ZAMBIA
Power Sector Restructuring Program
Technical Assistance to ZESCO
Report Completed in 1998

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Currency Equivalents

Currency unit	=	Kwacha
1US$	=	65 Kwacha (1991)
	=	130 Kwacha (4/92)
	=	300 Kwacha (9/92)
	=	425 Kwacha (1/93)
	=	500 Kwacha (8/93)
	=	900 Kwacha (1/96)

Acronyms

DOE	Department of Energy
DSM	Demand-side management
ESCO	Energy Service Company
ESCOM	Electricity Supply Commission of South Africa
FINNIDA	Finnish International Development Authority
IMF	International Monetary Fund
IOB	Inspectorate of Boilers
KNBC	Kariba North Bank Company
MEWD	Ministry of Energy and Water Development
NEC	National Energy Council
NORAD	Norwegian Agency for Development Cooperation
SIDA	Swedish International Development Authority
TAP	Trade ally program
TAZAMA	Tanzania-Zambia Pipeline Corporation
ZCCM	Zambia Consolidated Copper Mines Ltd.
ZESCO	Zambia Electricity Supply Corporation
ZIMCO	Zambia Industrial and Mining Corporation
ZIMOIL	Zambia Oil Company

Zambian Fiscal Year = April 1 to March 31

Zambia: Power Sector Restructuring Program Technical Assistance to ZESCO

ESMAP has been involved in several activities in the energy sector in Zambia. In 1983 ESMAP undertook an energy assessment, which provided the first sectorwide review of the energy sector in Zambia. Subsequently, ESMAP has provided extensive technical assistance to the energy sector. Specifically, the assistance has addressed institutional issues, in-depth evaluation of operational efficiency of the power subsector, a comprehensive energy-strategy study, and an urban household energy-strategy study. These ESMAP technical assistance activities, particularly the energy-strategy exercise that was conducted in 1988, laid the foundation for energy lending operations by the World Bank and other international agencies.

ESMAP's Zambia Energy Sector Strategy report provided the basis for identifying priority investments and government policy reforms, which were implemented from 1989 to 1993. The government made notable progress in bringing energy pricing policies into line with overall macroeconomic adjustments. It also was able to rationalize the allocation of available resources in its public expenditure program to achieve cost-effective rehabilitation of the existing energy infrastructure.

The government relies on the Ministry of Energy and Water Development (MEWD) to execute its core responsibilities of policy and strategy development principally for the petroleum sector, and for monitoring the implementation of such policies and strategies through autonomous energy utilities, agencies, and organizations. The government relies onthe Zambia Electricity Supply Corporation (ZESCO) to improve its operational autonomy and efficiency, taking into account the findings and recommendations of previous ESMAP studies. This report is focused principally on ZESCO.

After about two decades of economic decline, by 1992 Zambia's energy situation had become critical. The country faced severe difficulties in paying for petroleum imports, the energy supply infrastructure was in urgent need of rehabilitation, and energy-sector organizations had become operationally and financially weakened. As the government began taking necessary steps to recover from this decline, it identified the energy sector as a key contributor to the recovery process.

Zambia's prolonged period of economic decline had three major implications for the government's efforts to formulate a long-term strategy for energy-sector development. First, stagnation in energy demand had resulted in excess capacity in the country's energy supply and distribution infrastructure. Second, macroeconomic difficulties, compounded by inadequate energy-pricing policies, had starved the energy-implementing agencies of financial resources and the foreign exchange required to carry out essential maintenance and repairs of their facilities, including hydropower stations, the refinery, petroleum pipeline and storage depots, and coal-mining facilities. Third, the government had been preoccupied with crisis management to the

extent that it had been unable to take action to eliminate redundancies in the institutional and operational setup of the sector.

The government's strategy for the energy sector gave priority to (a) streamlining of institutional responsibilities for energy policy; (b) restructuring and commercializing the operations of the main energy-sector parastatals; (c) reforming energy-pricing policies; (d) rehabilitating existing energy facilities and infrastructure; and (e) improving arrangements for petroleum imports so as to minimize expenditure of scarce foreign-exchange resources.

