

12.1 Introduction

A major issue directly related to poverty reduction, sustained economic growth, and environmental protection is the availability of modern energy services. Increasing accessibility of the majority of the population to modern energy services and efficient devices will lead to the improvement of living conditions of the Zambian people in rural and urban areas. Energy and poverty are directly related. Low income households, for example, tend to rely on basic forms of energy such as firewood and charcoal while high income households use higher forms of energy such as electricity. The use of low forms of energy such as wood, dung, and other biomass lead to indoor air pollution, which is a major by-product of traditional energy sources, further diminishing the quality of life of poor households. If patterns of energy use result in adverse effects on nutrition, health, productivity, and the environment, for example, benefits in economic growth are likely to be absorbed only very slowly by poor households. In contrast, programmes that focus directly on creating opportunities for poor people to improve their energy services by increasing the use of energy carriers can enable poor households to enjoy both short-term and self-reinforcing long-term improvements in their living standards.

12.2 Situation Analysis

While measures can be taken to specifically target the poor, an equally important goal is to ensure that the provision of energy is done in a sustainable manner to generate resources for re-investment in energy and other sectors. Apart from being a critical input in many sectors, energy is an industry in its own right with the capacity of earning foreign exchange and employing many people; these employment figures currently stand at 6,000 and 60,000 respectively for electricity and charcoal.

12.2.1 Energy Resource Base, Supply and Demand

Except for petroleum, which is wholly imported, Zambia is richly endowed with a range of indigenous energy sources particularly woodlands and forests for wood fuel, hydropower, coal, and new and renewable sources of energy. Woodland and forests cover about 66 percent of the total land area with the growing stock being equivalent to 4.3 million tonnes of wood that provides about 70 percent of the nation's energy needs. The hydropower resource potential is estimated at 6,000 MW although the installed capacity is only 1,715.5 MW, which contributes about 14 percent to total energy use. Hydroelectric plants represent 92 percent of installed capacity and account for 99 percent of electricity production. The major plants are Kafue Gorge (900 MW), Kariba North Bank (600 MW) and Victoria Falls (108 MW). Important international connections include two 330 kV lines to Zimbabwe and a 220 kV line connecting the Copperbelt to the Democratic Republic of Congo. The major electricity users are the mines, which consume up to 68 percent of total load, industry and commerce 4 percent, households 19 percent, agriculture and forestry 2 percent while the remaining 7 percent is taken up by government services.

Proven coal reserves are estimated at 30 million tonnes with several hundred million tonnes of probable reserves. Only one coal mine is in operation at Maamba Collieries with a design output of one million tonnes per annum. In recent years, the contribution of coal to total energy has declined to barely 2 percent due to production constraints at Maamba Collieries. The delayed privatisation of the firm has also contributed to poor performance. Petroleum is the

major energy source that is imported and accounts for about 12 percent of total national energy demand. Established infrastructure for petroleum import and processing include the 1,710-kilometre TAZAMA Pipeline and the INDENI petroleum refinery designed to process 1.1 million tonnes of spiked crude. Thus, with the exception of oil, Zambia is virtually self-sufficient in energy. Total annual energy consumption of all energy sources is in the range of 4.5 million Tonnes Oil Equivalent (TOE). At a sectoral level, wood fuel is mostly consumed by households while commerce and industry, particularly the mines, are the dominant consumers of petroleum, electricity, and coal.

12.2.2 Energy Sector Policy Framework

In 1994, the Zambian Government formulated a National Energy Policy (NEP). Its main objective is “to promote optimum supply and utilisation of energy, especially indigenous forms, to facilitate the socio-economic development of the country and maintenance of a safe and healthy environment”. Broadly, the policies in the energy sub-sectors are defined as follows:

- *Electricity*: Increase accessibility in its use as well as develop the most cost-effective generating sites for domestic and export markets.
- *Petroleum*: Supply and utilise petroleum in the most efficient and cost-effective manner.
- *Coal*: Promote its use with due regard to environmental protection.
- *Wood fuel*: Promote efficient production and utilisation of wood fuel.
- *New and Renewable Sources of Energy (NRSE)*: Promote wider application of proven NRSE technologies in meeting the energy needs particularly for remote areas.

Programmes in the energy sector to contribute to poverty reduction will aim at the following:

- Increasing the electricity access rate from the current 20 percent to 35 percent by the year 2010. In rural and urban areas, this will translate to access rates of 15 percent and 50 percent respectively. Increased access to electricity will enhance social and economic development by supporting agricultural activities such as irrigation and food processing, land preservation, etc.
- Reducing the production of charcoal by about 400,000 tonnes by 2010. To do this, the PRSP will promote efficient production and utilisation as well as encouraging the use of other fuels such as electricity, millennium gel fuel, and liquid petroleum gas by low and medium income groups instead of charcoal.
- Increasing of electricity exports to neighbouring countries by 300 percent by the year 2010 from the current levels.

