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ENERGY PROFILE: ZAMBIA

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(Revised June 1991)

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1. INTRODUCTION

This report is one in a series covering the energy supply and demand situation in African countries south of the equator. The purpose of the series is to summarize the energy situation, for those trading or intending to trade in these countries, and especially for those in the energy industry. It will eventually form part of an analysis on the scope for the regional energy interchange for sub-equatorial Africa.

Various sources of data have been used for this report. One of the most comprehensive studies has been that of the World Bank in 1983. Substantial use has been made of the World Bank data and the permission of the Bank to use the information and to reproduce their map is gratefully appreciated.

The assistance of Mr M. Gielink with the analysis of data is also acknowledged.

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2. COUNTRY PROFILE

2.1 Introduction

During the last two decades of the 19th century Rhodes sought to annex to his mining interests the gold deposits between the Limpopo and Zambezi Rivers[1,2]. He was aided in this by the British Government who were concerned about maintaining supremacy in the region in the face of possible competition from the Portuguese and Germans. In 1889 the British Government granted Rhodes a charter empowering him to make treaties and administer the region north of the Limpopo. In 1890 the British occupied the eastern part of what was to become Southern Rhodesia, and made treaties with various chiefs north of the Zambezi. By 1924 Rhodes' company, the British South Africa Company, transferred its administrative responsibility to the British Colonial Office.

The early colonial rule saw the rapid exploitation of copper mines to fill the demand for electrical wire and other copper devices for the electrical and

automobile industries. This rapid industrial expansion shaped Northern Rhodesia as a vast pool of labour resources. The British Government were at pains to maintain racial segregation and discouraged long-term African settlement in cities and towns and refused to allow the formation of black trade unions. When the Labour Government came into power in Britain in 1946 the pace of political change in Northern Rhodesia began to increase. In 1949 an African mineworkers' union was formed, which led to a prolonged strike in 1952, resulting in substantial wage increases.

Federation became an espoused political cause by the white settlers who were impatient for the end of rule by the Colonial Office, but who saw they were too small to achieve independence by themselves. The settlers therefore saw federation with Southern Rhodesia as a means to political independence. Most Africans opposed any link with Southern Rhodesia because they saw this as a way of the settlers obtaining control of Northern Rhodesia. Alienation of their land would then follow as had happened in the South. The advent of the Conservative Government in Britain in 1951, however, led to a Federation of Northern and Southern Rhodesia and Nyasaland into the Central African Federation. Whilst the Federation appeared to work at first, it became evident that it was mainly to the benefit of the European settlers in Southern Rhodesia, whilst Africans in Northern Rhodesia gained neither economic nor political advantage.

In 1958 the African political party, the Northern Rhodesia Congress (NRC), campaigned for the dissolution of the Central African Federation and for the formation of Northern Rhodesia as an independent State under the name of Zambia. The NRC was banned and its leader, Kenneth Kaunda, was imprisoned. On his release he again took over leadership of a new political party, the United National Independence Party (UNIP) which organized a massive campaign of civil disobedience. This forced the British Government to introduce a constitution for Northern Rhodesia, which was to lead to an African majority in the legislature. UNIP took part in elections and as a result formed a coalition government. The Central African Federation was formally dissolved in 1963.

Pre-independence elections in 1964 enabled Kaunda to form an all-UNIP Government. Zambia then started to become less dependent on the white-controlled southern countries. Its support for guerrilla groups operating in Mozambique and Rhodesia led to the closure of the border between Zambia and

Southern Rhodesia. Zambia rerouted its copper exports, but at a great economic cost.

The blockade along the Zambezi valley and continuing violence along the Rhodesian and Mozambique borders intensified the atmosphere of siege which had dominated politics in Zambia. Various incidents, including the closing of the University, and the detention of many opposition leaders eventually resulted in the formation of a one-party State. Elections to a new assembly in 1973 led to the re-election of Kaunda to a third term of office.

A world drop in the price of copper led to serious economic conditions in Zambia. This, together with mounting political problems, led to a number of unpopular measures being taken which resulted in high price increases, especially of foodstuffs, resulting in demonstrations and strikes. In 1990 the UNIP general conference voted to reject the one-party State concept and to re-introduce a multi-party system. Kaunda announced however, that a referendum was to be held in October 1990 on the subject of a multi-party system. This was postponed to August 1991.

After initial strained relations between Zambia and its neighbours, its role has been increasingly that of a peace initiator. President Kaunda has taken a major role in the peace initiatives in Southern Africa. In 1984 Kaunda became joint chairman of a conference on the issue of Namibian independence. In 1985 President Kaunda became chairman of the "front-line" States and in 1987 he became chairman of the Organization of African Unity.

2.2 Demography

Zambia had an estimated population of 7,8 million in 1989. With a land area of 752 614 km^2, Zambia's population density of 10,4 inhabitants per square kilometer is low by African standards for a country which has no truly arid area[1]. However, this overall figure is misleading since Zambia is the third most urbanized country in mainland black Africa, with 41% of its population residing in towns of more than 5 000 inhabitants. Some 78% of the urban population is, in fact, located in the ten largest urban areas. By comparison with urban high-density areas, the rural population density is 4,3 inhabitants per square kilometer.

The population growth rate was 3,3% during the 1974-1980 period compared with 2,9% in the preceding five-year period. Whilst this high growth rate is worrying, a greater problem is that of the speed of urban growth. During the 1969-1980 period the urbanization rate was 6,7%. This population growth has not been matched by employment or by the provision of housing, and peripheral shanty townships are becoming larger and the informal economic section more important.

There are 73 different ethnic groups in Zambia. The major group is that of the Bemba living in the north-east of the country. The Nyanja live in the Eastern Province, the Tonga are dominant in the Southern Province, whilst the Lozi live in the west.

There are over 80 languages, of which seven are recognized as official vernaculars. English is the official language of government.

2.3 Economy

In the immediate post-independence period, the economy of Zambia was buoyant with high, and rising levels of the world copper price, providing a sound base for government revenue and expenditure. Large investments were made in physical and social infrastructure. During this time much of the foreign-dominated private sector, including mining, was nationalized and import-replacement enterprises were instituted[3,4].

However, in 1975 the long period of high copper prices came to an end due to excess world capacity. The price of copper fell from 45 US cents per kilogram in 1974 to around 35 US cents in 1975. This led to a deficit on balance of payments. At that time it was thought that this fall was only of a temporary nature and the Government financed the deficit out of additional foreign borrowings. The contribution of copper exports to the Gross Domestic Product (GDP) fell from 33% to 15%. At the same time agricultural exports declined to zero.

The rising cost of oil in the 1970's added to the financial problems of the country. Extreme shortages of many goods occurred, leading to high inflation rates and a "black market" in foreign currency. The Government reacted by imposing price control and subsidies on basic commodities.

Conditions continued to deteriorate until negotiations with the World Bank in 1984 led to a range of measures including the exchange rate devaluation of the Kwacha by 60%, reductions in government spending, a cut in subsidies, and the rescheduling of foreign debts.

Whilst the GDP has been rising rapidly in current terms, the GDP in real terms has been largely stagnant over the last 15 years. The relationship between current and real[5,6] (1985 Kwachas) is shown in Figure 1. However, with an increasing population, the per capita GDP has been decreasing steadily, as shown in Figure 2. The yearly GDP growth rate is shown in Figure 3 from which it will be seen that growth, on a 5-point moving average basis, has been around zero for the last decade.

The wealth of the country until around 1975 was based largely on the mining industry, as shown in Figure 4. The dramatic decrease in the price of copper in the mid-1970's and the poor response of the agricultural sector to possible export potential has led to the steadily worsening economic situation. To add to the country's economic problems, current estimates suggest that copper reserves will be largely exhausted by the end of the century[4].

The breakdown of the contribution of the various sectors to the national economy is shown in Table 1.

Table 1. Contribution to the GDP by various sectors - 1988[4]

Sector	Percent of GDP
Agriculture, forestry & fishing	18,0
Mining & quarrying	8,7
Manufacturing	22,0
Electricity, gas & water	3,0
Construction	3,4
Trade, hotels & restaurants	10,5
Transport & communications	5,1
Financial institutions & insurance	2,6
Real estate & business services	8,8
Community, social & personal services	17,3
GDP at producer values	100,0

The Table above has been obtained from Reference 4 and is different from that of References 5 and 6. The ratio of GDP due to agriculture to that due to manufacturing has been decreasing over the years, as shown in Figure 5.

3. ENERGY

3.1 Introduction

Zambia has abundant resources of coal, hydropower, and fuelwood, but has to import all its oil products. Energy demand has stemmed largely from mining activities, principally copper. In 1981 the copper mining sector consumed 74% of electricity, 52% of coal, 94% of fuel oil, and about 24% of diesel oil[7].

At independence Zambia was heavily dependent on Zimbabwe for the supply of its commercial energy. Coal was imported from Hwange Colliery in Zimbabwe, electricity came from the Kariba South Bank Power Station, and oil products were imported through Zimbabwe. This situation has now changed, with Zambia being a net exporter of electricity, with local coal production, and with its own refinery which obtains crude through a pipeline from Tanzania.

However, the overall energy situation has been worsening because of problems in the mining industry, inadequacy in energy planning and policies, and shortages of skilled manpower and management expertise.

Problems in energy supply were aggravated by the fire at the Kafue Gorge Power Station, which resulted in a shortfall of 33% in domestic supplies of electricity and a suspension of electricity exports to Zimbabwe. This loss of exports led to an estimated foreign exchange loss of around US$ 1 million per month[3].

There is a growing awareness of the need to investigate fuel substitution, especially in the petroleum product sector, and for a rationalization of energy supply.

3.2 Energy Institutions

Recognizing the need for a body which would be ultimately responsible for the co-ordination of energy supply, conservation, and pricing, the Government has created a National Energy Council (NEC). The role of the NEC is to advise the Government on the formation of appropriate energy policy by identifying energy issues which need attention, and by advising how to implement such policies.

The NEC consists of 12 part-time representatives from Government, parastatal bodies, and private and university bodies, appointed by the Minister of Power, Transport, and Communications. The NEC meets every three months and reports directly to the Minister, with the individual members also reporting to their respective agencies.

The World Bank has suggested[7] that the NEC needs technical and economic expertise and that they should be responsible for the collation, analysis, and dissemination of statistical information, and also for liaison with the National Commission for Development Planning (NCDP) which is currently responsible for manpower planning in the country.

The Bank also recommends that the NEC should provide a five-to-ten year plan for energy, especially in the area of energy financing.

There are three organizations covering the Zambian electricity sector: the Zambian Electricity Supply Corporation (ZESCO) owned by the Government, the Copperbelt Power Company (CPC), a subsidiary of the copper mining company, and the independent Broken Hill Development Company (BHDC). A fourth organization, the Central African Power Company (CAPC), which controlled the supply of electricity from the Kariba Dam power stations has been disbanded by joint Acts of Parliament in Zimbabwe and Zambia, and now acts purely in a caretaker capacity, supervising the operation of the power stations, and with a planning function for the Zambezi River hydro-potential.

ZESCO was formed by an Act of Parliament in 1969 and was given responsibility for all electrical supply in Zambia, excluding that from Kariba. On its formation it took over the electricity supply and distribution from the various municipalities and from three utilities. On the recent disbanding of CAPC, ZESCO took over the role of distributing power from Kariba Dam, though the actual operation of the two

power stations at Kariba are still under the control of what has remained of CAPC. The Copperbelt company (CPC) remained as a separate entity with its own, limited, generating capacity and now acts as a distributor of electricity to the copper mines, buying in bulk from ZESCO.

The BHDC is isolated from the ZESCO system and operates as an independent utility.

The Forestry Department of the Government (FD), situated at Ndola, has overall responsibility for managing Zambia's planted woodlots. The FD administers nine field organizations to manage the forestry provinces. Fuelwood operations, including the allocation and management of charcoal production and the licensing of operators, are managed via Provincial Forest Offices. The staff allocated to the FD is inadequate to police this activity satisfactorily and wide-scale illegal tree-felling occurs. The Forest Product Research Division is responsible for testing and demonstrating kilns.

The Ministry of Power, Trade and Commerce also has a Technical Development and Advisory Unit (TDAU) which is responsible for renewable energy development.

4. ENERGY RESOURCES

4.1 Fuelwood

The resource situation concerning fuelwood is uncertain because of the lack of adequate data. Attempts are being made by the Natural Resources Department to obtain satellite photographs on which an assessment of fuelwood potential can be made. However, it is estimated[8] that 55% of the total land area is covered by forests. Table 2 shows the present estimate of the Forest Department concerning woodlots[7].

Table 2. Woodlot potential areas

	Area (M ha)
Forestry Department	
Production reserves	5,3
Protection reserves	1,8
Total State Forest	7,1
Other	
Unreserved woodlots	32,0
Old Barotse forests	0,3
Other forests	1,8
Total Non-State	34,1
Total woodlots	41,3

From Table 2 it is evident that State forests represent 10% of the total land area, whilst another 25% of the total land is available for fuelwood development.

Stocking intensities in the Copperbelt are reported[7] as 70-140 m^3/ha. The potential for fuelwood production is much lower in the low rainfall southern part of the country than in the north.

4.2 Petroleum

Until recently it was considered that the geology of Zambia (and of Zimbabwe) was not suitable for oil reserves. However, there are some sedimentary deposits in the Zambezi Basin which are now considered to be potential oil areas. There are four main sedimentary deposits in the west of the country, the largest being the Barotse Basin covering about 150 000 square kilometers and extending into Botswana and Angola. In December 1989 the Mobil Company signed an agreement with the Zambian Government which allows it to prospect for oil in the Zambezi Basin. This agreement covers a three-year period and places all the financial risk on Mobil. This exploration effort is paralleled by a similar exploration effort by Mobil in the Zimbabwe section of the Zambezi Basin.

