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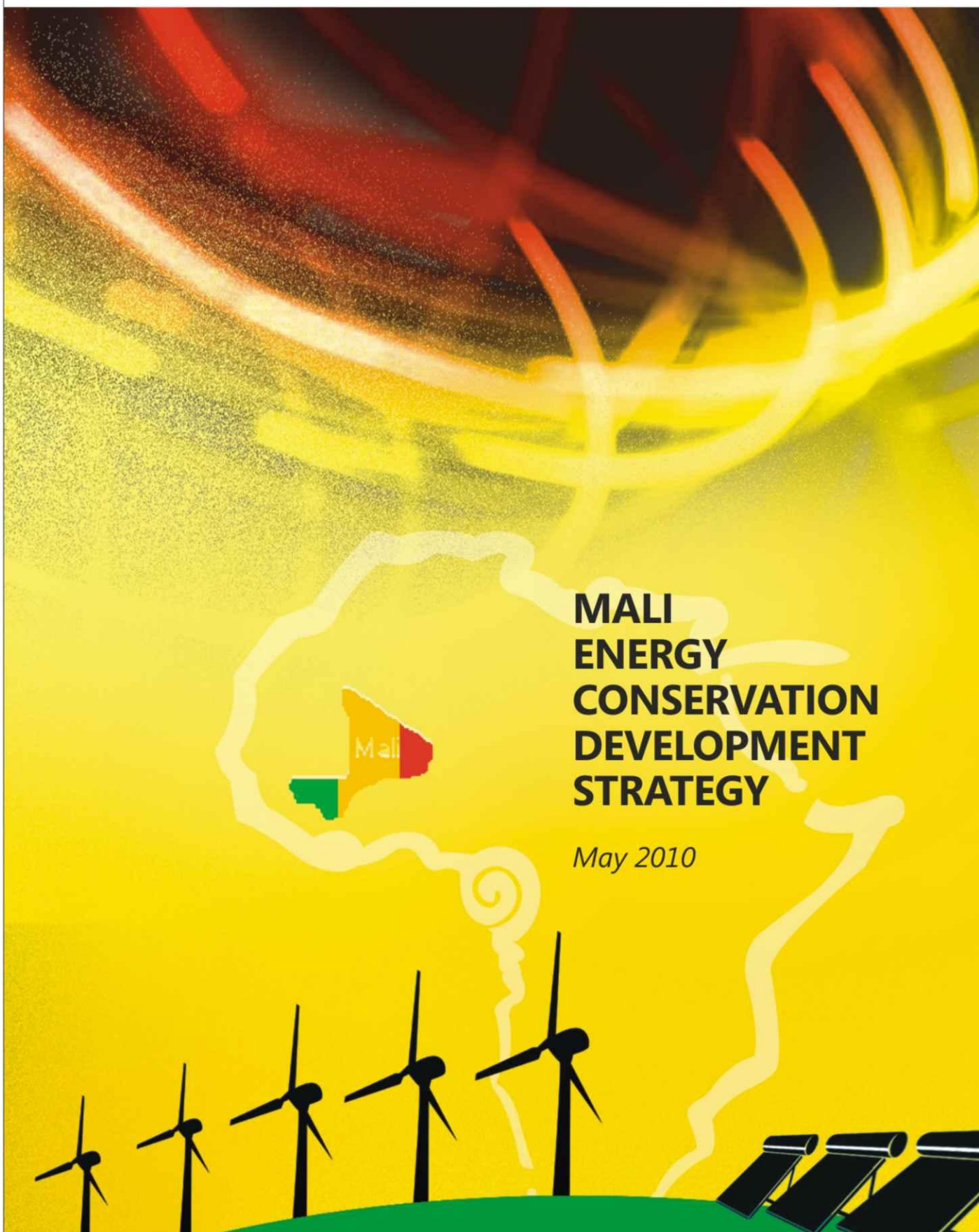

MALI ENERGY CONSERVATION DEVELOPMENT STRATEGY

May 2010

AFRICAN DEVELOPMENT BANK

MALI
ENERGY CONSERVATION DEVELOPMENT STRATEGY

COUNTRY REGIONAL DEPARTMENT, WEST II
ORWB
MAY 2010

This study was conducted under the responsibility of its authors. The views expressed therein do not necessarily reflect those of the Country Regional Department, West II, or of the African Development Bank (ADB) Group.

Foreword

As part of its support to the Government of Mali and, in particular, the Ministry of Energy and Water, the Country Regional Department, West II (ORWB) of the African Development Bank, through the Mali Field Office, MLFO, recruited ECO Ser/Tunisie Consultancy Firm to define a coherent and long-term strategy for creating an environment for scaling up energy conservation operations in Mali. This theme was selected in close consultation with other Technical and Financial Partners present in Mali.

Two experienced experts conducted the studies in accordance with the Terms of Reference prepared by MLFO. They are: Messrs **Sami Marrouki**: Expert specialised in energy conservation policies and strategies, including institutional, regulatory and technical aspects;

Rafik Missaoui: Economist and financial expert specialised in energy conservation and climate change.

The document consists of strategic thrusts for the development of energy conservation in Mali, and has two components:

- Energy efficiency: demand-side conservation and rational use of energy; and
- Renewable energies, particularly technically mature ones

Specifically, the document contains:

- A brief diagnosis of the status of energy conservation in Mali at the technical, institutional and regulatory levels;
- Strategic thrusts and roadmap for the development of energy conservation in Mali; and
- A response plan by donors, particularly the ADB Group, to support the Malian Government to implement a strategy for scaling up energy conservation.

The recommendations and proposals contained in this document reflect the energy situation in Mali and its development prospects, as well as the changing global energy, economic, technological and environmental context, particularly in relation to climate change.

The data and figures in this report were obtained from official records or were reconstituted based on the assumptions and calculation methods presented in the appendix.

List of Acronyms & Abbreviations

ADB	African Development Bank
AMADER	Mali Agency for the Development of Household Energy and Rural Electrification (*Agence malienne pour le développement de l'énergie domestique et de l'électrification rurale*)
ANADEB	National Agency for the Development of Biofuels (*Agence nationale de développement des biocarburants*)
BRT	Bus Rapid Transit
CDM	Clean Development Mechanism
CERUs	Certified Emission Reduction Units
CNESOLER	National Centre for Solar and Renewable Energy (*Centre National de l'Energie Solaire et des Energies Renouvelables*)
DNE	National Directorate of Energy (*Direction nationale de l'énergie*)
EB	CDM Executive Board
DOE	Designated Operational Entity
CO_2	Carbon Dioxide
COP	Conference of the Parties
CREE	*Electricity and Water Regulation Commission (Commission de régulation de l'électricité et de l'eau)*
EDM.SA	*Energie de Mali* (Mali Energy Company)
DNA	Designated National Authority
EE	Energy Efficiency
EM	Energy Conservation
GHG	Greenhouse Gas
GTZ	German Development Cooperation
HPS	High Pressure Sodium
kTe-CO_2	kilotonnes equivalent-CO_2
kWh	Kilowatt hour
LEC	Low Emissions Certificate
LELB	Low Energy Light Bulb
PIN	Project Idea Note
LPG	Liquefied Petroleum Gas
MEE	Ministry of Energy and Water (*Ministère de l'énergie et de l'eau*)
Mt- CO2e	Metric tonnes of carbon dioxide equivalents
MW	Megawatt (1000 kW)
PASE	Electricity Sector Assistance Project
PDD	Project Design Document
PV	Photovoltaic
R&D	Research and Development
RE	Renewable Energy
SWH	Solar Water Heater
Toe	Tonne of oil equivalent
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UTP	Urban Travel Plan

Summary

Energy conservation - with its two components, energy efficiency and renewable energy - is now a necessity for Mali, given its energy situation and structural dependency in this area. On this depends its energy security, economic competitiveness and social stability.

Added to these national requirements is the weight of the global context, characterised by an increasingly restrictive collective commitment towards reducing greenhouse gas emissions. The last meeting in Copenhagen confirmed the international community's commitment to maintain the increase in global temperature at below two degrees Celsius (2°C) by 2100. To this end, substantial financial resources are being mobilised for adaptation and mitigation projects in developing countries: USD 30 billion yearly, between 2010 and 2012, to be increased to USD 100 billion by 2020.

It is therefore in Mali's best interest to engage in a policy of long-term energy conservation, with the support of its Technical and Financial Partners (TFPs). This policy will build on the approach already adopted by the Malian Government in the area of energy-efficient rural electrification and domestic energy rationalisation.

In that regard, the five-year (2010-2014) energy conservation programme proposed in this document should help to achieve combined primary energy savings of about 180 ktoe over the duration of the programme, or over 20 percent of the non-wood primary energy consumption. For the duration of the measures, the total primary energy savings would be about 865 ktoe, equivalent to one year of national consumption.

This five-year programme consists of 17 activities aimed at demand-side energy conservation in various sectors of activity and the diversification of energy supply in Mali. These activities cover the following sectors: (i) residential, with 5 measures; (ii) tertiary, with 4 measures; (iii) industrial, with 3 measures; (iv) transport, with 2 measures; and (v) electricity production from renewable resources, with 3 measures.

The five-year programme is expected to be accompanied by a series of horizontal activities geared towards preparing major projects, national capacity building and communication as well as the promotion of energy conservation in Mali.

The cost of TOE saved, derived from the proposed programme, is about USD 110/TOE, compared to about USD 600/TOE of oil products on the international market, hence its importance for Mali.

The cumulative CO2 emissions avoided for the duration of the programme is estimated at around 573 kteCO2, worth approximately USD 6 million, under the Clean Development Mechanism (CDM).

To facilitate the implementation of the five-year programme and lay the groundwork for an operational policy for long-term energy conservation, it is essential to designate a structure devoted specifically to energy conservation activity. This structure could be established through a gradual process starting with an embryonic unit that evolves into an agency. In this case, back-up action is needed to transform this unit both organisationally and institutionally.

In the short-term, this structure will be required to implement a programme of support measures to operationalise the policy and the five-year programme. These support measures consist of capacity building, technical assistance and project preparation studies.

The total cost of the five-year programme is about USD 96 million, to be financed up to 83 percent by the private sector and the rest by the government and donors. It is worth indicating the importance of financing mechanisms in the multiplying effect of financial resources allocated to the programme. To that end, a Revolving Fund backed by a mechanism for the distribution of efficient bulbs is proposed as part of the implementation of the energy efficiency component of the PASE.

The cost of the support programme is estimated at about USD 4.5 million, to be financed mainly by donors.

The World Bank-financed PASE is an ideal opportunity to initiate the strategy and the five-year programme, as it provides immediately available funding. In that regard, it is recommended to harmonise the activities of the PASE with the priorities from the five-year programme. Nonetheless, the financial support of other cooperation partners, such as ADB, AFD, KfW, GTZ, etc., is essential to support the Government in implementing its programme.

Lastly, in order to get sector players to embrace the Government's energy conservation policy and the implementation of its five-year programme, a national conference on this theme is proposed with a view to building a consensus on the choices made and directly involving the stakeholders concerned.

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1 Introduction

Carrying out real reforms in energy conservation is a delicate process because of its special characteristics.

Firstly, energy conservation is a cross-cutting activity involving the transport sector, building, households, industry or even agriculture. However, this cross-cutting approach is not common in our thought structures or organisation and consumption styles. Both government and corporate actors prefer to sectorize activities.

Secondly, even in the case of a well organised and well resourced national policy, actions to be carried out in this domain depend on a multiplicity of actors, who sometimes have conflicting goals and interests.

These two characteristics make energy conservation a rather special domain where the facilitation, liaising and organisation of partnerships among actors constitute decisive factors. The institution of an energy conservation policy is thus an iterative process of constant consultation between the key players.

This document provides a basis for the establishment of the first prerequisites of this process. It outlines the main thrusts of an energy conservation strategy for the Ministry of Energy and Water (MEE) that is based on strengthening the guidelines and ongoing activities within the framework of Mali's energy policy, and implementing a five-year energy conservation development programme over the 2010 to 2014 period.

The document also outlines the support and technical assistance activities for operationalising the strategic thrusts of energy conservation by proposing an institutional and regulatory arrangement as well as incentives for the establishment of an optimal framework for promoting energy conservation in Mali, with its two components (i.e. energy efficiency and renewable energy).

2 Mission Context

2.1 Explanatory Statement

Currently, all countries, whether developed or developing, are subject to three major constraints that require them to define an energy change strategy: market pressures and rising oil prices, long-term energy security needs and degradation of the climate, with increasing local impacts.

The situation is of even greater concern in countries like Mali, which has no conventional energy resources and is totally dependent on external sources for its energy supply.

The constraint of the country's energy dependence will worsen in future under the combined effects of rising global oil prices and the expected increase in domestic demand for energy resulting from improved living standards and the phenomenal development of residential and commercial buildings in the country.

However, acting solely on the development of supply has shown its limitations, given the ever increasing volume of investment required compared to the increasingly limited public resources, also in high demand by other essential public sectors (education, health, basic infrastructure, etc.).

To allow the maintenance or development of less energy-intensive economic activities, efforts must focus on three areas: moderation in energy consumption, both in individual behaviour and in organisations; energy efficiency and use of renewable energy.

Such effort must be reflected in a clear, stable and long-term proactive energy conservation policy, with the following objectives:

- Guarantee the country's energy supply security through resource diversification and, particularly, making ample use of renewable energy;
- Enhance the competitiveness of economic sectors by improving their energy performance;
- Ease the pressure on the budget of households by reducing their energy bills;
- Reduce expenditure incurred by Government for direct and/or indirect subsidies on energy products;
- Reduce and ultimately optimise public investments in energy production, especially in the area of power generation; and
- Contribute to global efforts against climate change by reducing greenhouse gas emissions.

This calls for the consideration of energy conservation as an absolute priority for Government and declaring it an area of public utility.

This principle should be practically translated into significant institutional and regulatory arrangements geared towards creating an enabling environment for scaling up energy conservation operations.

It is against this backdrop that the Government Mali, with the support of the African Development Bank (ADB), commissioned this mission of experts to initiate the formulation and implementation of a strategy in this area.

To that end, the experts based their intervention methodology on:

- A diagnostic mission to Mali from 14 to 18 December 2009;
- The identification of strategic thrusts and the preparation of a five-year (2010 to 2014) energy conservation programme; and
- A mission to Mali to enrich and validate the proposals.

2.2 International Context

Soaring energy prices, global warming and climate change adaptation are all factors that, these days, make energy efficiency and alternative energy inevitable in the formulation of national energy policies. For both developed and developing countries, a progressive policy on energy conservation and the development of renewable energy imperatively entails:

- The establishment of a specific institutional framework;
- The implementation of a regulatory mechanism depending on the country's economic situation; and
- The development of incentives to support investments in this area.