National Energy Strategy

A comprehensive review of the policies and programs for the energy sector in 1993–94 led to the development of a national energy strategy that was endorsed by the government. The national energy strategy sought to minimize new investments by emphasizing improvement in existing capacity utilization and upgrading the operational efficiency of energy-implementing agencies. The strategy also sought to reform energy-pricing policies to improve the financial viability of energy entities as well as to enhance incentives for energy conservation.

The main features of the national energy strategy included:

- ?? Creating a viable framework to allow the MEWD to expand its current responsibilities ofcoordinating national energy policies and rolling public investment plans. Under the new framework, the MEWD also would regulate all public utilities (including nonenergy utilities) in a manner that would enhance management autonomy, eliminate the use of government support to meet revenue shortfalls, and apply a mechanism to automatically adjust energy prices on the basis of agreed criteria.
- ?? Implementing organizational reform measures to improve operational performance of major energy utilities, including greater efforts to improve management and operational efficiency through better training, enhanced rewards, and use of outside expertise where necessary.
- ?? Establishing effective systems and capabilities for strategic and contingency planning within the energy-supply organizations and their major customers. These measures would include coping with the possibility of accidental interruption of vital energy supplies, for example, of coal (possible dragline failure) and oil (lack of refinery storage in the event of a pipeline failure).
- ?? Avoiding investment in new energy-supply facilities, which because of surplus capacity, would not be needed. Instead, the emphasis would be on high-return investments for the rehabilitation and reinforcement of existing supply capacity and systems.

?? Minimizing energy imports through efficiency measures and the substitution of petroleum by indigenous energy resources. Efforts would be made to maximize economically justified energy exports (that is, electricity and coal).

Energy-Sector Objectives

The government's objectives for carrying out reforms in the energy sector were threefold. The first objective was to move energy prices as rapidly as possible toward levels that would reflect the actual economic costs of supply. The second objective was to ensure that energy prices would allow energy-sector organizations to become financially viable in day-to-day operations and allow them to achieve a fair rate of return on their capital assets. The third objective was to ensure that energy prices provided a clear and compelling incentive for consumers to use energy more efficiently and, where economically justified, to substitute indigenous energy for imported petroleum.

The government already had taken bold steps to increase energy prices and eliminate subsidies within the framework of an economic reform program that was agreed upon with the International Monetary Fund (IMF) and the World Bank in 1993. Nevertheless, there remained scope for further adjustments in energy-pricing policies to accommodate the second and third objectives. Hence, the principal issues facing the MEWD included (a) restructuring and streamlining the institutional framework of the sector and speeding up the process of corporatizing and divesting the energy parastatals; (b) developing a plan to mitigate adverse social impacts of energy-price increases for vulnerable groups in the country, such as households in major urban centers; and (c) transforming previous initiatives on energy conservation and fuel substitution into a comprehensive program that would extend the scope of the energy-pricing reforms to address critical constraints and opportunities to improve energy efficiency at the end-use level.

In June 1993 the government announced a long overdue tariff increase for ZESCO. The tariff increase, which in nominal terms exceeded 500 percent, triggered widespread protests, particularly from industrial and commercial consumers. The Zambia Consolidated Copper Mines (ZCCM) copper conglomerate, which accounted for about 70 percent of ZESCO's sales, raised strong objections to the increase and petitioned the government to reverse the tariff increase. The MEWD and ZESCO were unable to provide the necessary cost analysis to substantiate the tariff increase. The ZCCM contended that the increase was not in line with the Electricity Act. Against this backdrop, MEWD requested ESMAP assistance.

As a first step, ESMAP undertook a long overdue inventory review and revaluation of ZESCO's fixed assets to establish a suitable rate base for measuring ZESCO's financial performance. In addition, ESMAP arranged for a study to restructure electricity tariffs and prepare a demand-side management (DSM) program to assist consumers, particularly industrial and commercial consumers, to save electricity and reduce loads, thereby minimizing the impact

of tariff increases. The outputs of the above activities provided a means for determining ZESCO's financial viability, fiscal revenues, and consumers' reaction to the new tariff policies.

Meanwhile, ESMAP assistance to MEWD was put on hold at the end of 1993 because of the disruption arising from the tariff increase. Institutional and operational restructuring of ZESCO was still needed, however, because of ZESCO's poor bill collection, financial management, and loss of efficiency from delays in plant rehabilitation. ESMAP identified as priority issues the strengthening of ZESCO's institutional capacity, particularly in distribution planning and bill collections, the preparation of a rehabilitation program for generation and distribution, and the commercialization of ZESCO's operations.