An exploration by Mobil and Placid Oil in the north-east of the country did not result in any oil finds.

4.3 Coal

Zambia has several coal deposits in the south of the country and in the north-east. The probable total reserve is 280 million tons, though there is no proper assessment of the country's coal resources[7]. Between 1965 and 1967, 80 boreholes were sunk in an exploratory survey. Three coal deposits were located at Nkandabwe, Siankondobo, and Mulungwa. The only active mine is the Maamba Colliery which is mining the deposit at Siankondobo. The estimated reserves in the various areas are shown in Table 3.

Table 3. Coal reserves (Million tons)

Area	Proved	Probable	Total
Nkandabwe		80	80
Mulungwa		100	100
Siankondobo	58	33	91
Total	58	213	281

The coal in the Siankondobo deposit is a high ash coal. Little is known about the quality of the other coal deposits.

4.4 Hydro-electricity

Zambia has substantial hydro-potential and could be a net exporter of electricity. An overall hydro-potential survey has not been carried out, but a consultant's survey for ZESCO in 1975 identified some potential sites and calculated that the reserve was 3924 MW and 21 406 GWh per year[7]. The potential capacity from the Zambezi and Luapula Rivers is shown in Table 4.

The potential developments at most of these sites requires co-operation between Zambia and either Zimbabwe or Zaire. The quantities given in Table 4 are the estimated entitlement for Zambia from these projects.

Table 4. Potential hydro-power

Potential site	Capacity (MW)	Available energy (GWh/annum)
Kariba N Extension	300	600
Kafue Stape III	450	2500
Itewzhi-Tezhi	80	510
Lusiwasi III	40	146
Victoria Falls & Nangweshi	250	1900
Mpata Gorge	500	3000
Luapula	884	5000
Batoka Gorge	800	4250
Devil's Gorge	620	3500
Total	3924	21406

4.5 Other energy sources

4.5.1 Solar

Yearly average insolation in Zambia is about 5,4 kWh/m^2 per day, with a high of 6,2 kWh/m^2 in the area of Victoria Falls. Seasonal variations occur with a peak during the October/November period. Prospects are therefore good for the use of solar energy for water heating and especially for agricultural processes such as crop-drying.

4.5.2 Wind

Reasonable wind potential is available during the period August to October when the wind direction is south-easterly. Whilst potential for uses such as water pumping in remote areas is good, it is doubtful whether any significant large-scale potential is viable.

4.5.3 Biogas

No survey has been made of biogas potential, but some parts of the country have high concentrations of livestock, and therefore some exploitation could be possible.

4.5.4 Ethanol

In common with Zimbabwe, the Government has investigated the potential for the use of ethanol as an extender for gasoline. However, reducing amounts of gasoline production has led to a slow-down in the application of ethanol and no overall resource analysis has been carried out.

4.5.5 Geothermal

There are over 100 thermal springs heated by deep circulation in the major fault zones in the country. However, there are no volcanic activities, and it has been estimated[7] that the vertical temperature gradient is between 23°C and 50°C per kilometer of depth. Hence, workable temperatures of 150-370°C would occur only at depths of 8 kilometers, making this an economically unattractive energy source when compared with the more traditional forms.

5. ENERGY SUPPLY AND DEMAND

5.1 General

Unlike other countries in the region, the amount of traditional energy consumed is small compared with the total energy demand. Traditional to energy, as a percentage of total energy, has been increasing in the period 1971 to 1987, as shown in Figure 6, and was 18% at the end of the period.

Total final energy consumption increased until 1976, after which it has shown a steady decline. On a per capita basis, the energy consumption has undergone a rapid decrease, as shown in Figure 7. This mirrors the decline in economic activity per capita, as shown in Figure 2.

The main commercial energy forms have been oil and electricity which accounted for 40% each of final consumption in 1987. The breakdown of commercial energy final consumption in 1986 is shown in Table 5.

Table 5. Final energy consumption by energy type and sectorial use in 1986

Sector	Energy usage - percent			
	Coal	Oil	Electricity	Total
Industry	20,8	14,6	32,4	67,7
Transport	0,2	18,4	0,0	18,6
Agriculture	0,0	1,0	1,3	2,3
Residential	0,3	2,0	2,9	5,2
Commercial	0,3	3,3	2,5	6,2
Total	21,6	39,3	39,1	100,0

Energy usage correlates with the economic activity according to the pattern shown in Figure 8. The energy usage on a per capita basis is a straight line function of the wealth of the country. The relationship between total real GDP and final energy use on a year-by-year basis is shown in Figure 9. Whilst the GDP has remained approximately constant over the period 1976 to 1987, the total final energy use has decreased. This decrease is a direct result of the decrease in mining activity which fell from a 36% contribution to GDP in 1970 to a low of 14% in 1984 before starting a slow recovery to 23% in 1986. The main reason for the decline in mining activity was the decline in the copper demand. The reduction in copper production is illustrated in Figure 10.

This decline in the demand for energy is further illustrated in Figure 11 which shows the change in energy intensity over the period 1971 to 1987, where energy intensity is defined as the ratio of energy demand in the final sector to the GDP.

Because of the high cost of imported fuel, the Government is investigating the role of fuel substitution as a means of conserving foreign exchange. The main area where substitution could be possible is in the copper mines. Some mines favour the replacement of oil-based furnaces by electricity, whilst the Rokana Mine is investigating the replacement of oil by coal. The electrification of mine trolley trucks has already started.

The fertilizer industry is also looking at the possibility of replacing oil-fired furnaces by coal-fired ones.

5.2 Fuelwood

Whilst there is an overall sufficiency of fuelwood, there are local shortages due to excessive tree-cutting for the production of charcoal in the more densely populated areas. The main charcoal production areas are in Lusaka, Central, and Copperbelt provinces. Demand for charcoal has increased over the last two decades, with over 7500 charcoal plant operators. Licensed charcoal burners pay approximately 0,35 Kwacha per cord for charcoal produced. On average, 1 ton of charcoal is produced from 6-8 tons of wood[7]. A locally fabricated portable steel kiln is being introduced, which can produce 1 ton of charcoal from 4 tons of wood.

It is estimated[8] that 95% of households in Zambia use fuelwood or charcoal for cooking and heating. In the rural areas virtually 100% of households use fuelwood or charcoal, whilst the figure is 86% in the urban areas. Charcoal is preferred to fuelwood in urban areas because it is smokeless, less bulky, and easier to handle. Charcoal is also used in industry, in agriculture for tobacco-curing and fish-drying, and is also used as a fuel for boilers.

5.3 Petroleum

Zambia has no exploitable reserves of petroleum and therefore has to import all its needs. Until 1973 all oil products had to be imported. In 1973 the Indeni Refinery, situated at Ndola in the north-west of the country, came on stream. This refinery obtains its feedstock through a 1 704 km pipeline from Tanzania. The design parameters of the refinery are shown in Table 6.

Table 6. Indeni Refinery design yields[7]

Product	Yield '000 ton/year	% of Yield
Fuel gas	24	2,2
LPG	22	2,0
Gasoline	230	20,9
Kerosene	74	6,7
Gasoil (diesel)	360	32,7
Fuel oil	328	29,8
Asphalt	20	1,8
Refinery fuel	28	2,5
Refinery losses	14	1,3
Total	1100	100

The design throughput of 1 million tons of useful product is far in excess of demand which was 615 000 tons in 1988. The design production is also out of equilibrium with the country's requirements. For instance, the ratio of diesel fuel to gasoline in 1988 was 2,3, whilst the refinery ratio is 1,6. The diesel-to-gasoline ratio has been rising steadily, as shown in Figure 12. The mix of petroleum products over the last 15 years is shown in Figure 13.

The demand in 1988 and refinery design for a number of products is compared in Table 7.

Table 7. Country oil product demand and the design yields of the Indeni Refinery

Product	Yield '000 tons		
	Design	Demand	Ratio
Gasoline	230	118	1,9
Diesel	360	270	1,3
Fuel oil	328	77	4,2
Kerosene	74	38	1,9

Not only is the balance incorrect, but the refinery was built to handle Iranian Light, whilst it now runs on Arabian Light Crude. Changes have had to be made to the method of operating the refinery to accommodate the crude and product mix, which makes it expensive to operate.

5.4 Electricity

The main generating capacity in Zambia is the Kariba Dam power plant, the Victoria Falls plant, and Kafue Gorge. The Kariba Dam complex consists of the Kariba South plant of 666 MW commissioned in 1960, and the Kariba North plant of 600 MW commissioned in 1976. In terms of the agreement between Zimbabwe and Zambia the two countries share the available capacity equally, thus Zambia is entitled to 633 MW.

The Kafue Gorge plant was commissioned in two phases. Phase One was completed in 1972 and contains four 150 MW sets, whilst Phase Two consisted of two 150 MW sets completed in 1977. The total plant capacity is therefore 900 MW. With the completion of Kafue, the country became a net exporter of electricity.

At Victoria Falls there are three power stations with two 1 MW sets, two 3 MW sets, and ten 10 MW sets. Station A was completed in 1950 and Station C in 1972. The total plant capacity is 108 MW.

In addition to the hydro-plant, there are a number of thermal units operated by the mining companies. These consist of 50 MW of waste-heat plant, most of it over 40 years old, and 80 MW of gas-turbine providing emergency and synchronous compensation capacity.

The installed capacity from 1964 to 1991 is shown in Figure 14.

In addition to its own generating plant, Zambia has interconnection to Shaba Province in Zaire and to Zimbabwe via the Kariba Dam power plant.

By the beginning of 1989 Zambia's installed capacity was 2235 MW. Exports of electricity were mainly to Zimbabwe. However, the capacity situation changed dramatically in March 1989 when fire put the whole Kafue Gorge power station out of action. Repairs were carried out in 1989 and 1990 with the first 300 MW of the 900 MW station being recommissioned in December 1989, and the remaining plant by mid-1990. The repairs were carried out under funding from Sweden. The shutdown of Kafue had a significant effect on the economy of the country since it required significant load-shedding and the imposition of a 30-50% surcharge on electricity accounts to cover the cost of imported power from Zimbabwe and Zaire. Power exports to Zimbabwe worth US$ 1 million per month had to be suspended.

Electricity demand is shown in Figure 15. A rapid rise in demand during the period 1971 to 1976 was followed by a stagnant situation until the late 1970's. In that year Zambia started exporting power to Zimbabwe following the commissioning of the Kafue Gorge station. The decrease in demand after 1982 is a result of the decline in copper production, as shown in Figure 10. The importance of copper production in the energy scene is illustrated by the fact that in 1980, with copper production at its peak in the last 15 years, the Copperbelt used 74% of total electricity demand.

In the domestic sector the degree of electrification varies from area to area. In Lusaka Urban 67% of homes are electrified, but this drops to 13% in the Kallushi area. By comparison, charcoal provides between 76% and 92% of household needs, as shown in Table 8.

Table 8. Urban household demand for cooking fuel - 1969 census[7]

District	Charcoal	Electricity	LPG	Kerosene
Lusaka Urban	76,3	21,1	1,2	1,4
Ndola Urban	86,9	12,2	0,8	0,2
Kitwe	87,6	11,6	0,6	0,2
Mufulira	84,2	15,1	0,3	0,4
Luanshya	87,1	11,9	0,4	0,6
Kabwe Urban	86,5	11,6	0,7	1,2
Kalulushi	91,6	7,7	0,2	0,5

ZESCO has been expanding its rural electrification system to replace rural diesel sets and to bring electricity to a larger proportion of the inhabitants. It was the intention that the Government should provide the capital cost for this rural electrification, whilst ZESCO would bear operating and maintenance costs. There is therefore no attempt to recover the cost of providing the service from consumers since this would make it prohibitively expensive. Over the six-year period 1982 to 1988 the Government spent ZK 32,3 million on ten rural schemes[9]. However, this expansion has been aimed specifically at large agricultural schemes. The low population density in the rural areas has made the provision of electricity very expensive, the operating and maintenance costs alone are proving prohibitive. Rural electrification was being pushed by the Government as a means of arresting the drift from rural to urban areas. However, the programme has stalled and large areas remain without electricity.

5.5 Coal

The demand for coal has been falling steadily in unison with the worsening economic situation and especially the decrease in copper production. This trend is shown in Figure 16. The importance of the copper industry in the coal market can be judged from Table 9 which shows the coal consumption in 1981 expressed in tons of coal (Figure 16 is in terms of "tons oil equivalent").

Table 9. Coal consumption[7] by sector - 1981

	User	000's tons
Copper mines	320	52
Chemicals	120	20
Cement	84	14
Other	87	14
Total	611	100

The "other" category in the Table includes Zambia Sugar Factory, National Breweries, Chingola Brick Field, Cold Storage Board, Zambia Railways, and smaller industries.

Originally Zambia imported coal from Zimbabwe. From 1965 Zambia started exploiting its own resources with mining at Nkandabwa Colliery which has now been closed. In 1972 the Maamba Colliery started operation with a rated capacity of 1,2 million ton/year, though it has not exceeded 800 000 tons/year[4]. A combination of lack of spares, management problems, and design shortcomings have led to serious shortages in production, reaching a low of 453 000 tons in 1983 (253,000 TOE in Figure 16), though production has now picked up. Some exporting has taken place, as shown in Figure 17, though problems at Maamba required coal to be imported in certain years.

The World Bank[7] has recommended that rehabilitation of the colliery should take place in order to reach a level of production required in terms of forecasts. The World Bank study estimates a growth of 1,7% p.a. from 1990 to 2000 to a level of 819 000 tons per year (417,000 TOE) which is approximately the level that was achieved in 1974.