Such is the case of countries with successful experience in this domain (for instance the European countries, which are now targeting the 3x20% objective, or even developing countries which have assigned more or less specific objectives). We cite as examples:

- France: With the Environment and Energy Conservation Agency (ADEME), that has developed financing mechanisms, including notably tax credit for the thermal renovation of buildings, solar water heaters (SWH) and eco-buildings, in addition to mandatory provisions relating to consumption standards for buildings and household electrical appliances;
- Germany: With the German Energy Agency (DENA) and regional agencies that have established similar mechanisms to achieve their energy efficiency and renewable energy objectives;
- Algeria: With the Agency for the Promotion and Rational Use of Energy (APRUE), that in recent years has implemented a specific law on energy conservation and set up the national energy conservation fund which serves as a stable resource for financing national programmes adopted by the National Energy Conservation Board;
- Morocco: With support from donors, Morocco in 2009 embarked on the restructuring of its energy sector by converting the Centre for the Development of Renewable Energy (CDER) into the Renewable Energy and Energy Efficiency Development Agency (ADEREE), thus expanding its mission to all energy conservation activities. Morocco is also in the process of introducing an energy code for buildings and financing mechanisms for solar water heaters (SWH) and low energy light bulbs (LELB). A framework law on energy conservation is before parliament; and
- Tunisia: With the National Energy Conservation Agency (ANME), established in the 1980's, to implement Tunisia's energy conservation policy. ANME has for long established a comprehensive regulatory (energy conservation law) and incentive (National Energy Conservation and Tax Benefits Fund) framework that have enabled Tunisia achieve leading performance in the region in terms of energy intensity and rate of penetration of renewable energy.

With regard to the production of renewable electricity, all these countries have adopted an attractive system of feeding tariffs by the electricity companies, which have helped to attract private investors that support such countries' policies in terms energy mix diversification.

2.3 Malian Energy Context

The energy sector in Mali involves highly significant issues for economic development. Energy demand is fast outpacing GDP growth. This will pose problems of economic competitiveness and energy supply security. GDP grows by about 5 percent yearly against 14 percent for primary energy demand, excluding biomass, and by 10 percent for electricity. Furthermore, energy demand weighs heavily on the national budget as Mali's energy bill was estimated in 2007 at CFAF 316 billion, or EUR 486 million. LPG alone accounted for a subsidy of about CFAF 2.79 billion, compared to only CFAF 1.24 billion in 2004.

The apparent energy demand in Mali is dominated by the residential sector, which accounts for about 70 percent of the country's total consumption. This consumption is itself dominated by wood and charcoal. According to 2009 figures, the rate of access to electricity is estimated at 18 percent nationally and 59 percent in urban areas. This rate is set to increase rapidly in the coming years, given the ambitious electrification programmes that will likely increase demand for more conventional energy, especially in the residential sector.

3 Diagnosis of the Situation and Status of Energy Conservation in Mali

3.1 Mali's Energy Balance

In 2007, Mali's[1] overall energy consumption was around 3,500 ktoe, compared to final energy consumption of 2250 ktoe. Final energy requirements are mainly from biomass (78 percent), petroleum products (18 per cent) and electricity (4 percent).

An analysis of Mali's energy data for 2008 shows the following:

- Final energy consumption per capita is about 0.18 Toe. This is rather low compared to Africa's average of 0.5 Toe per capita. Electricity accounts for 300 kWh per capita; and
- Biomass, which accounts for 77 percent of the balance, is essentially used in the form of wood and charcoal. The weight of biomass in the national balance is higher than the African average of 60 percent[2].
- Sector distribution of energy consumption is dominated by the residential sector:
  - Household and tertiary consumption, which accounts for 79 percent of Mali's total consumption, is broken down as follows: firewood: 84 percent; charcoal: 13 percent; electricity: 2 percent and domestic

[1] Source: Mali Energy Information System for Mali, 2008 Report
[2] Source: Senegal Energy Information System

kerosene: 1 percent. Liquefied Petroleum Gas (LPG) accounts for only 0.6 percent, but rose by over 45 percent from 2004 to 2007;

- Transport sector consumption accounts for 17 percent of total consumption, with 88 percent for road transport and 9 percent for air transport;
- Industrial sector consumption is about 3 percent of the balance; with half this amount going to the extractive industries; and
- Agricultural sector consumption is less than one percent of the total.

- The entire volume of petroleum imports (CFAF 171 billion in 2007) is used for electricity production and to cover the needs of the economic sector in varying proportions (transport, building, industry and agriculture).

Mali's energy situation is thus characterized by:

- An energy balance dominated by fuel wood - an indication of the immense pressure on the country's forests. The deforestation rate is about 400,000 hectares per annum, to cater for approximately 6 million tonnes in yearly demand for wood;
- Sharp growth in electricity demand (about 10 percent yearly), leading to major investments to augment power generation capacity as well as transmission and supply;
- Rise in the electrification rate by 4 percent per annum. The rate is currently about 59 percent in urban areas and 12 percent in rural areas; and
- Sharp rise in transport sector consumption, 80 percent of which is due to vehicular movements and 20 percent to the increasing number of vehicles.

3.2 Institutional Framework

Mali's institutional framework for energy conservation is handled by the following institutions:

- The National Energy Directorate (DNE), responsible for formulating energy policy, general planning and coordinating the activities of energy sector stakeholders;
- Energie de Mali (EDM.SA), a para-statal responsible for power generation, transmission and supply. It is also responsible for drinking water supply;
- The National Centre for Solar and Renewable Energy (CNESOLER), established in 1990 to promote and tap the country's renewable energy potential;

- The National Petroleum Products Office (ONAP), established in 1992, and responsible for managing petroleum imports;

- The Electricity and Water Regulatory Commission (CREE), established in 2000, as an independent and autonomous authority responsible for pricing for concessionaires, consumer protection and compliance with market competition;

- The Malian Agency for the Development of Household Energy and Rural Electrification (AMADER), established in 2003, whose main purpose is to manage domestic energy consumption, ensure community forest conservation and develop access to electricity in rural and peri-urban areas; and

- The National Agency for the Development of Bio-fuels (ANADEB), established in 2009, with the prime purpose formulating and implementing the national bio-fuels policy.

Apart from CREE, which is under the supervision of the Prime Minister's Office, the other agencies are all under the supervision of the Ministry of Energy and Water.

3.3 Regulatory Framework

Mali has no regulatory framework for energy conservation.

The existing regulatory framework is limited to the energy sub-sectors. This framework partly deals with the following forms of energy:

- Traditional energy: in terms of organisation of the wood sector;

- Hydrocarbons: mainly for setting standards for petroleum products;

- Electricity: for the organisation of the sector and regulations for power supply for buildings; and

- Renewable energy for tax exemption on equipment and setting up the National Renewable Energy Commission.

3.4 Major Achievements

Mali has made strides solely in the area of streamlining biomass use and promoting renewable energy, mainly decentralised solar energy (lighting and PV powered pumps and solar thermal water heaters); there has been recent work in bio-fuels and pilot work on biogas and wind energy.

Ongoing or recently completed programmes include:

- The Domestic Energy and Rural Access to Basic Services Project (PEDASB) implemented by AMADER (2004-2008) and its extension (ongoing);

- The Regional Solar Programme (PRS) (2003-2008);
- The Village Solar Energy Lighting Project (PEVES) (2003-2006);
- Project to Promote New and Renewable Energy for Women's Advancement, (PENRAF);
- National Jatropha Plant Energy Development Programme (PNVEP) (2004-2008) (ongoing); and
- Low Energy Light Bulb (LELB) Distribution Programme under public-private partnership (ongoing).

Specifically, these programmes led to the following direct outcomes:

- About 688,000 improved household charcoal stoves distributed;
- Over 12,000 kerosene stoves distributed;
- Nearly 300,000 low-energy light bulbs installed; and
- About 1,800 vapour air coolers distributed.

Other organisational outcomes include:

- Support to the establishment of two companies with production capacity of 10,000 tonnes of briquettes yearly;
- Rehabilitation of 282 rural wood markets;;
- Creation of 342 modern charcoal making groups;
- Drawing up master plans for fuel wood supply for 11 towns in Mali; and
- About 873,000 ha of village forests under conservation.

An assessment of these outputs reveals the following:

- Pilot projects to introduce some suitable technologies for Mali's environment in the area of water heating, cooking, drying, pumping systems, etc.;
- Developing the technical capacity of public stakeholders involved in this area; and
- Creation of an initial incentive mechanism for renewable energy (Decree 02-026/P-RM of 30 January 2002 on the suspension of duties and taxes on imported renewable energy equipment, and Decree 09-503 P-RM of 23 September 2009).

3.5 Observation and Barriers

The major barriers currently impeding the natural development of the concept of energy conservation in Mali are:

- Too much focus on the social aspect in energy sector interventions;
- Lack of a consistent framework (energy conservation strategy, annual energy conservation programme, sectoral action plans) to help tap into opportunities in the country;
- Lack of a specific regulatory framework for energy conservation;
- Poor technical know-how in energy conservation, especially in the private sector;
- Uncoordinated institutional oversight of energy conservation; and
- Limited financing and no involvement of the banking sector in this area.

4 Strategic Thrusts and Roadmap for the Development of Energy Conservation in Mali

4.1 Sector Strategy

To define the strategic areas of energy conservation, we first identified the priority sectors, taking into account their weight in the energy balance, their typology, and forms of energy used. The priority intervention areas were then identified, taking into consideration the following:

- Demand-side energy conservation, taking into account the priority sectors;
- Optimising energy supply, by curbing losses and promoting the development of renewable energy to generate grid-connected electricity; and
- Capacity for implementing intervention areas, taking into account the typology of measures recommended and short- and medium-term financing possibilities;

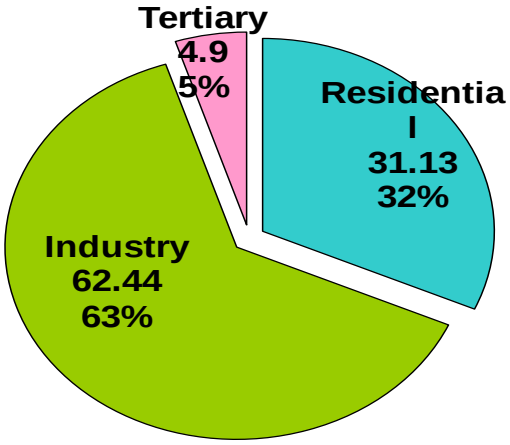
4.1.1 Priority Sectors

An analysis of energy demand and development prospects by type of energy helps to prioritize the sectors to be targeted and determine the categories of measures to be undertaken.

Electricity: the residential sector takes up one-third of total consumption, and industry, two-thirds. In future, consumption will rise for the residential and tertiary sector, as a result of ambitious programmes to extend the electricity network and also the large number of household appliances. Energy conservation activities should thus focus on the residential sector.

Industry: high energy consumption by the industrial sector and the challenges of competition make it imperative to take energy saving measures. Priority should be given to this sector, in the short-term especially, as the recommended measures are easy to implement because of the limited number of high energy consuming industries.

Breakdown of Electricity Consumption by Sector in 2007 (GWh)



Source: DNE, 2008

Total: 89.5 GWh

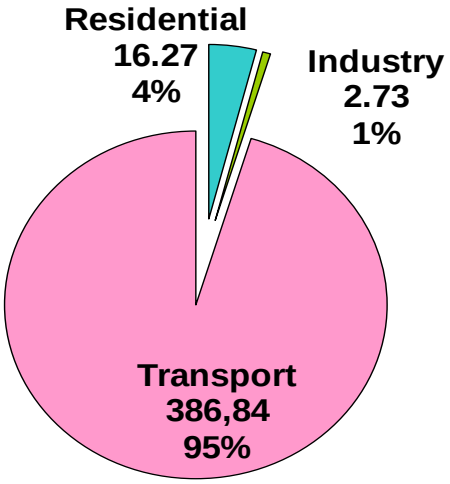
Petroleum products: transport, mainly road, accounts for 95 percent of petroleum products consumption. Residential accounts for only 4 percent, and uses biomass as the major source of thermal energy.

Demand by the transport sector rose sharply over the last few years, with consumption increasing by 160 percent from 2004 to 2007, compared to 40 percent increase for households.

The increased transport sector demand stems from the rise in the number of vehicles (by 20%) and heavy vehicular movement (by 80%).

The sector will certainly pose a challenge for Mali in future, as a result of the urban sprawl, which will generate more movement. Despite difficulties in implementing bold measures in the sector, the Government would stand to gain by introducing a long-term energy conservation policy for the sector.

Breakdown of Petroleum Product Consumption by Sector in 2007 (ktoe)

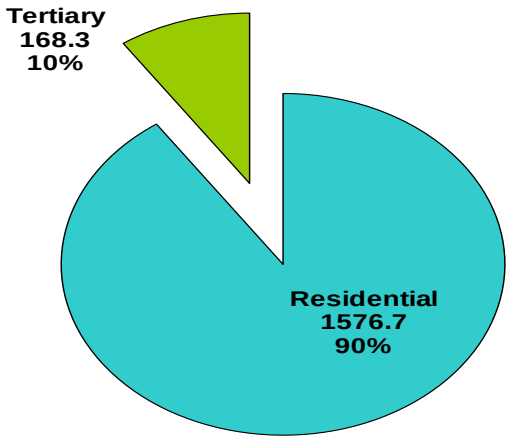


Source: DNE, 2008

Total: 406 ktoe

The use of **biomass** as the primary source of household energy poses a major environmental and social challenge to the country. Reducing biomass consumption in this sector is one major energy policy area under the AMADER programme.