12.3 PRSP Strategies for Poverty Reduction in the Energy Sector

Three strategies are identified for the energy sector as follows:

- Enhancing the capacity of current energy delivery infrastructure through rehabilitation and/or refurbishment to ensure reliable and efficient supplies, and to ensure access by more people.
- Creating new energy delivery infrastructure through, for example, building new power stations, transmission lines, etc. to cater for increased domestic demand and export.
- Targeted interventions aimed at achieving particular results such as increased access and promotion of alternative technology.

The three strategies are translated into specific activities presented below.

12.3.1 Enhancing the Capacity of Current Energy Delivery Infrastructure

The two main ongoing projects under this programme are the power rehabilitation and the petroleum rehabilitation projects. The objective of the projects under this programme is to achieve particular results such as expanded electricity coverage; promotion of alternative technology; and steering energy use in a particular direction, for example energy substitution

to uplift the living standards of low income households. The projects are aimed at rehabilitating the power and petroleum infrastructure, which has been in use for more than thirty years without any major maintenance works.

Power Rehabilitation Project: Studies to establish the scope of works for rehabilitating the power infrastructure started in 1995/1996. Technical audits of the major infrastructure such as hydropower plants, the transmission network, and the distribution system concluded that major rehabilitation work would be needed to bring them to design operation levels and extend the economic life of the assets. The main components of the power rehabilitation project were Victoria Falls, Kafue Gorge and Kariba North Bank; ZESCO Power Transmission System; Lusaka distribution network; the distribution networks of Ndola and Kitwe on the Copperbelt; loss reduction in the Lusaka West Area; Gwembe-Tonga Rehabilitation and Development Programme; ZESCO Institutional Strengthening; and Hydropower Development and Transmission Line Policy. A consortium lead by the International Development Agency (IDA) funds the project whose total cost is estimated at \$235 million. The financing is split between credits from IDA, European Investment Bank, and Development Bank of Southern Africa (DBSA). In addition, other funds are in the form of grants from cooperating partners, funding from ZESCO and the government budget especially for certain components of the Gwembe-Tonga Development project. The project has been in operation since 1998.

Petroleum Rehabilitation Project: The main components of this project, which was funded by IDA and the European Investment Bank, are the rehabilitation of the TAZAMA pipeline from Dar es Salaam to Ndola including the tank farm in Dar es Salaam; cathodic protection of the pipeline, refurbishment of pumps on the pipeline, improvement of pumps on the pipeline and improvement of telecommunications; rehabilitation of the fuel terminal at Ndola; construction of a 40,000-tonne capacity crude oil tank at Ndola; and creation of a technical cell on petroleum in the Ministry of Energy and Water Development.

In parallel with the rehabilitation of petroleum infrastructure, government is pursuing other reforms in the sub-sector that include exploring modalities for setting up strategic reserves of petroleum products; and facilitating private sector participation in the procurement of petroleum feedstock for refining at the refinery. The overriding goal of the rehabilitations is to ensure that petroleum products are supplied to the country at the least cost and are utilised in the most efficient manner.

12.3.2 Creating New Energy Delivery Infrastructure

According to projections of power demand, it is anticipated that the current installed capacity may be outstripped by projected demand in the year 2005. In order to forestall a power shortage, two power generation projects and two inter-connector projects are planned:

- *Kafue Gorge Lower Hydro Electric Scheme (KGL):* The project is located two kilometres downstream from the existing 900 MW Kafue Gorge Upper power station. The project will be rated at 600MW and is estimated to cost \$ 430 million. This will be a private sector-led investment.
- *Itezhi-Tezhi Hydro Electric Project:* This project is located on the Itezhi-Tezhi Dam, some 230 kilometres upstream of the Kafue Gorge power station. The estimated capacity of the project is 120 MW at an estimated cost of \$100 million. An additional cost of \$28 million will be required for the construction of a 200-kilometre 220 kV transmission line from Itezhi-Tezhi to Muzuma, which is the nearest point of inter-connection to the national grid.

12.3.3 Zambia-Tanzania Interconnector

The project involves the construction of a total of 700 km of 330 kV transmission line, 600 km on the Zambian side and about 100 km on the Tanzanian side. The proposed line will be able to supply an estimated load of up to 200 MW of power. The project cost is about \$153 million. Its

scope has since changed to include reinforcement within the Tanzanian system and exports to Kenya and beyond. Private investors will develop the project.

12.3.4 Zambia-Democratic Republic of Congo Interconnector

This project involves the construction of a 387 kV transmission line from Kolwezi in Democratic Republic of Congo to Luano (Zambia) via Solwezi. It is part of the priority projects within the SADC region master plan to transfer 1,000 MW of power from Democratic Republic of Congo to South Africa and vice-versa. This hydroelectric line also opens up the possibility of connecting Northwestern Province to the grid. Costs are estimated at \$120 million. About 70 kilometres of towers belonging to ZESCO were constructed between Luano and Kansanshi in the 1970s. The World Bank has been approached regarding financing of the feasibility study of the Kolwezi-Luano Interconnector. Furthermore, the United States Trade and Development Agency (USTDA) has provided funds for a feasibility study on the Luano-Kansanshi portion of the line.

