CONSULTANCY REPORTS

ZIMBABWE INSTITUTE OF DEVELOPMENT STUDIES

6

An Assessment of Human Resources For The Development of Electric Power, Household Energy and Energy Planning in Zimbabwe.

Ben Zwizwai
Sam Moyo

ZIDS
P.O. Box 880 HARARE

CONSULTANCY REPORT

Number 6

AN ASSESSMENT OF HUMAN RESOURCES FOR THE DEVELOPMENT OF ELECTRIC POWER, HOUSEHOLD ENERGY AND ENERGY PLANNING IN ZIMBABWE

By

Ben Zwizwai

and

Sam Moyo

(assisted by D. Munasirei and A. Kandlela)

ZIMBABWE INSTITUTE OF DEVELOPMENT STUDIES

HARARE, 1991

P O Box 880

Harare

Zimbabwe

First Printing 1991

Printed and published in Zimbabwe.

This paper is a Consultancy Report prepared by the Zimbabwe Institute of Development Studies (ZIDS) for the International Labour Organisation (ILO). The survey was conducted over a two and a half month period between October and December, 1984 and the draft report was submitted in January 1985.

The views and opinions expressed in this report are those of the authors, and do not necessarily reflect those of ZIDS.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF ABBREVIATIONS USED

ESC	Electricity Supply Commission
CAPCO	Central African Power Corporation
HMED	Harare Municipal Electricity Department
BMED	Bulawayo Municipal Electricity Department
KNBC	Kariba North Bank Corporation
ZESA	Zimbabwe Electricity Supply Authority
ZISCO	Zimbabwe Iron and Steel Company Limited
MLMPSW	Ministry of Labour, Manpower Planning and Social Welfare
BEI	British Electricity International
WAPCOS	Water and Power Consultancy Services
EDF	Electricite de France
PETS	Power Engineers Training Society
IBRD	International Bank for Reconstruction and Development
TNDP	Transitional National Development Plan

INTRODUCTION

This report is the result of a study undertaken to assess manpower needs and training priorities for the development of the electric power and household energy sectors and for energy planning in Zimbabwe. The study, which was carried out in about two and a half months, was done in three parts, namely: Electric Power Study, Household Energy Study and Energy Planning Capability Study. In brief, the study had to:

- describe the organisation of the subsectors concerned;
- assess the manpower inventory of the sectors; and
- describe their manpower training programmes and make projections of their future manpower requirements.

The report is presented in four chapters beginning with a discussion of the study approach, methods and problems encountered. Chapter Two deals with the Electric Power Sector, Chapter Three with the Household Energy Sector and the final chapter discusses Energy Planning in Zimbabwe.

CHAPTER ONE

STUDY APPROACH - METHODOLOGY AND PROBLEMS

As pointed out in the Introduction, the study was undertaken in three parts. This approach was adopted because of the differences in both organisational structure and manpower requirements that exist between the two energy sectors and between these and the energy planning machinery. This necessitated the use of different approaches for the three aspects which are therefore treated separately in this section.

THE ELECTRIC POWER SECTOR

The Electric Power Sector study covered the four major organisations in Zimbabwe engaged in electricity generation, transmission and/or distribution. These are the Electricity Supply Commission (ESC), the Central African Power Corporation (CAPCO), the Harare Municipal Electricity Department (HMED) and the Bulawayo Municipal Electricity Department (BMED).

Before any fieldwork was undertaken, an extensive study of available secondary material was made. This included an examination of the annual reports of the different power organisations and a review of other studies carried out on the power sector. Publications from the Central Statistical Office (CSO) in Harare relating to the electricity sector were also examined. However, the research team was faced with problems when using CSO data as a result of their system of sectorial classification. Electricity is combined with gas and water as one sector for the purposes of CSO data collection. This caused problems for us since this particular study was concerned with electricity only.

Problems Encountered

Given the time frame within which the study was to be undertaken, the amount of statistical details to be collected during the study and other problems explained below, it was not possible to collect data on all the issues as stipulated in the terms of reference. The main problems can be summarised as follows:

- The timing of the project in relation to other activities being undertaken by the organisations concerned; and
- Availability of data from the organisations studied.

Early in 1983, the Ministry of Energy directed the four major electricity undertakings to present details of their manpower stock and projections of their manpower needs for the following ten years. This was done in part to meet the conditions laid down for acquiring a loan from the World Bank. Just before this study was commissioned, the four major electricity undertakings had been requested to and were in the process of updating their manpower plans. By the time fieldwork was undertaken, the electricity organisations had just submitted their manpower plans to the Ministry of Energy and Water Resources and Development.

The manpower data was made available to the study team by the Ministry. This was supposed to make the work of the study team easier, but it actually posed a problem. The electricity undertakings had used up a lot of time in meeting the request made by the Ministry on behalf of the World Bank. They also felt that the objectives of this study were not very different from the requirements of the World Bank and it was therefore viewed as a duplication of the same work. As a result, the organisations were reluctant to spend too much time on this project. However, the World Bank requirements were far much narrower than the terms of reference of this study. According to our terms of reference, the power organisations were required to give:

- their current manpower inventory, differentiating between nationals and foreigners;
- vacancies; and
- projected manpower needs up to about 1993.

Besides that, the survey was carried out at a time when the major electricity undertakings were engaged in discussions with Electricite de France for the financing and establishment of a manpower training centre for the electricity sector. The persons engaged in the negotiations were the same persons who were to be interviewed for the purposes of this project. This therefore meant that the relevant persons could not spare much time to this particular project. It was also difficult to make appointments at the scheduled times and when we did succeed, the time devoted to discussions was very short.

Given the above problems, the research team decided first of all to visit the Ministry of Energy and Water Resources and Development to obtain World Bank requested manpower studies by the different electricity organisations. At the same time, this would give us an overview of the manpower problems in the whole sector as perceived by the Ministry and the measures undertaken to fill the manpower gaps in the critical areas at the macro-level. The standard questionnaire approach was observed to be inappropriate in a situation where the respondents could not devote much time to the project.

The danger of "no-response" was also anticipated; and to overcome this, it was decided to carry out on-the-spot discussions with the relevant personnel after having explained the general objectives of the study at the time of making the appointment. The interview then closely followed the terms of reference. However, problems arose in a number of areas where data was not readily available and in certain cases where it just did not exist.

In cases where data was not made available to the research team in the form specified by the terms of reference, either because it was confidential or simply because it was non-existent, the research team partly overcame the problem by requesting for more general and qualitative information rather than specific and quantitative data which was more difficult, if not impossible, to obtain. The major criterion used in such cases was to ensure that data or information central to the achievement of the study objectives was, in one form or another, incorporated.

The problem of using secondary materials mentioned above was not confined to CSO data only. In order to give an accurate picture of the electricity power sector of Zimbabwe, data from the four major electricity undertakings had to be used. However, problems arose because of the differences in either classifications used or in the type of data incorporated in the annual reports of the four organisations.

As the Household Energy Sector comprised a wide range of different organisations, the sources of data required were themselves numerous. In describing the sector, the study had to rely on secondary sources based on both empirical data and descriptions of the various organisations as well as on empirical studies on the household utilisation of various energy forms and their supply. For the latter, two surveys were reviewed, namely: the Central Statistical Office, Permanent Household Survey (1984) and the Beijer Institute Household Energy Study (*Policy Options for Energy and Development in Zimbabwe,* 1984).

Regarding data on manpower and utilisation of skills, questionnaire interviews based on the data stipulated within the terms of reference were undertaken.

Initially, an attempt was made to interview the following eight organisations involved in the supply of household energy, related equipment and support services:

- The Department of Energy
- Agritex
- Kango (Hot plate producers)
- Forestry Commission
- Wattle Company
- Ministry of Community Development and Women's Affairs
- Silveira House
- Zimcast (Pvt) Ltd (Manufacturers of brick/metal stove).

Problems Encountered

The major problems encountered in the investigation of the Household Energy Sector arose mainly because of its scattered and differentiated nature, with so many competing organisations in the public and private sector. The data collection task therefore initially involved too many trips to organisations without any significant quantities of valuable information gathered. The information itself was therefore highly uneven in terms of quantity and quality as will be evident in the section describing the sector. This problem is probably a result of the fact that there is no planning sub-department in Government that caters for the household energy sector *per se,* so that there is no central point which the relevant organisations report to and which collates related data, especially on manpower and skills. This problem arises because most of the organisations are private and are not required by law to submit plans, etc.

Another set of problems encountered relates to the nature of operation and attitude of the private sector organisations themselves. The private sector is generally suspicious about Government manpower assessments. This is so because, usually, the private sector does not *grade* certain labourers as semi-skilled or skilled, nor pay them as such even though they are qualified through long experience in turning machinery and tools. The nomenclature of manpower categories is thus also usually unrepresentative of skills. The private sector fears Government sanctions and thus tends to be secretive and uncooperative. We faced these problems in particular with the Wattle Company and in general had to go through long-drawn protocols before getting responses.

Overall, however, most of the companies do not keep manpower tabulations according to grade, age, sex, education, etc, as would be the case in some Government agencies which are engaged in some form of comprehensive planning for a given sector. They tend to have a list of names on the payroll and individual files for each employee. With luck, some may at least have an organogram which shows the hierarchy of manpower and vacancies but, in general, such data has to be collected from individual files specifically for the study in question.

As a result of these problems, therefore, it was decided to focus the manpower data collection on the Forestry Commission, which is not directly involved in the woodfuel sub-sector as this is the source of energy for 80 percent of the population which mostly resides in the countryside. Even this organisation, however, does not have composite records, which again caused many delays.

ENERGY PLANNING

In assessing the capabilities and needs of the energy planning unit, very little, if any, secondary material was used. Discussions were carried out with officials in the Department of Energy in the Ministry of Energy and Water Resources and Development, who also provided the research team with schedules giving in detail the functions of the different sections of the department.

It was not possible to get data related to qualifications and salaries because these were considered "personal" by the Department of Energy. Other data related to staff movements could also not be obtained because this department has had a high turnover of staff since independence and records were not easily available as the department had been moved around three different ministries since 1980. Even the Public Service Commission could not readily provide the required data. Most of these data gaps are evident in Chapter Four of this study.

CONCLUSION

Overall, this whole study was constrained by inappropriate timing (coming as it did in the wake of the World Bank survey) and the time factor. The time available (two and a half months) from the commissioning of the study was too short in particular because of the sensitivity of the topic in question. For historical and other reasons, the issue of manpower is generally sensitive in Zimbabwe and it is highly regimented by the bureaucratic machinery. It therefore takes time to convince authorities about the need for such data, especially in the private sector. In some cases, this is because of the way in which skills were defined under past regimes.

The nature of records is poor because of the novelty of the concept of manpower planning in Zimbabwe. The form in which records are kept is therefore either disjointed or does not contain details relevant to contemporary planning considerations.

Finally, the timing of the study around Christmas caused numerous practical problems

CHAPTER TWO

HUMAN RESOURCES IN THE ELECTRIC POWER SECTOR

This chapter focuses on manpower problems in the electric power sector. Roughly, the chapter consists of five parts. The first part presents a brief historical background of the development of the electric power sector. The second part provides an overview of the organisational structure and size of the sector. The next section discusses the manpower problems faced by the power sector and gives the present technical manpower inventory for the four major electricity undertakings, i.e. ESC, CAPCO, HMED and BMED. Then comes the section that deals with manpower training programmes in this sector. Finally, the fifth and concluding section of this chapter focuses on future manpower requirements for the sector.

HISTORICAL BACKGROUND[1]

To appreciate the history of electricity in Zimbabwe, one has to understand the economic history of the country. Mining was by far the most important economic activity in early colonial Zimbabwe. In 1913, it accounted for 93% of the country's exports. Hence mining investments shaped demands for inputs and supporting services which in turn produced change at every level of material life. Electricity, construction, engineering and haulage enterprises mushroomed on the heels of bigger mining concerns.

The history of electricity may be dealt with under two main headings, namely Municipal and Non-Municipal.

Municipal

Bulawayo

The first large-scale electricity supply in Zimbabwe was established in 1897 in Bulawayo. At that time, Bulawayo had the largest settler community in the colony. In 1898, the British Chartered Company issued the Electric Lighting Regulations. These regulations, which were supplemented in 1903, granted concessions to companies or individuals to operate electric lighting schemes. The regulations also sought to control the electricity supply industry and to safeguard users by stipulating minimum standards of safety.

Harare

It was not until 1914 that Harare (then called Salisbury) had electricity. This was mainly because Harare had not yet established itself as an important commercial and industrial centre of the colony. Moreover, the town suffered from severe depression in trade, commerce and agriculture during the years 1902-1908, following the Anglo-Boer War. However, with the end of the depression, the Chartered Company expressed interest in assisting the town council which had up to then repeatedly failed to avail the town of electricity. In 1911, the Salisbury Water and Electricity Supply and Loan Ordinance was promulgated. It authorised the Council to raise a loan of 120 000 pounds sterling for roads, water and electricity purposes and provided, furthermore, that subject to the concurrence of the administrator, the Council would supply water and electricity to approved areas outside the limits of the Municipality. Powers were also included for the Council to make by-laws in respect of electricity supply, to appoint inspectors and to fix tariffs. The Council started running its own power station in 1914.

Non-Municipal

As noted earlier, electricity was an essential service to the emerging mining industry. At first, seam and suction gas plants burning indigenous timber were used by mines. But as timber became scarcer and more costly, crude oil machines began to replace the woodfuel plant. These independent power plants were expensive to acquire and operate under local conditions. Maintenance was especially heavy. Mines were underpowered and engine maintenance impaired the running prime factor. An all-embracing electricity supply which could be drawn on at a low cost when additional power was needed, was the best way of removing the limitations on this industry: operations set by the use of small independent power plants. Thus the Electricity Supply Act promulgated in July 1936 brought the ESC of Zimbabwe into being.

To meet the ever-increasing demand for electricity, the Federal Government of Rhodesia and Nyasaland approved the proposed scheme of damming the Zambezi River at the gorge for the purpose of hydro-electricity generation. The construction of the dam was completed in 1958 and is owned and jointly operated for Zambia and Zimbabwe by the Central African Power Corporation.