Issues Facing the Sector

ESMAP drew up a reform program for ZESCO in response to its worsening financial crisis, primarily created by the poor planning of tariff increases. On the basis of prevailing tariffs, ZESCO should have been able to generate a reasonable profit. In reality, however, ZESCO was incurring losses and could not provide a reasonable level of service to its customers. The situation called for urgent measures to address these operational and efficiency issues.

The study sought to address the following main needs:

- ?? Improving the operational autonomy and efficiency of ZESCO
- ?? Alleviating the impact of energy price increases, particularly on low-income groups
- ?? Promoting energy efficiency and fuel substitution

Improving the operational autonomy and efficiency of ZESCO. The initial tasks in the government's parastatal-reform program involved detailed institutional reviews to identify key institutional, managerial, and policy changes to improve the operational efficiency and financial viability of each energy organization. In the case of ZESCO, which had severe operational and management deficiencies and was a major recipient of subsidies, the government had requested external technical assistance to conduct a more extensive review of all aspects of the organization and also to formulate a comprehensive plan to restructure and strengthen the utility. As a first step, through the World Bank's Privatization and Industrial Reform Credit operation, ZESCO commissioned a team of specialists from the Electricity Supply Corporation of South Africa (ESCOM) to undertake a management audit covering all aspects of operations. The findings and recommendations were outlined in the ESCOM report, *Audit of the Management Processes of ZESCO*, in September 1992.

ESMAP conducted another study, the Power Subsector Efficiency Study, to identify actions to improve ZESCO's financial viability. The study found that (a) ZESCO's tariff levels were maintained at inadequate levels to generate cash reserves for operation and maintenance or for servicing debt; (b) the procedure to adjust tariffs was time consuming and did not provide the

utility with flexibility to adjust tariffs to keep pace with inflation; and (c) low employee productivity and inadequate procedures in commercial operations created billing and collection delays that resulted in the accumulation of high accounts receivable and subsequent cash-flow problems.

Alleviating the impact of energy pricing reform, particularly on low-income groups. The MEWD was concerned that rapid increases in electricity and kerosene prices might have an inordinately large impact on the expenditure patterns for households, especially those in the large, urbanized centers in Lusaka and the Copperbelt. Although most people in urban Zambia use charcoal for cooking, there were indications that kerosene prices provided a cap for charcoal prices. Increases in electricity and kerosene prices might cause charcoal prices to increase as well, forcing households to pay a higher percentage of their incomes on fuel. Despite provisions made for lifeline tariffs for the poor, in practice, poor households were unable to obtain electricity service connections at the lifeline level because of infrastructure constraints. This situation was substantiated in the Urban Household Energy Strategy Study conducted by ESMAP in 1990.

The government was concerned that equity and efficiency issues were not being adequately addressed through the energy price increases. Despite consensus that efficiency issues would ultimately be addressed as part of overall restructuring of operations of energy-sector organizations, in general there was less understanding of how to address the equity issue, especially potential adverse social impacts ion low-income and other vulnerable groups.

Promoting energy efficiency and fuel substitution. The MEWD conducted preliminary energy surveys of about 30 industrial plants in 1986/87 and subsequently detailed energy audits in about 6 plants to assess the scope of energy saving and substitution of petroleum products (that is, fuel oil and diesel oil) with coal or electricity. Findings of the surveys led MEWD to believe that minor adjustments in operating practices and investments in retrofit measures could lead to reductions in expenditure for energy of between 7 and 33 percent. Although the initial survey sample was small, there were clear indications of potential energy savings in the industry.

Cost reductions, energy savings, and minimizing foreign-exchange expenditures for petroleum were the three objectives of the government's policy to promote energy efficiency and fuel substitution in all sectors, especially in the industrial, mining, and commercial sectors. The government would then benefit from the projected reduction in petroleum import requirements.