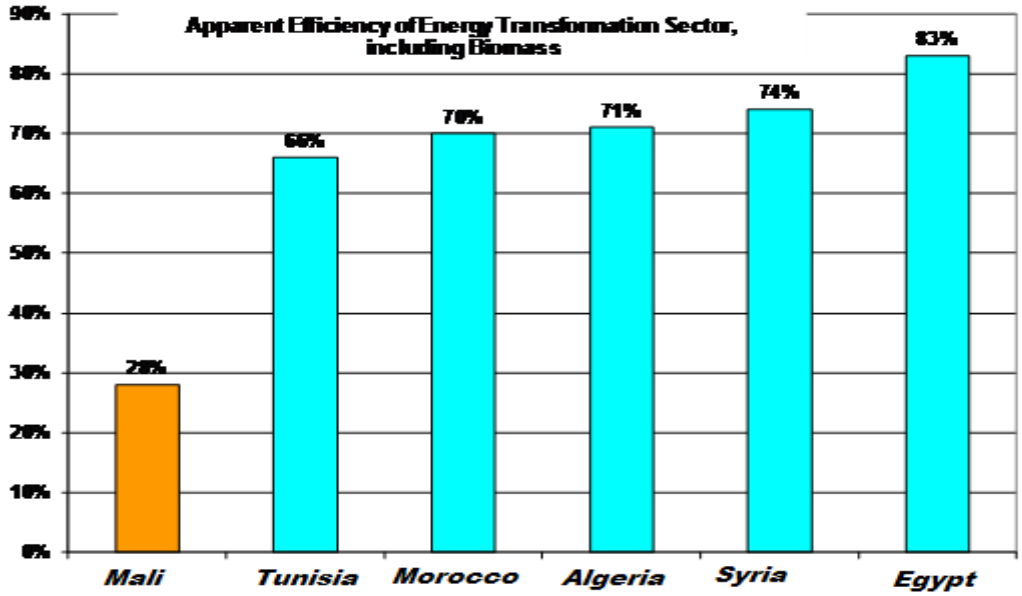
Breakdown of Biomass Consumption by Sector in 2007 (ktoe)



Source: DNE, 2008

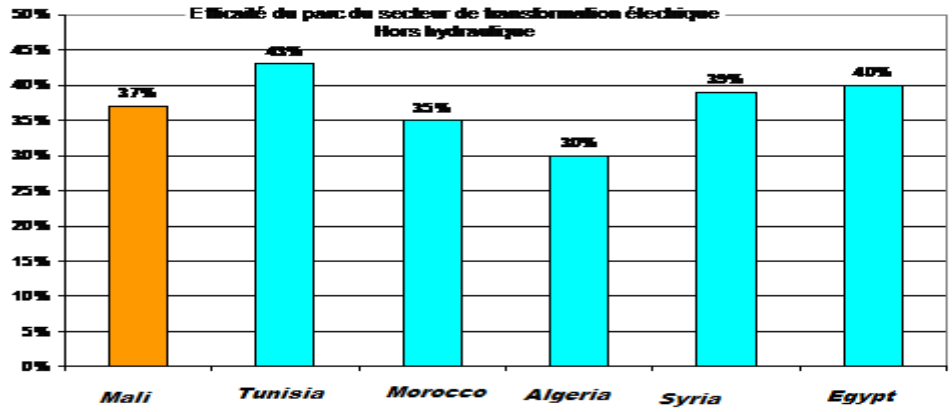
Total: 1745 ktoe

In terms of energy supply, indicators point to poor energy performance by the energy transformation sector. The efficiency ratio of the transformation sector defined as the ratio between final energy and available primary energy is largely below that of other developing countries, as shown by the following graph:



The low efficiency ratio is due to the rampant charcoal production, which yields a mere 15 to 20 percent.

However, the efficiency ratio of electric power plants, minus hydro-electricity, is about 37 percent (electricity production/primary energy input). While this is still low, it is comparable to that of other African countries like Algeria and Morocco, as shown in the graph below.



Moreover, the technical and non-technical losses suffered by EDM.SA are being addressed as part of the MEE's national goals and areas of intervention. The company hopes to reduce:

- Technical losses from 12 to 10 percent; and
- Non-technical losses from seven to five percent.

The analysis above helps to identify certain important pointers, including the need to:

- Redouble efforts to improve charcoal production yields;
- Improve and replace the current power generation facilities and promote the integration of renewable energies into the power generation system (hydro-electricity, wind, thermal-solar, CSP, etc.); and
- Rehabilitate transmission and distribution facilities to curb power losses.

4.1.2 Priority Intervention Areas

The following matrix sums up the sector priorities recommended for the proposed energy conservation strategy.

Sector	Petroleum Product Savings	Management of Demand-side Electricity	Wood Energy Savings	Grid-Connected Renewable Electricity	Reduction of Power Losses
Demand					
Buildings (Residential & Tertiary)					
Industry					
Transport					
Electricity Supply					
Production					
Transmission and Distribution					

Existing strong area
Area to be strengthened

4.1.2.1 Demand-side Electricity Conservation

Demand-side electricity conservation is aimed at the following:

- Postpone or even reduce public investments in electricity generation facilities;
- Bring down the national energy bill by reducing primary energy consumption for power generation;
- Ease the pressure on the budget of households, thereby contributing to poverty reduction;
- Improve competitiveness and viability of the country's economic activities; and

- Lastly, contribute to reducing greenhouse gas emissions, thereby combating climate change.

Two types of measures will be taken for these:

Immediate impact measures: These are essentially large-scale distribution of low-energy light bulbs (LELB) for buildings and street lighting. These measures are an important component of the Electricity Sector Assistance Project (Projet d'Assistance au Secteur Electrique - PASE), under which one million low energy light bulbs will be distributed for the residential sector and administrative buildings, and 15,000 high pressure bulbs will be released for street lighting.

Structural measures, whose impact is felt in the medium-to-long term. These measures mainly include:

- Improved building enclosure energy performance;
- Transformation of the household appliances market (air conditioners, fridges, etc.) into an energy saving one; and
- Development of efficient energy programmes for the industrial sector.

4.1.2.2 Petroleum Product Savings

The transport sector is the main consumer of petroleum products. Energy conservation for the sector often requires major preparatory work, namely:

- Conducting energy efficiency project preparatory studies such as the Bamako Urban Travel Plan (UTP), urban river transport development, clean sites transport (rapid bus transit, tram), etc.;
- Including the transport and mobility component in urban planning, as a means of curbing urban sprawl; and
- Substituting hydrocarbons with bio-fuels by developing Jatropha oil.

4.1.2.3 Wood Energy Savings

Wood energy savings is now a major intervention area of the Malian Government, under AMADER's household energy development initiative.

The social dimension of this form of energy would require more time to implement the measures recommended.

4.1.2.4 Improving Energy Performance for the Electricity Sector

Improving consumption for the electricity sector will hinge on the following interventions:

- A priority strategic thrust of the Malian Government is to improve the efficiency of generation facilities and curb electric power transmission and distribution losses. The PASE project, which primarily focuses on curbing electricity losses, is in line with this effort;

- Optimising the energy mix to diversify electricity generation sources and integrate high performance renewable energies. This area is generally in line with the national energy policy to diversify energy resources by developing local ones.

However, apart from hydro-electric power, the development of grid-connected renewable energies per se does not seem to be a priority strategic thrust of Mali's current energy policy.

4.2 Capacity Building and Technical Assistance

Specifically, this entails taking support measures to provide an enabling environment for implementing energy conservation programmes and ensuring that knowledge gained in future is disseminated.

4.2.1 Capacity Building

Energy conservation is a multi-stakeholder horizontal concept, requiring the intervention of operators with relevant skills. Therefore, energy efficiency and renewable energy skills development must be an essential component of national energy conservation programmes.

The goal is to develop local skills to provide the industry, household, tertiary and transport sectors with the requisite know-how. The exercise will involve the use of renewable energies like solar thermal, photovoltaic, wind and hydro-electric systems, biomass and bio-fuels, adapting them to new technologies and managing their use.

Eventually, Mali should have appropriate local skills for supporting national programmes. These include energy auditors, consultant engineers, architects, equipment installers, energy officers in various establishments, operational and maintenance technicians, etc.

Awareness and communication campaigns will also be carried out to ensure stakeholder endorsement of the intervention programme and consumer shift towards more rational energy use.

4.2.2 Technical Assistance

This entails developing a technical assistance project at the Energy Ministry over a three-year period to help key stakeholders to operationalise their energy conservation guidelines. Interested international cooperation agencies or the donor community present in Mali will finance the project. However, the Energy Ministry will take the necessary steps to put together the application and raise funds for the project.

The specific goals of the technical assistance are to:

- Improve awareness about Mali's energy conservation potential and challenges;
- Introduce institutional, regulatory and economic instruments for the energy conservation policy, using the following methods:
  - Redeploying available resources and setting up a special body to deal with energy conservation in Mali;
  - Drawing up a work programme and introducing monitoring indicators for the body;
  - Assessing and programming operational budgets for the body;
  - Training and building the capacity of relevant public and private stakeholders, especially the body responsible for energy conservation;
  - Introducing energy conservation financing systems;
  - Setting up a monitoring/evaluation system for the energy conservation programme;
  - Enacting laws and implementing instruments for energy conservation, etc.; and
- Preparing conditions for scaling up energy conservation programmes and activities.

4.3 *Energy Information System*

From the outset, the energy conservation body must have the monitoring and evaluation capacity to assess the impact of programme activities and disseminate the results obtained, thereby creating a snowball effect that would accelerate the implementation of other activities.

Specifically, this measure entails:

- Drawing up relevant energy indicators;
- Developing the appropriate information system; and
- Disseminating and communicating information, so as to build on results.

This activity could be carried out with the help of outside experts.

4.4 Financing Energy Conservation

Financing is the major stumbling block for energy conservation, and quite often, a hindrance to achieving the goals for enhancing activities. Such financial constraints stem from:

- The high initial investment cost for Malian consumers (households and private businesses);
- The often lengthy investment pay-back period, which discourages the consumer from deciding to make a medium-term investment; and
- Lack of access to bank loans, which could be a solution to facilitating the initial investment.

Quite apart from the major issue of introducing mechanisms for promoting and programming energy conservation activities, financing is crucial to the significant development of energy conservation in Mali.

Three essential aspects should be considered:

- Raising funds through the donor community and local resources;
- Designing and introducing appropriate financing mechanisms to facilitate the spread of energy efficiency and renewable energy technologies; and
- Taking into account opportunities offered by the carbon market, under the Clean Development Mechanism (CDM).

4.4.1 Role of Donors

To operationalise its energy conservation policy, Mali needs donors to finance the proposed five-year programme. The programme comprises two groups of measures:

- The Priority Development Programme, over the 2010 to 2014 period, comprising energy conservation sector measures and projects to generate power from renewable energies; and
- The support programme, consisting of technical assistance and capacity building activities as well as specific studies.

4.4.2 Energy Conservation Financing Mechanisms

The development of large-scale energy conservation is dependent on the removal of barriers to the transfer of adopted technologies. The biggest obstacle is often the cost of the initial investment in energy conservation that would have to be borne by the consumer. The use of financing mechanisms would help to:

- Promote demand to facilitate scaling-up;
- Expand domestic supply and create new niches in the market;
- Improve control of the quality and performance of adopted technologies; and
- Constantly monitor energy conservation activity through the body responsible for managing the programme.

LELBs must be distributed using a specific mechanism. Developing such a mechanism is considered a priority for Mali, due to the direct effects it will have on the demand for electrical power, on Mali's energy bill and on household budgets. Other mechanisms must be introduced, depending on which priorities are selected. Some of these are:

- Energy-efficient buildings;
- Distribution of solar water heaters; and
- Energy audits and prior consultations.

4.4.3 Carbon Revenue (CDM)

The Clean Development Mechanism (CDM) is one of the three flexibility mechanisms under the Kyoto Protocol. This mechanism allows industrialized countries to more easily meet their emission reduction commitments by purchasing forms of reduction permits or units at far lower prices than they would have done were they to implement such reductions in their own countries.

The CDM provides additional revenue that will generally contribute to improving project savings.

The emissions avoided during the proposed Five-year Energy Conservation Programme, will be approximately 573 kte$CO_{2,}$ worth about USD 6 million, under the Clean Development Mechanism (CDM). However, in order to enjoy the advantages of this Mechanism, specific procedures have to be followed, from the formulation of the Project Information Note (PIN) and the Project Design Document (PDD) to approval by a Designated Operational Entity (DOE) and project registration with the Executive Board (EB).

However, considering the potential of the energy conservation sector to reduce greenhouse gas (GHG) emissions, we believe it would be advisable to prepare a portfolio of CDM projects for the sector and to quickly promote this mechanism among initiators.

During a CDM initialisation stage, the initiators of mature projects must be supported throughout the registration process with the CDM Executive Board.

4.5 Institutional and Regulatory Arrangements

4.5.1 Institutional Framework

A diagnosis of the energy conservation institutional framework reveals the following:

- An awareness, at the Ministry of Energy and Water and at the various sector institutions, of the challenges of the energy sector and of the role of energy conservation as a key element in the country's development;

- The existence of a well-known energy sector policy and a renewable energy strategy;

- The existence of several energy conservation public agencies (DNE, CENSOLER, ANADEB, AMADER) which helped create the first core group of experts in the country. These agencies together employ a relatively significant number of people (over 100);

- The opening up of the energy sector, albeit still governed by a structured framework;

- A tariff system that shows the cost pricing for most of the energy products marketed in Mali;

- The existence of a relatively important energy conservation component in the Electricity Sector Assistance Project (PASE); and

- The willingness of donors to support energy conservation activities in Mali.

Currently however, institutional support for energy conservation is quite erratic. This situation does not foster the capitalisation of skills due to the piecemeal involvement of several institutions (DNE, AMADER, CNESOLER, EDM and ANADEB). Available human resources must be deployed to these energy conservation institutions in order to make optimum use of the resources.

Energy conservation is a horizontal concept involving all the sector actors and requires that its promotion and the leadership roles of its actors be properly defined with appropriate institutional support.

The following are examples of institutional support for various aspects of energy conservation at the supply and demand level.

Energy Supply:

- Increased electricity generation from renewable sources such as wind, solar thermal power stations, and by adding value to waste and biomass, etc...; and

- Promoting the use of solar thermal energy for heating water, which is partially financed by CNESOLER.

Demand-side:

- Promotion of improved thermal performance of buildings (energy efficiency of the building enclosure);

- Promotion of other energy saving equipment apart from low energy light bulbs (ongoing activities by EDM, DNE and AMADER) and distribution of kerosene stoves (AMADER); and

- Promotion of energy efficiency in the economic sectors, specifically in industry, tertiary, transport and agriculture.

Based on this analysis, an operating structure will have to be appointed to facilitate the implementation of the five-year programme and lay the foundations for a long-term energy conservation operational policy. This structure could be set up gradually, starting with an embryonic unit which would later develop into an agency. As such, back-up action is needed to transform this unit both organisationally and institutionally. Eventually, the duties of the structure will be:

- To contribute to formulating the Malian Government's policy on energy conservation, with its two components (energy efficiency and renewable energies);
- To support the energy conservation regulatory and incentive framework with a view to its improvement;
- To coordinate and plan with specialised agencies such as AMADER and ANADEB;
- To implement national energy efficiency and renewable energy programmes;
- To conduct the studies needed to develop these areas;
- To build the capacity of public and private sector actors in energy efficiency and renewable energies;
- To raise the awareness of energy consumers in order to promote energy conservation activities;
- To source and mobilise funds for investing in energy conservation and put appropriate mechanisms in place;
- To monitor and evaluate energy conservation programmes and policies; and
- To promote the Clean Development Mechanism for energy conservation programmes and projects.

Ultimately, the structure will have the following operational functions: (i) technical function covering energy efficiency and renewable energies; (ii) research and planning; (iii) programme monitoring and evaluation; (iv) awareness-raising and communication; and (v) cooperation and mobilisation of funds.

The key priority areas of energy conservation that are still not covered by current institutional structures include:

Breakdown of Institutional Responsibility for Various Energy Conservation Themes

Structure	R&D and Training	Supply Management								Demand-side Management				
		Grid-Connected Renewable Electricity (wind, CSP)	Solar Thermal	Off-Grid Solar PV	Bio-fuel	Wood Energy	Biomass/ Waste	Hydro-electric Power	Reduction of Power Losses	Energy-Saving Equipment	Residential and Tertiary Buildings	Tertiary Sector	Industrial Sector	Transport Sector
DNE														
AMADER														
CNESOLER														
ANADEB														
EDM														

Operational Mission
Policy Mission
Partial Operational Mission

4.5.2 Regulatory Framework

The regulatory measures are designed to establish the legal framework sustaining Government strategic choices. These include measures on designating the structure responsible for implementing energy conservation activities.