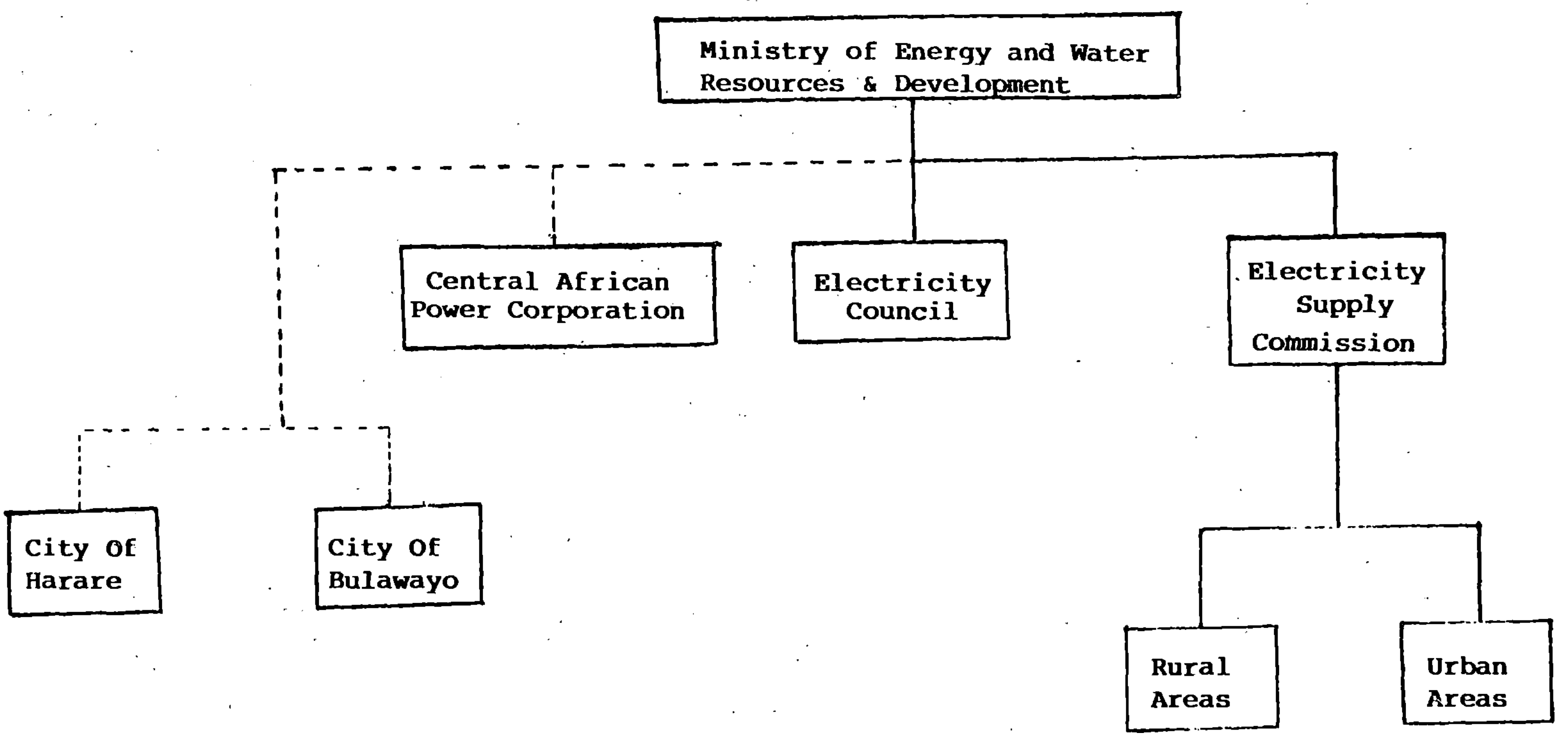
CURRENT SECTOR ORGANISATION

The overall responsibility of planning and co-ordinating energy development in Zimbabwe falls under the Ministry of Energy and Water Resources and Development which is responsible for electric power, coal policies, liquid fuels and energy research and development. The Ministry of Mines is responsible for coal (and other minerals) and also has interests in energy, while the Ministry of Finance, Economic Planning and Development has an interest in the electricity undertakings by virtue of its central role in the operations of the whole economy.

The major organisations engaged in electric power generation, transmission and/or distribution include the ESC, CAPCO, HMED, BMED and the electricity departments of Mutare and Gweru. Mines and sugar plantations also have captive plants, but these contribute a relatively insignificant amount of electricity into the national grid. Although in the final analysis, the activities of these electricity organisations are controlled and/or co-ordinated by the responsible Ministry - which was only established after independence - these bodies are almost independent in that they formulate their own plans. Figure 1 shows the organisation of the electricity power sector in Zimbabwe.

FIGURE 1

ORGANISATION CHART OF THE POWER SECTOR



_______ Direct control through the Electricity Act (Chapter 282)

------- Indirect control through the Central African Power Act (Chapter 279) The Electricity Act (Chapter 232) and the Urban Councils Act (Chapter 214)

Source: Report of the Joint UNDP /World Bank Energy Sector Assessment Program. Report No. 3765 - ZIM. P. 54. "Zimbabwe: Issues and Options in the Energy Sector".

CAPCO, jointly owned by Zimbabwe and Zambia, was originally established to own and operate the Kariba hydro complex. However, since 1978, the complex has been divided into two parts - CAPCO owning the South Bank (Zimbabwe) and Kariba North Bank Corporation (KNBC) owning the North Bank (Zambia). CAPCO owns almost all of the major 330 KV transmission system in Zimbabwe and Zambia, and operates the power grids in both countries from a control station located at Sherwood in Zimbabwe. CAPCO sells the electricity generated by Kariba, by the Zimbabwe thermal plants, and that imported from Zambia to the ESC, Harare and Bulawayo for distribution. The ESC in turn sells electricity to industries, to urban and rural areas, and also to Mutare and Gweru municipalities for distribution in these cities.

The existence of many organisations concerned with electric power generation, transmission and distribution has resulted in the anomalous situation where similar consumer categories, e.g. households, in different parts of the country, say Harare and Bulawayo, are faced with different prices for electricity. It has also caused problems for the Ministry of Energy in the process of overall planning for the electric power sector. The Government has therefore decided to rationalise the organisation of this sector by bringing together the different organisations under the umbrella of a single national electricity supply undertaking - the Zimbabwe Electricity Supply Authority (ZESA). When established, ZESA will first take over the assets, liabilities and staff of the ESC. ZESA will also be empowered to acquire the electricity undertakings operated by the various local authorities. But before the takeover, the local authorities will operate subject to the directions of ZESA. After unification, ZESA will become the employer of all the staff currently employed by the ESC and local authorities' electricity departments.[2]

INSTALLED GENERATING CAPACITY

Kariba

The Kariba Hydro-Electric Power Station is still the main source of electricity in Zimbabwe. Prior to the commissioning of some of the generating units at Hwange Thermal Power Station, the total installed generation capacity of the country was 1 151 Mw. But because of the sharing arrangements at Kariba and the fact that some thermal units are old and nearing obsolesence, the effective capacity was 1 051 Mw.

Although hydro-power from Kariba made up 60% of effective installed capacity (633 Mw) in 1980, it supplied 90% of the electric energy generated in Zimbabwe and thermal power stations with an effective capacity of 418 Mw (or 39,8%) supplied the other 10%.

Hwange Thermal Power Station

The Hwange Thermal Power Station, which is currently under construction, will be the biggest generating station in the country. The construction of the thermal station was divided into two stages. Stage I consists of four generating sets with capacity of 120 Mw each, while Stage II consists of two generating sets of 220 Mw each. In total, this will result in an installed capacity of 920 Mw, although this will not be the station's output since some installed capacity must be kept in reserve.

At the present moment, two of the units in Stage I are already producing electricity, and the third will be commissioned in April 1985. The other unit of Stage I was virtually destroyed in an explosion in early 1984 and will only start operating on 30 June 1986.

The two 220 Mw generating units of Stage II of the power station are scheduled to start operating in March and July 1986 respectively.[3]

Other Thermal Plants

Besides the Hwange Thermal Power Station, there are four small, but relatively large coal-fired thermal plants. These are in Harare, owned by the Harare Municipality; Bulawayo, owned by the Bulawayo Municipality; Umniati, owned by the ESC; and Wankie, owned by the Wankie Colliery Company. It is hoped that as these plants become old and are written off, they will be eventually phased out.

In addition to the above four, there are captive plants belonging to plantations and mining companies. The captive plants are owned by Triangle Limited, Hippo Valley Estates Limited, Zimbabwe Iron and Steel Company Limited (ZISCO), Empress Mining Company Limited and Lomagundi Smelting Limited. Table 1 below provides a summary of the generating stations connected to the national grid indicating their installed capacity and, where data is available, effective capacity.

ELECTRICITY SUPPLIES

Electricity Supply Commission

The Electricity Supply Commission of Zimbabwe, which derives its authority from the Electricity Act (Chapter 282), has wide powers to generate, acquire and distribute electricity in Zimbabwe. The Commission's licensed area of supply embraces the whole of Zimbabwe except for areas under the jurisdiction or within licensed areas of the cities of Bulawayo, Gweru, Harare and Mutare.

For the purpose of supply of electricity and its internal administration, the Commission sub-divides the country into the following divisions:

Northern	-	Harare, Marondera, Chinhoyi, Bindura
Central	-	Kadoma, Kwekwe, Gweru
Eastern	-	Mutare
Western	-	Bulawayo, Hwange
Southern	-	Zvishavane, Masvingo
South	-	Eastern-Chiredzi, Chipinge

In 1983, the ESC had a total length of transmission and distribution lines of 32 853,7 km. These were broken down as follows:

Table 1

INSTALLED GENERATING CAPACITY IN ZIMBABWE

Interconnected	Plant Name	Owner	Installed Capacity (Mw)	Effective Capacity (Mw)	Commission Date
Thermal (Coal-fired)	Kariba South	CAPCO	666[1]	633	1960-62
	Hwange[2]	ESC	240		
	Harare	City	135	127,6	1916-55
	Umniati	ESC	120	112,8	1947-57
	Bulawayo	City	120	113,7	1948-54
Captive Plant:					
Thermal (Coal-fired)	Triangle Limited		45	20	
	Hippo Valley Estates		23	23	
	ZISCO		5,5	5,5	
	Empress Mining Company Limited		8,0	1,8	
	Lomagundi Smelting Limited		1,5	1,5	
	TOTAL		1 391		

Notes: 1. Zimbabwe's share is 633 Mw (based on Kariba sharing agreement)

2. Based on the two units which are already producing electricity.

330 kv	-	1 003,0 km
132 kv	-	934,8 km
110 kv	-	5,0 km
88 kv	-	1 496,1 km
66 kv	-	178,6 km
33 kv	-	5 648,3 km
11 kv	-	21 731,0 km
LV	-	1 857,5 km
TOTAL	-	32 853,7 km

In 1982/83, the ESC sold 5 113,781 million Kwh of electricity to mining, industrial, farming and municipal and domestic consumers. Table 2 below shows a breakdown of energy sales to the different consumer categories.

Table 2

ENERGY SALES BY ESC

Consumer Category	Energy Sales (Millions of Kwh)	Average Price (Cents/Kwh)
Mining	1 255,456	2,548
Industrial	2 462,286	1,657
Farming	523,101	3,464
Municipal (1)	288,278	2,453
Commercial & Lighting	188,592	4,173
Domestic	157,464	4,477
Total Sales/Average Price	4 875,177	2,136

Notes: 1. Municipal sales represent bulk supplies to the cities of Gweru and Mutare.

Harare Municipal Electricity Department

The Harare Municipal Electricity Department purchases power from CAPCO, which it then sells to the commerical, domestic and industrial sectors. In 1981/82 HMED distributed 1 314,323 million units (Kwh) (See Table 4).

Table 3

SOURCES OF ELECTRICITY IN ZIMBABWE

Generating Station		Number of Units	Size (Mw)	Plant Capacity
Kariba South	Hydro	6	111	666
Hwange 1	Coal	4	120	480
Hwange 2	Coal	2	220	440
Umniati	Coal	2	10	
		5	20	120
Harare 2	Coal	2	10	
		5	20	120
Harare 3	Coal	2	30	60
Bulawayo	Coal	2	15	
		3	30	120
Imports from Zambia	Hydro			
TOTAL				2 006

Source: Electricity Supply Commission

Table 4

ENERGY SALES BY HMED

Consumer Category	Units Sold (in million Kwh)
Domestic	544,027
Farming	29,522
Industrial	482,143
Street Lighting	15,009
Commercial & Other	243,622
TOTAL	1 314,323

The department employs 912 people. Total installed mains is 6 910,5 km long, broken down as follows:

Table 5

CIRCUIT LENGTH - HMED

Total Cable in Service	Circuit Length
132 kv double - circuit overhead line	38,6 km
132 kv single - circuit overhead line	10,5 km
33 kv overhead line - circuit overhead line	179,2 km
33 kv cable- circuit overhead line	192,2 km
11 kv overhead line - circuit overhead line	958,9 km
11 kv cable - circuit overhead line	1 205,1 km
LT overhead line - circuit overhead line	1 972,9 km
LT cable - circuit overhead line	1 920,0 km
Pilot cable - circuit overhead line	433,1 km
TOTAL	6 910,5 km

Bulawayo Municipal Electricity Department

Like the HMED, the BMED purchases power from CAPCO. In 1981/82, BMED distributed 750,786 million units (Kwh). System peak load was 150 Mw and system losses amounted to 4,54%.

Units sold to various groups of consumers during 1981/82 were as follows:

Table 6

ENERGY SALES BY BMED (in million Kwh)

Consumer Category	Units Sold (in million Kwh)
Commercial	49,622
Domestic	190,789
Industrial	279,254
Public	197,009
TOTAL UNITS SOLD	716,665

BMED in 1981/82 employed an average workforce of 1 050.

Table 7

CIRCUIT LENGTH - BMED

Total Cable in Service	Circuit Length in Km
88 kv cable in service	15,56
33 kv cable in service	58,68
11 kv cable in service	449,9
LV underground lines in service	730,01
88 kv overhead lines in service	90,97
33 kv overhead lines in service	19,23
11 kv overhead lines in service	686,98
LV overhead lines in service	1 429,00
TOTAL	3 480,33

Electricity Imports

In addition to the electricity generated from the installed units in the country, Zimbabwe also imports electricity from Zambia and South Africa. For several years, imports from Zambia have been a major element in the electrical energy balance of Zimbabwe. In 1980, the country imported 1 756 Gwh which was about 24% of Zimbabwe's total requirements.

A small area in the southern part of the country around Beitbridge is supplied with electricity imported from South Africa. In 1980, this constituted a proportion of less than 0,2% of Zimbabwe's total requirements.