12.3.5 Electrification of Mkushi Farm Block

This project, which has been outstanding since the early 1970s, is meant to unlock the tremendous agricultural potential in the block, which has not been fully exploited. Although the southwest part of the block was partly electrified by government, ZESCO, and the farmers in 1997 through a 33 kV line, the supply is not sufficient for the whole area. It is in this context that plans are under way to promote the electrification of the farm block through a private or public-private partnership. The indicative cost of the project at current prices is \$ 40 million inclusive of financing costs.

12.3.6 Promoting Efficient Production and Utilisation of Wood Fuel

Activities under this programme have so far involved studies of the various aspects of the charcoal industry, starting with the resource base (forests), charcoal production, transportation, marketing, and distribution of charcoal. The aim is to minimise the use of wood fuel because of its adverse effects on the environment. When fully operational, the programme will result in annual wood savings of about 10 percent of total wood consumption, which is equivalent to 400,000 tonnes per annum. Projects under this programme include the following:

- *Efficient production and use of charcoal:* Zambia has produced a charcoal production manual that can assist rural communities increase their production efficiency in earth kiln. In addition, efforts to improve end-use efficiency through adoption of an appropriate improved stove will continue.
- *Substitution of charcoal in urban households with millennium gel-fuel:* The government is considering the introduction of the use of millennium gel fuel in urban households. The millennium gel fuel currently on trial use in Zimbabwe and soon to be introduced in Malawi provides an opportunity for replacing charcoal use in urban households. The gel fuel will either be imported from Zimbabwe/Malawi or produced in Zambia at Nakambala Sugar Estate (where molasses for production of ethanol already exist).

Efforts will also be made to look at other alternative fuels that can replace charcoal in households. Other fuels such as Liquid Petroleum Gas (LPG) will be used to undertake the necessary studies first before determining the way forward. Much of the future growth in the energy sector will depend on the energy requirements of other sectors. Zambia offers a great opportunity for investors in that its principal energy resource base is composed of renewable sources. The programmes that have been identified in this chapter will be monitored through the Department of Energy, which already collaborates with other institutions in the various energy sub-sectors.

12.3.7 Rural Electrification Programme

Although the rural electrification programme has been implemented over a long time, less than 20 percent of the population has access to electricity power supply. To improve the funding of the programme, the government created a rural electrification fund in 1994. The money for this fund is raised from a levy on all electricity consumption. To make the programme even more effective, the government will create a conducive environment for the development of a national Rural Electrification Master Plan (REMP), which will identify all options for electrification at least cost; review and improve the administration of the rural electrification fund as well as the actual implementation of rural electrification; and work towards the integration of the use of new and renewable sources of energy in the provision of energy services to rural communities.

Under the REMP, projects will be identified based on the least cost energy source option. In this regard, the Plan will rank all projects in a priority order with an indication of each project's budget and the time frame for implementation; define modalities for including other potential financiers for rural electrification projects as well as private sector involvement in project implementation; explore opportunities for designing appropriate incentives for encouraging supply of energy services to rural areas; and work jointly with economic and social sectors to take electricity where it is critically needed such as the proposed new farming blocks. The methodology for preparing the REMP will be through a broad-based consultative process.

Grid extension is another important aspect under the Rural Electrification Programme. It is recognised that current efforts will continue until such time that the REMP has been finalised and launched. In this regard, the projects that involve extension of the grid will continue under PRSP implementation. Solar energy is another important addition. Despite the abundance of sunlight, the utilisation of solar photovoltaic (PV) technology has been very low in Zambia. The problem in this respect is the high upfront cost of installation. In this context, this project will target rural institutions that may not be connected to the grid in the short and medium term. The installations will be implemented as demonstration units of this technology by providing solar energy for educational purposes (computers/television), small-scale lighting and water pumping to rural schools, and providing solar energy for small-scale lighting, medical, refrigeration, and water pumping to Rural Health Centres (RHCs). The Department of Energy is currently implementing a pilot project in which Solar Home Systems (SHSs) are being provided to households that pay monthly service fees to a locally-based Energy Services Company (ESCO).

One way of increasing options for energy supply to rural areas is that of promoting the construction of small power stations (mini/micro power stations) for small towns, villages, businesses, and households where the potential exists. These programmes, coupled with urban electrification, are expected to increase electricity access rate from the current 20 percent to 35 percent by 2010. In rural and urban areas, this will translate into access rates of 15 percent and 50 percent respectively. The following will be initially implemented:

Mini-hydro: These will be developed in the northern part of the country where small waterfalls already exist for electrification of rural communities. Some of these projects will replace existing diesel generators while in some cases hybrid systems will be considered. It is estimated that about \$10 million will be required over three years.

Micro-hydro: Micro-hydro schemes will target individual households. Micro generating schemes for households can be installed at a cost of about \$200 per household; with a target of 500 households a budget of \$100,000 will be required.