income households 40%, and low-income households 30%⁵. The rural population accounts for 85% of the realizable market

⁵ Upper income annually: CFA 1,200,000 to 6,000,000, or approximately US\$ 2,400 to 12,000; Middle income annually: CFA 480,000 to 1,200,000 or approximately US\$ 960 to 2,400

- Origin of Hardware

Biomass/gas

- Resource Availability
Jatropha, vegetable oil, sugar cane, crop residues
- Applications
Gasifiers, biogas digestors⁶, biofuels (oil and alcohol)⁷
- Existing Market Opportunities
- Origin of Hardware

Small Hydro

- Resource
Nearly 1050 MW of electricity are estimated to be stored in 20,000km² of water surface at a production capacity of 5.000 GWh/year.
- Application
Grid electrification
- Existing Market Opportunities
At present, only 50MW of the hydro potential are exploited.
- Origin of Hardware

Wind

- Resource Availability
- Existing Market Opportunities
Wind power is used to pump water and to generate electricity.
- Origin of Hardware
From 1982 hundreds of windmills have been built at an artisan's centre in Ségou; CNESOLER designed, built and marketed a series of small-scale windmills designed for the irrigation of fields and orchards
However, due to the lack of spare parts, the inadequacy of the equipment for the application and technological immaturity several programmes have so far failed (AEROMOTOR windpumps in the 1960's, SAHORES wind pumps in CMDT villages during the 1980's, LESO wind pumps).

⁶ The Malian Textile Company (CMDT) have built several types of biogas digesters for cooking, lighting, and to power industry. Between 1987 and 1991, the division of Agriculture Mechanisation built 50 simple, inexpensive clay digesters for the PSE, and a Catholic mission in Ségou built digesters of various sizes.

⁷ The Special Energy Programme (PSE) has worked on fuel substitution using the oil of the physic nut (*Jatropha curasm*). During the 1970s, alcohol made from sugar cane was also experimented with.

Solar Water Heating

- Resource Availability
5-7 kWh/m²/day of solar irradiation
- Applications
Crop drying, water heating,
- Existing Market Opportunities
Shell-type solar dryers were recently introduced in the country and have proven reliable; thermal pumps and water heaters used in the past proved to be less so.
- Origin of Hardware
Various solar thermal technologies, especially solar heaters and dryers, have been conceived, tested, and manufactured in Mali by CNESOLER, universities and other research institutions.

Other

CONVENTIONAL TECHNOLOGIES PRESENTLY USED AND SUBSTITUTION POSSIBILITIES

Conventional Technologies	Energy Source	Consumption	Possible Substitutions
Wood or charcoal stove	wood	1-2.5 kg/pers/day	Biogas stove for cooking and solar thermal for water heating
Candle	paraffin	5.5-7.2 g/hour	PV* lighting kit
Oil lamp	cocoa butter	-	PV lighting kit
Kerosene lamp (wick)	kerosene	16-39 g/hour	PV lighting kit
Kerosene refrigerator	kerosene	1 liter/day	PV refrigerator
Generator set (600 W)	petrol	0.475 liter/hour	PV electrification system
Moto pump (2.5 kW)	petrol	0.7 liter/hour	PV pump
Flash light and radio/cassette player	dry cells	2 in 20 hours	PV Charging system + rechargeable cells
Battery powered TV	grid or generator set + transport	2 to 3 recharges per month	PV battery charger or PV electrification kit

* PV = photovoltaic

Source: Present Utilization and Future Prospects...

RELIABILITY OF RENEWABLE ENERGY TECHNOLOGIES IN MALI

Technology	Number introduced	Power (kW)	% still functioning

Photovoltaic pumps	250	350	80
Telecommunication systems	50	150	>80
Lighting kits	4,000	200	>80
PV refrigerators	40	12	>80
Solar thermal refrigerators	3	n.c.	0
Solar thermal pumps	3	82	0
Solar water heaters	300	-	<10
Solar dryers	60	-	>80
Wind pumps	169	-	<10
Biogas digesters	about 30	-	<10

Programmes and Organisations

<i>Organisation</i>	<i>Project</i>	<i>Contact</i>
ENDA-TM	Multipurpose Platform, installation of 45 platforms, including 14 water and/or electricity networks, plan 450 platforms 1999-2003, to make rural energy services accessible to support productive activities for the rural poor, part. women Funding from UNIDO, IFAD, UNDP	Enda-tm : Environnement- Developpement du tiers monde Tel: (221) 822 24 96, 822 24 96 Fax : (221) 821 75 95 Email : energy2@enda.sn Postal address: B.P. 3370 Dakar Dakar, Senegal Office address: 54, rue Carnot Dakar, Senegal
UNDP/Ministry of Industry, Trade and Handicraft	Multipurpose Platform, (1996-98) additional partners including the EU, French Co-operation, UNCDF, World Vision	

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2. NGOs and Research Institutions Active in Solar Energy

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Economist Intelligence Unit

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