The electric power sector of Zimbabwe is among the largest in Southern Africa, with maximum demand of 1 140,2 Mw in 1983 (1 130,6 in 1982) and per capita consumption of about 1 000 Kwh. The power supply system in the country is geared mainly to serve industry and commerce. Most of the electricity generated is consumed by the manufacturing and mining sectors which together account for about 69% of total electricity consumption (1980). Only a small proportion of the country's households, mainly urban based, are served with electricity. In 1980, domestic consumers accounted for only 13% of total electricity consumption. The 190 000 domestic consumers served with electricity in that year represented 16% of all the households.

MANPOWER

With the attainment of independence in 1980, a large number of the settler community left Zimbabwe either because they were uncertain about their future in the country or because they were opposed to the newly established Government on racial and/or ideological grounds. Prior to independence, Africans were denied the opportunity to acquire skills through formal training. The emigration of White settlers during the post-independence period resulted in shortages of high-level experienced technical manpower. This gap was more pronounced in some sectors of the economy than in others. The electricity power sector was among the more seriously affected by the emigration of skilled workers. Most of the White emigrants went to South Africa, which at that time was experiencing a power boom, while others went to the United Kingdom. There was also internal labour migration from the electricity departments towards the private sector. At the same time, construction of the Hwange Thermal Power Station, which had been suspended due to United Nations-imposed sanctions, was resumed - implying increased demand for skilled manpower in the electricity sector. A crisis was created in the replacement of lost technical manpower. In September 1981, the Umniati Power Station actually ground to a halt due to staff shortages. Skills were needed urgently to keep all power undertakings viable and remedial measures had to be taken to solve the problem from both short-term and long-term perspectives.

Remedial Measures

Given the prevailing situation, the only possible short-term solution to enable the continuation of electric power operations was resort to external recruitment. This was handled by the Ministry of Energy in collaboration with the power organisations. The first attempts at external recruitment were made in Canada through Hydro Quebec International and Italy through ANSALDO. The attempts were unsuccessful mainly due to the exorbitant salary demands and bureaucratic delays. For example, the Canadians demanded remuneration four times the local salaries.

Eventually, the manpower gap was partially filled by recruiting expatriate staff through British Electricity International (BEI) and Water and Power Consultancy Services of India (WAPCOS). The British were recruited to fill middle and top management posts at Hwange, i.e. from the level of supervisor upwards, whilst WAPCOS provided operating staff (excluding engineers). The BEI staff were recruited on expatriate conditions and on higher salaries than local staff of the same skills category - about three times more than local staff. On the other hand, WAPCOS staff were recruited on local conditions; the reason being that salaries in Zimbabwe are higher than those in India for the specific skill categories.

Middle and top management were recruited from Britain because of the similarity between the Zimbabwe and British systems of operation. In addition, BEI was able to provide personnel at short notice. Delays experienced in getting the government's approval to provide personnel was the main reason ANSALDO lost out. BEI personnel were in Zimbabwe at Umniati Power Station by January 1982. The station was back in operation after the recruitment of a power station superintendent, shift supervisors and operators.

In 1983, the Government recruited distribution staff from Ireland. Most of them are still in Zimbabwe. WAPCOS was charged with recruiting lower level personnel because there is more job fragmentation in India, implying that for a certain amount of work requiring high-level capabilities, more WAPCOS staff would be required than BEI staff.

Salaries

Whereas the power organisations lost manpower to the private sector, it was not possible for them to recruit from this sector because of the higher salaries offered by the latter. For certain posts in the power sector, there have not been any salary increases since 1981. Given the fairly high rate of inflation prevailing in Zimbabwe, this effectively means a reduction in the real incomes of the persons affected. Salaries have not been rationalised among the power undertakings themselves and between these undertakings and the private sector. For example, the Harare Municipal Electricity Department, which distributes only 20% of the country's electricity consumption, is allowed to pay its City Electrical Engineer and his deputy a basic salary which is higher than the salary paid to any member of the ESC's staff other than the General Manager, yet the ESC is a far much larger organisation, distributing 70% of Zimbabwe's electricity consumption.

The Government's Wage Freeze Regulations appear to have been ignored by the private sector which pays higher salaries than all the power organisations with the result that personnel of various disciplines from these organisations have been attracted away from them to industrial, mining, engineering and agricultural companies in the private sector.

Given that the power organisations cannot recruit internally from the private sector, as has been pointed out, they have to rely on external recruitment of expatriates. The absurd part of the whole issue is that external recruitment is extremely expensive. Not only do the power corporations have to pay for the travelling and settling costs of expatriates, they also pay them far much higher salaries than those accorded to locals even in the private sector. For example, BEI salaries at Hwange are about three times local salaries. In addition, expatriates enjoy fringe benefits which permanent Zimbabwean staff do not receive, such as free, though taxable, furnished accommodation, a free return air ticket for holiday purposes during the period of the contract, remittability of up to one-third of their monthly salary and in some cases the use of the organisation's car for private purposes.

The salary gap between expatriates and Zimbabweans undertaking similar responsibilities becomes a bone of contention and frustration among the local counterparts who are then tempted to seek greener pastures within the private sector where they are more likely to enjoy similar benefits. In fact, at the present moment, salaries are the main cause of resignations. But in 1980, the problem was mainly ideological, and resignations and emigration were a response to the pronounced socialist thrust of the Government of independent Zimbabwe.

Technical Manpower Inventory

Below is a summary of the technical manpower situation of the four major electricity undertakings as at 1 October 1984. The major occupational categories adopted are those used by the power organisations in their manpower submission to the Ministry of Energy, i.e. professional engineers, technicians and artisans. These categories are under certain circumstances too broad to depict and highlight the magnitude of the manpower problems existing in certain organisations. For example, the category "professional engineers" includes management engineers, senior engineers and junior or inexperienced graduate engineers. An organisation may have, for instance, a fairly adequate inventory of junior engineers while facing an acute shortage of senior engineers. In such a case, the junior engineers will not operate efficiently without the guidance of the senior engineers, nor will they be able to train and gain experience to advance to senior engineers within the normal period without tuition from the senior engineers. This problem is common to the two municipal electricity departments of Harare and Bulawayo. In spite of that shortcoming, the categories employed will at least give a broad picture of the manpower situation. Disaggregation of the occupational categories will be undertaken where possible depending on the availability of data.

Table 8 below provides a summary of the professional engineers inventory as at 1 October 1984, for the four major electricity undertakings.

Table 8

PROFESSIONAL ENGINEERS INVENTORY

	Total No. of Posts 1.10.84	Manned Posts as at 1.10.84	Vacancies as at 1.10.84	No. of Foreign Staff at Dec. 84	Posts Not Filled by Local Staff at Dec. 84
ESC Head Office					
& Distribution	47	37	10	2	12
Generation	55	32	23	32	55
CAPCO Head Office					
& Distribution	27	17	10	2	9
Generation	22	18	4	3	4
HMED Head Office					
& Distribution	33	15	18	Nil	15
Generation	8	1	7	Nil	5
BMED Head Office					
& Distribution	9	3	6	1	7
Generation	4	1	3	Nil	3
TOTAL	205	124	81	40	110

According to the above table, the overall requirements of professional engineers for the four major electricity organisations total 205. But only 60,5% of the manpower needs were met and of these, about 32,3% of the available engineers are expatriates. Most of the foreigners (85%) are employed by the ESC, and were recruited to operate the Hwange Thermal Power Station whose construction was resumed at independence in 1980. Prior to the Hwange Power Station, there was no thermal power station in Zimbabwe using as much advanced technology as that used at Hwange. There was therefore need for excessive foreign recruitment to engage experienced expatriate engineers, who would in turn train local Zimbabweans. In addition, resumption of construction, and eventual commissioning of some of the units at Hwange occurred at a time when experienced engineers were either leaving the country or were being attracted into the private sector.

Of the total number of professional engineers employed in the four departments, the

ESC accounts for about 56%, while CAPCO accounts for 28,0%. Harare and Bulawayo together employ the remainder (about 16%). In relative terms, the two municipal electricity departments suffer most in terms of manpower shortages in this broad occupational category. In the case of Bulawayo, only 31% of the established posts are manned, while in Harare, 39% of the posts are filled. The ESC and CAPCO have shortages of 32% and 29% respectively.

Technicians

Table 9 below shows that, in all, the major electricity organisations have a total establishment of 141 for technicians' posts.

Table 9

TECHNICIANS INVENTORY

	Total No. of Posts as at 1.10.84	Manned Posts as at 1.10.84	Vacancies as at 1.10.84	No. of Foreign Staff at Dec '84	Posts not filled by local staff at Dec '84
ESC Head Office					
& Distribution	27	13	14	Nil	14
Generation	13	4	8	1	9
CAPCO Head Office					
& Distribution	30	21	9	2	8
Generation	14	8	6	1	2
HMED Head Office					
& Distribution	10	7	3	Nil	Nil
Generation	26	20	6	1	6
BMED Head Office					
& Distribution	13	8	5	Nil	5
Generation	9	3	6	1	7
TOTAL	141	84	57	6	51

Of the total established posts, 84 (59,6% of total posts) are filled and mainly by Zimbabweans. There are far much fewer expatriate workers in the technician occupational category than in the case of professional engineers. Only six out of a total of 84 technicians are expatriates. This represents a percentage of foreign to local personnel of 7,1% compared with 32,3% in the case of professional engineers. This trend is normal in the sense that manpower problems are usually more pronounced at the higher levels of the occupational ladder.

Table 10

ARTISANS INVENTORY

	Total No. of Posts as at 1.10.84	Manned Posts as at 1.10.84	Vacancies as at 1.10.84	No. of Foreign Staff at Dec. '84	Posts not filled by local staff by Dec '84
ESC Head Office					
& Distribution	233	174	59	42	101
Generation	98	37	61	29	90
CAPCO Head Office					
& Distribution	13	8	5	Nil	4
Generation	17	15	2	Nil	Nil
HMED Head Office					
& Distribution	185	99	86	1	87
Generation	19	12	7	1	8
BMED Head Office					
& Distribution	87	36	51	5	56
Generation	44	31	13	Nil	13
TOTAL	696	412	284	78	359

Table 10 above shows the artisans' inventory situation for the four electricity undertakings. Of the 696 established posts, 59% were manned as of October 1984, with expatriates accounting for only 19% of this figure. Of the 359 vacant posts (representing 51% of total established posts), the ESC contributed the most to this, accounting for 53% of the vacancies. The other three establishments - HMED, BMED and CAPCO - accounted for 26%, 19% and 1,1% of the vacancy situations respectively. The ESC once more accounted for the greatest proportion of foreign artisans - 91% as at the end of 1984. CAPCO was the only establishment which did not utilise foreign staff in this field.

Other Technical Staff

Table 11 gives a summary of the staff situation of other technical staff in the four major electricity undertakings.

Table 11

OTHER TECHNICAL STAFF INVENTORY

	Total No. of Posts as at 1.10.84	Manned Posts as at 1.10.84	Vacancies as at 1.10.84	No. of Foreign Staff Dec '84	Posts not Filled by Local Staff by Dec '84
ESC:					
Operators	315	181	134	45	179
Foremen Linesmen	-	-	-	-	-
Draughtsmen	1	1	Nil	Nil	Nil
CAPCO:					
Operators	10	9	1	Nil	Nil
Foremen Linesmen	6	2	4	2	4
Draughtsmen	6	5	1	1	2
HMED:					
Operators (1)	268	268	-	-	-
Foremen Linesmen	2	1	1	Nil	1
Draughtsmen	20	10	10	Nil	9
BMED:					
Operators	35	25	10	Nil	10
Foremen Linesmen	-	-	-	-	-
Draughtsmen	5	3	2	Nil	2
TOTAL	628	505	163	48	207

Note:

1. *There is no fixed number of operators for Harare; the figure used is the same as that for posts manned.*

Of a total of 628 established posts for other technical staff, over 80% were filled. This figure represents a much higher level of manned posts compared with the other occupational categories. It should be pointed out that the overall staffing situation of this category masks shortages faced by some individual organisations. In the case of the ESC, only about 57% of the manpower requirements were met and 24% of the filled posts were occupied by expatriates. The overall expatriate ratio in this category is about 20%. In fact, almost all the expatriates are operators with the ESC. This expatriate component was hired to operate the Hwange Thermal Power Station because no Zimbabweans had experience in operating a power station of such high technology. The ESC therefore engaged operators from WAPCOS to train Zimbabweans.

Table 12

TECHNICAL MANPOWER INVENTORY FOR THE MAJOR ELECTRICITY UNDERTAKINGS

	Total Established Posts	Manned Posts as at Dec'84	Vacancies as at 1.10.84	No. of Foreign Staff as at	Posts Not Filled by Local Staff as at Dec '84
Professional Engineers	205	124	81	40	110
Technicians	141	84	57	6	51
Artisans	696	412	284	78	359
Other Technical Staff	668	505	163	48	207
TOTALS	1 710	1 125	585	172	727

Table 12 shows that there are 1 710 established posts for technical manpower in the major electricity undertakings. Sixty-six percent of the posts are filled, giving an overall manpower deficit of 34%. Of the filled posts, 85% are occupied by Zimbabweans and the remaining 15% consists of expatriates. Relatively speaking, expatriates are concentrated mostly in the professional engineers category where 32% are foreigners. In the technicians, artisans and other technical staff categories, expatriates account for 7%, 19% and 10% of total staff respectively.

The high ratio of expatriates in the professional engineer category highlights the difficulties of recruiting engineers from the local labour market (private sector) because salary differentials are more pronounced in this category. It also reflects the general shortage or scarcity of engineers at a national level, mainly because of the very low output of engineering graduates from the local University.

Staff Movements

Data on staff movements was not readily available from some of the electricity undertakings. However, it was possible to get some data on this aspect from the ESC Manpower Plan and BMED Annual Report. In addition, the Ministry of Labour, Manpower Planning and Social Welfare (MLMPSW) conducted a study on the "Causes of Manpower Drift from the Public Sector to the Private Sector". The study covered 16 parastatals including the ESC. The study, which covers the period January to December 1983, provides a picture of some of the causes of staff losses in parastatals in general.

According to the Ministry of Labour, Manpower Planning and Social Welfare study, the major causes of manpower movement were as follows:

Resignations	54%
Retirements	21%
Dismissals	10%
Emigration	9%
Deceased	4%
Further Education	2%
TOTAL	100%

For those who resigned, the reasons given were:

A More Lucrative Job	27%
Domestic/Personal	36%
Medical/Health	8%
Dissatisfaction	2%
Unknown	27%
TOTAL	100%

The above figures should be treated with caution. According to the Ministry's study, some parastatals felt they could not disclose the reasons for staff resignations because the information was classified as personal. In some cases, the employees themselves on leaving the parastatals did not give "genuine" reasons. Finally, some of the reasons enumerated tend to overlap.