To realize the savings, the MEWD needed to focus on addressing the following major deficiencies in energy-use practices in target sectors: (a) the installation of oversized energy-using and heat-producing systems; (b) the failure to trim energy requirements of combustion systems or process equipment in proportion to reduced production levels; (c) the failure to conduct regular maintenance (that is, operating with a "breakdown" philosophy); (d) the lack of energy-management awareness and information systems among managers; and (e) the lack of understanding at the operating level of actions that would reduce energy waste. To assist the

firms in capturing potential energy savings from low-cost measures, the reactivated National Energy Council (NEC) would establish a cost-effective institutional arrangement that would facilitate direct access by public- and private-sector industries to the types of services and equipment required to implement housekeeping measures.

Design of ESMAP's Program

Before commencing the ESMAP program, the average tariff was estimated to be about US5 cents/kWh. This rate was too low to support use of alternative sources of energy by ZESCO's customers. A tariff study was proposed to correct this situation. The study was designed to review the existing tariff structure, taking into consideration savings achievable through DSM measures. Other problem areas related to the financial situation were identified, including collection procedures and their effectiveness and the age and level of outstanding accounts. ZESCO's manual billing system, together with deficiencies in meter reading, resulted in inaccurate bills and delay in bill issuance. Urgent assistance was needed to streamline the billing and collection systems.

In addition, other needs were identified for improving corporate planning and management information systems, finance and accounting systems, personnel and human resources functions, staff and development training, warehouse management and maintenance, distribution maintenance and planning, and generation and transmission maintenance planning. Options also were proposed for privatization, including disengaging from noncore business activities.

Thus, ESMAP's assistance was directed toward reform actions in the power sector to increase ZESCO's commercial focus through a study of the structure and level of its tariffs and DSM initiatives. In addition, revaluation of ZESCO's assets for determining a rate base and financial revenue requirements was used as a starting point of the technical assistance.

The assistance to ZESCO comprised the following activities:

- ?? Activity 1: Commercialization of ZESCO
- ?? Activity 2: Review of financial requirements, asset values, and tariffs
- ?? Activity 3: Demand-side management/end-use efficiency
- ?? Activity 4: Distribution system planning

Implementation

Activity 1: Commercialization of ZESCO. A study was undertaken by ESBI (Ireland) to create a work plan for the commercialization of ZESCO. The output was a set of terms of reference that addressed priority issues requiring immediate assistance. Model terms of reference were prepared by ESBI for the following:

- ?? Options for the institutional arrangement of the power sector in Zambia
- ?? Corporate planning in ZESCO
- ?? Master plan for management information systems for ZESCO
- ?? Provision of financial and management accounting systems for ZESCO
- ?? Human resource systems and capability building in ZESCO
- ?? Tariffs and pricing for ZESCO
- ?? Commercialization of the distribution business in ZESCO
- ?? Commercialization of the generation/transmission business in ZESCO
- ?? Noncore services provided by ZESCO
- ?? Consultancy assistance to ZESCO for management of the commercialization program

Activity 2: Review of financial requirements, asset values, and tariffs. The first step was the revaluation of ZESCO's assets to determine a rate base and revenue requirements. This task was carried out by a financial consultant. The analysis determined that ZESCO's revalued net fixed assets were worth about US$2.5 billion (using an exchange rate of 1US$ = 500 Kwacha). To achieve its target of a minimum 8 percent rate of return on revalued net fixed assets, ZESCO needed to earn revenues of about US$350 million per year. Prior to the tariff action, ZESCO had expected to earn only about US$40 million from revenues. Even with the tariff increases of June 1993 and sales for a normal year, ZESCO would only earn US$139 million compared with the target revenue of US$350 million.

A tariff study was then carried out by an independent tariff expert on the basis of terms of reference prepared by ESMAP. The objective of the study was to derive a tariff system that balanced ZESCO's costs of meeting demand and its actual cost to provide service. The study was designed to address both the structure and level of the tariffs and ensure that tariffs gave the right signals to consumers.

The study revealed that ZESCO's tariff structure was inadequate and was not suited to the Zambian system. Another major problem was the level of tariffs, which produced no net revenues. The study found that, aside from ZESCO's marginal cost of US8.8 cents/kWh, about 93 percent of the domestic electricity supply was being subsidized**.** Likewise, bulk sales to the copper mines, which accounted for about 65 percent of ZESCO's sales, also were being subsidized since ZCCM was paying only about 20 percent of its marginal costs, which were estimated to be about US2.7cents/kWh. Accordingly, the tariff consultant recommended a gradual realignment of the tariffs to reflect marginal costs.