The framework law and implementing texts on energy conservation in Mali should also be enacted. The development of renewable energies for power generation would entail the introduction of a specific regulatory mechanism spelling out the framework for independent power generation and conditions of access to the national grid.

To improve the energy performance of buildings, a thermal code should be introduced for construction. The code should set out the minimum thermal requirements for buildings.

Measures can be taken to institute mandatory labelling of household appliances and lay down minimum requirements for the classification of the performance of energy consuming equipment such as refrigerators, air-conditioners, etc.

Other types of measures may be recommended for instituting an energy audit system for high energy consuming institutions in the industrial and tertiary sectors, and prior consultations for energy-consuming projects.

This regulatory framework can also govern incentives and advantages granted by Government to promote energy conservation in Mali. These may include regulations on tax exemption, tax suspension and/or award of bonuses or grants.

5 Roadmap for Energy Conservation Development Strategies

The roadmap for operationalising the priority strategic thrusts proposed is in two major components:

- A five-year investment programme in energy conservation, called the "Five-Year Energy Conservation Programme"; and
- A support programme to facilitate implementation of the investment programme.

5.1 Five-Year Energy Conservation Development Programme, 2010-2014

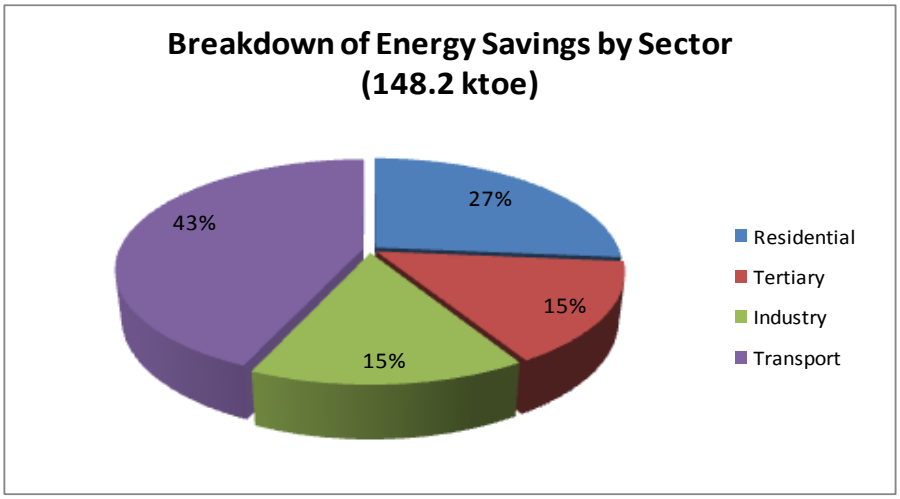
The Energy Conservation Programme, 2010-2014 will generate 178 ktoe in energy savings over the programme period and 865 ktoe over the entire duration of project activities, for a total investment of USD 96.5 million, of which USD 10 million will be from Government and donors and the remainder from consumers and the private sector.

Relevant indicators from this five-year programme are as follows:

- The cost per Toe saved will amount to USD 540, over the period 2010-2014. This figure is to be compared to the sourcing cost of the Toe of gasoil on the world market, currently at USD 600, and very likely to rise sharply in future;
- The cost per Toe saved would be only USD 110, if we consider energy savings made over the entire duration of activities; and
- Government's contribution to the investment per Toe saved would be a mere USD 17.

The programme comprises two sets of proposed activities:

- **Demand-side sector activities for**: residential, tertiary, industrial and transport sectors, for which energy savings is broken down as follows:



- **Electricity generation from renewable energy sources:** wind, concentrated solar power (CSP) and biomass, accounting for 56 per cent of savings expected from the programme (about 31 ktoe over the duration of the programme and 482 ktoe over the life-span of the facilities). Twenty-five megawatts of renewable electricity installations will be made under the project at a total cost of about USD 47 million, to be borne by the private sector.

5.1.1 Residential Sector

Five main activities have been planned for the residential sector:

A1. **Distribution of 700,000 low-energy light bulbs (LELB) to households:** this will be the most profitable operation by far, with 28 ktoe in primary energy savings over the programme period, and 111 ktoe over the shelf life of the LELBs. The project will also help reduce the demand power by about 25 Mw at the end of the programme and avoid 89 kteCO_2 of emissions over the programme's duration.

- **Objective: Manage electricity demand and reduce household energy budget in Mali**
- **Cost of operation: USD 2.1 million**
- **Financing: PASE**

A2. Energy-efficient Buildings Pilot Project: this is a long-term project designed to improve the thermal performance of new buildings. One hundred buildings have been earmarked for the pilot phase, expected to realize about 1 ktoe in primary energy savings during the entire period of operations. The exercise must be assessed for replication in a second phase.

- **Objective: Manage electricity demand and reduce household energy** budget in Mali
- **Cost of operation: USD 0.3 million**
- **Financing: PASE (proposal).**

A3. Energy classification for air-conditioners: this entails instituting energy labelling for air-conditioners on the market to inform consumers about the energy classification of the air-conditioners. The exercise will cover 5,000 units and generate 0.25 ktoe in energy savings over the project period and 0.7 ktoe over the life-span of the air-conditioners.

- **Objective: Manage electricity demand and reduce household energy budget in Mali**
- **Cost of operation: USD 0.2 million**
- **Financing: Private sector**

A4. Energy classification of refrigerators: this entails instituting energy labelling for refrigerators, to inform consumers about the energy classification of refrigerators on the market. The exercise will cover 15,000 units, and generate 0.38 ktoe in energy savings over the programme period and 1 ktoe over the life-span of the refrigerators.

- **Objective: Manage electricity demand and reduce household energy budget in Mali**
- **Cost of operation: USD 0.6 million**
- **Financing: Private sector**

A5. Pilot programme for distribution of 10,000 solar water heaters to households: this programme will lead to about 10 ktoe in energy savings over the programme period and 60 ktoe over the life-span of the SWH. It will also help to reduce the demand power by about 5 Mw at the end of the programme and avoid 32 kteCO_2 of emissions during the programme.

- **Objective: Manage electricity demand and reduce household energy budget in Mali**
- **Cost of operation: USD 12 million**
- **Financing: Private sector**

5.1.2 Tertiary Sector

Four activities have been earmarked for this sector:

A6. **Distribution of 300,000 LELB to tertiary institutions:** this operation will lead to 12 ktoe in primary energy savings and 48 ktoe over the shelf-life of the LELBs. It will also help reduce the demand power by about 11 Mw at the end of the programme and avoid 38 kteCO_2 of emissions over the programme period.

- **Objective: Manage electricity demand**
- **Cost of operation: USD 0.9 million**
- **Financing: PASE**

A7. **Pilot project for thermal renovation of administrative buildings:** this is a demonstration operation to improve the thermal performance of existing public buildings. The pilot phase covers 10 000 m², with 0.21 ktoe in primary energy savings over the programme period and 1.61 ktoe over the duration of operations. The exercise should be assessed for replication in the second phase.

- **Objective: Manage electricity demand and improve comfort**
- **Cost of operation: USD 0.2 million**
- **Financing: Government or donors**

A8. **Distribution of 15,000 energy-efficient bulbs for street lighting:** this operation will lead to 9 ktoe in primary energy savings over the programme period and 11 ktoe over the shelf-life of the LELBs. It will also help reduce the demand power by about 11 Mw at the end of the programme and avoid 29 kteCO_2 of emissions over the programme period.

- **Objective: Manage electricity demand**
- **Cost of operation: USD 0.8 million**
- **Financing: PASE**

A9. **Energy diagnosis and pilot activities in public institutions:** the operation entails carrying out 10 energy diagnostic studies that should lead to energy saving pilot activities. The operation will help realize 0.9 ktoe in primary energy savings over the programme period and 7 ktoe over the period of operations.

- **Objective: Manage electricity demand and reduce the public administration energy bill**
- **Cost of operation: USD 1 million**
- **Financing: Government or Donors**

5.1.3 Industrial Sector

Three activities have been proposed for this sector:

A10. Energy audits for high-consumption industries: this operation entails carrying out 10 energy audits in industries belonging to different areas of activity, by way of energy monitoring and accounting. The exercise will lead to 3 ktoe in primary energy savings over the programme period and 8 ktoe over the period of operations.

- **Objective: Manage electricity demand and reduce industrial energy bill**
- **Cost of operation: USD 0.4 million**
- **Financing: USD 0.3 million from Government or Donors and USD 0.1 million from the private sector**

A11. Prior consultations for heavy-energy consuming industrial projects: this operation entails carrying out five prior consultations on five energy-consuming industries operating in different areas of activity, by selecting the most efficient technologies. This will help realize about 6 ktoe in primary energy savings over the programme period and 26 ktoe over the life span of operations.

- **Objective: Manage electricity demand and reduce industrial energy bill**
- **Cost of operation: USD 2.5 million**
- **Financing: USD 1.8 million from Government or donors and USD 0.7 million from the private sector**

A12. **Pilot activities in the industrial sector**: this operation entails carrying out three energy saving projects following the energy audits in five industrial concerns. It will lead to 13.5 ktoe in energy savings over the programme period and 29 ktoe over the period of operations.

- **Objective: Manage electricity demand and reduce industrial energy bill**
- **Cost of operation: USD 4 million**
- **Financing: USD 2 million from Government or donors and USD 2 million from the private sector**

5.1.4 Transport Sector

Two activities have been planned for the transport sector:

A13. **Develop bio-fuels as additive**: this operation involves introducing a mix of 5% bio-fuel with gasoil, to substitute imported gasoil by 5%, accounting for about 19.3 Toe over the programme period and 62 kteCO_2 of avoided emissions.

- **Objective: Substitute energy and reduce government energy bill**
- **Cost of operation: USD 23.4 million**
- **Financing: Private sector**

A14. Introduce the Urban Travel Plan (UTP) for Bamako: this operation involves carrying out a pilot urban travel plan for Bamako and introducing energy saving exercises under the plan. This will lead to about 45 ktoe in primary energy savings over the programme period and 75 ktoe over the period of operations. About 144 kteCO_2 emissions will also be avoided over the five-year programme period.

- **Objective: Reduce consumption for the sector and by vehicle users**
- **Cost of operation: USD 1.2 million**
- **Financing: Government or donors**

5.1.5 Electricity Generation from Renewable Sources

Three projects have been planned for the renewable energy sector:

A15. Develop grid-connected wind energy: this project entails carrying out pilot work on a 10 Mw wind farm for the production of electricity connected to the EDM SA grid. This will lead to 7.84 ktoe in primary energy savings over the programme period and 117.6 ktoe over the life-span of the windmills. This will help avoid about 25 kteCO_2in emissions during the five-year programme.

- **Objective: Reduce fuel consumption**
- **Cost of operation: USD 20 million**
- **Financing: Private sector**

A16. Develop grid-connected CSP: this project involves carrying out a 5 Mw pilot CSP centre to generate power, connected to the EDM.SA grid. It will lead to 3.4 ktoe in primary energy savings for the duration of the programme and 70 ktoe for the centre's life-span. This will help avoid about 11 kteCO_2in emissions during the five-year programme.

- **Objective: Reduce fuel consumption**
- **Cost of operation: USD 15 million**
- **Financing: Private sector**

A17. Develop electricity generation from biomass: this project entails carrying out a pilot 10 Mw installation to generate electricity from agricultural biomass, to be connected to the EDM.SA grid. It will lead to about 19.6 ktoe in primary energy savings over the programme period and 294 ktoe over the life-span of the windmills. The project will also help avoid about 63 kteCO_2in emissions over the five-year programme period and avoid 10 mw of electrical power.

- **Objective: Reduce fuel consumption and avoid use of electric power**
- **Cost of operation: 12 USD million**
- **Financing: Private sector**

The following table sums up the 2010-2014 five-year energy conservation programme; it shows the cost for each activity, its financing and energy, environmental and economic impact. The impact of activities is not systematically aggregated due to their replication.

Development Programme

	Unit	Implementation (2010-2014)	Investment (USD M)	Financing		Primary Energy Savings for Duration of Plan (ktoe)	Energy Savings over Programme Life (ktoe)	Avoided CO2 Emissions (kteCO2)	Avoided Power (MW)	Reduction of Energy Bill (USD M)	Avoided Power Generation Investment (USD M)
				Govt. & Donor Contribution	Private Sector Contribution						
Demand											
Residential			**15,2**	**2,0**	**12,8**	**39**	**179**	**125**		**23**	
LELB Distribution Programme	LELB	700 000	2,1	1,7		28	111	89	25	16,7	20,0
Efficient Buildings Pilot Project (with private promoters)	New Housing Units	100	0,3	0,3		1	5	2	0,3	0,4	0,2
Energy Classification of Airconditioners	Airconditioners	5 000	0,2		0,2	0,252	0,7	1	0,3	0,2	0,1
Energy Classification of Refrigerators	Refrigerators	15 000	0,6		0,6	0,378	1	1	2,4	0,2	1,2
Pilot SWH Distribution Programme	SWH	10 000	12,0		12,0	10,08	60	32	5	6,0	10,4
Tertiairy			**2,9**	**2,7**	**-**	**22**	**67**	**71**		**13**	
LELB Distribution Programme	LELB	300 000	0,9	0,7		12	48	38	11	7,2	15,7
Pilot Programme for Thermal Renovation of Office Buildings (insulation of roofs)	m^2	10 000	0,2	0,2		0,21	1,61	1	0,1	0,1	0,2
Efficient Public Lighting	SHP	15 000	0,8	0,8		9	11	29	0,75	5,5	6,1
Energy Audit and Pilot Activities in Office Buildings	Buildings	10	1,0	1,0		0,9	7	3	0,3	0,5	0,8
Industry			**6,9**	**4,0**	**2,9**	**23**	**63**	**72**		**14**	
Energy Audits	Entreprises	10	0,4	0,3	0,1	3	8	10	2	1,8	3,2
Prior Consultations	Projects	5	2,5	1,8	0,8	6	26	19	4	3,6	6,5
ES Pilot Actions in some High Energy Consumption Industries	Enterprises	5	4,0	2,0	2,0	13,5	29	43	8	8,1	14,5
Transport			**24,4**	**1,2**	**23,2**	**64**	**75**	**206**	**-**	**39**	**-**
Development of Bio-fuels (5%)	% of substitution	5%	23,2		23,2	19,3		62		11,6	
Establishment of Bamako UTP	UTP	1	1,2	1,2		45	75	144		27,0	
Total 1			**49,4**	**10,0**	**38,8**	**148**	**383**	**474**	**-**	**89**	**-**
Energy Supply											
Development of Grid-Connected Wind Energy	MW	10	20		20	7,84	117,6	25		4,7	
Development of Grid-Connected CSP	MW	5	15		15	3,5	70	11		2,1	
Electric Power Generation from Biomass	MW	10	12		12	19,6	294	63	10	11,8	
Total 2			**47,0**	**-**	**47,0**	**30,9**	**481,6**	**99,0**	**10,0**	**18,6**	**-**
Overall Total			**96,4**	**10,0**	**85,8**	**179,1**	**864,9**	**573,2**	**10,0**	**107,5**	**-**

5.2 *The Support Measures Programme*

The Support Measures Programme includes all activities needed to facilitate the implementation of the energy conservation programme presented above. These activities will also lay the foundations for a long-term national energy conservation policy.