The study made the following general observations:

- There is a very high staff turnover in parastatals (and the public service).
- The high staff turnover affects professional, skilled and semi-skilled occupational categories.
- Financial inducement plays a major role in instigating the manpower drift, but other factors have to be considered as well.

Electricity Supply Commission

Data that was readily available on manpower movements in the ESC related to the years 1981/82 and 1982/83. During those two years, the ESC lost a total of 449 of its staff - 275 in 1981/82 and 174 in 1982/83. The tables below summarise staff losses during the two years in the different occupational categories.

Table 13(a)

STAFF LOSSES IN ELECTRICITY SUPPLY COMMISSION

Occupational Category	1981/82	1982/83	1983/84
Engineers	12	7	19
Technician Engineers	0	2	2
Technicians	9	6	15
Technician Assistants	3	2	5
Electricians	78	44	122
Motor Mechanics	13	7	20
Instrument Mechanics	2	0	0
Artisans (Fitter/Builder)	7	5	12
Control Staff	12	2	14
Power Station Plant Operators	18	5	23
Non-Technical	121	94	215
TOTAL	275	174	449

Table 13 (b)

SENIOR STAFF EMPLOYED BY THE ESC AS AT 1ST JANUARY 1983

Occupational Category	Losses 1982/83		% Turnover
Engineers	47	7	15
Technicians	39	10	26
Artisans	137	56	41
OVERALL	223	73	82%

It is clear from the above tables that the staff turnover rate in the ESC is very high. During the two years, there was a steady manpower drain from the ESC to the private sector and to other countries, especially South Africa.

Table 14 summarises the main reasons for staff losses.

Table 14

CAUSES OF STAFF LOSSES IN ELECTRICITY SUPPLY COMMISSION

Reason	1981/82	1982/83
Died	7	11
	2,5%	6,3%
Retired	17	13
	6,2%	7,5%
Emigrated	85	67
	30,1%	38,5%
Alternative Employment	69	36
in Zimbabwe	25,1%	20,7%
Absconded	6	6
	2,2%	2,3%
Mutual Agreement	6	6
	2,2%	3,4%
Dismissal	10	4
	3,6%	2,3%
Dissatisfaction with	7	1
Working Conditions	2,5%	0,6%
Domestic	51	19
	18,5%	10,9%
Other	17	12
	6,2%	6,8%
TOTAL STAFF LOSSES	275	174
Joined	259	207

The occupational category that suffered most in terms of staff losses is the artisans. During the year, 56 artisans, mostly electricians, left the ESC, resulting in a staff turnover ratio of 41%. Most of the people who left ESC either emigrated or joined the private sector in Zimbabwe. Those who emigrated were attracted by higher salaries in the neighbouring countries.

Bulawayo Municipal Electricity Department

In 1982/83, BMED employed an average of 1 044 of whom 634 were in the Distribution Department, 377 in the Generation Department and 33 in Administration. During the same year, BMED lost 127 of its staff. This gives a staff turnover ratio of 12,2%.

Training

Training of local personnel is, in the final analysis, the most effective way of solving the skilled manpower shortage problem. Viewing the problem at a national level, there are a number of training programmes that have been undertaken to fill the manpower gap in both the short run and the long run. Some of the training programmes are local, while others are external.

- The electricity undertakings have made use of local programmes at local technical colleges, and these include Bulawayo Technical College, Harare Polytechnic and Kwekwe Technical College.
- The Energy Department, on behalf of the electricity undertakings, has taken advantage of external training programmes organised by the Ministry of Labour, Manpower Planning and Social Welfare.
- The electricity undertakings themselves organise in-house training schemes at all levels. In cases where expatriate staff are employed, locals are supposed to understudy them so as to take over the job on the expiry of the contracts. In practice, problems occur at the higher levels, e.g. engineers, since there is need for theoretical background and certain facilities which may not be available.
- Finally, there are training programmes organised by the power organisations in collaboration with external organisations in certain cases as part of donor aid to Zimbabwe. The ESC features more prominently in this connection because it is the largest power organisation in terms of both personnel and coverage.

Government Policy on External Recruitment

Before discussing the different training programmes and training philosophies of the power organisations, it is appropriate at this stage to outline Government policy relating to manpower development and recruitment. The power organisations, being either parastatals or municipal departments, are required to operate strictly within the framework of stated Government policy. The Government of Zimbabwe, through the Ministry of Labour, Manpower Planning and Social Welfare, has emphasised the need to develop local skills at all levels. Recruitment of expatriate labour is therefore viewed as a necessary evil which should be minimised and closely monitored. A Foreign Recruitment Committee was established to ensure that:

- No expatriates would be recruited in those cases where Zimbabweans are available.
- Any companies recruiting expatriate staff will ensure that the expatriates will transfer their skills to Zimbabweans, so that by the time of contract fulfilment, the expatriates can be replaced by qualified Zimbabweans, thus reducing the need for more expatriate labour in that particular field.

The Manpower Planning Committee on Foreign Recruitment realises that in a country like Zimbabwe with a lot of transnational corporations, there is a danger of some companies promising to carry out training only as a means of obtaining permission to recruit staff from abroad. The Committee therefore requires companies applying for foreign recruitment to submit a training schedule which spells out the nature, duration and goals of the proposed training, in addition to particulars of the trainees. Follow-up operations are carried out on a monthly basis by the Monitoring Committee to ensure that training obligations are fulfilled.

In short, the Government of Zimbabwe recognises the need to develop local skills and the danger of depending on expatriate labour to such an extent that it requires that any employer who wishes to recruit externally should obtain certification from the Committee on Foreign Recruitment stating that there are no Zimbabweans available to occupy the specific post. Permission to recruit a foreigner will only be granted on condition that a Zimbabwean has been identified to understudy the recruit. In cases where the employer fails to identify an understudy, he should then pay a fee to the Government which will be used for the training of someone to replace the foreign recruit.

Training Programmes

INTERNATIONAL BANK FOR RECONSTRUCTION AND DEVELOPMENT (IBRD) LOAN

The ESC in December 1982 entered into a loan agreement with the International Bank for Reconstruction and Development (IBRD), for the financing of Stage II of the Hwange Thermal Power Station. Besides increasing electric power generating capacity of Zimbabwe, the project also aimed at addressing the short and long-term manpower requirements of the power sector. Approximately US$18 million was made available from the IBRD loan for training purposes, including the construction of a training centre. Although the World Bank loan was signed by the ESC, and mainly for the Hwange project, it can also be used by other power organisations. The loan has been used by the power organisation to finance external training of its technicians and engineers.

ELECTRICITE DE FRANCE (EDF) PROGRAMME

Electricite de France (EDF) is the most heavily involved international organisation in the training of manpower in the electricity energy sector of Zimbabwe. On 29 April 1983, the then Ministry of Industry and Energy Development signed an agreement approving of EDF's participation in training programmes for semi-skilled workers, artisans and technicians for the entire electricity power sector of the country. Two programmes were envisaged. First, a general training programme for the electricity supply industry of Zimbabwe and, secondly, a special "crash programme" for the Hwange Thermal Power Station, whose aim is to reduce the ESC's dependence on expatriate personnel for the running of the station.

The Hwange "crash programme" commenced in 1984 and it is aimed at producing power station operators for the station in the shortest possible time. At the moment, this EDF programme trains assistant unit operators who can possibly be promoted to unit operators. At the school, the trainees undergo a six-month course which covers, among other things:

- the technological aspects of the facilities;
- the procedures and interpretations of the various test phases; and
- the operating procedures related to power generation.

This is followed by four months of attachments and finally three months of on-the-job training. After this, the trainees graduate as assistant unit operators with the possibility of becoming unit operators.

At the training school, the trainees operate under an EDF team leader - for the theoretical aspects. WAPCOS and EDF participate at the operational level, i.e. giving practical tuition and experience. The ESC projection is that by the first half of 1987, the Commission should be self-sufficient in unit operating staff, leading to a reduction in expatriates.

The major EDF programme is establishment of the recently approved Harare Training Centre. The centre will train artisans and technicians for the whole power sector. It will fall under ZESA after the amalgamation of all power organisations. The centre will have an intake of about 144 trainees. The Hwange Training School will be required to offer familiarisation courses to some of the persons to be trained at Harare. In a sense, the Harare Training Centre offers a "crash programme" since the training period will be shorter, i.e. two years.

POST-GRADUATE TRAINING FOR THE ESC

The ESC runs a graduate engineers' training programme, part of which has to be completed overseas to be able to meet the standards of the relevant engineers' institutions. At the moment, there are 16 graduate engineers undergoing generation courses - mainly for the Hwange Thermal Power Station. At Hwange there are currently 35 post-graduate trainee engineers and 28 training in the Electrical Distribution Department. By the first half of 1985, the ESC hopes to have recruited a further 16 trainee graduate engineers.

During 1983, 16 graduate engineers and 16 technician engineers were sent to the Power Engineers Training Society of India to do intensive courses (52 weeks for engineering and 44 weeks for technicians), involving "hands-on" power station training at the PETS Training Institute in Nangpur. These Zimbabwean engineers and technicians are understudying BEI contract staff and Hwange and were financed through the IBRD loan.

OTHER ESC TRAINING SCHEMES

The ESC is also engaged in a number of training schemes to upgrade its semi-skilled staff. A scheme is currently being implemented to train semi-skilled workers as common service erectors in the following categories:

- Substation Erectors
- Service Erectors
- Street Lighting Erectors and Maintenance Servicemen
- Transformer Maintenance and Workshop Servicemen.

This scheme, which was primarily aimed at upgrading semi-skilled staff in the ESC's district depots, is being extended to the Central Workshops. Although the programme appears to be encouraging fragmentation, it is actually aimed at providing training courses for suitable staff which will eventually enable them to achieve journeymen status through trade testing.

The ESC periodically offers line erector courses to staff with suitable experience and, on completion, they may progress in time to become linesmen and foremen linesmen. Finally, the Commission from time to time offers training courses in Harare and at its district depots for meter readers. Recruits for vacant meter reader posts are drawn from existing distribution staff who already have an electrical background and show an aptitude for the job.

SPECIALISED TRAINING

The ESC sends its qualified graduate engineers for specialised training in installation, use and maintenance of specialised equipment. This training programme is offered to graduate engineers with a few years of working experience, after being posted to specific sections of the Engineering Department, such as protection, distribution, system planning, production, operations, metering, communications, electrical contracts or substations. The Commission sends its staff to training courses offered by major power and control equipment suppliers since experience to install, use and maintain specialised equipment is best received from the manufacturers of the equipment. This practice has been extended to technician engineers. A problem that has arisen is that some employees, after having undergone such training, have resigned from the ESC to join the private sector or other organisations offering better conditions of service. The Commission is therefore introducing bonding to persons who undertake such courses, i.e. such persons would be required to repay the Commission the full costs if they resign within a predetermined period after completion. However, the number of personnel who can be released to undertake such specialised training is limited due to the severe shortage of engineers, technicians and artisans in the ESC's Engineering Department.

CAPCO, with a total workforce of about 200, including administration staff (but excluding messengers and cleaners), is far much smaller than the ESC in terms of staffing. The current number of trainees at all levels is 40, which is 20% of the total workforce. CAPCO sponsors eight engineering students at the University of Zimbabwe and since 1983 it has sponsored four engineering students currently studying at the University of Zambia (for its Zambian operations). There are six under-graduates who are on a two-year in-service training programme and six technicians being trained at Kariba and Sherwood. There are also four technicians being trained in Zambia. CAPCO has about 11 apprentices doing electrical, mechanical fitting trades and drafting.

HARARE MUNICIPAL ELECTRICITY DEPARTMENT

Until recently, the only major training programme of the Harare Municipal Electricity Department was journeyman training through technical colleges. Average annual intake is 12 per year and it is hoped that the number will be increased to 16 in 1985. The number of apprenticeships that can be taken is limited by the intake of the existing colleges. The department is hoping, starting from 1985, to sponsor engineering students at the University of Zimbabwe, which it does not do at the moment. The HMED has embarked on a training scheme to upgrade labourers to semi-skilled and skilled categories. The training is undertaken both on the job and at the old Harare Power Station which has been converted into a training school. It is hoped that training will be extended to technicians and engineers once training officers and the necessary facilities become available.

BULAWAYO MUNICIPAL ELECTRICITY DEPARTMENT

The Bulawayo Municipal Electricity Department depends mainly on technical colleges for the training of its apprentices (like the HMED). The department feels that most of the electricians trained externally, in countries like West Germany, Zambia, Romania and others, are of a lower calibre. Two trainee engineers have been sent to Ireland. There are at present a total of 26 apprentices and BMED does not have plans to take any more this year. At present, there are two engineers who are not experienced and therefore cannot train others. The situation is similar to Harare, where there are no senior engineers to train junior inexperienced graduate engineers.

Future Manpower Requirements

The discussion on the current manpower inventory showed that the electricity power sector of Zimbabwe had a technical manpower deficit of 34% as at 1 October 1984. That figure was arrived at after taking into consideration the available local and foreign manpower. If expatriate staff is excluded, the shortage of local manpower as at December 1984 was almost 43%.

This section presents projections of manpower needs for the four major electricity undertakings. Projections are also made of output of trained manpower from confirmed programmes for the different occupational categories. A programme that arises in making projections of manpower requirements is that the future requirements are not static. They change over time and are determined by factors such as growth, organisational structure of the sector and expectations.

In making forecasts of future manpower requirements, the Department of Energy assumed that the established posts for technical manpower would grow at a rate of 4% per annum. Percentage staff loss was forecast at 7% up to 1985, after which it would drop to 6%, 5% and 4% in 1986, 1989 and 1992 respectively. Below is presented the forecast of foreign manpower requirements in a condensed form.