In reviewing the financial analysis, the tariff consultant determined that the past financial data of ZESCO were unreliable because the assets were not revalued. A preliminary financial analysis

was carried out, however, based on the marginal cost calculation (and the asset revaluation by the financial consultant). The tariff consultant recommended that ZESCO adopt the following financial performance criteria:

- Operating income/average revalued net fixed asset in operations (that is rate of return >6 percent)
- Operating expenses/operating revenues (that is, operating ratio range of 50 to70 percent)
- Total internal cash generation/total debt service (that is, debt service cover >1.8)
- No operational deficits
- Accounts receivable less than 90 days

Activity 3: Demand-side management/end-use efficiency. The DSM program was implemented by an independent consultant who worked closely with a task force from ZESCO. The principal components included:

- Collection of end-use data and analysis of energy-conservation opportunities
- Personnel training to build local capacity
- Formulation of a short-term DSM strategy that would be supported by institutional mechanisms for continuation of DSM and other energy-efficiency activities after ESMAP technical assistance ended.

The DSM activity was carried out as planned. Capacity-building measures were addressed along with institutional strengthening to implement DSM programs. A ZESCO-sponsored workshop was held in Lusaka to discuss the findings of a pilot project that reviewed the results of 15 energy audits. The program had five main benefits:

- Building the capacity of ZESCO's staff to market the program and conduct independent energy audits
- Design of a DSM implementation plan
- Identification of interested institutions to finance energy-conservation projects
- Foundation of a trade ally program (TAP) to promote energy conservation and DSM
- Stimulation of business opportunities in Zambia

Activity 4: Distribution system planning. This activity was not completed although several efforts were made to set it in motion. Subsequently, it was incorporated in the Bank's Power Rehabilitation Project.

Effectiveness

ESMAP's technical assistance to ZESCO has been satisfactory, based on subsequent developments in the power sector. Of particular note are the following developments:

- Tariff increases are now planned quarterly, and an automatic tariff adjustment clause has been introduced. (Note: An adjustment took place in July 1995 that provided a 9 percent increase in Kwacha terms. Unfortunately, the next planned increase of US1.4 cents/kWh, which was to have taken place in October 1995, was not implemented.)
- Steps were taken to set up a performance contract between the government and ZESCO to ensure sound financial management and efficient operations. A final draft of the performance contract was submitted to the MEWD in April 1995.
- The government obtained parliamentary approval for enabling legislation to permit greater private-sector involvement in the power sector and for setting up an Energy Regulatory Board.

The Road Ahead

MEWD and ZESCO have been instrumental in effecting changes recommended by ESMAP and its consultants. The process was very open, with a high level of participation from Zambian officials. Although the technical assistance achieved several benefits, a lot more remains to be accomplished. The continuing commitment on the part of MEWD and ZESCO toward meeting the objectives will help ensure a successful transformation of ZESCO to a more commercially viable energy entity.

A significant impact was achieved through the adoption of the new national energy policy in 1994. The government, by adopting the new policy, laid the groundwork for improving operational autonomy and efficiency by giving a policy focus to encourage optimal utilization of resources, energy pricing, and energy conservation and substitution. The government also enhanced the institutional and legal framework, particularly by establishing the Energy Regulatory Board. Adherence to the energy policy will go a long way to achieving the government's energy-sector objectives and addressing priority energy-sector issues.

Meanwhile, a World Bank power project was being prepared that included technical assistance to further the commercialization process at ZESCO and to step up initiatives on DSM/ fuel substitution. In addition, a distribution planning study and rehabilitation of generation would help overcome the temporary loss in capacity. The Bank project further supported the government's policy of institutional and regulatory reform and took into account the findings of ESMAP's technical assistance.

To sustain the initiatives taken so far, MEWD and ZESCO should concentrate on the following agenda for the short term:

- ?? Establishing a coherent pricing policy that addresses issues of equity and fairness. The tariff structure should reflect economic costs and the level should depend on financial requirements. Life-line tariffs for the poorer segments of society should be maintained.
- ?? Continuing the commercialization process at ZESCO. MEWD and ZESCO should recognize the effectiveness of having corporate business plans, strategic business units, and an information systems approach to management, finance, accounting, personnel, and human resources.
- ?? Concentrating on the financial viability of operations. MEWD and ZESCO should adopt prudent decision-making processes for investment and borrowing, reinforce bill collection, and stress the importance of meeting an acceptable return on revalued net fixed assets.
- ?? Realizing benefits from initiatives on DSM and end-use efficiency. MEWD and ZESCO should build on the DSM system that has been developed for implementation and monitoring results.