Three categories of activities are envisaged:

- Studies and project preparation;
- Capacity building, including technical assistance to the structure to be made responsible for implementing the energy conservation programme; and
- Awareness-raising and communication activities.

Estimated to cost about USD 4.5 million, this Programme is to be funded mainly by donors as part of the support to the Malian Government in implementing its energy conservation policy. The breakdown is as follows:

	Cost in USD M	2010	2011	2012	2013	2014
Studies and Project Preparation	1,3					
Strategic Study on Energy Mix in Mali	0,2					
Installation of an Energy Information System	0,1					
Study on Inland Water Transport in Bamako	0,3					
Harmonisation of Urban Planning Tools	0,1					
Study on Setting Up of Financing Mechanism	0,2					
Identification of Projects and Pre-feasibility Study (Wind, CSP, Biomass, etc.)	0,3					
Preparation of CDM Energy Projects Portfolio	0,1					
Capacity Building	2,7					
Training on EM and CDM	0,3					
Formulation and Implementation of Regulatory and Institutional Measures	0,1					
Technical Assistance and Support to MEE	2,0					
CDM Project Support	0,3					
Awareness and Communication	0,5					
National Conference on EM	0,1					
Preparation and Creation of Communication Tools	0,4					
Total	**4,5**	**0,8**	**1,5**	**1,1**	**0,9**	**0,1**

5.2.1 Studies and Project Preparation

This category contains seven activities, necessitating the raising of USD 1.3 million.

B1. **Strategic study on the energy mix in Mali:** the aim of this study is to define the country's energy matrix from 2020 to 2030, and by 2050. This strategic planning tool will help ensure secure energy supply for the country.

- **Objective: Provide the Government with medium and long-term strategies**
- **Cost of operation: USD 0.2 million**
- **Financing: Donors**

B2. **Put in place an energy information system in Mali:** this action is intended to define all the indicators of an energy information system and ensure its implementation, including training the key actors. This strategic monitoring tool will help to monitor the impact of the energy conservation policy in Mali.

- **Objective: to provide the MEE with strategic performance indicators**
- **Cost of operation: USD 0.1 million**
- **Financing: Donors**

B3. **Study on river transport in Bamako:** the demand for energy in the transport sector has risen sharply, two important reasons for this being the urban sprawl and mobility. The study will examine the feasibility of river transport as an energy saving solution in the sector.

- **Objective: Feasibility of developing a new mode of transport**
- **Cost of operation: USD 0.3 million**
- **Financing: Technical and Financial Partners (TFPs)**

B4. **Harmonisation of urban planning tools in Mali:** improved urban planning will help optimise consumption at source. Planning tools must be designed and managed by public-sector actors in a consistent manner. The actors must be trained in the use of the tools when these are created.

- **Objective: Equip public sector actors with urban planning tools**
- **Cost of operation: USD 0.1 million**
- **Financing: TFPs**

B5. **Study on the creation of a financing mechanism:** the lack of funding for energy conservation activities is a great barrier to scaling-up. Financing mechanisms are the appropriate solution. These must be identified and designed, and their conservation procedures put in place.

- **Objective: Sustainable development approach to energy conservation**
- **Cost of operation: USD 0.2 million**
- **Financing: PASE (proposal)**

B6. **Identification and pre-feasibility of energy projects:** the development of renewable energies for the production of electricity requires exploratory studies, which will help identify potential sources of renewable energy and determine project pre-feasibility so that investment decisions can be taken.

- **Objective: Diversify energy sources in Mali (wind, CSP, biomass, etc.)**
- **Cost of operation: USD 0.3 million**
- **Financing: TFPs**

B7. **Developing CDM projects portfolio in Mali:** CDM revenue from the carbon market can make energy conservation projects more profitable through the mobilisation of additional financing. To attract investors, projects will have to be promoted as part of a portfolio.

- **Objective: Promotion of energy conservation projects in Mali**
- **Operation cost: USD 0.1 million**
- **Financing: PASE (proposal)**

5.2.2 Capacity Building Programme

Four activities are planned under this category, at an estimated cost of USD 2.7 million

B8. There is the need for a study on the training needs of key EM and CDM actors to help draw up a three-year capacity-building programme, which will develop the capacity of key EM actors in Mali. For this purpose, those officials from the sectors involved in EM would benefit greatly from a study tour of Tunisia, where they could learn from that country's experience in the areas of policy, institutional organisation and regulatory framework.

- **Objective: Build capacity for the key EM and CDM actors and operators**
- **Cost of the operation: USD 0.3 million**
- **Financing: PASE**

B9. **Design and implement regulatory and institutional measures:** regulatory and institutional mechanisms are the basis for an EM policy. Therefore, this activity should make it possible to develop the appropriate regulatory framework and operationalise the institutional framework for energy conservation in Mali.

- **Objective: Put in place the legal and institutional framework in Mali**
- **Cost of operation: USD 0.1 million**
- **Financing: PASE**

B10. **Technical assistance and support to MEE:** the MEE and the EM implementing structure will need assistance and support in the early years. It will be necessary to develop a three-year technical assistance project at the MEE to help the actors meet objectives and carry out energy conservation activities.

- **Objective: Operationalise the strategy and set up the EM framework conditions in Mali**
- **Cost of operation: USD 2 million**
- **Financing: TFPs**

B11. Support measures for CDM projects: to benefit from carbon financing, all projects must comply with CDM procedures. This activity makes provision for the integration of energy conservation projects into the CDM procedure, particularly projects intended to reduce GHG emissions.

- **Objective: Benefit from carbon financing to promote EM in Mali**
- **Cost of operation: USD 0.3 million**
- **Financing: TFPs**

5.2.3 Awareness-raising and Communication

This category comprises two activities:

B12. National energy conservation conference: dialogue among the actors is a fundamental element of an EM policy. In this vein, this activity provides for the organisation, in 2010 and 2013, of national conferences on the energy conservation strategy in Mali.

- **Objective: Obtain the support of actors and mobilise funds**
- **Cost of the operation: USD 0.1 million**
- **Financing: PASE (proposal)**

B13. Develop communication tools: raising awareness among energy consumers is a horizontal activity which gradually helps to influence behaviour towards more efficient energy use. This activity will equip the EM implementing body with a communication plan, help it develop appropriate tools (adverts, brochures, guides, web sites, etc.) and implement awareness programmes. Experts will be called upon to help formulate the communication plan, and the services of communication specialists will be sought to help with the awareness activities.

- **Objective: Establish a legal and institutional framework in Mali**
- **Cost of operation: USD 0.4 million**
- **Financing: PASE**

5.3 Logical Framework of the Roadmap

The following matrix presents the simplified logical framework of the Energy Conservation Programme. It incorporates the objectives of each activity, expected outcomes, impact indicators, responsibilities and implementation risks.

Activities	Objectives	Outputs	Means	Impact Indicators	Responsibilities	Implementation Risks
Demand						
Residential						
Energy-efficient bulbs distribution programme in residential sector	Transform Mali's light bulb market towards the gradual elimination of incandescent bulbs	700000 LELB bulbs distributed to households in Bamako and major urban centres	Investment of USD 2.1 million	Primary energy savings of 28 ktoe achieved from the programme	DNE EDM ESP	Failure of LELB distribution system Failure to raise awareness in households Poor quality bulbs
Energy-efficient buildings pilot project	Gradual transformation of building habits towards more energy-saving methods	100 energy-efficient housing units produced by government and private promoters for demonstration purposes	Investment of USD 0.3 million	Primary energy savings of 1 ktoe achieved from the programme	DNE Ministry of Housing, Lands and Urban Planning Association of Real Estate Developers	Failure to raise awareness among operators High additional costs and market's low absorptive capacity Lack of local implementation capacity
Energy classification of air conditioners	Transform the air conditioner market in Mali towards the gradual elimination of inefficient equipment	A system of energy performance labeling for air conditioners is introduced and made mandatory	Investment of USD 0.2 million	Primary energy savings of 0.25 ktoe achieved from the programme	DNE National Standardization Authority	Irrelevant system of classification and labeling Failure to control air conditioner imports Failure to raise awareness in households
Energy classification of refrigerators	Transform the refrigerator market in Mali towards the gradual elimination of inefficient equipment	A system of energy performance labeling for refrigerators introduced and made mandatory	Investment of USD 0.6 million	Primary energy savings of 0.4 ktoe achieved from the programme	DNE National Standardization Authority	Irrelevant system of classification and labeling Failure to control air conditioner imports Failure to raise awareness in households
Pilot programme for distribution of solar water heaters	Create a spontaneous market of solar water heaters in Mali	10000 solar water heaters distributed to households	Investment of USD 12 million	Primary energy savings of 10 ktoe achieved from the programme	DNE CNESOLER	High cost of water heaters beyond the households' ability to pay Failure to raise awareness in households Poor quality of solar water heaters Lack of qualified installers
Tertiary						
LELB distribution programme in tertiary sector	Transform the refrigerator market in Mali towards the gradual elimination of incandescent bulbs	300000 LELB distributed to service industries in Bamako and in major towns and cities	Investment of USD 0.9 million	Primary energy savings of 12 ktoe achieved from the programme	DNE EDM ESP	Failure of LELB distribution system Failure to raise awareness in tertiary institutions Poor quality of bulbs
Pilot programme for thermal renovation of public buildings (insulation of roofs)	Be a pacesetter for the private sector and launch the thermal insulation market by public demand	About 10000 m² of public building roofs undergo thermal insulation	Investment of USD 0.2 million	Primary energy savings of 0.2 ktoe achieved from the programme	DNE Ministry of Housing, Lands and Urban Planning	Lack of qualified local operators
Distribution of energy-efficient street lighting	Gradually transform the light bulb market towards the gradual elimination of inefficient bulbs	15000 energy-efficient bulbs installed for street lighting	Investment of USD 0.8 million	Primary energy savings of 9 ktoe achieved from the programme	DNE EDM ESP	Failure to raise awareness in municipalities Poor quality of bulbs Municipalities resume use of traditional bulbs after shelf-life of energy-efficient lamps due to lack of resources
Energy diagnosis and pilot activities in public buildings	Be a pacesetter for the private sector and initiate the creation of local expertise by providing them with the opportunity to practice energy audit and carry out EE activities	Energy diagnosis and pilot energy efficiency activities carried out on 10 public buildings	Investment of USD 1 million	Primary energy savings of 1 ktoe achieved from the programme	DNE Ministry of Housing, Lands and Urban Planning Association of Real Estate Developers	Lack of local expertise Failure to raise awareness of staff of public agencies targeted
Industry						
Energy audits for high-consumption industries	Initiate the energy audit market in the industrial sector and promote the creation of local expertise by giving national experts the opportunity to practice energy audit and carry out EE activities	Energy audits performed on 10 major industries on a pilot basis while involving local expertise	Investment of USD 0.4 million	Primary energy savings of 3 ktoe achieved from the programme	DNE Ministry of Industry	Failure to raise awareness of industrialists Lack of local expertise
Prior consultations for heavy-energy consuming industrial projects	Formulate regulations instituting prior energy consultations for the establishment of heavy energy-consuming industrial projects	Prior consultations involving local experts held on 5 new industrial projects	Investment of USD 2.5 million	Primary energy savings of 6 ktoe achieved from the programme	DNE Ministry of Industry	Failure to raise awareness of industrialists Lack of local expertise
Pilot EE activities in some high energy consuming establishments	Initiate the EE market in the industrial sector and promote the creation of local expertise by giving them the opportunity to practice energy audit and carry out EE activities	5 pilot EE activities carried out in high energy consuming industries with the involvement of local experts	Investment of USD 4 million	Primary energy savings of 13 ktoe achieved from the programme	DNE EDM ESP	Failure to raise awareness of industrialists Lack of local expertise
Transport						
Development of use of biofuels in transport	Reduce transport sector's dependence on petrloleum products	5% of fuel sold in Mali substituted for jatropha biofuel	Investment of USD 23.16 million	Primary energy savings of 19 ktoe achieved from the programme	DNE ANADEB Ministry of Equipment and Transport	Failure to produce Jatropha seeds Lack of quality control of bio-fuels High production costs of biofuels
Implementing a UTP for Bamako	Reduce energy consumption in transport sector through organisational activities	Bamako UTP implemented	Investment of USD 1.2 million	Primary energy savings of 45 ktoe achieved from the programme	DNE Ministry of Equipment and Transport	Lack of support from stakeholders Poor technical capacity of municipalities Lack of financial resources in municipalities
Energy Supply						
Development of grid-connected wind energy	Improve the specific consumption of the power sector and diversify its energy mix	First grid-connected 10 MW wind project implemented	Investment of USD 20 million	Primary energy savings of 18 ktoe achieved from the programme	DNE EDM Private investors	Difficulty in identifying sites with good wind conditions Failure to attract private investors
Development of grid-connected Concentrated Solar Power	Improve the specific consumption of the power sector and diversify its energy mix	First grid-connected 5 MW CSP project implemented	Investment of USD 15 million	Primary energy savings of 4 ktoe achieved from the programme	DNE EDM Private investors	High cost of kWh produced Failure to attract private investors
Electricity generation from biomass	Improve the specific consumption of the power sector and diversify its energy mix	10 MW biomass power generation project implemented	Investment of USD 12 million	Primary energy savings of 20 ktoe achieved from the programme	DNE EDM Private investors	Failure to attract private investors

6 Conditions for Operationalising the Roadmap

6.1 National Energy Conservation Conference

The aim of this conference is to reach a consensus, at the national level, on adopting a national energy conservation policy, and to approve the strategic recommendations from the study.

This conference must be at a sufficiently high level with respect to decision-making to guarantee firm commitment from the various institutions concerned.

The meeting will be attended by policy-makers, representatives of the institutions concerned, donors, support organisations, experts and civil society for the purpose of evaluating the level of commitment and drive of the stakeholders in implementing the strategic thrusts.

The recommendations from this study and the outcomes of the national conference will be the subject of an energy conservation policy letter in Mali. This letter will express the Government's intentions for a proactive commitment to the promotion of energy conservation.

6.2 *Initialisation of Implementation of the Strategy by the PASE*

The PASE, with its energy efficiency component, is the best formula for initialising the five-year Energy Conservation Programme for the 2010 to 2014 period. The table below shows a summarised plan of this component's activities:

PASE Activities	Cost in USD M	2010	2011	2012	2013	2014
Project Preparation and Implementation	4,1					
Programme for distribution of LELB in residential sector	2,1					
Programme for distribution of LELB in tertiary sector	0,9					
Energy-efficient street lighting (HPS)	0,8					
Study for setting up of financing mechanisms	0,2					
Preparation of CDM Energy Projects Portfolio	0,1					
Capacity Building	0,4					
Training in EM and CDM	0,3					
Formulation and introduction of regulatory and institutional measures	0,1					
Awareness and Communication	0,5					
National conference on EM	0,1					
Preparation and development of communication tools	0,4					
Total	**5,0**	**0,63**	**2,03**	**1,68**	**0,58**	**0,08**

In view of the total amount of contributions by the Government and donors, PASE activities account for over 30% of the resources to be mobilised for the five-year programme, which will come to a total of USD 14.5 million over the five years.