Table 15

FORECAST OF FOREIGN MANPOWER REQUIREMENTS

Occupational Category	1985	1986	1987	1988	1989	1990	1991	1992	1993
Professional									
Engineers	114	59	34	20	6	(7)	(18)	(30)	(41)
Technicians	55	33	21	0	(12)	(32)	(41)	(62)	(73)
Artisans	347	274	174	89	5	(72)	(143)	(211)	(285)

According to Table15 above, the Zimbabwe electric power sector will be self-sufficient in its technical manpower requirements in the next six years. The manpower gap for professional engineers and artisans will be closed in 1990, while that of technicians will be covered by the end of 1988. It should be pointed out that this does not necessarily mean that all expatriate staff will have been replaced by 1990. There are certain posts, especially in the professional engineer category, which require extensive experience which may not have been acquired by Zimbabweans by 1990. The ability of the power sector to retain its experienced staff will therefore be crucial in reducing and eventually eliminating reliance on expatriate staff.

Finally, it should be emphasised that the accuracy of the above projections depends on the validity of the assumed growth rate of established posts and the anticipated percentage loss of staff. It is not very clear why 4% was assumed as the rate of growth in established posts. A more reliable approach in making forecasts of manpower requirements is one based on the development plans of the sector concerned. In this case, it would be necessary to take into consideration the timing of new projects such as the expansion of the Hwange Thermal Power Station, the construction of hydro-power stations as per Power Development Plan and rural electrification programmes. Using this approach, projections would then be made of the absolute numbers of the necessary manpower in different occupational categories.

Notes:

1. This section relies heavily on a document written by the MLMPSW entitled "Electricity and Water".
2. See Draft ZESA Bill.
3. *The Financial Gazette*: 21 December 1984.
4. "Causes of Manpower Drift from the Public Sector to the Private Sector". MLMPSW internal document.

HOUSEHOLD ENERGY SECTOR

This section is presented in three parts beginning with household energy utilisation, followed by descriptions of the sub-sectors and finally manpower aspects.

HOUSEHOLD ENERGY UTILISATION

Rural Domestic Energy Use

Our analysis of rural household energy utilisation is based on a National Household Energy Survey undertaken by the Beijer Institute (1984) and a survey undertaken by the Permanent Household Survey Unit of the Central Statistical Office (CSO) during the first half of 1984. The sampling frame of the latter included over 5 000 households, 80 percent of which were in the rural areas. The rural returns to the survey were broken down into four distinct sub-sectors, namely communal areas, resettled areas, small-scale commercial farming areas (SSCFA) and large-scale commercial farming areas (LSCFA).

Rural domestic energy consumption is the largest energy consuming sector in Zimbabwe. In 1982, the energy consumed by this sector was estimated at 126,6 PJ, nearly 53% of the national total (Beijer Institute, 1984). These figures are further broken down by sub-sector in Table 16. The table highlights the relative importance of wood as a source of energy in rural Zimbabwe.

Table 16

RURAL HOUSEHOLD ENERGY CONSUMPTION(PJ = Peta-Joules)

Sub-Sector	Fuelwood	Poles	Paraffin Jetfuel	Electricity	Sub-Sector
Communal Areas	78,71	22,82	0,31	-	101,83
Resettled Areas	3,51	0,67	0,02	-	4,20
SSCFA	2,74	-	0,02	-	2,76
LSCFA	17,66	-	0,15	0,02	17,13
TOTAL	102,62	23,49	0,50	0,02	125,92

Source: Beijer Institute (1984)

Wood is used primarily for cooking, heating and often for lighting by rural households. Paraffin, used largely for lighting in most rural households, constitutes the second most important fuel in the rural sector. Table 17 presents rural domestic energy use in percentage terms by sub-sector and fuel-type (Beijer Institute, 1984). The low percentages show that woodfuel constitutes between 70% and 90% of the energy used in each sub-sector. Domestic use in the communal areas represents approximately 80% of energy consumption in the sub-sector. This is followed by energy consumption by households in the large-scale commercial farming sector. This consumption pattern should change soon, due to the growing shortage of wood.

Table 17

PERCENTAGE OF RURAL HOUSEHOLD ENERGY USE BY SUB-SECTOR & FUEL

Sub-Sector	Fuelwood	Poles	Paraffin Jetfuel	Electricity	Sub-Sector Total
Communal	7,67	97,1	62,0	-	80,4
Areas	(77,3)	(22,4)	(0,3)	-	(100,0)
Resettled	3,4	2,9	4,0	-	3,3
Areas	(83,6)	(15,9)	(0,5)	-	(100,0)
SSCFA	2,7	-	4,0	-	2,2
	(99,3)	-	(0,7)	-	(100,0)
LSCFA	17,2	-	30,0	100,0	14,1
	(99,0)	-	(0,9)	(0,9)	(100,0)
Rural Household	100,0	100,0	100,0	100,0	100,0
TOTAL	(81,0)	(18,6)	(0,4)	(0,0)	(100,0)

Note: The top figure in each column denotes column percentage while the bottom figure (in parentheses) is row percentage.

Source: Beijer Institute, 1984.

As has already been pointed out, 90% of rural households use wood for cooking, and 3,19 tonnes of wood (in 1983) are burnt in open-hearth stoves (choto), which have an efficiency of 10% or less (Chadzingwa, 1984):

> If certain proportions of households can be provided with a fuel-efficient stove, a net saving of up to 5% of total fuel-wood consumption can be gained. When this small figure translated to equivalent forest areas, this constitutes savings of 13 000 ha of woodlots per year (Chadzingwa, 1984).

Such a saving becomes significant when one considers rural development and land management. The average consumption estimate for paraffin was 0,7 litres per household per week or roughly 36,37 litres per household per year (Chadzingwa, 1984). Unless alternative energy sources are used, the consumption of paraffin will increase dramatically.

The four rural sub-sectors have varying levels of energy intensity as shown in Table 18. In the Beijer Institute report it is pointed out that while households in communal areas, SSCFA and LSCFA sub-sectors use roughly equivalent quantities of wood for cooking, households in resettled areas utilise roughly 50% more wood for cooking every year. This is attributed to the fact that most resettled areas are newly cleared for agriculture and thus are presently experiencing a temporary surplus of wood. In the case of paraffin used for lighting, resettled areas and LSCFA households use more energy per household than do their counterparts in communal areas and on small-scale commercial farms.

Table 18

ENERGY INTENSITY IN THE RURAL DOMESTIC SECTOR

Sub-Sector	Energy Intensity of Cooking with Wood (GJ/Household/Annum)	Energy Intensity of Lighting with Paraffin (GJ/Household/Annum)
Communal Areas	83,65	0,456
Resettled Areas	128,40	1,076
SSCFA	81,10	0,783
LSCFA	72,88	1,117

Source: Beijer Institute, 1984.

Urban Domestic Energy Use

Out of an estimated total of 344 000 urban households in Zimbabwe, 229 000 were estimated to live in the high-density suburbs and the remainder in the low-density areas (Beijer Institute, 1984). In these households, an estimated total of 6,01 PJ of energy was used (Beijer Institute, 1984). Table 19 shows the estimated urban household energy consumption for 1982. Fifty-three percent of the total energy consumed was used by high-density households. Electricity, the primary energy source for urban households, supplied nearly 10% of the total energy used by urban households.

Table 19

URBAN HOUSEHOLD ENERGY CONSUMPTION (Peta Joules-PJ)

Subsector	Paraffin	LPG	Electricity	Fuelwood	Total
High-Density Areas	0,30	0,15	1,44	1,3	13,20
Low-Density Areas	0,18	0,24	2,13	0,27	2,81
TOTAL	0,48	0,39	3,57	1,58	6,01

Source: Beijer Institute, 1984.

Electricity is more commonly used in the low-density areas despite the fact that a large number of low-density households, especially domestic workers, have limited purchasing power. Fuelwood was the next most important energy source, supplying about 26% of the total. Wood consumption by urban households was estimated in 1978/79 at 191 tonnes per year and in 1983 at 680 tonnes per year which is 7,5 m^3 per year per family averaging 6,4 persons (Hoiser, 1984; Furness, 1983).

In the big urban centres paraffin consumption averages 1,60 litres per week for a family averaging 3,4 persons (Hoiser, 1983). In the urban areas surrounding small towns, consumption of wood/paraffin is not clear cut. In these areas, 32 out of 100 households use paraffin for cooking/lighting, 40 out of 100 households use wood for cooking and the rest either use electricity (two households out of 100), or use a combination of wood, paraffin and electricity (26 households out of 100) (Chadzingwa, 1984).

Wood is the traditional fuel in the rural areas and high-density areas. Until recently, wood has always been plentiful. The situation has changed, particularly in Mashonaland East, Manicaland and Masvingo. Near the larger urban centres and in rural areas of these provinces with a high population density, wood is now a scarce commodity. Alternative fuels such as coal, paraffin, gas, charcoal and biogas are relatively recent introductions and are generally too expensive. Electricity is available only in the urban areas. Introduction of electricity in rural areas is expensive and considered uneconomical and is only projected to be extended to growth points in the medium term.

THE FUELWOOD SUB-SECTOR

Tree Planting and Management

Estimates of standing stock and yields of wood for eight land-use categories providing Zimbabwe's wood resource base were made by members of the ZEAP Team (Harare, 1984). The land-use categories considered are LSCF, SSCF, communal, resettlement, parks and reserves and demarcated indigenous forest: Wood resources from commercial plantations and non-commercial plantations larger than five hectares were based on reports produced by the Forestry Commission.

Demarcated forest areas include forest reserves, commercial and industrial plantations. Of a total of 62 712 hectares of softwood plantation in Zimbabwe, 62 065 hectares are found in Manicaland Province and 647 hectares (1%) in the Midlands and Mashonaland provinces (Katerere, 1984). Wood from the coniferous plantations is used mainly for commercial purposes. The stocks and yields on existing softwood plantations reflect conditions of supplies being above the levels of demand as Zimbabwe is presently unable to utilise all commercial timber (Beijer Institute, 1984).

The total area of commercial eucalyptus plantations is 18 214 hectares, found in all provinces except Masvingo. Of this total, 14 000 hectares are at the Forestry Commission's Mtao Forest Reserve in the Midlands. These eucalypts are used primarily for poles (fencing and utility), pulp, mining, timber and fuelwood.

A total of 13 786 hectares of wattle (*Acacia meansii)* are found in Manicaland Province. At present, the use of the wood by-products in wattle timber production is very limited. The surplus is available for pulpwood or expansion of the charcoal industry with the possibility for export (Wattle Company, 1984).

Tables 20 and 21 summarise the results of the wood resource estimates for Zimbabwe (Beijer Institute, 1984). The figures are presented on a hectare basis to highlight the variations between different stocking rates by natural region and land-use categories. The demand for wood in its various forms is drawn from different causes within the natural wood-supply base.

Table 20

WOOD YIELD BY ECOLOGICAL ZONE AND LAND TYPE (Tonnes/Hectare/Annum)

	ECOLOGICAL ZONE			
Land Type	**I**	**II**	**III**	**IV**
LSCFA Exotic Forest	8,50	5,05	5,20	2,78
LSCFA Indigenous Forest	3,60	1,60	11,30	1,20
Resettlement Indigenous Forest/Grazing	1,60	0,73	0,20	0,55
Communal Land Exotic Forest	-	3,84	3,08	2,53
Communal Land Indigenous Forest/Grazing	1,60	1,32	0,20	0,56
Parks and Reserves	3,60	1,57	1,38	1,11
Demarcated Exotic Forest	10,60	7,47	2,63	0,80
Demarcated Indigenous Forest	3,60	-	0,80	0,80

Source: Katerere, 1984.

Table 21

TOTAL STOCKS AND SUPPLIES BY LAND TYPE (Million Tonnes)

Land Type	**Stocks**	**Supplies**
LSCFA Exotic Forest	0,89	0,06
LSCFA Indigenous Forest	251,69	5,45
Resettlement Indigenous Forest/ Grazing	10,87	0,27
Communal Land Exotic Forest	0,19	0,26
Communal Land Indigenous Forest/ Grazing	102,28	1,95
Parks and Reserves	269,40	0,26
Demarcated Exotic Forest	28,75	0,64
Demarcated Indigenous Forest	0,70	-
TOTAL	664,77	8,64

Source: Katerere, 1984

Rural wood demand is met primarily by supplies from local wood resources on indigenous forests/grazing lands, on agricultural lands, on existing woodlots and by residues from construction obtained from adjoining State and commercial lands (Katerere, 1984).

Table 21 summarises total wood stocks and supplies by land-use category at a national level. The supply figures refer to the national wood resources that are accessible to the population. Parks and reserves, with 269, 640 million tonnes of woody biomass, have the largest stocks (41%), but they supply barely 3% of the national wood requirements

(Katerere, 1984). About 63% of current wood supplies come from the LSCFA indigenous forest category which has 251,69 million tonnes or 38% of total stocks. The communal indigenous forests and grazing areas with 15% of the stocks supply 23% of the fuelwood.

In the Beijer Report (1984), an estimate of provincial wood stocks and supplies was made (see Table 22). For each of the provinces, it is possible to identify where the largest wood stocks are held and what the major sources of supply are. The provinces with stocks greater than 100 million tonnes are Matabeleland North (206,76 million tonnes), Matabeleland South (143,32 million tonnes) and Mashonaland West (106,98 million tonnes). The LSCFA indigenous forest land-use category has the highest wood stocks in each of the following provinces: Manicaland (38%), Mashonaland East (52%), Mashonaland West (35%), Matabeleland South (83%) and the Midlands (60%). In Mashonaland Central, the highest stocks (about 57%) are found in the communal indigenous forest/grazing areas, while in Matabeleland North and Masvingo, they are in the Parks and Reserves.

In all provinces except Mashonaland Central and Matabeleland North, most wood supplies are derived from the LSCFA indigenous forest and grazing areas (ZEAP Team, 1984). Findings of the ZEAP Team indicate that for Mashonaland Central, supplies from LSCFA indigenous forest are equal to those from the communal area indigenous forest areas. Most of the wood requirements of Matabeleland North are met from supplies in the communal indigenous forest and grazing areas.

Sawmill Waste

The ZEAP Team conducted a survey to find out the amount of sawmill waste from indigenous and exotic timber harvested annually (Beijer Institute, 1984). The findings of the ZEAP Team show that nearly 80% of the wood designated for commercial use in Zimbabwe goes to waste. Of the 637 000 tonnes (approximately 740 000 cubic metres) of indigenous and exotic timber harvested annually, only about 120 000 tonnes wind up in the form of finished products (Beijer Institute, 1984). The entire process has an efficiency of about 20%. Only 40% of the commercial timber harvested annually is used as mill feedstock, and only 50% of the sawmill feedstock is used for the production of final products. The bulk of the commercially harvested wood is left in the forest, and the remaining sawmill waste is either in the form of sawdust or rough-cut slabs. It is estimated that half of the total sawmill waste of 127 400 tonnes and 60% of the wood harvesting waste of 382 000 tonnes is available for use as fuelwood. Thus 293 000 tonnes of commercial timber wood (or 4,78 PJ) becomes a potential supply of fuelwood.