6. PRICING AND MARKETING

6.1 Oil and oil products

The wholesale price levels of crude oil and oil products are controlled by the Government and are based on the cost of procurement, pumping, processing, etc. At the consumer level, oil products are divided into controlled and

uncontrolled categories. The controlled category includes gasoline, kerosene, and diesel oil.

Besides the cost of production of oil products, the final price includes Government taxes and subsidies. A World Bank study[7] in 1982 showed that the price of gasoline was double the import parity price, the prices of diesel oil and kerosene were 16% higher, whilst the price of fuel oil was half of the import parity price. This is illustrated in Table 10.

Table 10. Oil Products Prices (1982)

Product	Actual US$/l	Wholesale Index	International Index
Premium gasoline	0,73	218	95
Regular gasoline	0,67	200	91
Kerosene	0,34	100	100
Diesel oil	0,39	113	98
Fuel oil	0,15	46	72

The index quoted in Table 10 is the ratio of the price of the given product to that of kerosene. The "international" index quoted is the international comparison for the ratio of product to kerosene price on the international market.

Thus the users of gasoline and diesel are the main subsidizers of industrial use of fuel oil. There is an additional distortion of the final product due to additional taxes, dealer margins, etc., which, according to the Bank, encourages inefficient allocation of petroleum products. One example of this is the imbalance between the price of kerosene and and that of diesel oil, which has resulted in some consumers switching from diesel to kerosene, thus putting pressure on kerosene supply.

6.2 Coal

As with oil, the price of coal is fixed by the Government. Extensive subsidies are used by the Government to decrease the cost to major industries. For instance,in May 1980 the production cost was US$ 46,9/ton, whilst the official coal price was US$ 35,6, and the price to copper mines was even lower. Coal production costs at Maamba are high, especially with the reduced levels of output. The cost of US$ 46,9 quoted above should be compared with the price of US$ 15-20 in

neighbouring Zimbabwe. An inadequate transport system further aggravates the high cost of delivered coal.

6.3 Electricity

No up-to-date information is available on the relative price-to-cost ratios of electricity in Zambia, but prior to 1984 the electricity tariffs were inadequate to cover costs. Supply to the copper mines was heavily subsidized, with the price being some 60% of the cost of supplying power[7]. The average cost of electricity is so low that there is no incentive to conserve electricity and encourages wasteful practices. The World Bank proposed[7] in 1983 that the electricity price to non-mining and mining consumers should be raised by 30% and 40% respectively.

The cost of rural electrification is also proving to be a burden to ZESCO with inadequate support from the Government for the capital expenditure and a tariff which does not cover operating and maintenance costs.

6.4 Fuelwood

Fuelwood is considered a free commodity when collected for personal use. For resale or charcoal production a licence is required and a fee is payable based on the quantity cut. Even though the fee is nominal and far below that in neighbouring countries, there is widespread evasion of the fee. Illegal tree-felling is widespread in certain areas due to lack of guards.

The Government fixes the wholesale price for charcoal delivered to the main urban areas. However, lack of adequate control has resulted in the price finding its own level which in 1981 was approximately 50% above the official price. It is felt that the price of charcoal will rise steeply in the main urban areas unless the Government institutes some measure of re-aforestation.

7 DISCUSSION

Zambia has sufficient reserves of coal and hydro-electricity to satisfy its energy demand for the foreseeable future. The one shortage is that of oil which has to be imported via Tanzania. Because of the distance for pumping and because of design problems at the refinery, oil products are expensive and the product mix in final consumption is distorted by a subsidy system on price.

Improvements in maintenance and operating in the coal industry and in electricity supply, coupled with a realistic pricing policy which would allow cost recovery, are required to ensure efficient energy supply.

The energy demand situation is governed largely by one consumer - the copper mining industry - and any forecast or planning for the energy industry has to be based on the world situation in copper demand.

The Government-backed rural electrification programme has stalled due to lack of funding for capital investment and because the tariff in this sector does not cover operating and maintenance costs.

8. REFERENCES

1. Williams, G.J. Zambia - Physical and social geography. In Africa South of the Sahara 1991, 20th Edition, Europa Publications, London, 1991.

2. Roberts, A.D. Zambia - Recent history. In Africa South of the Sahara 1991, 20th Edition, Europa Publications, London, 1991.

3. Colclough, C. Zambia - Economy. In Africa South of the Sahara 1991, 20th Edition, Europa Publications, London, 1991.

4. ------ Country Profile - Zambia - 1989-90. The Economist Intelligence Unit, London, 1989.

5. United Nations. Statistical Year Book, 1985/86, United Nations, New York, 1986.

6. United Nations National Accounts Statistics - 1978-86. Main aggregates and detailed tables. United Nations, New York, 1986.

7. ------ Zambia: Issues and options in the energy sector. Joint UNDP/World Bank energy sector assessment program. Report No. 4110-ZA, World Bank, New York, January 1983.

8. ------ Woodfuel. SADCC Energy II, June/August 1984, pp. 20-22.

9. Konayuama, C.D. and Mundia, S. Rural electricfication opens up 1 000 000 Ha irrigated cereal in Zambian Copperbelt. SADCC Energy No. 17, 1988, pp. 39-40.

10. ------ World energy statistics and balances - 1971-1988. International Energy Agency, Paris, 1989.

TABLES

TABLE A: ECONOMIC DATA

YEAR	POPULATION	GROSS DOMESTIC PRODUCT AT MARKET COST MILLIONS OF CURRENCY UNITS						GDP AT 1985 PRICES (MARKET)	EXCHANGE RATE KW per US$	GDP PER CAPITA	
	MILLIONS	AGRICUL-TURE	MINING QUARRYING	MANUFAC-TURE	ELEC, GAS WATER	CONSTRUC-TION	TOTAL			US$ CONSTANT	KWACHA REAL 1985
1945	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1946	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1947	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1948	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1949	NA	NA	NA	NA	NA	NA	NA	NA	0, 7	NA	NA
1950	2, 44	NA	NA	NA	NA	NA	NA	NA	0, 7	NA	NA
1951	2, 50	NA	NA	NA	NA	NA	NA	NA	0, 7	NA	NA
1952	2, 57	NA	NA	NA	NA	NA	NA	NA	0, 7	NA	NA
1953	2, 65	NA	NA	NA	NA	NA	NA	NA	0, 7	NA	NA
1954	2, 72	30, 7	157, 5	9, 0	0, 8	17, 5	273, 0	NA	0, 7	141, 36	NA
1955	2, 79	30, 7	201, 8	11, 6	2, 7	21, 2	345, 0	NA	0, 7	174, 16	NA
1956	2, 87	36, 3	212, 2	13, 5	7, 1	25, 7	378, 0	5040, 0	0, 7	185, 50	1756, 10
1957	2, 96	39, 2	132, 9	15, 5	6, 7	27, 6	313, 0	3294, 7	0, 7	148, 93	1113, 09
1958	3, 04	36, 7	103, 1	15, 3	8, 2	28, 0	285, 0	2805, 1	0, 7	132, 04	922, 74
1959	3, 12	43, 7	181, 2	15, 1	8, 8	22, 9	379, 0	4115, 1	0, 7	171, 09	1318, 94
1960	3, 21	44, 5	210, 4	16, 9	8, 0	20, 0	419, 0	3774, 8	0, 7	183, 84	1175, 94
1961	3, 30	47, 8	190, 8	21, 0	7, 5	17, 3	406, 0	3759, 3	0, 7	173, 28	1139, 17
1962	3, 40	45, 7	184, 3	21, 6	7, 6	15, 5	401, 0	3747, 7	0, 7	166, 11	1102, 25
1963	3, 50	49, 8	189, 0	24, 7	8, 2	16, 3	420, 0	3818, 2	0, 7	169, 01	1090, 91
1964	3, 60	52, 9	203, 0	32, 8	9, 4	24, 7	502, 0	4327, 6	0, 7	196, 40	1202, 11
1965	3, 70	65, 7	255, 3	53, 6	12, 7	42, 7	711, 0	5598, 4	0, 7	270, 65	1513, 09
1966	3, 80	67, 2	266, 1	66, 9	14, 6	60, 0	848, 0	5367, 1	0, 7	314, 31	1412, 39
1967	3, 90	75, 3	289, 3	83, 2	15, 6	63, 5	957, 0	5629, 4	0, 7	345, 61	1443, 44
1968	4, 05	75, 1	310, 4	93, 1	16, 5	79, 8	1062, 0	5771, 7	0, 7	369, 33	1425, 12
1969	4, 12	111, 5	427, 7	124, 0	19, 2	95, 9	1314, 0	5945, 7	0, 7	449, 20	1443, 13
1970	4, 25	126, 3	458, 0	129, 2	17, 7	90, 3	1277, 0	6449, 5	0, 7	423, 20	1517, 53
1971	4, 39	139, 4	273, 5	149, 7	20, 6	96, 1	1188, 0	6187, 5	0, 7	381, 15	1409, 45
1972	4, 53	154, 4	322, 9	181, 2	28, 5	97, 4	1349, 0	6711, 4	0, 7	419, 43	1481, 55
1973	4, 68	161, 2	513, 7	195, 3	30, 4	101, 7	1592, 0	6661, 1	0, 7	523, 34	1423, 31
1974	4, 83	178, 0	614, 0	238, 5	38, 4	125, 3	1893, 0	7116, 5	0, 6	612, 38	1473, 40
1975	4, 98	182, 9	213, 2	250, 3	39, 8	151, 2	1584, 0	6917, 0	0, 6	496, 99	1388, 96
1976	5, 14	244, 0	339, 4	275, 6	44, 0	185, 4	1902, 0	7231, 9	0, 7	513, 94	1406, 99
1977	5, 30	325, 6	233, 7	353, 0	47, 6	113, 7	1986, 4	6873, 4	0, 8	474, 42	1296, 86
1978	5, 47	363, 0	286, 8	430, 1	57, 7	111, 5	2250, 7	6904, 0	0, 8	514, 33	1262, 15
1979	5, 52	397, 2	469, 3	486, 7	59, 9	101, 2	2660, 4	6701, 3	0, 8	610, 07	1214, 00
1980	5, 56	435, 3	501, 7	566, 1	61, 0	136, 5	3063, 6	6900, 0	0, 8	697, 48	1241, 01
1981	5, 87	553, 8	488, 4	684, 1	66, 3	111, 7	3485, 4	7322, 3	0, 9	682, 49	1247, 41
1982	6, 03	492, 2	396, 6	740, 4	72, 2	127, 0	3595, 3	7119, 4	0, 9	641, 11	1180, 66
1983	6, 24	593, 7	641, 6	829, 8	70, 4	133, 1	4181, 2	6980, 3	1, 3	535, 88	1118, 28
1984	6, 44	717, 2	673, 8	1010, 6	69, 7	153, 3	4931, 0	6954, 9	1, 8	427, 76	1079, 95
1985	6, 73	925, 2	1101, 9	1610, 0	71, 1	182, 9	7072, 0	7072, 0	2, 7	387, 76	1050, 82
1986	7, 28	1304, 6	2978, 6	2431, 5	72, 3	304, 0	12963, 0	7110, 8	7, 3	243, 82	976, 36
1987	7, 56	NA	NA	NA	NA	NA	19632, 0	7097, 6	8, 9	291, 95	938, 34
1988	7, 53	NA	NA	NA	NA	NA	22495, 0	NA	NA	NA	NA
1989	7, 80	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE B: COMMERCIAL AND TRADITIONAL ENERGY