6.2.1 Distribution of Low Energy Light Bulbs

6.2.1.1 Distribution Guidelines

To ensure that LELB distribution can continue permanently, we recommend the creation of a Revolving Fund, which will be initially replenished from the energy efficiency component of the PASE. This Fund must be tried on a pilot basis to test the distribution mechanism. The prospects for subsequently expanding the Fund are subject to the implementation of other similar energy conservation activities. The distribution must be guided by the following:

- Avoid free distribution of LELBs: to ensure the sustainability of this activity, the end customer must pay the actual cost of the LELB, in other words, the consumer must pay for any light bulb he acquires under the distribution system. The wider the distribution of LELB, the lower the cost for the consumer as a result of economies of scale.

- Facilitate payment of electricity bills by refundable credit: to remove the initial investment barrier for the end consumers, they must be given a refundable credit on their electricity bill by EDM.

- Keep the household electricity bill constant: in order not to overburden household budgets, we recommend that the refunded amounts be calculated so as to be equal to the reduction in the electricity bill caused by the energy savings.

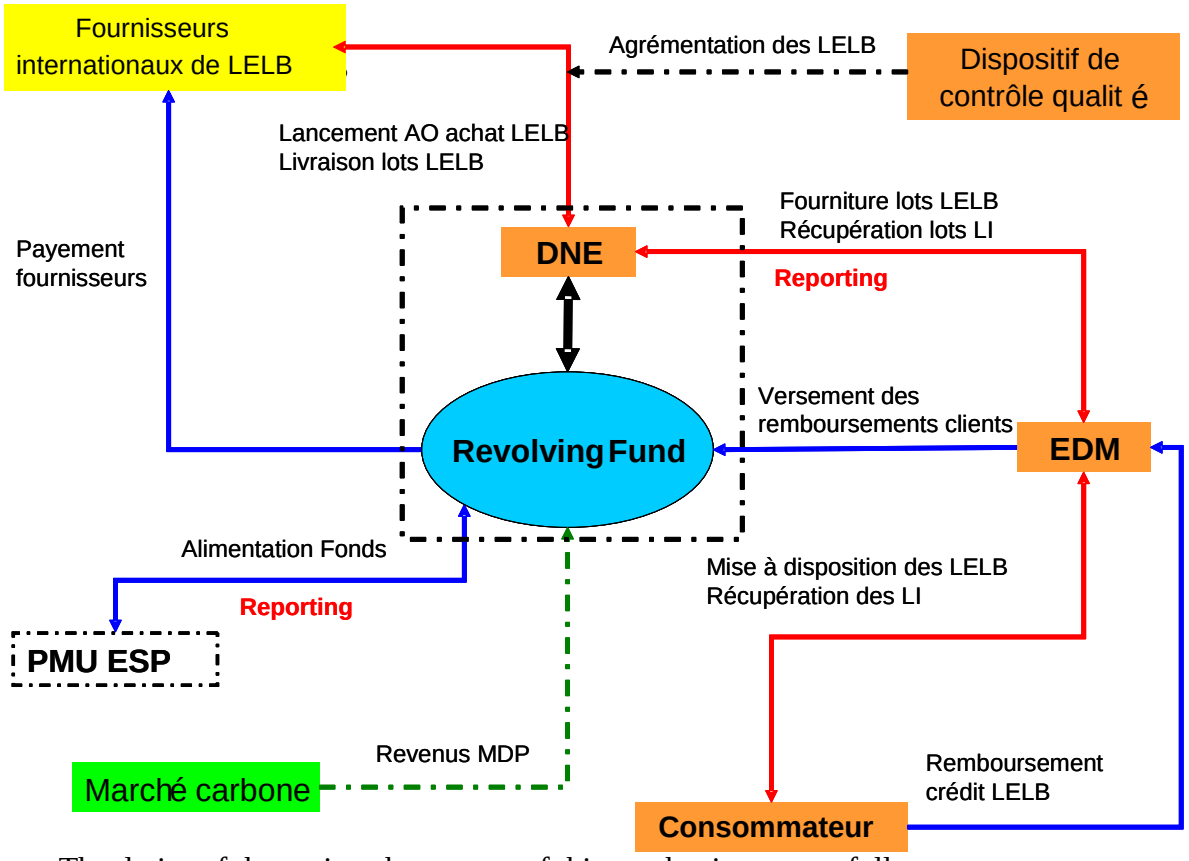
- Guarantee a minimum shelf life of the LELB: this activity is a guarantee to the consumer of the expected return on their investment. This presupposes that the light bulbs have been subjected to quality control checks, among others.

- Collect replaced incandescent lamps: to avoid loss of savings, collect and destroy replaced incandescent lamps.

- Increase **the value of energy savings through CDM (PoA):** revenue from carbon credit should help decrease even further the cost of implementing and sustaining the programme.

6.2.1.2 Organisational Chart of the Distribution Mechanism

The mechanism is organised as follows:



The duties of the various key actors of this mechanism are as follows:

The National Energy Directorate (DNE) will manage the mechanism and the Revolving Fund. It will:

- Plan LELB purchases from international suppliers based on requests by EDM and depending on the rate of distribution of the light bulbs to customers;
- Prepare the specifications, launch and open international bids, put in place a quality control procedure (to be defined) for the LELB procured;
- Provide the EDM with batches of LELB as previously planned;
- Destroy the replaced incandescent light bulbs that are collected by EDM from its customers;
- Conduct conservation audit of the distribution mechanism at the level of various actors;
- Coordinate the CDM component of the programme, which has been drawn up using the programme approach.

Energy Mali (EDM.SA) is responsible for the operational conservation of the LELB distribution mechanism to its registered customers. Its duties include:

- Communication and awareness-raising among its customers to promote the LELB distribution mechanism;
- Planning distributions so that requests for supplies can be made to the DNE;
- Supplying LELB to customers through its workers, as well as teach them the proper use of the LELB;
- Collecting replaced incandescent lamps;
- Dealing with client credit through the customer bills conservation system;
- Recovering repayments of electricity credit bills;
- Making regularly collected repayments into the Revolving Fund; and
- Sending reports to the DNE and the Revolving Fund conservation body

Revolving Fund (RF)

This Fund eliminates the need for the activity initiated by the initial investment made, by putting back into the Fund repayments of credit granted to LELB beneficiaries. The initial RF replenishment was provided by the energy efficiency component of PASE, which provided the funds needed for 1 million LELBs. The Fund is periodically replenished with the credit repayments collected by EDM and from the revenue generated by the programme from achieving reductions in carbon emissions.

The Fund will be managed by a light structure within the DNE and which will be responsible for the following:

- Make regular requests for funds from the PASE Project Conservation Unit (PMU) based on the demand by DNE for the procurement of the LELB batches;
- Report to PMU-PASE on the use of funds
- Pay suppliers of LELB, on the instruction of DNE

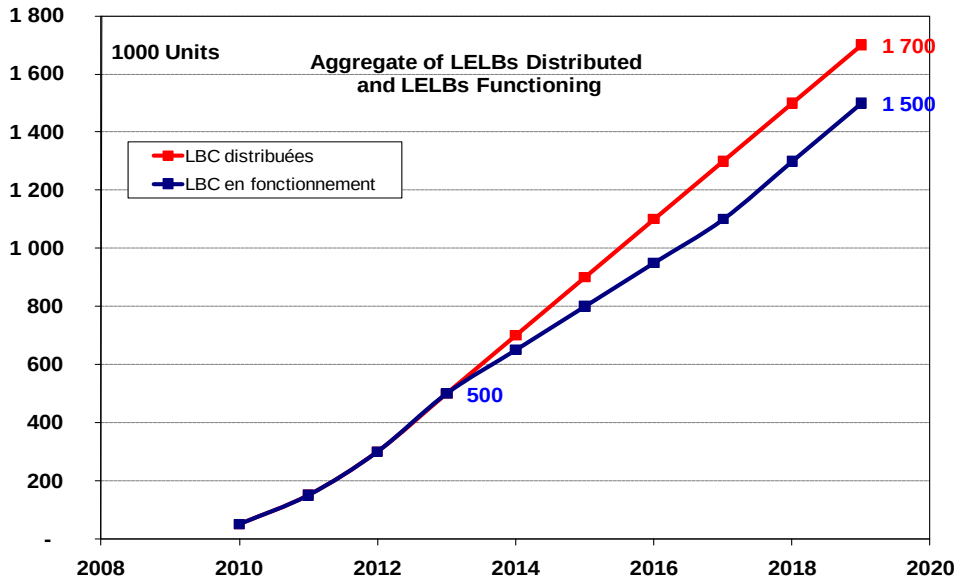
PASE Project Conservation Unit

The PMU's main mission is to manage various components of the PASE. For the LELB activity, it will be responsible for monitoring the use of funds allocated to the RF, based on the reports of the RF conservation structure.

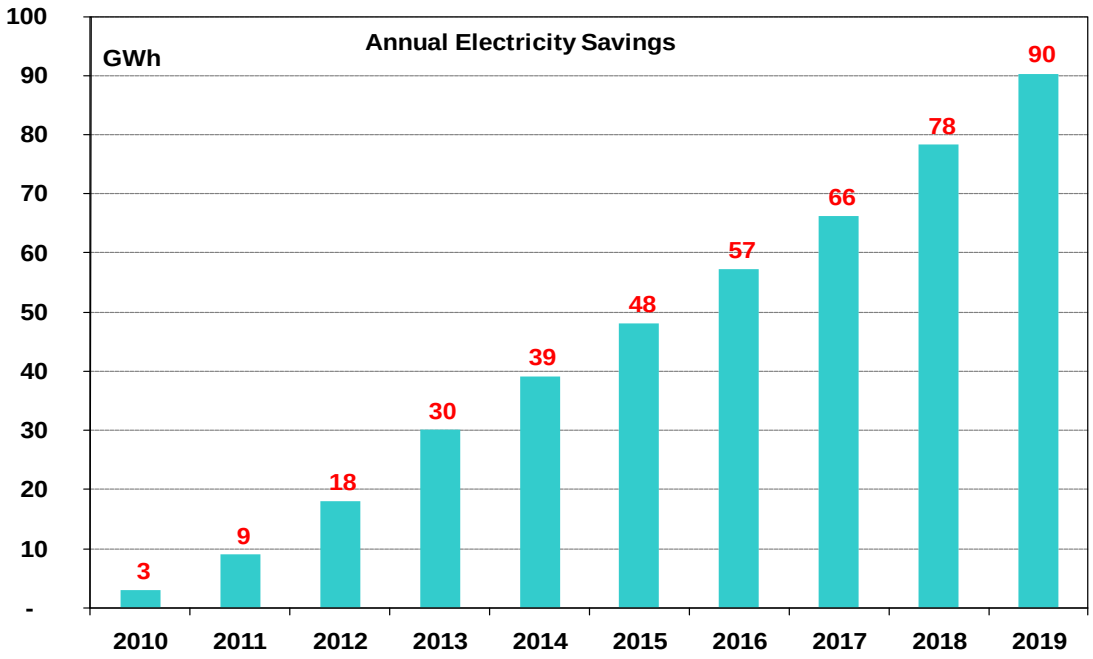
In order to start up the mechanism and absorb leakages throughout the LELB distribution programme, the RF will require an initial investment of USD 2.7 million from the PASE.

The mechanism is expected to help distribute 1.7 million LELBs by the end of 2019. Once the market is conditioned, Mali may consider banning the sale of ordinary incandescent bulbs as from 2020.

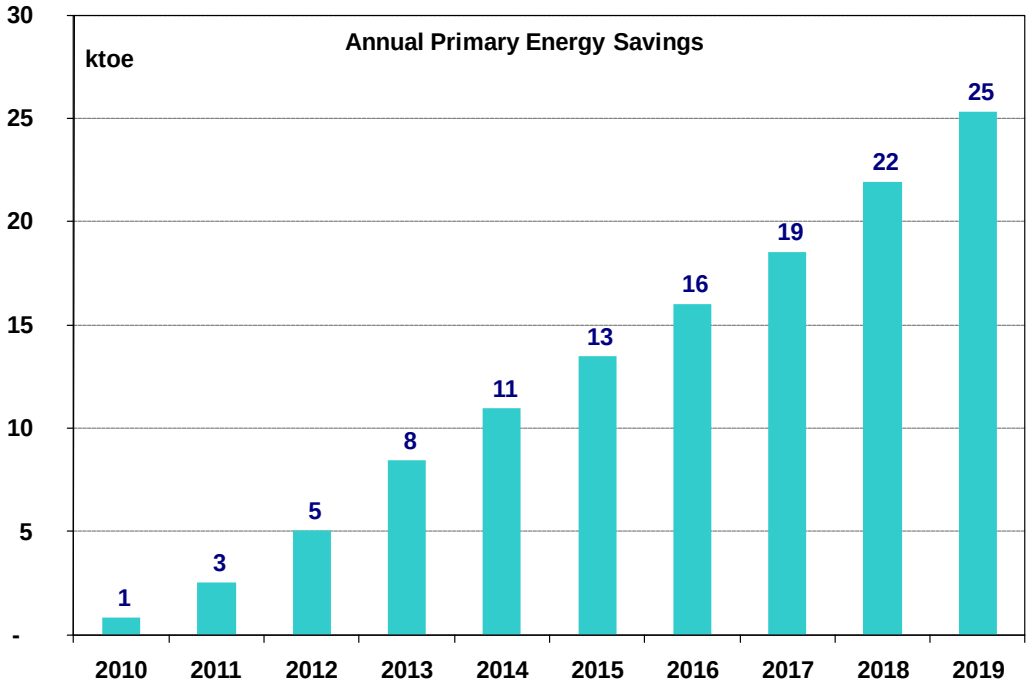
The chart below shows the rate of distribution of LELB as well as the aggregate of LELB distributed and LELBs functioning from 2010 to 2019.