Management of Resources

Until recently, the Forestry Commission, the only body entrusted with management of forests, had not been involved in the communal lands. However, the establishment of plantations in the communal areas since the early 1930s has been very slow. For a long time, the main grower of eucalyptus in the communal lands was the Government. "Native" councils were encouraged to plant trees or take over Government plantations, but gradually, the tree planting (of eucalyptus) by families or individuals gained prominence in the communal lands. These woodlots are seldom in excess of 0,5 hectares, while Council and Government plantations are usually about 20 hectares, sometimes as much as 200 or 3 000 hectares in extent (Forestry Commission, 1983).

Table 22

PROVINCIAL TOTAL WOOD STOCKS AND SUPPLIES BY LAND TYPE (Million Tonnes)

	Manicaland		Mashonaland Central		Mashonaland East		Mashonaland West		Matabeleland North		Matabeleland South		Midlands		Masvingo	
	Stock	Supp.	Stock	Supp.	Stock	Supp.	Stock	Supp.	Stock	Supp.	Stock	Supp.	Stock	Supp.	Stock	Supp.
LSCFA Ex.F.	0.17	0.02	0.23	0.01	0.32	0.03	0.13	0.00	0.00	0.00	0.00	0.00	0.30	0.00	0.10	0.00
LSCFA Ind.	13.80	1.02	10.88	0.36	8.80	0.57	37.04	0.83	8.14	0.17	118.61	0.49	29.23	1.09	25.18	0.93
Resett. Ind.	1.84	0.06	0.47	0.01	0.88	0.04	0.69	0.01	1.03	0.02	2.45	0.02	1.64	0.02	1.83	0.09
Comm. Ex.F.	0.01	0.00	0.00	0.00	0.02	0.00	0.01	0.00	0.02	0.00	0.00	0.00	0.09	0.01	0.02	0.00
Comm .Ind.F.	7.66	0.28	19.92	0.37	5.36	0.30	7.90	0.14	24.76	0.36	20.56	0.18	10.60	0.14	5.51	0.18
P./Reserves	0.92	0.01	3.38	0.00	0.10	0.00	61.18	0.04	156.21	0.06	1.70	0.00	6.50	0.01	39.41	0.14
Demar. Ex.	11.62	0.35	0.23	0.01	0.60	0.02	0.03	0.00	15.93	0.26	0.00	0.00	0.33	0.00	0.01	0.00
Demar. Ind.	0.02	0.00	-	-	-	-	-	-	0.66	0.00	-		-	-	0.03	0.00
TOTAL	36.04	1.74	35.11	0.76	16.80	0.95	106.98	1.02	206.76	0.85	143.32	0.70	48.43	1.26	72.05	1.35

There are currently some 3 950 hectares of eucalyptus plantations in the communal lands under the following ownership:

Government	
(District Development Fund)	1 339 ha
District Councils	1 013 ha
Family and Individual	
Woodlots	1 598 ha
TOTAL	3 950 ha

The Forestry Commission will spearhead a pilot National Rural Afforestation Project funded by the World Bank, at an estimated cost of Z$9 million. The objectives of this project are:

- To establish self-sufficiency in woodfuel in the communal lands through the establishment of individual woodlots.
- To develop an infrastructure for production and distribution of seedlings; and
- To provide education, information and extension services and where necessary to promote conservation and tree awareness.

These objectives are contained in a report prepared by the Forestry Commission in conjunction with the Regional Mission of the World Bank in East Africa which was appraised by the World Bank in 1982.

The Rural Afforestation Project aims at ameliorating the fuelwood deficit in 30% of the rural districts over the eight provinces in the country by planting fast-growing exotics. Most areas in these districts experience chronic fuelwood shortages. They have an estimated deficit of over six cubic metres of wood per family every year. To initiate the afforestation project, liaison between interested Ministries via a coordinating committee was established. The fuelwood demand/supply position was established via the Beijer Institute data collection system and the Ministry of Industry and Energy Development (MIED). Extension and support services will come from the Ministry of Agriculture and the Ministry of Resettlement and Rural Development and MIED (Chadzingwa, 1984).

In more detail, the project involves the establishment of nurseries near rural service centres in 16 districts involving 44 communal lands. The total seedling production at full development will be about 76 million seedlings per annum, enabling the planting of about 4 300 hectares. In addition to the main nurseries, seedling distribution points, averaging two per nursery, will be established at selected points to ensure access to seedlings by communal land farmers, since transport of seedlings is currently a constraint on the establishment of family woodlots. At or near main nurseries, 5 ha woodlots will be established to demonstrate proper planting, maintenance and harvesting techniques to communal land farmers. The woodlot area will also be used to conduct tree species trials. Block plantations will be established in four of the Forestry Commission demarcated forests which are adjacent to communal lands where, due to ecological factors, plantation establishment by individuals is unlikely to be a success. Over the four-year period of the project, a total of 1 650 hectares will be established. These plantations will provide poles and fuelwood for persons living in the adjacent communal lands. It is also proposed to establish 100 hectares at each of five sites adjacent to the larger urban centres in Zimbabwe to offset the dependence of these centres on the rural areas as their source of fuelwood (Judge, 1982).

The Rural Afforestation Project was inaugurated in July 1982. The first year's (1982/83) target of establishing 12 nurseries in four provinces was met. Four of the nurseries have been established in Mashonaland East, five in Masvingo, two in Manicaland and one in the Midlands. A minimum production of 80 000 seedlings per nursery was envisaged during the first year of the project.

Forestry Research in Zimbabwe

Forestry research in Zimbabwe dates back to 1920 and is summarised in a paper by the Forestry Commission (1984). The present research and programme deals mainly with the following topics: tree breeding, management trials, wood utilisation, indigenous forests and agroforestry.

One of the major focuses of research in Zimbabwe at the moment is baseline data collection on tree planting in rural areas. This area has previously been neglected and therefore deserves detailed treatment in this study.

A Tree Planting Survey was carried out by the ZEAP Team as part of the Rural Energy Survey. The major objective of the study was to establish whether or not there was any form of tree planting in rural Zimbabwe and if so, the level of such tree planting. More specifically, the study sought to establish the following:

- Types of trees planted
- Sources of seedlings
- Reasons for planting trees
- On whose initiative trees are being planted.

Katerere (1984) summarised the results of the survey. Seventy percent of the households interviewed indicated that they had planted trees. Tree planting is carried out by all members of the household, although the male members appear to plant most of the trees.

The most frequently planted trees are fruit (67%), followed by eucalypts (31%) and jacaranda (2%) (Table 23). The planting of jacaranda trees might increase in the drier zones as they appear to be more termite resistant than eucalypts and the foliage is fed to cattle and goats. In some communal areas, jacaranda also provides poles. Less than 1% of the trees planted were indigenous and the majority of such species are planted mostly as live fences.

Table 23

TYPE AND FREQUENCY OF TREES PLANTED IN COMMUNAL AREAS

Types of Tree	Frequency of Planting	Percentage
Fruit	77	67
Eucalypts	35	31
Jacaranda	2	2
Pine	1	1
Indigenous	1	1
TOTAL	116	102

As highlighted in Table 23, 57% of the households either raise their own seedlings or collect them from the wild. Only 16% of the households purchased their seedings. Twenty-seven percent received their seedlings free on National Tree Planting Day.

Table 24

PERCENTAGES OF SEEDLING SOURCES

Sources of Seedlings	Number of Households	Percentage
Self-Grown	22	43
Collected Wild	7	14
Free on Tree Day	14	27
Purchased	8	16
TOTAL	51	100

Sixty-six percent of the households planting trees did so on their own initiative, 15% on the initiative of schools and 8% on group initiative (Table 25). Only 3% cited extension workers as having influenced them to plant trees.

Table 25

PERCENTAGES OF TREE PLANTING INITIATIVES

Initiative	Number of Households	Percentage
Own Idea	93	66
Group Idea	12	8
School	22	15
National Tree Day	9	6
Tree Day and School	2	2
Agritex	4	3
TOTAL	142	100

The main reasons cited for planting trees are fruit (60%), poles (17%), shade (14%) and fuelwood (6%) (Table 26). Droughts, termites and animal browsing were consistently cited as the most serious problems affecting tree growing in the rural areas.

Table 26

PERCENTAGES OF TREE PLANTING PURPOSES

Purposes	Number of Households	Percentage
Shade	17	14
Ornamental	0	0
Fruit	76	60
Fuelwood	6	6
Poles	21	17
Sawdust	4	3
Fodder	0	0
Prevent Soil Erosion	0	0
TOTAL	12	100

Organisations in Woodfuel Programmes

Apart from the Forestry Commission, several non-governmental organisations are involved in tree planting on a small scale. These organisations include:

- Conservation Trust of Zimbabwe (Harare) which is active in providing financial support to tree planting and solar projects.
- Driefontein Mission (Mvuma) which runs a tree planting programme.
- Jaycees Zimbabwe (Mutare) who have energy activities for communal fuel farms.
- Tree Society of Zimbabwe which focuses on soil conservation and fuelwood plantations in communal areas.
- Zimbabwe Tobacco Association (Harare) which is involved in energy activities and focuses on tree planting for use in tobacco drying and fuelwood for plantation workers.
- Zimbabwe Young People's Service (Mutare) which focuses on agroforestry and tree planting on farms.

Commodification of Woodfuel

Although the majority of the people in rural areas regard it as their God-given right to cut as much wood as they want, and without necessarily having to pay for it, supplies are falling rapidly (Whitlow, 1979; Johnston, 1980). In urban areas, wood is no longer a "free" commodity as in rural areas. Many of the high-density urban households obtain wood at high financial costs or at the risk of being prosecuted when they fetch it illegally from municipal lands or commercial farms adjacent to the urban areas (Mazambani, 1982).

No comprehensive study has been carried out to highlight the scale and distribution of woodfuel in Zimbabwe. However, Mazambani (1980) studied woodfuel patterns in Harare and Chitungwiza through interview surveys involving 12 wood traders, 112 wood vendors and 524 urban households. The study revealed that:

- 110 000 m^3 (stacked volume) of woodfuel were being transported into the high-density residential areas per year;
- Consumers paid very high prices for woodfuel. For example, an average household with six members used 70 cents worth of wood per day, if it relied entirely on woodfuel for cooking and heating;
- High costs of woodfuel were the result of profiteering by wood traders and vendors, as well as the high transport costs from the source areas;
- Low-income households without electricity supply were the main users of woodfuel as they could not afford the cost of other energy resources such as paraffin; and
- Woodfuel sold to urban residents came largely from commercial farming areas, and was being transported to Harare and Chitungwiza by individual lorry owners as well as some private transport companies over distances of up to 200 kilometres.

Mazambani (1984) discussed in more detail the commodification of woodfuel, that is the woodfuel cycle which involves its transportation from the source areas and its marketing in the urban areas. Table 27 below highlights the monthly mean quantity of wood sold by an individual vendor in Harare and Chitungwiza in 1980, 1982 and 1983.

Table 27

MEAN MONTHLY QUANTITY OF WOOD SOLD BY A VENDOR (Tonnes)

Year	May-August	September-April	Total
1980 (x)	33,4	12,8	46,2
1982 (xx)	9,8	7,0	16,8
1983 (xx)	9,1	4,8	17,9

Sources: (x) Mazambani, 1980;
(xx) Beijer Institute, 1984.

The quantities of fuelwood sold vary seasonally. The figures show that the highest sales of wood occurred during the winter season (May to August) than at any other time during the year. During the cold season, woodfuel is used for space heating as well as cooking. The marked drop in the quantity of wood sold by the vendor per month in 1982 and 1983 resulted partly from the competition for the same market with unlicensed wood sellers and partly from some wood traders who began to sell wood directly to the consumers. However, the quantities of wood sold by vendors during the same period (Table 27) did not meet the total demand. Evidence of this is the continued felling of trees for woodfuel around Harare and Chitungwiza.

Table 28

TOTAL QUANTITIES OF WOOD SOLD TO VENDORS PER YEAR

Year	No. of Vendors Interviewed	Tonnes of Woodfuel Sold
1980	112	5 174,4
1982	86	1 444,8
1983	86	1 109,4

Source: Mazambani, 1984

Today a family of the same size spends $1,3 per day to get the same quantity of wood if it relies entirely on woodfuel for cooking and heating. In most high-density suburbs, the units commonly used when selling wood are small bundles each consisting of four chopped pieces and weighing about 4 kg. Each bundle is sold at 6,9 cents per kilogram (Mazambani, 1984).

Transportation and Marketing Channels of Woodfuel

A large proportion of the woodfuel sold in the two municipalities comes from commercial farming areas or resettled areas where pieces of land are cleared for cultivation. Woodfuel is also obtained illegally from some communal areas in the Mashonaland provinces (Table 29). Over the past four years, an increasing quantity of wood was obtained from the communal areas. In years of crop failure due to drought communal dwellers cut trees for sale in order to obtain cash.

Table 29

SOURCES OF WOODFUEL IN HARARE AND CHITUNGWIZA MUNICIPALITIES

Year	PERCENT FREQUENCY	
	Commercial Farming Areas	Communal Farming Areas
1982	92,9	7,1
1983	96,4	3,6
1984	79,5	20,5

Source: Mazambani, 1984

Between 1978 and 1981, tree felling for sale of woodfuel was widespread within municipal lands, particularly around Harare (Mazambani, 1982;1983).

Transportation of woodfuel from source areas to urban centres is carried out by wood traders who own lorries or smaller trucks/vans. The traders employ drivers and loaders on a full-time basis. The wood merchants consist of a few transport firms and individual businessmen. They deliver wood to 90,7% of the 86 wood vending enterprises surveyed (Mazambani, 1984). Only two vendors use their own vehicles to transport wood to their operational sites. Of the 84 vendors who rely on traders, 92% depend on their supplies on individual businessmen, while only 2% depend on commercial transport firms.

Table 30 shows the age-sex composition of the owners of wood vending enterprises surveyed in February 1984. The majority (80,8%) are engaged in wood vending because of lack of employment opportunities. Some are involved in selling wood on a part-time basis to supplement household incomes. Others, mostly elderly people, took up wood vending as an occupation after retiring from formal employment. About 91,8% of the establishments are owned by family enterprises.