YEAR	COMMERCIAL ENERGY FORMS IEA ENERGY TOTAL FINAL CONSUMPTION 000'S TOE						ENERGY/GDP TOE/REAL 19 1985KWA		TRADITIONAL ENERGY	TRADITIONAL AS % OF	ENERGY PER CAPITA TOE/CAPITA		
	COAL	OIL	GAS	HYDRO	ELECT	TOTAL	1PT	3PT MA	000'S TOE	TOTAL	COMMERCIAL	TRADITIONAL	TOTAL
1964	606, 6	158, 9	0, 0	0, 0	235, 1	1000, 6	2, 312E-04		NA	NA	0, 3	NA	NA
1965	710, 2	206, 0	0, 0	0, 0	251, 6	1167, 8	2, 086E-04	2, 142E-04	NA	NA	0, 3	NA	NA
1966	636, 5	195, 0	0, 0	0, 0	257, 3	1088, 8	2, 029E-04	2, 240E-04	NA	NA	0, 3	NA	NA
1967	847, 7	341, 0	0, 0	0, 0	278, 4	1467, 1	2, 606E-04	2, 386E-04	NA	NA	0, 4	NA	NA
1968	785, 7	381, 0	0, 0	0, 0	288, 8	1455, 5	2, 522E-04	2, 502E-04	NA	NA	0, 4	NA	NA
1969	672, 8	432, 0	0, 0	0, 0	309, 2	1414, 0	2, 378E-04	2, 332E-04	NA	NA	0, 3	NA	NA
1970	574, 5	439, 0	0, 0	0, 0	339, 1	1352, 5	2, 097E-04	2, 221E-04	NA	NA	0, 3	NA	NA
1971	496, 1	481, 0	0, 0	0, 0	375, 9	1353, 0	2, 187E-04	2, 167E-04	221	14, 0	0, 3	0, 050	0, 359
1972	559, 0	525, 6	0, 0	0, 0	403, 5	1488, 1	2, 217E-04	2, 276E-04	230	13, 4	0, 3	0, 051	0, 379
1973	520, 5	657, 2	0, 0	0, 0	437, 0	1614, 7	2, 424E-04	2, 345E-04	240	12, 9	0, 3	0, 051	0, 396
1974	454, 7	776, 0	0, 0	0, 0	473, 7	1704, 4	2, 395E-04	2, 429E-04	251	12, 8	0, 4	0, 052	0, 405
1975	417, 0	814, 4	0, 0	0, 0	476, 4	1707, 8	2, 469E-04	2, 432E-04	262	13, 3	0, 3	0, 053	0, 396
1976	430, 1	830, 5	0, 0	0, 0	499, 3	1759, 9	2, 434E-04	2, 423E-04	267	13, 2	0, 3	0, 052	0, 394
1977	400, 1	740, 4	0, 0	0, 0	485, 5	1626, 0	2, 366E-04	2, 357E-04	273	14, 4	0, 3	0, 052	0, 358
1978	389, 0	696, 3	0, 0	0, 0	484, 1	1569, 4	2, 273E-04	2, 304E-04	279	15, 1	0, 3	0, 051	0, 338
1979	339, 4	694, 5	0, 0	0, 0	489, 1	1523, 0	2, 273E-04	2, 261E-04	289	15, 9	0, 3	0, 052	0, 328
1980	335, 2	708, 1	0, 0	0, 0	501, 2	1544, 5	2, 238E-04	2, 189E-04	293	15, 9	0, 3	0, 053	0, 330
1981	276, 2	691, 1	0, 0	0, 0	537, 0	1504, 3	2, 054E-04	2, 130E-04	289	16, 1	0, 3	0, 049	0, 306
1982	297, 8	649, 7	0, 0	0, 0	545, 6	1493, 1	2, 097E-04	2, 071E-04	296	16, 5	0, 2	0, 049	0, 297
1983	253, 5	633, 8	0, 0	0, 0	550, 8	1438, 1	2, 060E-04	2, 075E-04	303	17, 4	0, 2	0, 049	0, 279
1984	262, 6	634, 2	0, 0	0, 0	542, 0	1438, 8	2, 069E-04	2, 001E-04	307	17, 6	0, 2	0, 048	0, 271
1985	281, 5	535, 2	0, 0	0, 0	509, 6	1326, 3	1, 875E-04	1, 980E-04	308	18, 8	0, 2	0, 046	0, 243
1986	332, 3	563, 2	0, 0	0, 0	523, 3	1418, 8	1, 995E-04	1, 938E-04	310	17, 9	0, 2	0, 043	0, 237
1987	290, 0	584, 1	0, 0	0, 0	506, 1	1380, 2	1, 945E-04	NA	310	18, 3	0, 2	0, 041	0, 223
1988	NA	NA	NA	NA	NA	NA	NA	NA	300	NA	NA	0, 040	NA
1989	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
1990	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE C: ELECTRICITY DATA

INSTALLED CAPACITY (MEGAWATTS)

YEAR	PUBLIC			SELF PRODUCERS			TOTAL		
	HYDRO	THERMAL	TOTAL	HYDRO	THERMAL	TOTAL	HYDRO	THERMAL	TOTAL
1964	8	21	29	42	190	232	50	211	261
1965	8	20	28	42	190	232	50	210	260
1966	8	20	28	42	190	232	50	210	260
1967	8	19	27	38	190	228	46	209	255
1968	72	19	91	38	230	268	110	249	359
1969	79	19	98	38	250	288	117	269	386
1970	268	19	287	38	250	288	306	269	575
1971	718	21	739	38	250	288	756	271	1027
1972	721	21	742	38	250	288	759	271	1030
1973	721	22	743	38	250	288	759	272	1031
1974	721	22	743	38	250	288	759	272	1031
1975	721	22	743	38	250	288	759	272	1031
1976	721	22	743	38	250	288	759	272	1031
1977	721	22	743	38	250	288	759	272	1031
1978	1500	19	1519	38	171	209	1538	190	1728
1979	1500	19	1519	38	171	209	1538	190	1728
1980	1500	19	1519	38	171	209	1538	190	1728
1981	1500	19	1519	38	171	209	1538	190	1728
1982	1500	19	1519	38	171	209	1538	190	1728
1983	2000	19	2019	45	171	216	2045	190	2235
1984	2000	19	2019	45	171	216	2045	190	2235
1985	2000	20	2020	45	171	216	2045	191	2236
1986	2000	20	2020	45	171	216	2045	191	2236
1987	2000	20	2020	45	171	216	2045	191	2236
1988	2000	20	2020	45	171	216	2045	191	2236
1989	1400	20	1420	45	171	216	1445	191	1636
1990	1400	20	1420	NA	NA	NA	NA	NA	NA
1991	2000	20	2020	NA	NA	NA	NA	NA	NA
1992	NA	NA	NA	NA	NA	NA	NA	NA	NA

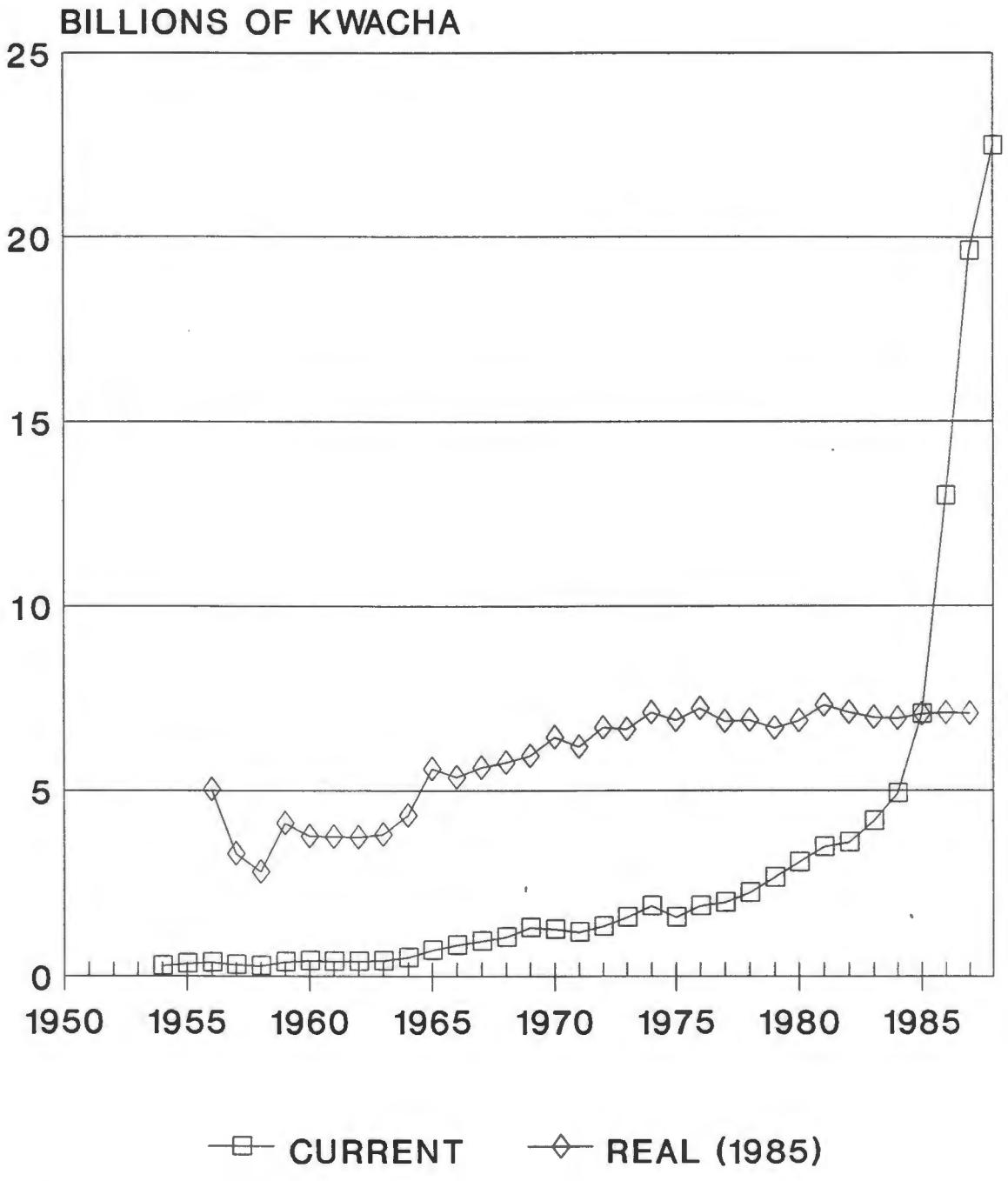
TABLE D: COAL DATA

000's TOE

YEAR	PRODUCTION	IMPORTS	EXPORTS	TFC
1964	NA	NA	NA	606, 6
1965	NA	NA	NA	710, 2
1966	NA	NA	NA	636, 5
1967	NA	NA	NA	847, 7
1968	NA	NA	NA	785, 7
1969	NA	NA	NA	672, 8
1970	NA	NA	NA	574, 5
1971	479, 2	90, 7	0, 0	496, 1
1972	565, 9	63, 9	0, 0	559, 0
1973	554, 7	39, 6	0, 0	520, 5
1974	478, 0	61, 1	-13, 6	454, 7
1975	480, 3	10, 4	0, 0	417, 0
1976	449, 7	24, 7	0, 0	430, 1
1977	414, 8	54, 6	-0, 6	400, 1
1978	362, 9	64, 4	0, 0	389, 0
1979	350, 5	0, 0	0, 0	339, 0
1980	341, 7	6, 5	0, 0	335, 5
1981	299, 2	0, 0	0, 0	276, 2
1982	356, 4	0, 0	0, 0	297, 8
1983	267, 3	0, 0	0, 0	253, 5
1984	301, 5	0, 0	0, 0	262, 6
1985	301, 5	0, 0	0, 0	281, 5
1986	328, 7	0, 0	-5, 9	332, 3
1987	273, 2	0, 0	0, 0	290, 0
1988	309, 2	0, 0	0, 0	NA