Demand-side Management Activity

As a subproject of the Power Sector Rehabilitation Project, an industrial energy conservation survey was implemented in 1997 to evaluate the opportunity for designing a program of boiler, steam systems, and furnace rehabilitation. The program would be designed as a demonstration project to promote energy-efficiency improvements in industry on a national basis. Training would be included as part of the program, in order to create a base for a future energy-efficient infrastructure and a national energy-efficiency unit.

Altogether, Zambia operates about 200 boilers with a capacity of 1 ton of steam per hour for various applications. The energy conservation survey investigated boilers using coal, liquid fuels, and bagasse in 25 companies. The survey area included the Central, Copperbelt, Lusaka, and Southern Provinces.

The main objective of the survey was to gather data on the actual fuel consumption of industrial boilers and use the data to confirm and correct energy consumption data in use by industrial boilers in Zambia.

Major specific tasks in the survey included collection and verification of data of fuels used by industrial boilers from different sources, including the Department of Energy (DOE), Inspectorate of Boilers (IOB), Maamba Collieries Limited, BP Zambia Limited, Mobil Oil Zambia Limited, and Zambia National Oil Company; checking and analyzing the reliability of the

data obtained; collecting up-to-date data on the level of boiler operation in Zambia, and visiting 25 selected companies to obtain data on fuel consumption and technical status of the boilers.

The methodology adopted involved physical visits to boiler plants to obtain data on fuel consumption and technical status of the boilers and having discussions with management and plant operators.

Data collected and analyzed from 25 selected companies and other sources included boiler status and fuel by location; actual data on energy consumption; technical data on boiler steam capacity; pressure and temperature of steam; current steam production; monitoring and instrumentation facilities; nature and integrity of insulation; steam leaks; nature and extent of utilization of steam condensate; type of water treatment used; maintenance practices and housekeeping; and assessment of existence of energy conservation and efficiency policies, programs, and practice.

Following are major findings from the survey:

a) In some cases, data supplied by the IOB regarding fuel types used by some boilers was found to be inaccurate.

b) According to the survey, the most commonly used fuel in Southern, Lusaka, and Central Provinces is coal because of proximity to the supplier, Maamba Collieries. The most commonly used fuel in the Copperbelt-based industries is liquid fuels (diesel and LFO) because of proximity to the producer, in this case, Indeni Refinery.

c) Data on the type of fuel used in a particular company, obtained by the survey and that from IOB, differed in 12 cases.

d) Fuel flow measuring and instrumentation facilities were inadequate.

e) Flue gas analysis facilities to determine combustion efficiency were nonexistent.

f) Level of sophistication of water treatment varied considerably and water treatment practices were inadequate in the majority of cases.

g) Generally, record keeping of data related to energy consumption was in a bad state.

h) Level of training of boiler attendants was low.

i) Although most of the industries recovered steam condensate, the condensate recovered was not necessarily re-used either for preheating water or as make-up water.

j) Energy consumption and efficiency policies, programs, and practices were largely nonexistent.

k) Integrity of insulation on steam distribution pipes was generally fair.

l) Steam leaks in most industries were minimal.

m) Level of housekeeping in most of the industries was fair. With respect to maintenance, however, although the majority of the industries carried out maintenance, there was no scheduled preventive maintenance.

Recommendations arising from the survey include:

a) Implement a training program on various aspects of boiler operations, maintenance, monitoring, and cost-reduction measures in selected industries for boiler operators, supervisors, plant managers, and middle managers. Training also is recommended for IOB staff on how to accurately collect and interpret data on boilers.

b) Institute an awareness progam for all management levels on the need for energy conservation, efficiency policies, programs and practices, and monitoring and instrumentation.

c) Implement, with the assistance of a revolving fund, low-cost energy conservation and efficiency measures in selected industries.

d) Introduce specialized support services in energy auditing and analysis, cleaning services, and test equipment.

e)