Table 30

AGE-SEX COMPOSITION OF WOOD VENDORS IN HARARE AND CHITUNGWIZA

Age Groups	Males	Females	TOTAL Absolute No.	TOTAL Percentage
20 - 25	1	0	1	1,4
26 - 30	1	2	3	4,1
31 - 35	0	3	3	4,1
36 - 40	1	3	4	5,5
41 - 45	7	3	10	13,7
46 - 50	8	4	12	16,4
51 - 55	7	2	9	12,3
56 - 60	3	4	7	9,6
61 - 65	21	3	24	32,9
TOTALS	49	24	73	100,00

CHARCOAL PRODUCTION

Charcoal is a first-class fuel for heating and cooking, though for household use it should be burnt in a properly constructed stove, with an outside oven. The heating power of charcoal is greater than that of the same kind of wood, weight for weight, and a good kiln burnt charcoal has about the same calorific value as medium quality domestic coal (Forestry Commission, undated).

Charcoal production in Zimbabwe is done on a very small scale. The largest proportion of charcoal is produced by the Wattle Company. The Forestry Commission produces very limited quantities. The carbonisation process carried out by the Wattle Company and the Forestry Commission involves use of the Brick (Mission) Kiln and the Metal Kiln. The Metal Kiln used by the Forestry Commission is a Mark V Kiln with an efficiency of 25% (Forestry Commission, undated).

The Zimbabwe Wattle Company manages a total of 13 786 hectares of wattle in Manicaland Province. At present, the use of the wood by-products from wattle timber production is very limited. The surplus, however, is available for pulpwood, firewood or expansion of the charcoal industry.

The potential for charcoal production using surplus wattle is about 30 000 tonnes per annum, using the existing 14 kilns owned by the Wattle Company. The company, however, has a significant charcoal production of about 1 500 tonnes annually from 6 000 tonnes of wattle timber. Using the kilns, the recovery of charcoal is in the ratio 4:1. Even though the production of charcoal is significant, the current demand in Zimbabwe is small. About 7 000 to 10 000 tonnes are sold annually to industry/commerce and high-income urban dwellers (Scott, 1983). The charcoal is sold mainly to mines (e.g. Bikita Minerals) and the car industry.

The current cost per tonne of charcoal is $120,00, but the company would like to expand its markets to include member countries of the SADCC. Potential markets for this intended expansion of production (15 000 tonnes annually) are in Arabia and Kenya (Chadzingwa, 1984 and Scott, 1983).

The small-scale production of charcoal by the Forestry Commission also depends on wattle timber from Nyanga in the Eastern Highlands of Zimbabwe. About eight tonnes of wattle timber are converted to two tonnes of charcoal weekly, using the metal kilns (Camp, 1983). The product is sold to local hotels/stores, farmers and the mining sector, but the general demand for charcoal is at present very small.

COAL PRODUCTION

Zimbabwe possesses ample coal reserves to supply a large proportion of the country's primary needs. Presently, the only active collieries in the country are operated by Wankie Colliery Company. The company is involved in a large expansion programme designed particularly to supply the needs of the Hwange Thermal Power Station. The Zimbabwean Government has assisted in the procurement of finance for this expansion by purchasing a large number of the company's shares. The Government is seeking to expedite the substitution of coal for imported fuels wherever possible.

Coal, which is mined at Hwange, is used to produce coke and coal tar at Hwange and ZISCO. Small quantities of low-sulphur coal and some coke are imported from South Africa for use by the ferrochrome industry. The total domestically-produced coal requirements (2 630 000 tonnes or 80,2 PJ) were supplied from Wankie Colliery (Wankie Colliery Company, 1983). Production figures for the financial years spanning 1982 are listed in Table 31 below.

Table 31

COAL PRODUCTION AT HWANGE (Thousand Tonnes)

	1981/82	1982/83
Total Mined	2 810	2 708
Discarded from Mining Process	391	318
Saleable Production	2 419	2 390

Source: Beijer Institute, 1984

The requirements of coal and its products for different purposes for 1982 are presented in Table 32.

Table 32

COAL REQUIREMENTS 1982 (Thousands of Tonnes)

Direct Uses	1 259
For Cooking	843
Electricity Generation	109
Total Domestic	2 211
Net Exports	174
NET TOTAL	2 405

Source: Beijer Institute, 1984

Coke and coal tar fuel (CTF) are produced at Hwange by Wankie Colliery Company and at Redcliff by the Zimbabwe Iron and Steel Company (ZISCO). The Hwange ovens, built in 1970/71, have a capacity of 240 000 tonnes per annum, while the ZISCO ovens, put into operation in 1975, have a capacity of approximately 660 000 tonnes per annum (Wankie Colliery Company, 1983). With conversion efficiencies in the order of 70%, the 1982 coke and CTF requirements of 670 000 tonnes (19,50 PJ) of conversion factor of 29,1 GJ/tonne for coke) is met by 38 000 tonnes of imports (1,1 PJ) and the processing of 862 000 tonnes of coal (26,29 PJ on a conversion factor of 30,5 GJ/tonne) (Wankie Colliery Company, 1983; Beijer Institute, 1984). Due to mining losses of 15%, 1 150 000 tonnes of coal must be mined for coking purposes.

Table 33

COAL CONSUMPTION BY SECTOR 1982 (PJ or Millions of Giga Joules)

End Use Sector	COAL PRODUCTS		
	Coal	Coke	CTF*
Rural Household	-	-	-
Urban Household	-	-	-
Agriculture	8,80	-	-
Industry	14,14	13,45	0,74
Transport	7,55	-	-
Construction	-	-	-
Municipality	-	-	-
Informal Industry	-	-	-
Commercial Distribution & Other	3,4	-	-
TOTAL	38,89	13,45	0,74

**CTF = Coal Tar Fuel*

Source: Beijer Institute, 1984

Final coal consumption for 1982 is summarised in Table 33. The table contains the number of peta-joules of end-use coal and its products by each sector of the economy. The total consumption came to 53,08 PJ. The most important user of coal is the industrial sector. Coal consumption by this sector amounted to 14,14 PJ or 29,5% of total energy consumption. The largest coal consuming sub-sectors are mining (31%), non-metallic minerals (26%) and foodstuffs (12%) (Beijer Institute, 1984). In all, 13,45 PJ of coke was used in the metals and foodstuffs sub-sectors. On the other hand, the use of coal products by other sectors is so insignificant that no figures have been entered in Table 33. Note that the rural and urban households do not depend on coal or coal products for their energy requirements, although a very small number of households do use it.

STOVE PRODUCTION

A wide range of stoves exists in the rural and urban households. These are discussed below and classified according to the fuel type used. It is important to note that not all the stoves discussed below are widely used. Some have been designed by different organisations like the Department of Energy and Silveira House and have not been widely adopted. The source of information discussed below, unless otherwise stated, is Harris (1984).

Woodstoves

There are nine woodstoves found in Zimbabwe and these are:

- The three-stone hearth: The traditional open fire used by a large number of rural households and by some of the urban population. This stove has been largely replaced by the open-grate metal stove that provides stable support for several pots simultaneously and eases adjustment of the fire.
- The open grate (high): A welded iron frame holding three pots above an open fire. This is largely manufactured by the informal sector.
- The open grate (low): This is a modified version of the open grate described above, experimentally lowered closer to the fire to increase the efficiency of heat transfer.
- The shield grate: A modification of the open grate described above, experimentally shielded with galvanised iron-sheeting on three sides to reduce lateral draughts and to reflect radiant heat back to the cooking area.
- The shielded fire: An experimental sheet steel tube stove incorporating an air entry door and grate in the lower position and cords to suspend a pot in the upper position above the fire.
- Metal Stove (Jairos Jiri): A sheet steel stove supporting one pot above a small insulated combustion chamber; manufactured by the Jairos Jiri Association.
- Brick Stove (Seke): A brick stove holding three pots incorporating a grate, damper, chimney and hot plate. To counteract widespread use of inefficient stoves, the Department of Energy has developed this stove for demonstration

in the communal farming areas and urban areas. However, rural areas are facing severe hardships and the prototype, if adopted, would alleviate hardship by saving 50% collection effect (Chadzingwa, 1983).

- Lorena Stove (McGarry): A Lorena stove is similar to the Hlekweni stove in interior construction except that it lacks the hot water tank. It is currently being used as a demonstration stove at Silveira House.
- Brick Stove (Hlekweni): A brick Lorena and cement stove holding three pots and incorporating a door, internal baffling, damper, chimney and hot water tank, promoted by Hlekweni Training Centre.

Charcoal Stoves

There are two types of charcoal stoves in Zimbabwe:

- Metal stove (Sable): A pair of metal cylinders each supporting one and each incorporating an internal wire fuel basket and a jet for provision of air by means of an external pump, manufactured by Copperwares (Pvt) Ltd.
- Metal Stove (Jiko): The national East African charcoal brazier, a short sheet steel bucket supporting one pot, incorporating a grate and air door manufactured by the informal sector, East Africa.

The standard charcoal stove would perhaps need to be modified slightly, but only by reducing its height to bring cooking pots closer to the source of heat. Presently, however, the manufacture of charcoal is so limited that it is unrealistic to expect individual households to learn the technique and begin making it for their own requirements.

Coal Stoves

The two existing coal stoves are:

- Brick/metal stove (Coalburn): A low brick stove supporting three pots on a flat cast iron frame and incorporating a grate and chimney manufactured by Zimcast (Pvt) Ltd for Wankie Colliery.
- Metal stove (Colray 100): A cast iron stove on legs, supporting one pot and incorporating a grate, door and chimney manufactured by William, Smith and Gourock (Pvt) Ltd.

Paraffin Stoves

There are two types of paraffin stoves:

- Wick Stove: A tin stove with adjustable cotton string wicks, supporting one pot, and widely used in the urban areas, manufactured by Tregers (Pvt) Ltd.
- Pressure Stove: A brass primus type stove supporting one pot and equipped with a pump, valve and jet burner, imported from Optimus Sweden.

Gas Stoves

The major type of gas stove is a ring stove, which is a valved burner attached to a gas cylinder, supporting one pot, manufactured by GEM (Pvt) Ltd.

Electric Stoves

Although there are many types of electric stoves on the market, the most commonly used is the hot-plate, a switchable electric resistance heater equipped with a metal plate supporting one pot, used in many urban households, manufactured by Tregers (Pvt) Ltd.

Biogas Stoves

Some work has already been done on biogas digesters, most notably at Silveira House. The main constraints seem to be the initial reluctance of some people to feed the digester with waste material, the slow pace at which it has been possible to train people on how to construct a biogas system and the relatively expensive installation cost (Reif, 1983).

Solar Stoves

Some promising development work has also been done on solar stoves at Silveira House and at the Institute of Agricultural Engineering. Like biogas digesters, the introduction of solar cookers involves a difficult change of attitude and custom among rural communities.

STOVE EFFICIENCY

Laboratory tests carried out by the ZEAP Team indicate that LP gas, paraffin and electric cooking devices currently available in Zimbabwe have a much higher laboratory efficiency than do any of the cooking appliances making use of wood (Harris, 1984). Charcoal and coal devices provide cooking energy at about the same level of efficiency as do existing woodstoves (Beijer Institute, 1984). Biogas, while relatively efficient, is an alternative fuel supply entailing a major change in patterns of daily life. It has received a great deal of attention as a potential wood substitute.

Programmes in Fuel-Efficient Stoves

The technical and organisational issues of fuel-efficient stoves are being handled by a number of organisations whose scale of operation is still small. These organisations include:

- University Technology Forum (Harare) which has activities in biogas and fuel-efficient woodstoves;
- Friends Rural Training Centre (Hlekweni, Bulawayo) which focuses on woodstoves, biogas and rural appropriate technology;
- Silveira House (Chishawasha) which is developing Lorena stoves and biogas units as well as training locals in building these units;

- Beijer Institute (Harare) which is involved in testing a variety of stoves for their efficiency; and
- Department of Energy (Harare) which is involved in the Seke Woodstove.

Woodstove technology is relatively undeveloped in the rural areas. The commonly found stove is the open hearth that is made to accommodate two to three cooking utensils at a time. Although the pot directly above the fire can heat up quickly, other utensils cannot obtain sufficient heat from the fire, due to uncontrolled draught and lack of mechanisms to transfer convective heat from the fire on to those utensils. The Seke Woodstove Project was initiated by the Department of Energy to:

- Counteract the widespread use of the inefficient open-hearth stove and provide a more fuel-efficient, durable, cheap to make and safe to use stove; and
- Conserve the depleted indigenous wood by encouraging the use of an efficient stove.

Apart from considering the technical aspects of the stove, it was also important to consider the dissemination of the appropriate stove models. The site chosen for this project was Chitsvatsva Village, in Seke Communal Area. Chitsvatsva Village was chosen as a site for studies on the acceptability of woodstoves, as well as a test site for efficiency of six different stove designs. The village was one of the several sites chosen for survey conducted by Ascough (1980) because it also typifies a rural set-up.

At the time of the survey, only open fires and Harare stoves (purchased from a nearby foundry), were used for cooking. These were not efficient because of the scarcity of fuelwood. The villagers had even resorted to using cow-dung, roots of trees and mealie-cobs during the dry season.

The survey team introduced a closed metal stove ("Mbaura") assembled by McDiarmid and Company, a private firm, but this was not accepted by the people, although it is fuel-efficient. The reasons given by the families were that the "Mbaura" heated up to dangerous temperatures and could only accommodate one utensil at a time.

In view of the fact that most rural people belong to the low- income groups, it was decided that stoves destined for rural areas be designed and built from locally available materials. If the materials were not available, they could be purchased for a small sum of money.

The following are the six stoves which were constructed and analysed for efficiency:

Stove No. 1

Modified "Nocena Stove": This stove is constructed by using fired bricks, cement, sand, cast iron hot plate, metal chimney and mesh wire grate. It has two holes for cooking pots, and one hot plate for hot water. The types of fuel that could be used are wood, charcoal, mealie cobs, briquettes and cow-dung. After testing, the stove proved to have a very low efficiency of about 5%.

Stove No. 2

Modified "Herl-Chulha": The construction materials and types of fuel used for this stove are the same as those for Stove No. 1 above. This design shows a good level of efficiency of about 18%. The user was satisfied with this stove because the hot plate retains heat for over 12 hours. It is also good for space heating and a bundle of firewood lasts for four days instead of about one and a half days.

Stove No. 3

Modified "Nepal Chulha": The construction material is the same as in Stove No. 1. This stove has a good level of efficiency (20,7%). It, however, suffers from cracks from time to time. If this problem is solved, the stove would do well as a demonstration prototype for those who cannot obtain fired bricks.