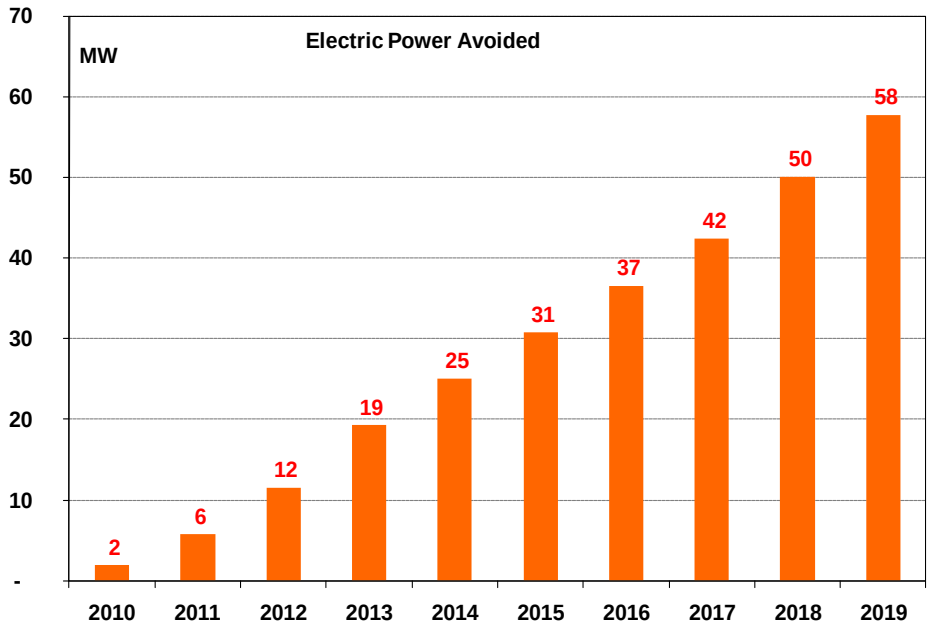
Based on this rate, the expected annual savings in electricity are given in the following graph:



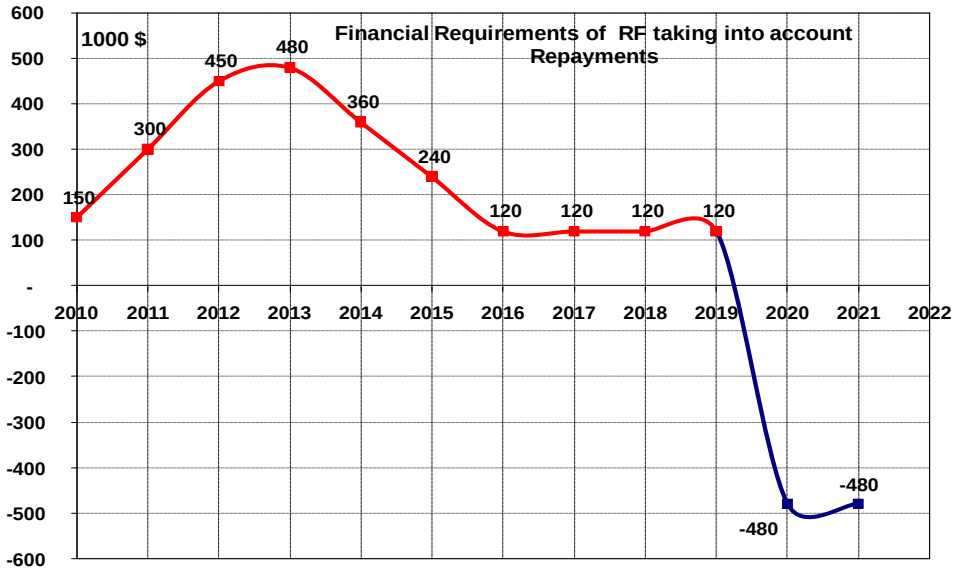
The primary energy savings over the duration of the programme are presented in the chart below:



In addition to the expected energy savings, the implementation of this programme will also help to reduce the demand power for lighting while the unused electric power at the end of the five-year programme is estimated at 25 MW, with 700 000 LELBs distributed. This unused power would be 58 MW with 1.7 million LELBs distributed.



To carry out this programme, the financial requirements of the Revolving Fund, taking into account repayments by the beneficiaries, are given in the graph below:



The RF requirements are estimated at USD 2.46 million over the entire 2010 to 2019 period. The fund will show a surplus by the end of the programme, and it is expected to generate USD 960 000.

6.2.2 Energy-Efficient Street Lighting

This programme involves the distribution of 15 000 energy-efficient sodium vapour bulbs in place of the mercury bulbs used for street lighting. The expected savings are estimated at 9 ktoe for the duration of the programme and 11 ktoe for the shelf life of the bulbs.

According to the PASE document, the cost of this operation is estimated at USD 0.8 million; the gross return time is about 9 months.
In practical terms, the DNE will manage the programme, which will involve:

- Confirming the inventory of installed lighting points;
- Preparing bidding documents for the procurement of the HPS bulbs;
- Distributing the bulbs to the structures that operate the street lighting systems;
- Assessing the impact of the operation; and
- Communicating the findings and raising awareness among decision-makers for the widespread use of the HPS bulbs.

6.2.3 Capacity Building

First, this will involve carrying out a diagnosis of the training needs of key players in energy conservation, which will help mainly to identify the target and prepare a matrix of capacity building needs.

This activity can be carried out using the services of external experts, which could be covered by the PASE energy efficiency component. This activity should help develop an integrated national capacity building programme, comprising:

- The Objective of each programme activity;
- The nature and description of each activity;
- The target of each activity
- The evaluation of its cost; and
- The planning of activities.

Once the needs have been identified, an annual capacity building plan must be prepared by the PASE PMU and the MEE, based on the proposed training programme.

This is followed by the organisation of the training courses for the target group, which will simply consist in implementing the training plan drawn up by the MEE. The training sessions will be facilitated by international experts recruited for the purpose. The PASE PMU and the MEE must first identify and recruit qualified trainers, based on the content of the training programme.

The MEE will make local trainers participate in the training sessions in order to ensure subsequent replication of the training and its dissemination on a wider scale.

Lastly, it is important to evaluate the training programme, at the end of each course and at the end of each annual capacity building plan, to enable MEE to conduct an assessment of actions and plans, based on the indicators that it will prepare in that regard. This assessment is intended to gradually improve the planning and quality of activities.

The training plan can include organising study trips and exchange of experiences with other leading countries. The purpose of such activities is to allow decision makers and key stakeholders to learn from the successful experiences of countries that have instituted energy conservation policies and programmes.

6.2.4 Communication and Awareness

Energy conservation often results from a behaviour change towards the use of an appliance. To foster the rational use of energy among consumers, communication and awareness-raising form an important aspect of the intervention. The five-year Energy Conservation Programme plans to undertake communication and awareness-raising measures with USD 0.4 million, representing 9 percent of the total cost of support measures.

This activity will mainly involve:

- Preparation of a communication action plan consistent with the five-year EM Programme;

- Preparation of communication tools (brochures, flyers, tips and guides, radio and television adverts, etc.);

- Creation of a website on energy conservation containing relevant useful information;
- Implementation of communication and awareness-raising activities (campaigns, seminars, etc.);
- Assessment of actions to improve tools and the approach; and
- Identification of national communication focal points

7 Contingency Plan for Donor Support to Mali in Implementing the Roadmap

A number of actions have been identified as avenues for short-term intervention by donors present in Mali. This contingency plan involves the following support measures:

- Technical assistance for implementing the strategy and EM framework conditions;
- Strategic study on energy mix in Mali;
- Preparation of a CDM portfolio and project support;
- Line of credit (energy-efficient buildings); and
- Support to transport sector and harmonisation of planning tools.

The total cost of these support measures is estimated at USD 24.6 million. The details are as follows:

7.1 Support to the Transport Sector and Harmonisation of Planning Tools

Energy consumption in the transport sector is booming. This unbridled increase is attributable to the growing vehicle fleet (20 percent) and the increased mobility of Malians (80 percent), caused by poor urban development. Implementation of the Urban Travel Plan (UTP) and preparation of a study for the development of river transport should help achieve energy savings of at least 15 ktoe yearly.

This activity would provide an opportunity to harmonise the planning tools.
The cost of developing and implementing the UTP is estimated at about USD 1.6 million.

7.2 Establishment of a Line of Credit (Energy-Efficient Buildings)

The pilot project for improving the thermal performance of buildings should help introduce a market for energy-efficient technologies such as insulation, effective glazing, etc.

Scaling up at this level would be achieved by implementing a funding mechanism and establishing a line of credit to finance the initial investment of such activities.

This line of credit is estimated at USD 20 million, for a programme involving 10,000 houses.

7.3 Preparation of a CDM Portfolio and Project Support

The energy conservation sector presents a huge potential for CDM projects. In order to better characterise the sector and benefit from opportunities, it is necessary to prepare a portfolio of CDM projects in this sector and support a number of projects to build momentum in that regard.

The overall cost of this activity is estimated at USD 0.4 million.

7.4 Technical Assistance to MEE

This activity involves setting up a technical assistance project at the MEE to ensure the gradual provision of enabling conditions for the development of energy conservation in Mali and the formulation of an energy audit system, as well as the establishment of an energy information system (EIS). The technical assistance project will provide support in the preparation of specific studies for the development of power generation from renewable energies.

The cost of this activity is estimated at USD 2.4 million.

7.5 Strategic Study on Energy Mix in Mali

Renewable energies such as wind, solar thermal, PV and biomass are becoming increasingly competitive in ensuring part of energy supply. As such, Mali will stand to gain if it carries out a specific study on the development of renewable and alternative energies as part of a strategic study on the energy mix in Mali by 2030.

This study, which is estimated at USD 0.2 million, should be undertaken as from 2012.

8 Conclusion

Mali has a significant energy efficiency and renewable energy potential, which can be harnessed for the country's energy supply security and the reduction of cost. This study is intended to propose the necessary strategic tools for rapidly harnessing this potential at lower cost for the community.

The study deliberately excluded from the analysis wood energy and rural electrification for which the national strategies and programmes are already in place. Similarly, the study did not dwell on improving the performance of the electricity network and reducing system losses as that issue is dealt with extensively by other programmes in Mali, particularly, the World Bank-financed PASE.

The study focused instead on demand-side energy efficiency in priority sectors, as suggested in the analysis of the national energy balance and prospects for its development. The analysis shows that the priority sectors to be targeted by the energy conservation strategy are mainly residential, industry and the tertiary sector (in terms of electricity demand), and the transport sector (for petroleum products).

With regard to energy supply, the study focused mainly on the most technically and economically mature renewable technologies of power production such as wind, solar and biomass.

In view of the foregoing, the priority intervention areas proposed by the strategy are mainly:

- Demand-side electricity conservation with immediate impact actions such as the distribution of low-energy light bulbs in the residential and tertiary sectors, and structural actions aimed at market transformation, such as the certification of appliances, energy-efficient building enclosures, etc.

- Petroleum product savings through the adoption of long-term structural measures in the transport sector. The review of approaches to urban development and planning is one of the substantive measures to implement.

- Wood energy savings in the residential and tertiary sectors, for which Mali has for long had a strategy and instituted major programmes in that regard.

- Optimisation of the power generation mix by stepping up the integration of renewable energy and local resources.

These strategic thrusts were then broken down into a concrete development programme over five years with relatively precise quantification and a logical framework specifying the objectives, means, impacts, responsibilities and implementation risks.
It is important to emphasize, however, that this action plan can only be carried out if certain preconditions are met:

- The establishment of a clear institutional framework for energy conservation that prevents the current dispersal of resources, by clearly designating an operational structure that will be responsible for the implementation and monitoring of this programme and, more broadly, Mali's energy conservation policy.

- The establishment of a specific energy conservation regulatory framework to support government policy in this area, through the promulgation of mandatory provisions and incentives.

- Sourcing the necessary financing for the energy conservation programme through private sector mobilisation, international cooperation funds and internal resources.

- Capacity-building of stakeholders in both public and private sector on the key aspects of energy conservation.

- Strengthening the current energy information system in order to enable effective monitoring and assessment of energy conservation policies and programmes.

These areas formed the subject of a study for a programme of support measures to be financed mainly by Mali's bilateral and multilateral cooperation partners. This support plan, which is estimated to cost about USD 4.5 million, contains three main categories of measures:

- Studies and project preparation;
- Capacity building and technical assistance activities for the implementation of the energy conservation programme; and
- Communication and awareness-raising activities.

Finally, it is worth emphasizing that the energy efficiency component of the PASE provides an opportunity for initialising and operationalising the proposed development programme, by adapting its intervention to the projected action plan.

An immediate action will consist in organising a study tour to Tunisia to learn about that country's experience in institutional organisation, regulatory framework and operational results.

9 Annexes

9.1 *Annex 1: Study Terms of Reference*

9.2 *Annex 2: Assumptions and Calculations*

Annex 1

Terms of Reference
Preparation of an African Development Bank (ADB)
Contingency Plan to Support the Scaling-up of Energy Conservation in the Republic of Mali

1 Background

Currently, developed and developing countries alike face three major constraints that call for strategy change in the energy sector: market tensions and rise in fuel prices; need for long-term energy security; and climate degradation, with increasing domestic impact.

The situation is even more critical for a country like Mali, whose conventional energy resources are meagre and which has to depend totally on the outside for its energy supply.
This dependence on external sources will worsen in future, with the combined impact of rising world oil prices and predicted increase in domestic demand following the improvement in living standards and development of residential and tertiary buildings in the country.

An attempt to boost supply has met with constraints, as Government's meagre resources are overstretched by the increasingly substantial investments needed, with other sectors like education, health and basic infrastructure also requiring attention.

To maintain or develop economic activities using less energy, efforts must be made in three areas: an energy saving attitude must be adopted by individuals and organisations alike; energy efficiency and resort to renewable energies.
Such effort must be reflected in a clear, stable and long-term proactive energy conservation policy, with the following objectives:

- Guarantee the country's energy supply by diversifying resources and making ample use of renewable energies;
- Enhance the competitiveness of economic sectors by improving their energy performance and promoting low-energy technologies;
- Ease strain on household budgets by reducing their energy bill;
- Reduce expenditure incurred by Government for direct and/or indirect subsidies on energy products;
- Reduce and optimise public investments in energy production in the long term, especially in power generation;
- Contribute to global efforts to combat climate change by reducing greenhouse gas emissions.

This situation calls for the consideration of energy conservation as a priority by the governments of developing countries.

Governments should introduce consistent long-term policies and strategies to create an enabling environment for scaling up energy conservation operations.

It is in line with this effort that the Malian Government, with assistance from the African Development Bank (ADB), wishes to recruit a mission of experts to initiate the formulation and implementation of such a strategy.

2 Objectives and Expected Outcomes

The purpose of the mission is to provide the Malian Government with the strategic thrusts for developing energy conservation, with its two components (energy efficiency and renewable energies), and set out the main thrusts of ADB intervention in this area in Mali. This should be based on good understanding and analysis of the country's energy situation and development prospects. It must also take into account global energy, economic, technological and environmental trends with respect to climate change. Specifically, this mission is expected to provide:

- A quick technical, institutional and regulatory situation analysis on energy conservation in Mali;
- Strategic thrusts and a roadmap for developing energy conservation in the country; and
- The Bank's contingency plan in terms of support to the Government of Mali for implementing a scaling up strategy in energy conservation.

3 Content of the mission

To achieve these objectives, the consultant will conduct the mission in five major stages:

- International context of the mission;
- Diagnosis of the situation of energy conservation in Mali;
- Formulating strategic areas for developing energy conservation in Mali;
- Drawing up a roadmap for developing energy conservation in the country;
- Formulating a response plan by ADB to support the country in implementing the roadmap.