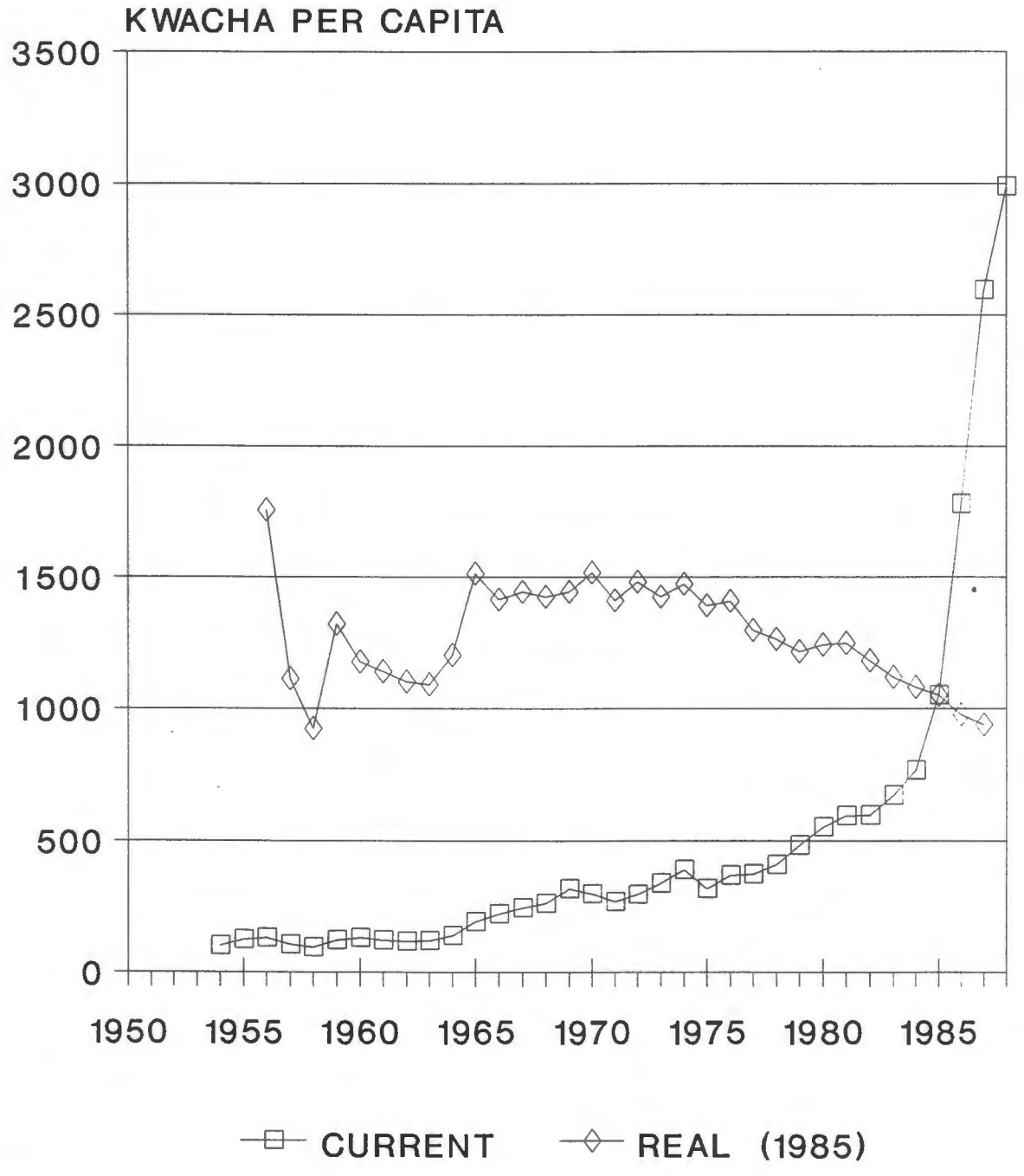
FIGURES

FIGURE 1. GROSS DOMESTIC PRODUCT AT MARKET PRICES



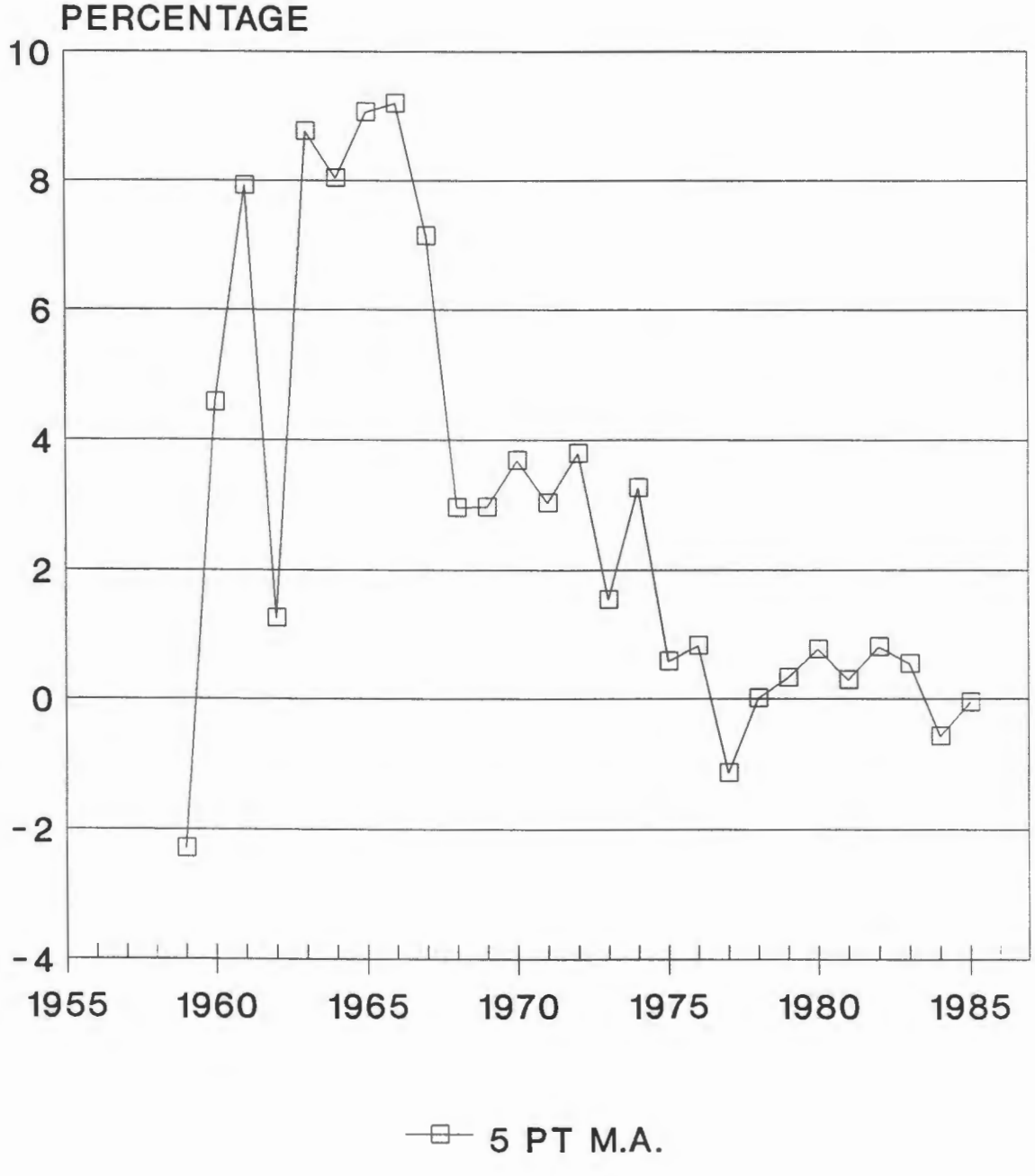
ZAMBIA/GDPYEAR/2004

FIGURE 2. GROSS DOMESTIC PRODUCT PER CAPITA



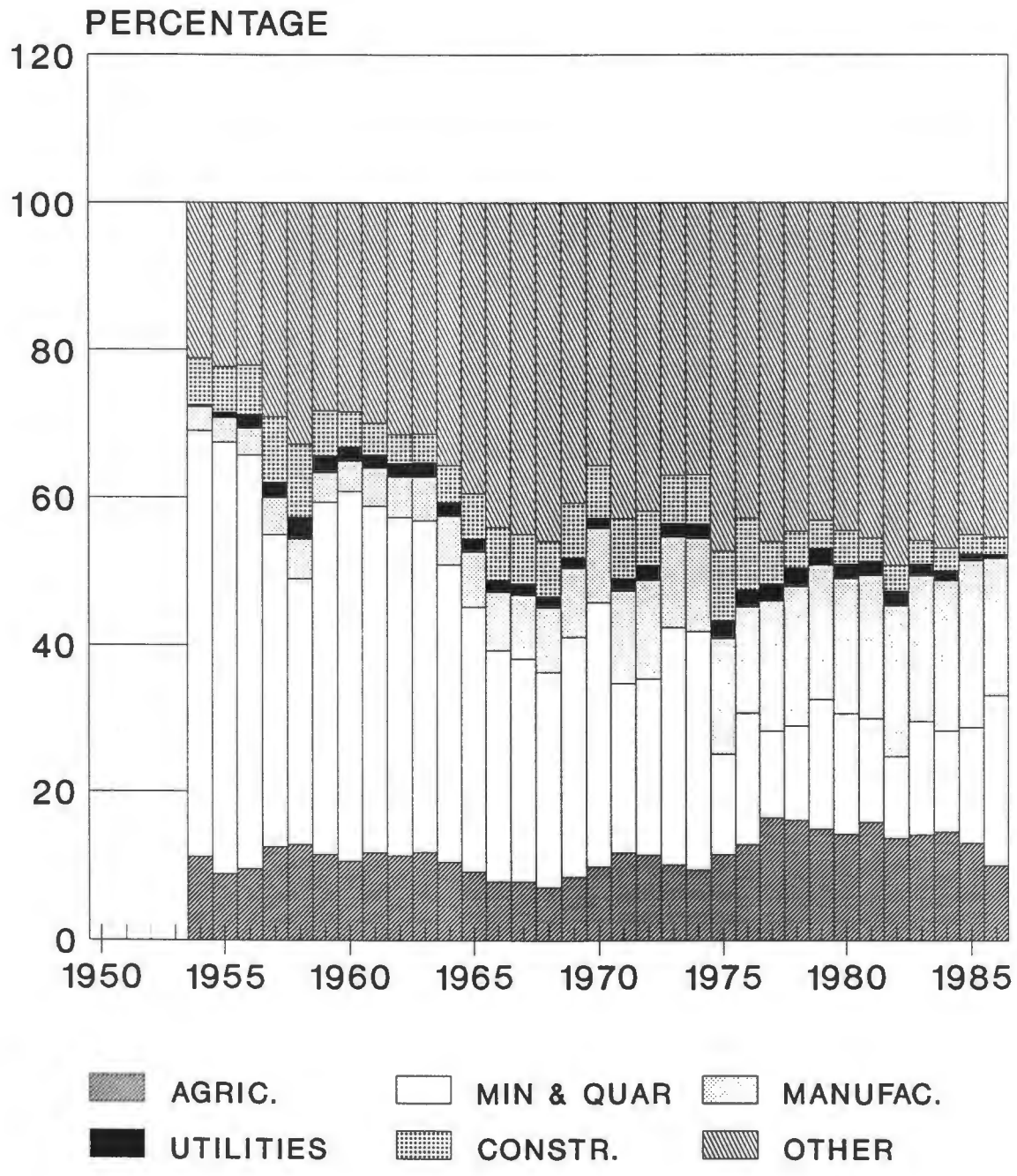
ZAMBIA/GDPCAPIT/2004

FIGURE 3. GROSS DOMESTIC PRODUCT GROWTH RATE, % PER YEAR (MARKET, REAL 1985 PRICES)