Stove No. 4

Modified Ghana stove: A brick stove with an oven controlled by a damper. Construction materials are the same as above.

Stove No. 5

Modified "Harl-Chulha": This stove has three pot holes and one hot plate metal grate and chimney damper to control emissions. Materials for construction and types of fuel used are the same as for Stove No. 1. It has a high efficiency level of about 33,23% and proved popular with the community. The fuel saving, as given by the user, is over 50%. As the stove has the highest efficiency of all, it has been used as a demonstration prototype.

Stove No. 6

Modified "Junagaah Chulha": Materials for construction and types of fuel are the same as for Stove No. 1. The absence of a damper could be the reason why this stove has a lower efficiency level of about 19%. However, the stove heats up well and shows fuel savings of around 40%-50%.

Evaluation

The evaluation of the six test stoves was done over a period of six months. The aspects considered were structure, design and cost.

Structural Evaluation

With the exception of the clay stove (No. 3), the bodies of the test stoves remained intact for three months. Cracks began to develop thereafter because of pressure from cooking "sadza" using the first pot hole, and excessive heat. This weakness could be overcome by the use of reinforced concrete around the fire-box.

Design Performance

All the users expressed complete satisfaction with the cooking performance of all designs except Stove No. 1. Although all the stoves have reasonable efficiencies, the users are not conversant with the proper operation procedures of the stoves. There is, therefore, a need to train the users in the correct use of these stoves to ensure maximum wood savings.

Cost Analysis

On the average, the cost of one stove was estimated to be Z$58,23. This cost, in rural areas, would be reduced if locally available materials are used. If the cost of bricks, labour, sand and chimneys is subtracted from the total cost, the final cost per stove would be Z$13,67. However, most of the stoves that have been installed for demonstration purposes cost about Z$25,00 over and above the chimney set.

From all the stoves tested, the fuel-efficient (33%) brick stove was chosen for demonstration purposes. This prototype, though bulky and static and therefore not easily marketable, is not only fuel-efficient, but is safe to use, cheap to make and ensures a smoke-free environment during cooking (Chadzingwa, 1984). If adopted in both rural and urban households, it would alleviate hardships by saving 50% collection effect.

The Department of Energy is responsible for setting up the prototype stove in many rural areas. To date, several areas in Matabeleland North, Masvingo, Mashonaland East and Central and Manicaland provinces now have demonstration stoves. The areas already visited for this purpose by a team from the department include Hlangabezi, Filabusi, Avoca Growth Point, Mutatire School, Bonda Women's Training Centre, Gata Training Centre, Magunje Growth Point, Guruve, Jamaica Inn Training Centre for Women and Sadza Growth Point.

The whole demonstration exercise is done through local leaders who, through interested parties, organise local builders and help collect local material like scrap metal to build the stoves in homes. The building of the stove costs Z$25,00 excluding the cost of the chimney set. The demonstration exercise has been received enthusiastically in most of the rural areas visited. Some people have also been innovative enough to change the design of the stove to suit their own kitchens.

CHAPTER FOUR

ENERGY PLANNING

This section discusses Government policy towards the energy sector and the existing machinery for planning and managing the sector. However, to fully appreciate the present structures, it is necessary to briefly describe the nature of the machinery inherited from the colonial government.

Prior to independence, there was no department or ministry directly responsible for overall energy planning. Different aspects of energy were scattered in a number of ministries and government departments. Power used to fall under the Ministry of Transport and Power, while liquid fuels were the responsibility of the Ministry of Mines, and forestry wood was managed by the Forestry Commission for the purpose of production of commercial timber and conservation measures *not* for fuelwood supplies.

New and renewable energies, especially "traditional" and non-conventional energy sources (biogas, etc) were not catered for within the existing structures. In addition to those departments, there was an energy liaison officer in the Prime Minister's Office, whose functions were not very clear.

All the above-mentioned organisations played mainly an administrative role. Energy and power planning was ad-hoc and developments that occurred were ad-hoc responses to particular situations. After independence, the Government of Zimbabwe, recognising the importance of energy and energy planning in the development process, began to take measures to centralise and establish a well defined energy planning machinery, by setting up establishing the Ministry of Energy and Industry and an Energy Department. This department was initially part of the Ministry of Industry and Energy Development and was finally transferred to the Ministry of Energy and Water Resources and Development.

ENERGY POLICY

Broadly speaking, there are two major concerns that influence the Zimbabwe Government policy on energy. One is the need to ensure adequate and secure supplies of energy to the whole economy at price levels which promote, *inter-alia*, the growth, development and equity objectives of Government. Secondly, Government wishes, as far as possible, to achieve self-sufficiency and security in energy supplies.

According to the Transitional National Development Plan (TNDP), the major elements central to energy policy and development in Zimbabwe are as follows:

- Development of indigenous energy sources and reduction of the dependence on hydro-carbon and electricity imports;
- A pricing policy for all energy sources which meets Government's growth and equity objectives and achieves an optimal energy balance, efficiency and conservation;

- A comprehensive and effective programme for fuelwood development to arrest the rate of deforestation and ensure adequate supplies at affordable prices;
- A comprehensive and effective programme of energy development to meet the urgent requirements in rural areas;
- Development and exploitation of new and renewable energy sources; and
- An optimal financial plan to meet the large investment requirements in energy development (TNDP Volume 1, Page 76).

FUNCTIONS OF THE DEPARTMENT OF ENERGY

Given the above guidelines, the Department of Energy was established to plan and manage the development of the energy sector in Zimbabwe. The tasks of the Energy Department may be summarised under five headings:

Energy Policy Formulation

The Department of Energy has the responsibility of formulating and updating the energy policy of the country. This it does within the framework of Government overall developmental policy and in consultation with other relevant organisations such as those agencies which implement the energy policies and plans. Such policy covers the exploitation of local energy resources and the importation of the balance and, finally, the supply of the processed product to the consumer.

Energy Supply Planning

The Department should ensure that Zimbabwe has an adequate supply of energy to meet all its requirements in a suitable form and quality and at prices the consumers can afford. This entails:

- Making demand forecasts for all forms of energy, taking into consideration changes in energy consumption patterns;
- Identifying and evaluating indigenous energy resources and making medium and long-term plans for their exploitation;
- Identifying the quantities and forms of imported energy requirements as the need arises, and possible exports;
- Keeping account of all usable and available energy resources and the related consumption rates so as to establish an energy balance on a continuous basis;
- Implementation of energy conservation measures for all forms of energy; and
- Manpower planning for the energy sector.

Administration

The administrative function of the Energy Department is mainly concerned with monitoring and controlling the operations of the organisations responsible for implementing plans. These include organisations such as ESC, CAPCO, HMED, BMED and the National Oil Company of Zimbabwe (NOCZIM). The Department also assists those undertakings in a number of ways, such as procurement of employment permits for expatriates, procurement of customs duty suspense certificates, arrangements for long and short-term borrowing, etc.

Technical Research and Development

The Department undertakes research and development to minimise Zimbabwe's dependence on energy imports by making maximum use of local resources and by increasing efficiency in the consumption of energy.

Demonstration and Extension

As a logical follow-up to the research function, the Department of Energy undertakes extension work to train especially rural people and popularise the total range of technologies developed, such as biogas units, gas burners, cookers, etc.

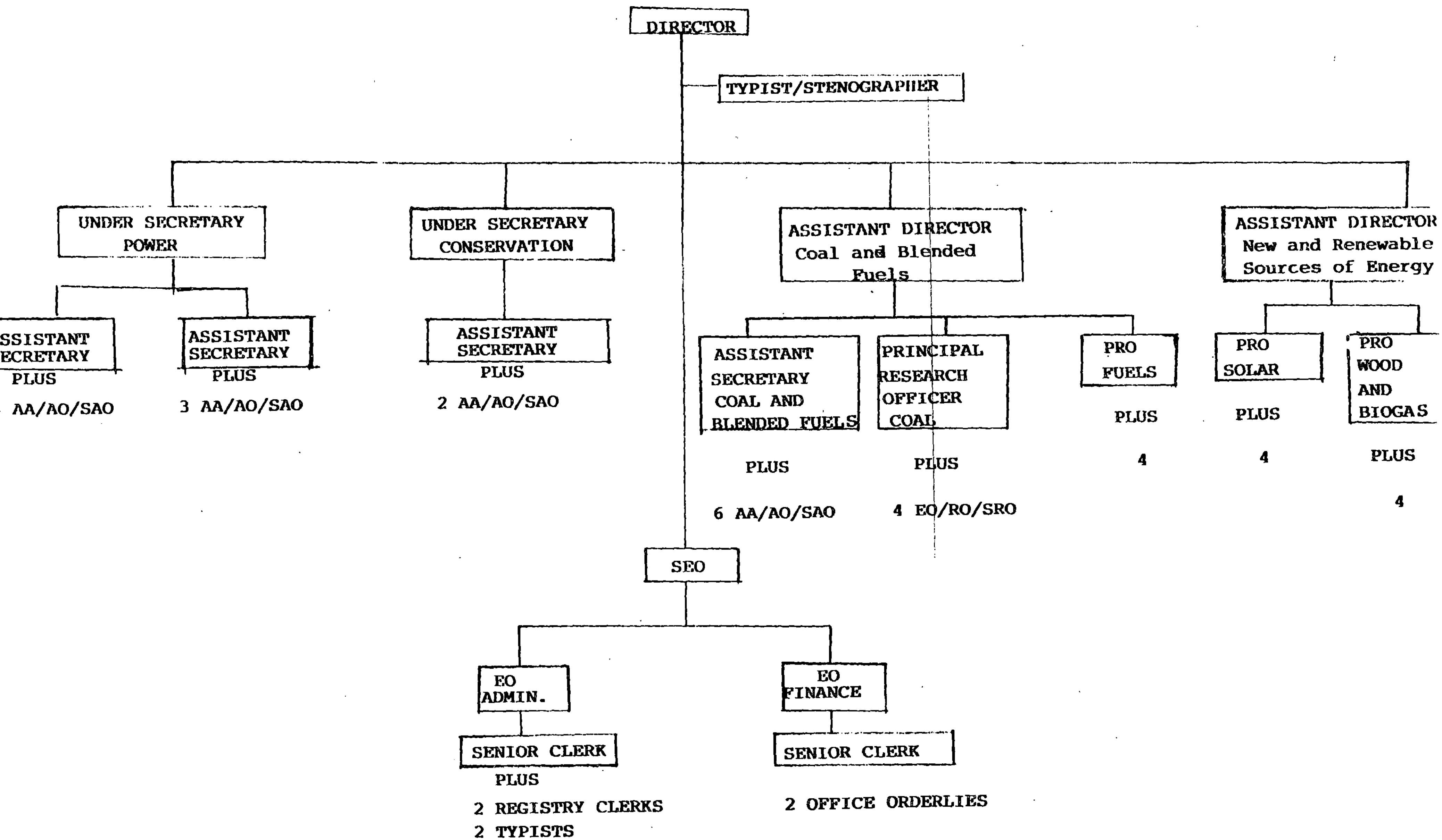
ORGANISATIONAL STRUCTURE OF THE DEPARTMENT OF ENERGY

To undertake the tasks enumerated above, the Department of Energy is divided into five sections, namely:

- The Liquid Fuels and Coal Section
- The Biogas/Woodfuel Section
- The Solar Energy Section
- The Electrical Energy Section; and
- Administration

The organisational structure of the Department of Energy is currently based on the type of energy resource (see organisational chart below). This structure was adopted because when the department was initially established, its emphasis was to be in energy research. However, it appears there has developed an awareness of the need to emphasise the planning, administration and integrated co-ordination of national energy development. Given this new emphasis, it appears a more suitable alternative form of organisation, that is likely to bring about more efficiency in the operations of the department, would be one based on functions rather than on energy forms.

ORGANISATION CHART OF THE ENERGY DEPARTMENT



REFERENCES

Beijer Institute, 1984: *Policy Options for Energy and Development in Zimbabwe*, Harare.

Camp, G. 1983: Forestry Commission, Harare.

Chadzingwa, J. 1982: "Determination of a Fuel-Efficient Woodstove for the Rural Areas in Zimbabwe". Department of Energy Development.

Chadzingwa, J. 1984: "Woodfuel Demand in Zimbabwe", SADCC Document, No. 4.

Financial Gazette, 1984: "Urban Domestic Fuel Supplies". *Financial Gazette*, 17th August, 1984.

Furness, C.K. 1979: *Some Aspects of Fuelwood Usage and Consumption in African Rural and Urban Areas in Zimbabwe-Rhodesia.*

Furness, C.K. 1979: "Estimating Resources for Fuelwood and Poles and Plantation Requirements in the Tribal Trust Lands of Zimbabwe-Rhodesia".

Forestry Commission (undated): *Manufacturing of Charcoal.*

Forestry Commission, 1984, *Forestry Research in Zimbabwe.*

Harris, T., 1984: *Preliminary Report: Performance Testing Project for Domestic Stoves.*

Judge, T. G., 1982: *Fuelwood Production and Rural Afforestation Projects in Zimbabwe.*

Katerere, Y., 1984: *Tree Planting and the Potential Role of Farm Forestry in Zimbabwe's Rural Areas.*

Mazambani, D., 1980: "Woodfuel - A Neglected Energy Source in Zimbabwe". Paper presented at the Energy Symposium held in Harare, October, 1980.

Mazambani, D., 1982: "Aspects of Peri-Urban Cultivation and Deforestation Around Harare 1955-1980". (Unpublished M. Phil thesis.), University of Zimbabwe.

Mazambani, D., 1983: "Peri-Urban Deforestation in Harare, 1955-1981", in Proceedings of the Geographical Association of Zimbabwe, Vol. 14, pp.66-81.

Mazambani, D., 1984: "Commodification of Woodfuel in Zimbabwe's Urban Areas: A Case Study of Harare and Chitungwiza 1980-1984".

Relf, C., 1983: "Appropriate Rural Technology in Zimbabwe: Problems, Prospects and Proposals", International Labour Office, World Employment Programme.

Scott, R., 1983: Wattle Company (Communication).

Wankie Colliery Company Ltd., 1983: *60th Annual Report 1985.* Harare: Wankie Colliery Company.

Whitlow, J.R., 1980: *Deforestation in Zimbabwe: Some Problems and Prospects,* Natural Resources Board, Harare:

Government of Zimbabwe, 1982: *Transitional National Development Plan,* 1982-1985, Vol.1, Harare: Government Printers.