3.1 International Context of the Mission

This stage should provide a brief analysis of major global trends in energy conservation, to draw lessons for Mali. The analysis should deal with the following aspects:

- Institutional, regulatory and economic approaches for scaling up energy conservation;

- Energy/climate change linkages and opportunities offered globally for energy conservation financing, through mitigation and adaptation; and

- Technological trends in renewable energies, identifying the most technically and economically mature technologies, and tailoring them to the context of developing countries.

3.2 Diagnosis of the Status of Energy Conservation in Mali

The objective of this stage is to carry out a diagnosis of the status of energy conservation in Mali, while highlighting the barriers and constraints to its development. This diagnosis should deal with the following:

- Analysis of the country's energy policy and the institutional and regulatory framework of the energy sector (electricity sector, petroleum products, traditional energy, etc.);

- Supply and demand-side characterization of the country's energy status and development prospects, highlighting the challenges facing the country's energy balance;

- Brief analysis of energy consumption by sector to highlight the priority sectors for energy conservation;

- Identification and critical analysis of energy efficiency and renewable energy activities in the country; and

- Identification of technical, economic, regulatory and institutional impediments to scaling up development of various components of energy conservation in the country.

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3.3 Formulation of Strategic Thrusts for the Development of Energy Conservation

Based on the diagnosis and in close consultation with the Malian authorities and ADB officials, the consultant will propose the major long-term policy areas for enhancing the development of energy conservation. This strategy must take into account the country's overall social and economic development policy, and holistically cover the following major aspects:

- Identifying priority sectors to be targeted by supply- and demand-side energy conservation;

- Institutional and organisational measures needed to promote energy conservation;

- Regulatory and legal provisions to be recommended;

- Incentives to be introduced through tax reform, direct assistance and financial mechanisms for energy conservation projects in the priority sectors identified;

- Financing energy conservation and raising funds at the national and international level;

- Mobilising national and international private sector and promoting public-private partnership in energy conservation;

- Promoting the Clean Development Mechanism for energy conservation and developing carbon financing in the country; and

- Support and capacity building measures of key energy conservation stakeholders.

3.4 Formulation of a Roadmap for Strategic Thrusts

This stage outlines a roadmap of the ***institutional support and technical assistance activities*** for implementing the strategic thrusts decided previously, in consultation with the Malian authorities.

Over a five-year period, this roadmap will show:

- Activities to undertake to lay out the strategy proposed;
- Their timely planning;
- Cost and possible sources of financing of these activities;
- Stakeholder responsibilities in implementing each of the activities; and
- Monitoring/evaluation indicators of the roadmap.

The consultant will also draw up a summary logical framework for the roadmap, focusing on the critical conditions as well as risks that could hamper the implementation of activities, and means to mitigate such risks.

3.5 Defining an ADB Contingency Plan

This part should define within the framework of the roadmap developed earlier on an ADB contingency plan to support Mali in implementing the strategic thrusts that have been identified.

The plan must be prepared in consultation with the Country Department covering Mali to ensure consistency with ADB overall strategy in the country. The formulation process must also involve the relevant officials of the ADB Energy and Environment Departments.

Specifically, the contingency plan should clearly outline the following:

- A justification of the strategic nature of ADB intervention in Mali in the area of energy conservation;

- A selection of technical assistance and institutional support activities to be financed by ADB, in conformity with the roadmap and based on an array of criteria to be agreed upon with Bank officials and the Malian authorities;

- A portfolio of priority investment projects to be financed by the Bank;

- A detailed description of all activities and projects to be financed by ADB as well as the expected outcomes of each activity in terms of energy, environmental, economic and social impact;

- The local and international partners to be involved in the implementation process;

- A financing plan for these activities and projects;

- A five-year ADB financing plan; and

- A monitoring/evaluation system for implementing the contingency plan.

4 Reporting and Planning

At the end of each of the five stages set forth above, the consultant will submit a report highlighting the major outputs.

The assignment is expected to last six months with an estimated effort of 4 to 5 person-months.

5 Qualification **of** E**xperts**

The completion of this assignment will require two experts with at least ten years of specific experience in the area of energy conservation and extensive knowledge of the context of developing countries, especially Africa.

- An expert specialised in energy conservation policies and strategies, with emphasis on institutional, regulatory and technical aspects;

- An economist/financial expert specialised in energy conservation and climate change.

Annex 2
Programme of the Start-up and Diagnostic Mission

Institution	Meeting Date	Persons Met
Ministry of Energy and Water	Monday 14 November 2009 at 11h00	Sinalou DIAWARA, National Director Shiek Ahmed SONOGO, DNE Deputy Tezana COULIBALY
World Bank	Monday 14 November 2009 at 16h00	Koffi EKOUEVI, Head, PASE Project
EDM	Tuesday 15 November 2009 at 11h00	Abdoulaye Djiril DIALLO, Director, Commercial Station
MEE	Tuesday 15 November 2009 at 15h00	Mamadou DIARRA, Minister
AMADER	Tuesday 15 November 2009 at 16h00	Isamail Oumar TOURE, GM Seydou KAEITA, DED
Ministry of Housing, Land and Urban Development (Housing Department)	Wednesday 16 November 2009 at 9h00	Nouhoum SIDIBE, Moussa TANGARA Ouarazan DEMBELE, Sounkatou KOULIBALY, Issa DEMBILE, Amadou DIAKITE
Donors: European Union, AFD, WAB, ADB	Wednesday 16 November 2009 at 10h00	Daouda TOURE, Ousmane TRAORE Abdoulaye Mohamane TANDINA
Ministry of Infrastructure and Transport	Wednesday 16 November 2009 at 10h00	DJibril TALL Malick KASSE
Ministry of Industry – National Directorate of Industry	Wednesday 16 November 2009 at 14h00	Syedounour DIALLO
National Solar Energy Centre	Wednesday 16 November 2009 at 15h30	Sekou Omar TRAORE
WB Project Task Manager, Ministry of Energy and Water	Wednesday 16 November 2009 at 16h30	Sekou Omar TRAORE
Ministry of Environment and Sanitation	Thursday 17 November 2009 at 9h00	Moudibo DIALLO
MDP National Authority Designate	Thursday 17 November 2009 at 10h00	Abdoulaye KANTE
Ministry of Economy and Finance	Thursday 17 November 2009 at 11h00	Souley BAH Abdoulay Ali DIALLO
AFD	Thursday 17 November 2009 at 15h00	Hervé Hugo BOUGAULT
Association of Real Estate Developers	Thursday 17 November 2009 at 18h00	Moussa COULIBALY
UNDP	Friday 18 November 2009 at 8h30	Kalfa SANOGO
ANADEB	Friday 18 November 2009 at 9h30	Hamata AG HANTAFAYE
CREE	Friday 18 November 2009 at 11h00	Brahima KASSAMBARA, Oumar BERTHE Brahima SIDI TRAORE, Moktar TOURE Seydou CAMARA
ADB: Mission closing meeting with the Ministry of Energy and Water	Friday 18 November 2009 at 16h00	Lahcen Moulay ENNAHLI Abdoulay Mahamane TANDINA Sinalou DIAWARA, National Director Tezana COULIBALY, MEE Seydou KAEITA, AMADER

Annex 3
Mali Energy Development and Conservation Strategy

Summary Record of the Study Restitution Workshop
Bamako, 9 April 2010

To discuss the outcome of the study proposing an energy development and conservation strategy for Mali, a restitution workshop was organized on 9 April 2010. The workshop drew the participation of representatives of various sector institutions concerned as well as donors represented in Mali.

Following a presentation of the study content by the ADB Resident Representative in Mali, the workshop was opened by the Secretary-General, Ministry of Energy and Water (MEE) who emphasized the importance of optimizing the country's energy supply by fighting energy wastage at all levels.

The National Deputy Director of Energy presented Mali's energy policy by highlighting the policy objectives, achievements and sector challenges.

Thereafter, the consultants presented the diagnosis and the strategic orientations on energy conservation proposed in the study. They stated that the orientations would take the form of intervention programmes over five years, for which they had assessed the energy, economic and environmental impacts.

The presentation also discussed the accommodating measures necessary to implement the contingency plan, especially the institutional arrangements and the required technical support.

Lastly, the consultants highlighted the conditions for operationalising the proposed programme and the role that the PASE Programme could play in the initialization phase.

In the wake of the discussion, the participants concluded and recommended as follows:

1. Initially, PASE planned to finance a study on Mali's energy effectiveness strategy. In light of the study discussed, proposals were made to consider financing some of the activities proposed under the energy effectiveness strategy study by reallocating the related PASE programme budget component (i.e. energy effectiveness component). That would particularly concern the organization of a national consultative conference on the energy conservation strategy.

2. Participants insisted on the need for broad consultation of various actors concerned by the proposed strategy, including the guild of architects and consulting engineers. That could be part of the objectives of the national conference.

3. It was also recommended to deepen the energy conservation regulatory framework. In that regard, the consultant insisted on the fact that the regulatory framework only offered a legal basis for the strategy; its content will depend on the scope of orientations adopted. The consultant will flesh out the chapter in the final document.

4. It was also requested that the proposal concerning the institutional arrangement be reviewed by not naming a structure dedicated to energy conservation since that activity was covered by the National Directorate of Energy.

From the consultants' point of view, the implementation of a programme as important as the one proposed (USD 100 million over 5 years) will inevitably require an operational structure capable of driving all sector actors and capitalizing programme achievements, with a view to speeding up Government policy in that area. Naturally, in its capacity as the national energy conservation leader, the DNE will play its sector policy and strategic supervisory role. However, it could lay no claim to implementing the operational activities.

5. MEE representatives suggested that the consultants further reflect on the mechanism proposed for distributing low energy light bulbs (LELBs), within the PASE framework. The consultants fully embraced the suggestion which will involve:

- The evaluation of real LELB demand at the level of targeted households;
- The evaluation of AMADER's experience in that regard;
- Negotiations and consultation with various actors concerned;
- The final design of the mechanism;
- The preparation of procedures manuals;
- The preparation of conservation tools, etc.

Naturally, PASE will undertake that task, within the framework of implementing that component.

6. Participants drew attention to the inadequate treatment of the wood energy issue in the study and suggested that given its importance, the matter should be included in the proposed strategy. According to the consultant, although the issue was very important within the Malian context, the wood energy component was voluntarily excluded from the study for the following reasons:

- The matter has received considerable consideration before; there already was a national strategy implemented by a specialized institution, AMADER;

- Consequently, the issue of wood energy was not included in the study terms of reference;

- Lastly, given the brief time allocated to the study and the complexity of the wood energy issue, the consultants would have found it difficult to propose relevant strategic solutions that would bring value added, compared to work already in Mali's possession.

Annex 4
Calculation Assumptions

Working Assumption						
Investment cost by Themal MW	800	USD				
Toe cost at USD 80/barrel	600	USD				
Specific Electricity Consumption	280	Toe/GWh				
USD 1	504	CFAF				
Efficient Buildings						
Cost by m²	250 000	CFAF				
Additional cost of efficiency measures	4%					
Energy Gains	50	kWh/m²/yr				
Average surface area	150	m²				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Rate of implementation	No./yr	20	20	20	20	20
Cumulative output	No./yr	20	40	60	80	100
Thermal Renovation of Buildings						
Energy Gains	25	kWh/m²/yr				
Cost per m²	20	USD/m²				
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Rate of Implementation	m²/yr	2000	2000	2000	2000	2000
Cumulative outputs	m²/yr	2000	4000	6000	8000	10000
Solar Water Heaters (SWH)						
Electricity substituted	1 200	kWh/yr				
Cost	1 200	$/m²				
Power	1.8	kW				
Replication	0.3					
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Rate of implementation	No./yr	2000	2000	2000	2000	2000
Cumulative outputs	No./yr	2000	4000	6000	8000	10000
Energy-efficient Airconditioners						
New number	10000					
Affected stock	50%					
Consumption	1200	kwh/yr				
Savings	5%					
Additional costs	40					
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Rate of implementation	No./yr	1000	1000	1000	1000	1000
Cumulative outputs	No./yr	1000	2000	3000	4000	5000
Energy-Efficient Refrigerators						
No. of new refrigerator purchases	30000					
Affected stock	50%					
Consumption	600	kwh/yr				
% Energy savings	5%					
		Year 1	**Year 2**	**Year 3**	**Year 4**	**Year 5**
Implementation rate	No./year	3000	3000	3000	3000	3000
Cumulative outputs	No./yr	3000	6000	9000	12000	15000
Additional costs	40	USD				
Power	0,2	kW				

Efficient Street Lighting (HPS)		Year 1	Year 2	Year 3	Year 4	Year 5
Implementation rate	No./yr	3000	3000	3000	3000	3000
Cumulative Output	No./yr	3000	6000	9000	12000	15000
Pilot Tertiary Actions						
Average consumption per building	50	Toe/yr				
Gains	20%					
		Year 1	Year 2	Year 3	Year 4	Year 5
Implementation rate	Action/yr	2	2	2	2	2
Cumulative Output	Action/yr	2	4	6	8	10
Cost	100000	USD/action				
Industry Pilot Actions						
Consommation moyenne par industrie	2000	Toe/yr				
Gains	15%					
		Year 1	Year 2	Year 3	Year 4	Year 5
Implementation rate	Action/yr	1	1	1	1	1
Cumulative Output	Action/yr	1	2	3	4	5
Cost	800 000	USD/action				
No. of towns						
Average consumption per industry	2000	Toe/yr				
Gains	5%					
		Year 1	Year 2	Year 3	Year 4	Year 5
Implementation rate	Audit/yr	2	2	2	2	2
Cumulative Output	Audit/yr	2	4	6	8	10
Cost	40 000	USD/action				
Industry Contract-Programme						
Average consumption per industry	2000	Toe/yr				
Gains	20%					
		Year 1	Year 2	Year 3	Year 4	Year 5
Implementation rate	CP/an	1	1	1	1	1
Cumulative Output	CP/an	1	2	3	4	5
Cost	500 000	USD/action				
Transport energy savings						
Number of towns	1	Bamako				
Gains	20%	15 ktoe/yr				
		Year 1	Year 2	Year 3	Year 4	Year 5
Implementation rate	Toe/yr	0	0	15	15	15
Cumulative Output	Toe/yr	0	0	15	30	45
Cost	1 200 000	USD/actions UTP				

Calculation Assumptions for Low Energy Light Bulbs				
USD 1	504	CFAF		
Specific Consumption	280	Toe/GWh		
Social Category	59	CFAF		
Category 2	98	CFAF		
Category 3	106	CFAF		
Diesel Emission Factor	3,2	TECO2/Toe		
Average Price/kWh	80,1			
Operating Time	3			
Lifespan	8000			
Power Substituted	75	w		
LELB Power	20	w		
Power Gains	55			
Replication Factor	0.7			
Electricity Savings	60	kWh/year		
Billing Gains	4 824	FCFA/year		
Billing Gains USD	10	$		
Return Time	4	months		
CERU Price	10	USD		

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