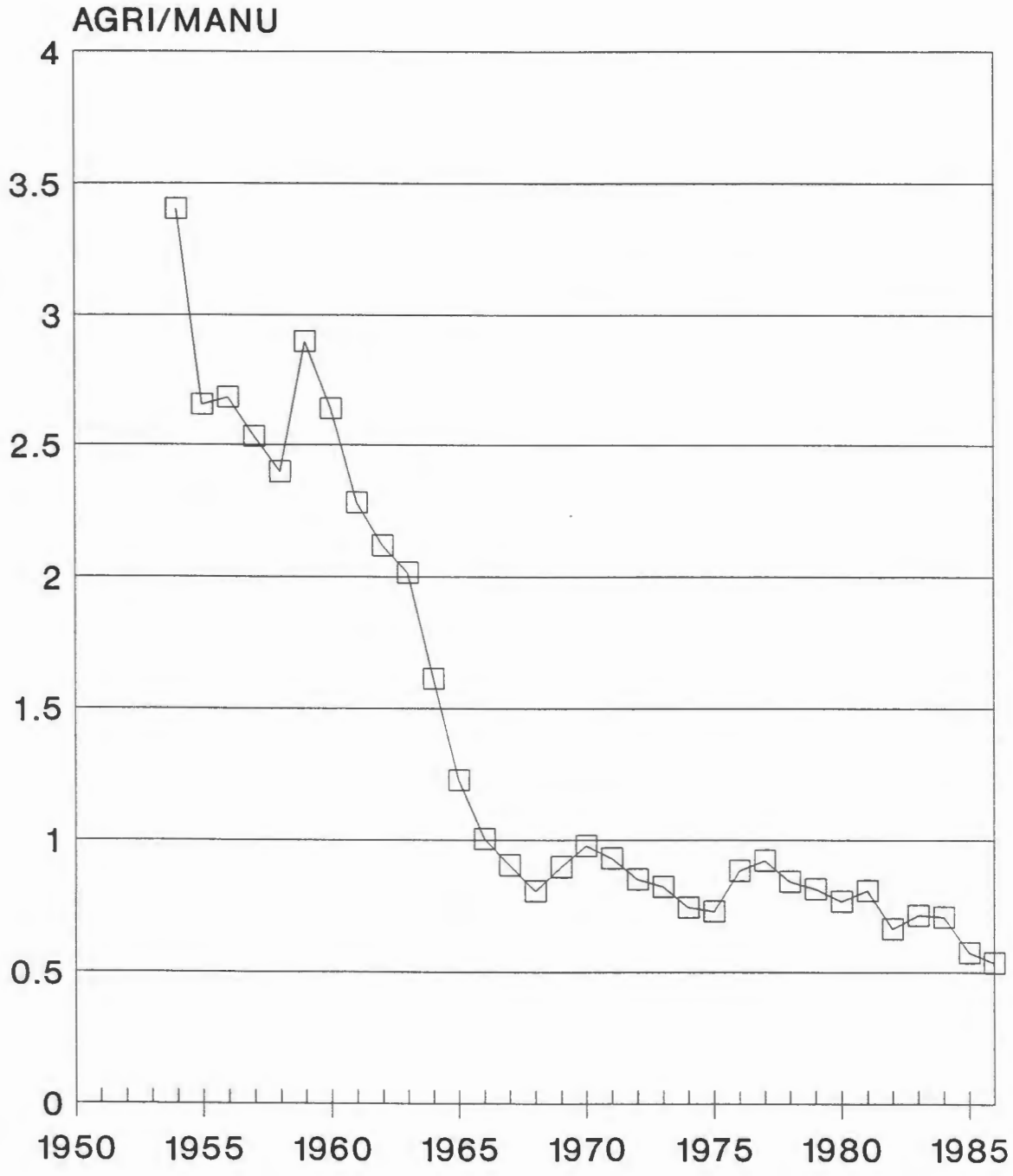
ZAMBIA/GDPGROW1/2004

FIGURE 4. GDP COMPONENTS AS % OF TOTAL



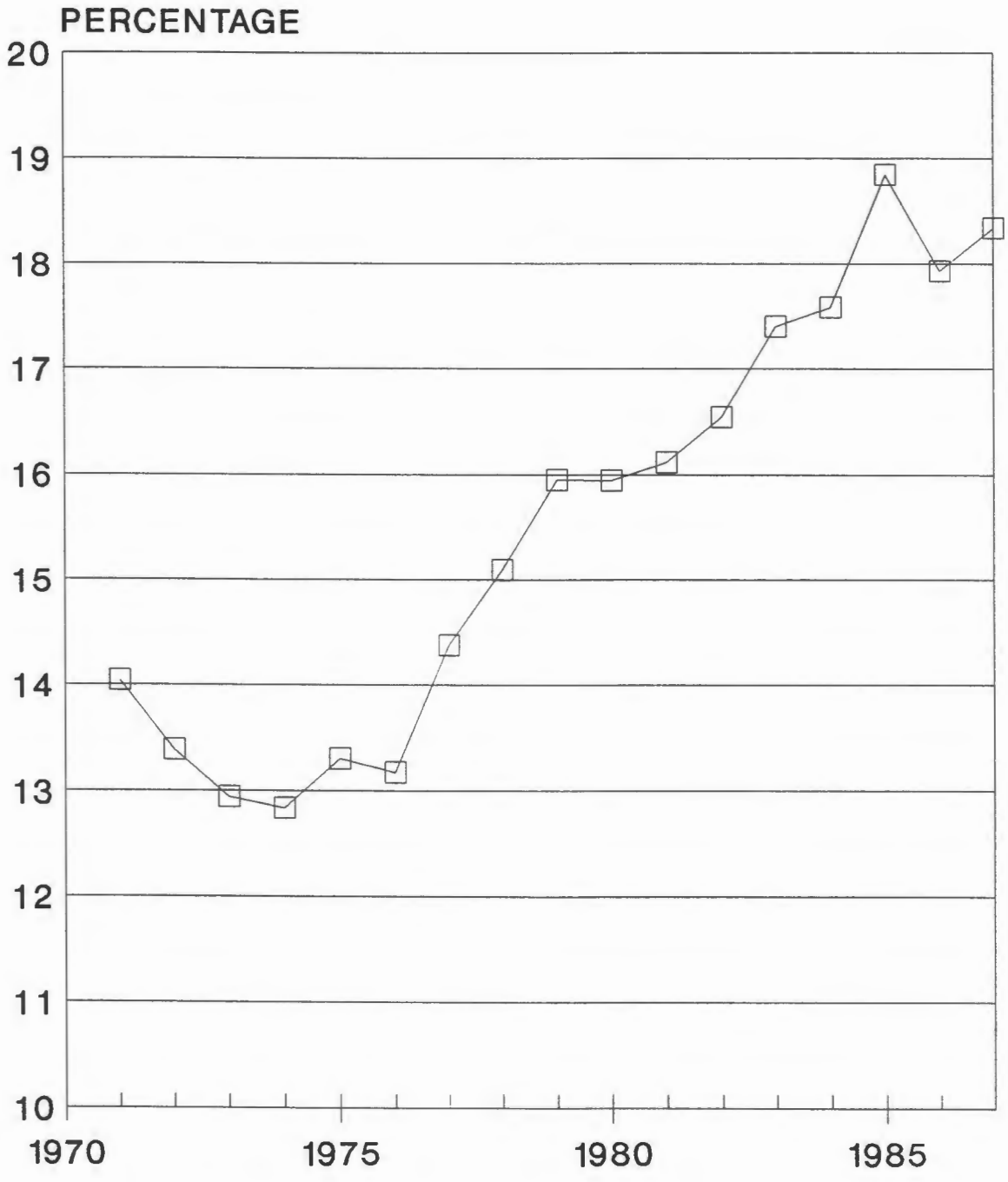
ZAMBIA/GDPCOMP/2004

FIGURE 5. RATIO OF CONTRIBUTION TO GDP BY AGRICULTURE AND MANUFACTURE



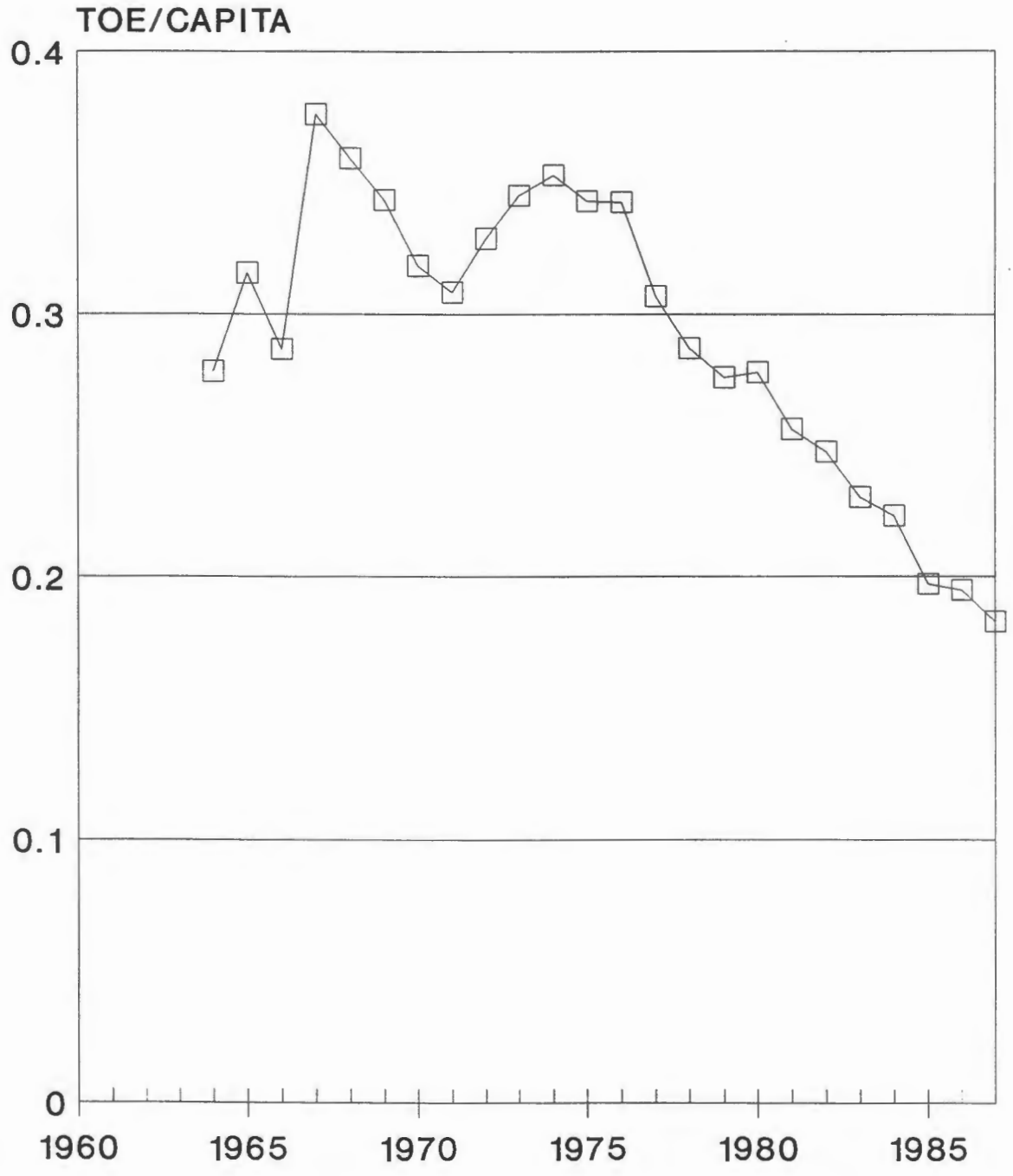
ZAMBIA/AGRIMAN/2004

FIGURE 6. TRADITIONAL ENERGY CONSUMED AS % OF TOTAL



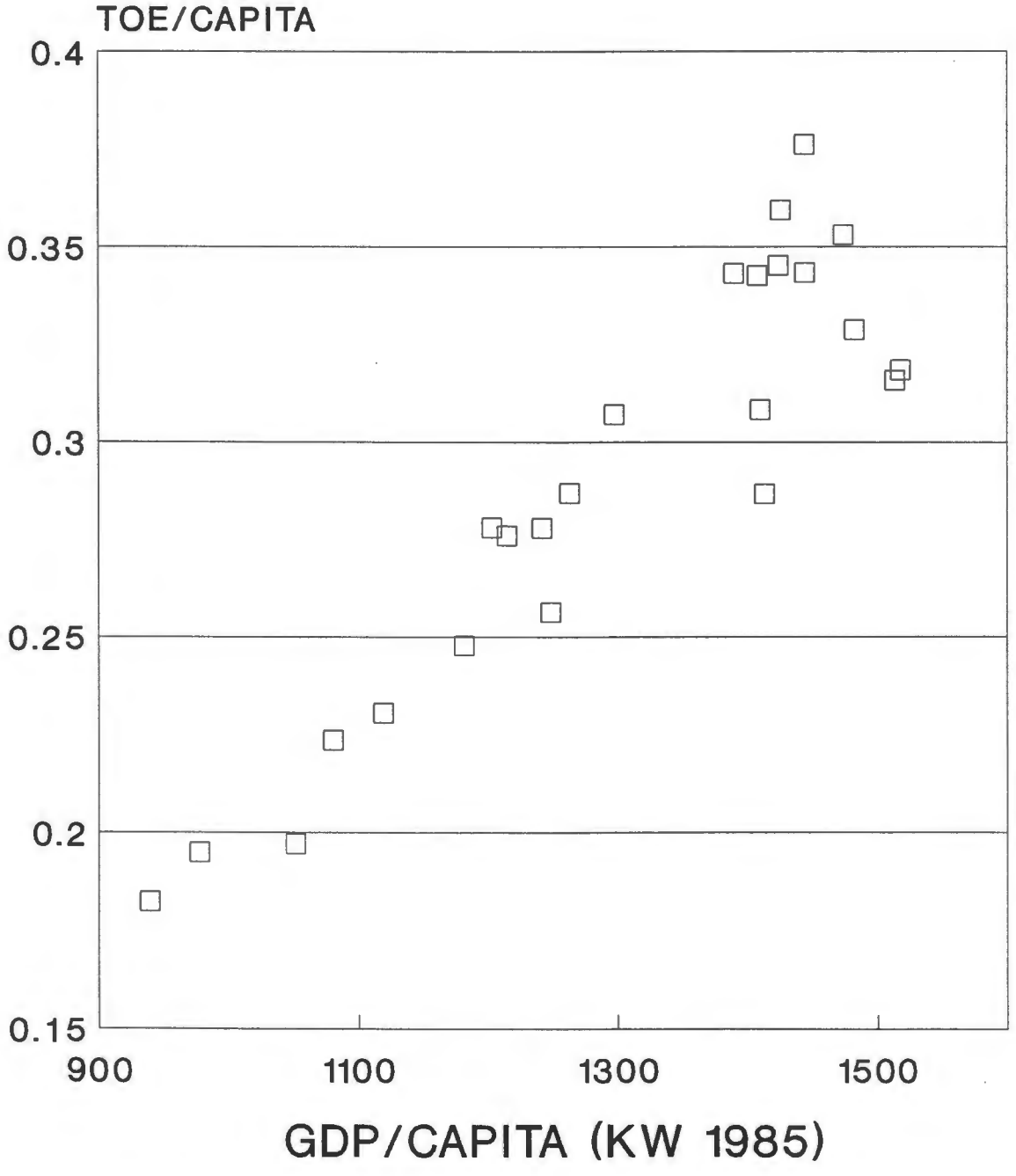
ZAMBIA/TRAD%/2004

FIGURE 7. TOTAL FINAL CONSUMPTION OF COMMERCIAL ENERGY PER CAPITA



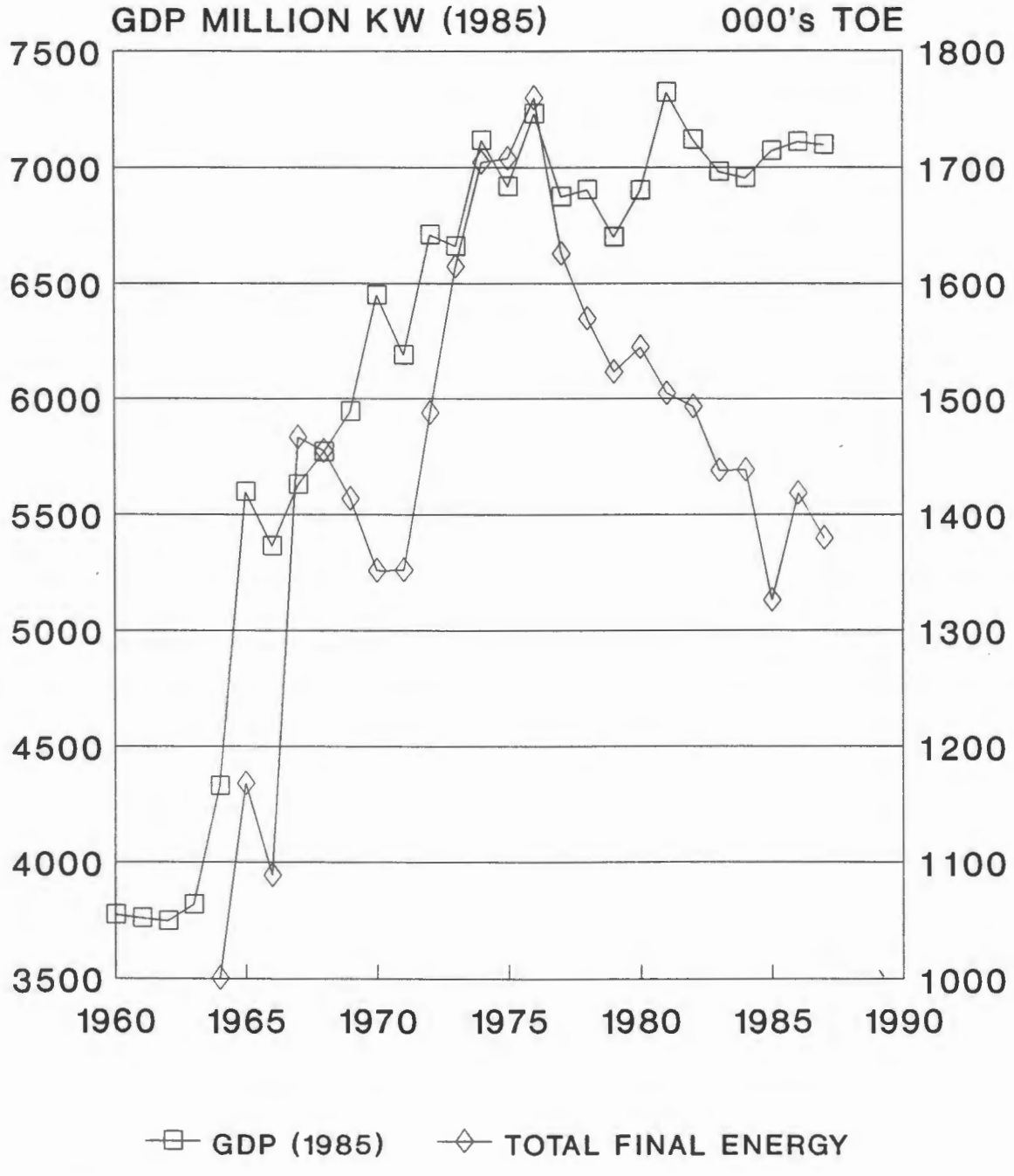
ZAMBIA/COMENCAP/2004

FIGURE 8. RELATIONSHIP BETWEEN FINAL ENERGY CONSUMPTION PER CAPITA AND GDP PER CAPITA



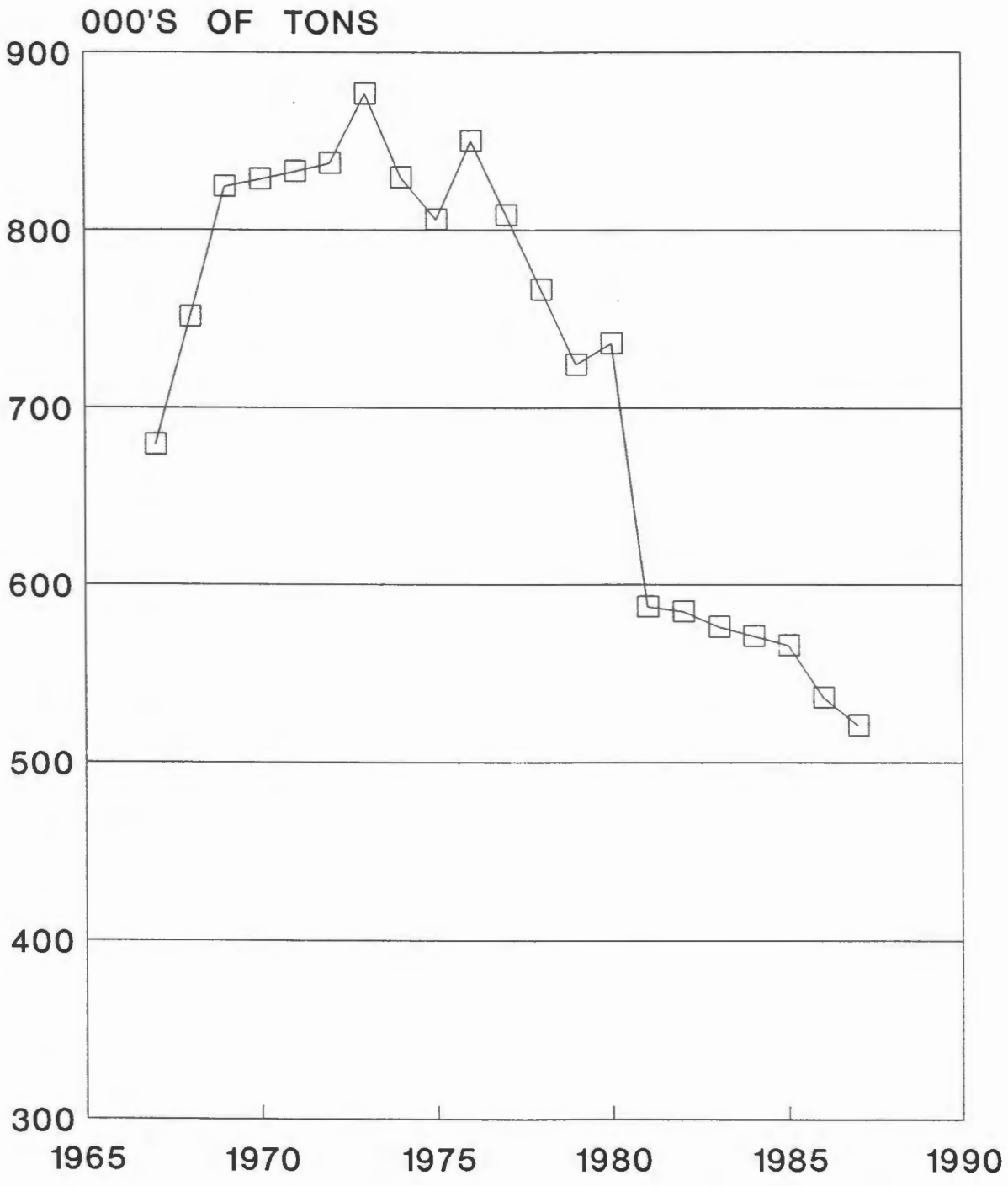
ZAMBIA/GDP1/2004

FIGURE 9. GDP(1985 CONSTANT) AND TOTAL FINAL ENERGY



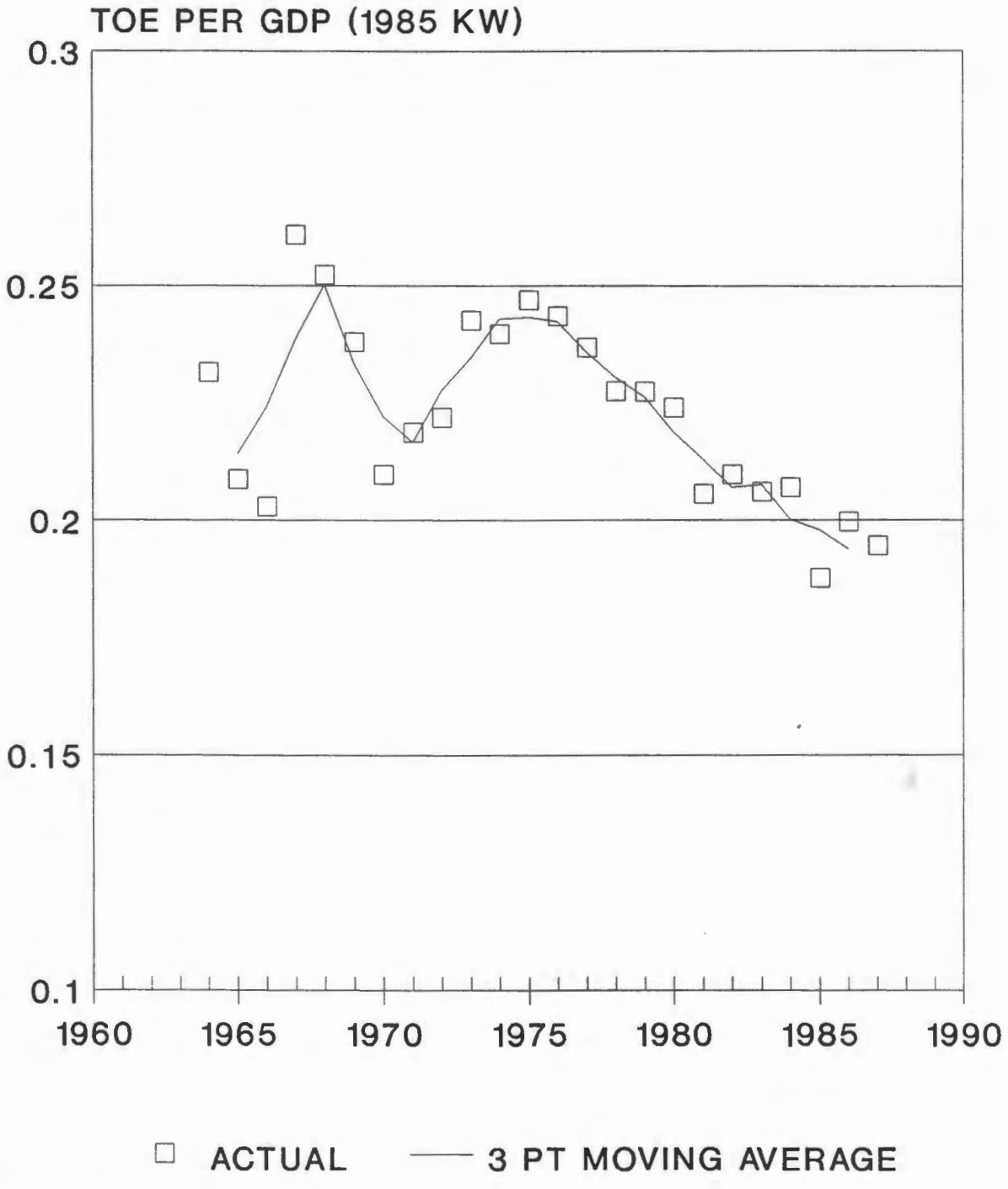
ZAMBIA/GDP2/2004

FIGURE 10. COPPER PRODUCTION



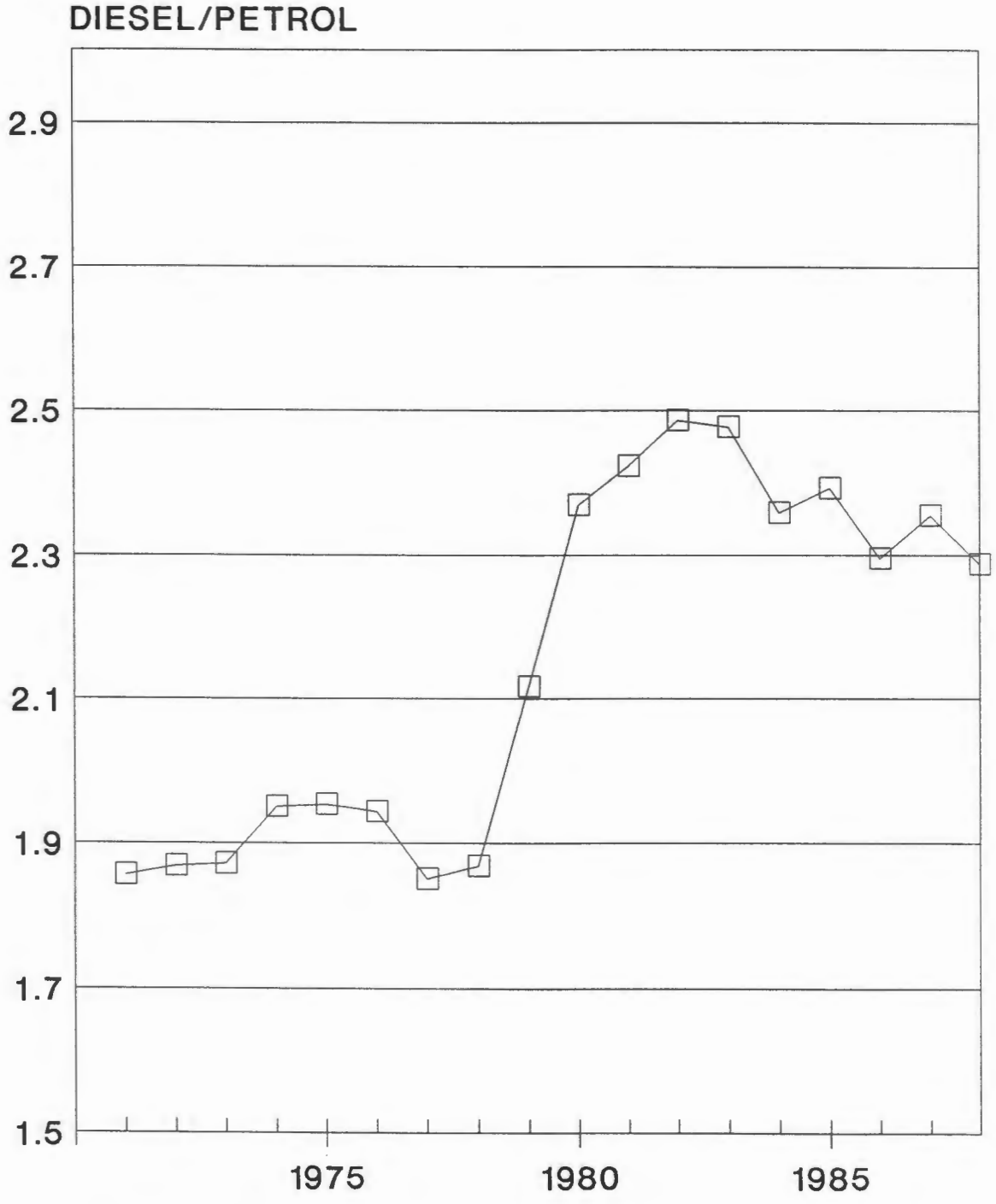
ZAMBIA/COPPER/2004

FIGURE 11. ENERGY INTENSITY



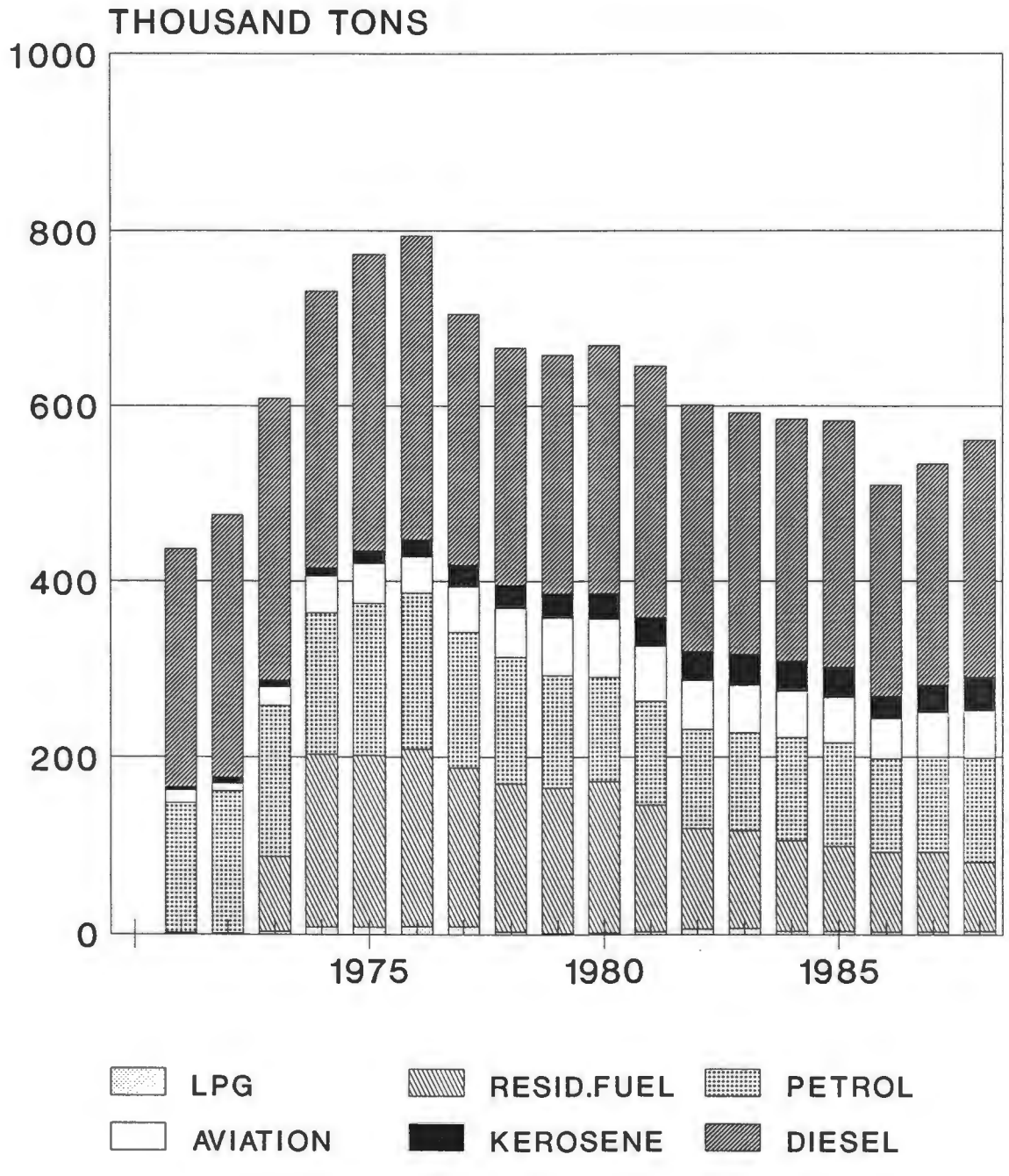
ZAMBIA/GDP3/2004

FIGURE 12. RATIO OF DIESEL TO PETROL



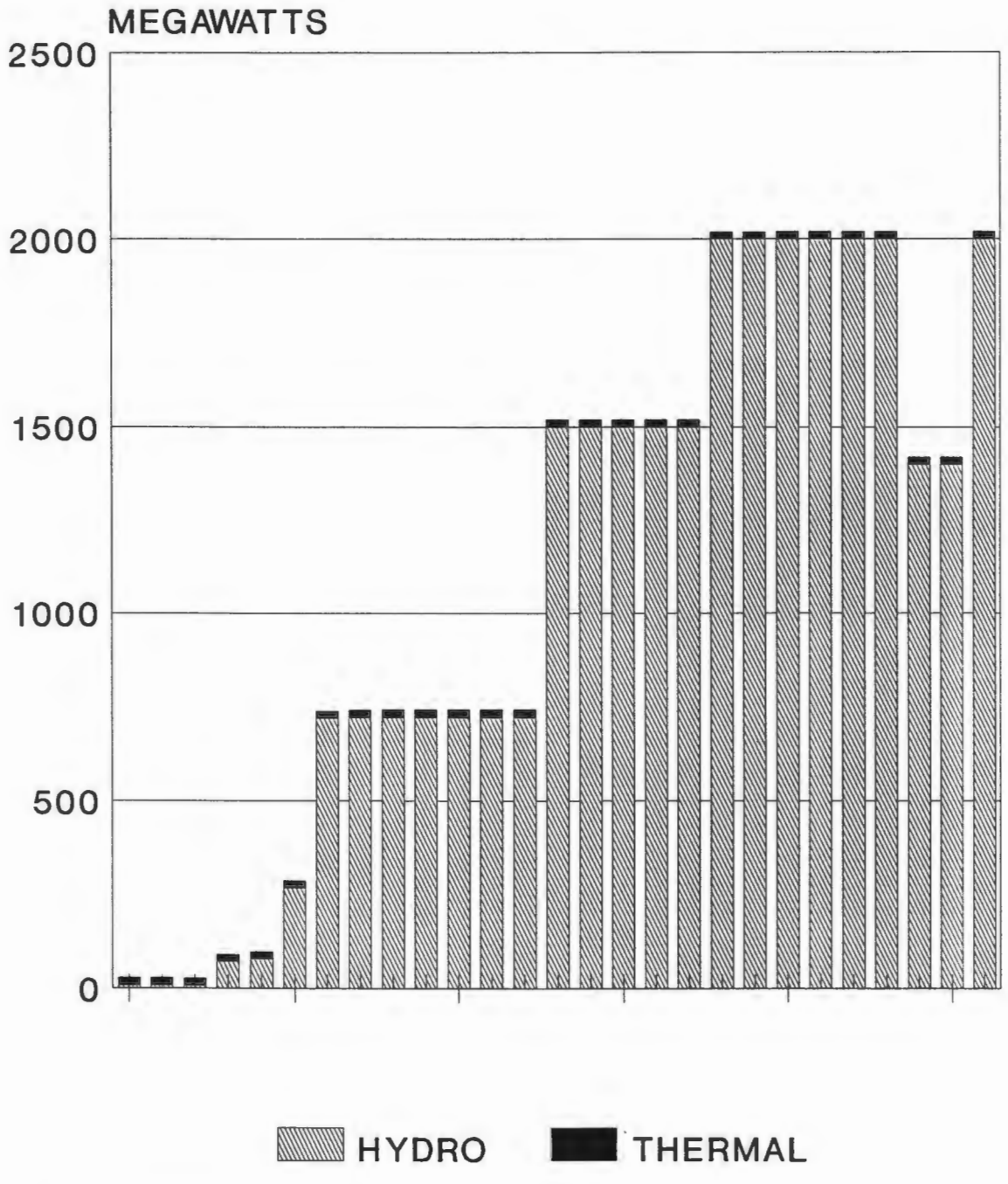
ZAMBIA/DIEPET1/2004

FIGURE 13. OIL PRODUCT CONSUMPTION BY TYPE



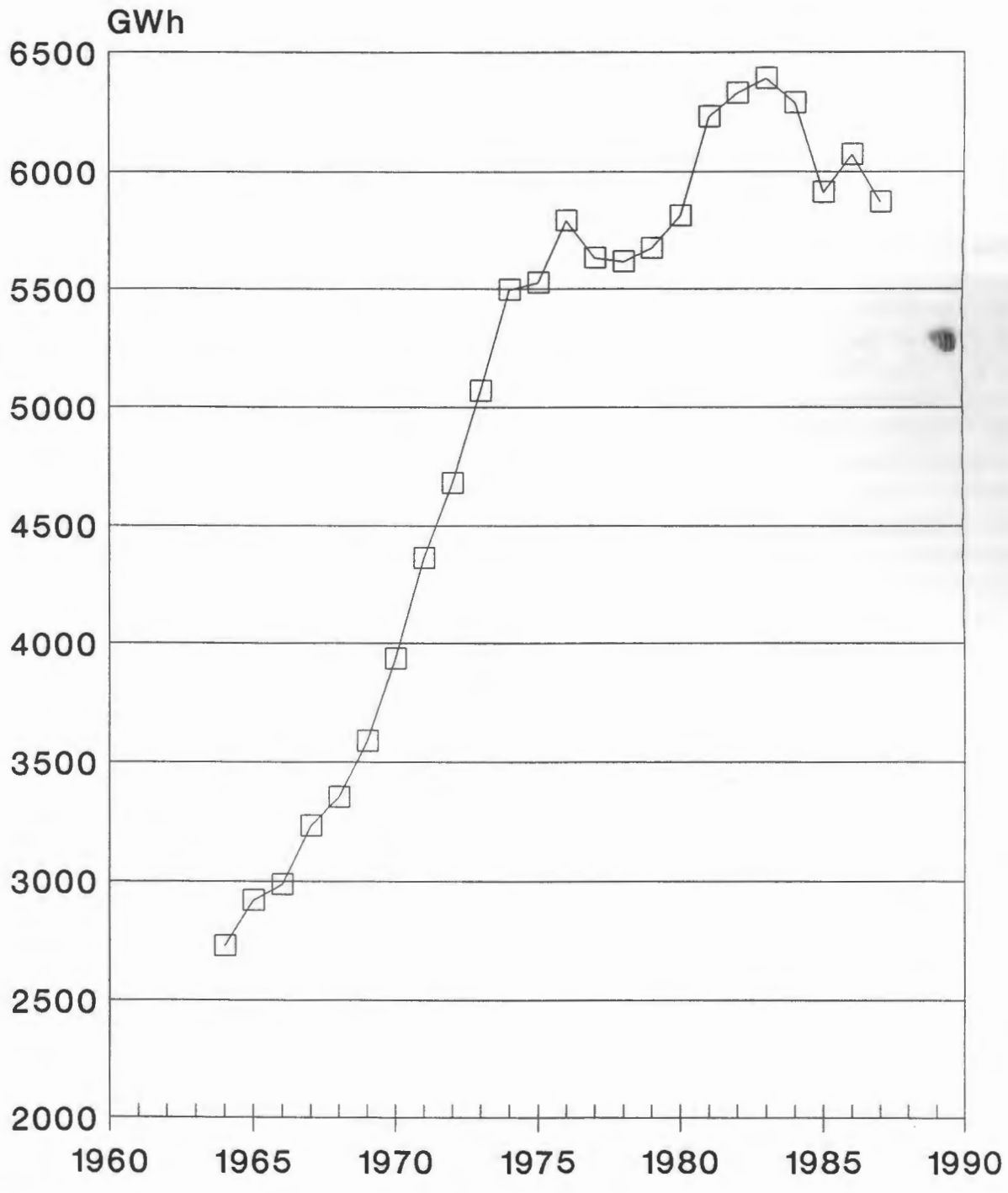
ZAMBIA/OILCAT1/2004

FIGURE 14. PUBLIC ELECTRICAL INSTALLED CAPACITY



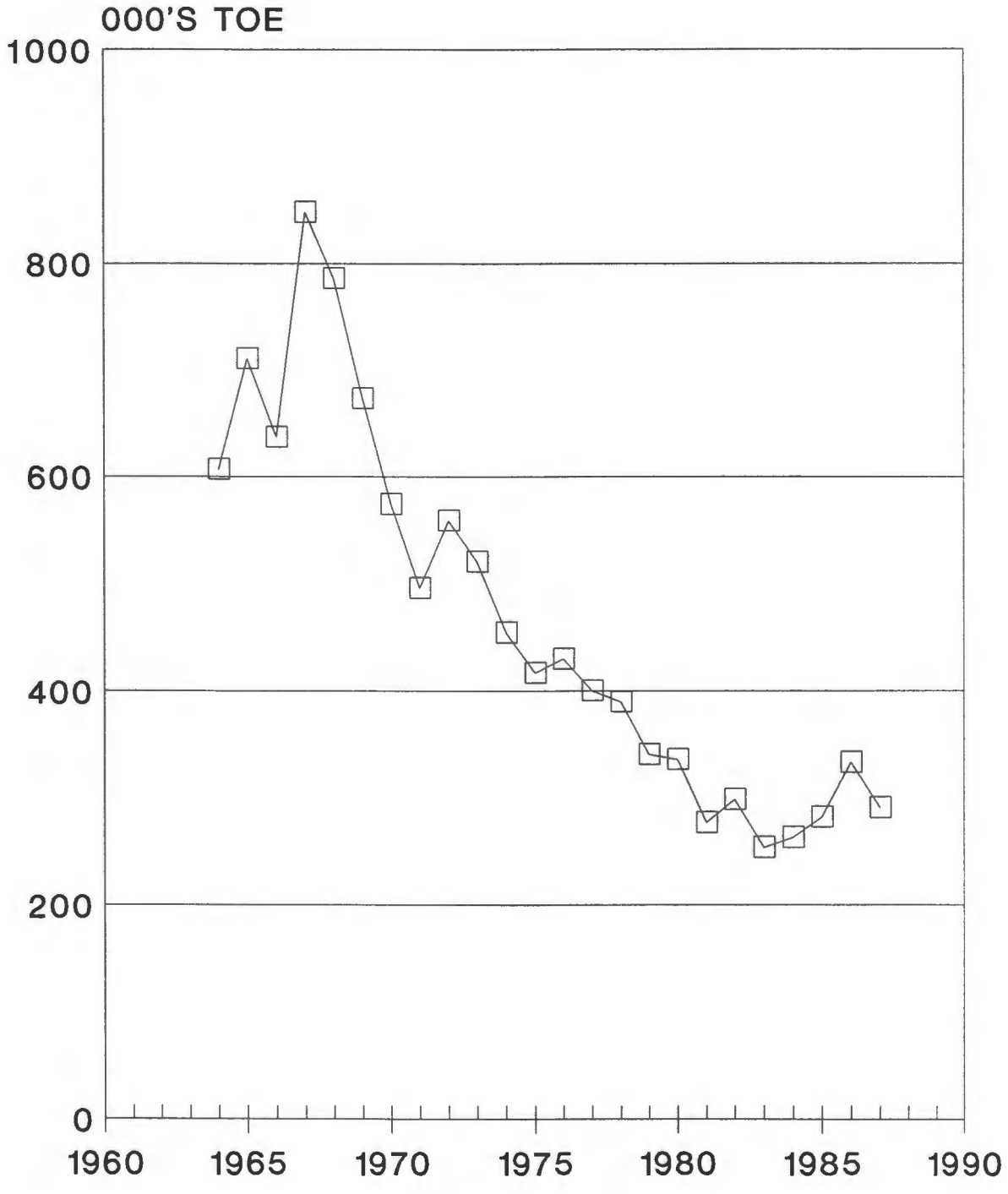
ZAMBIA/ELECPUB/2004

FIGURE 15. ELECTRICITY CONSUMPTION



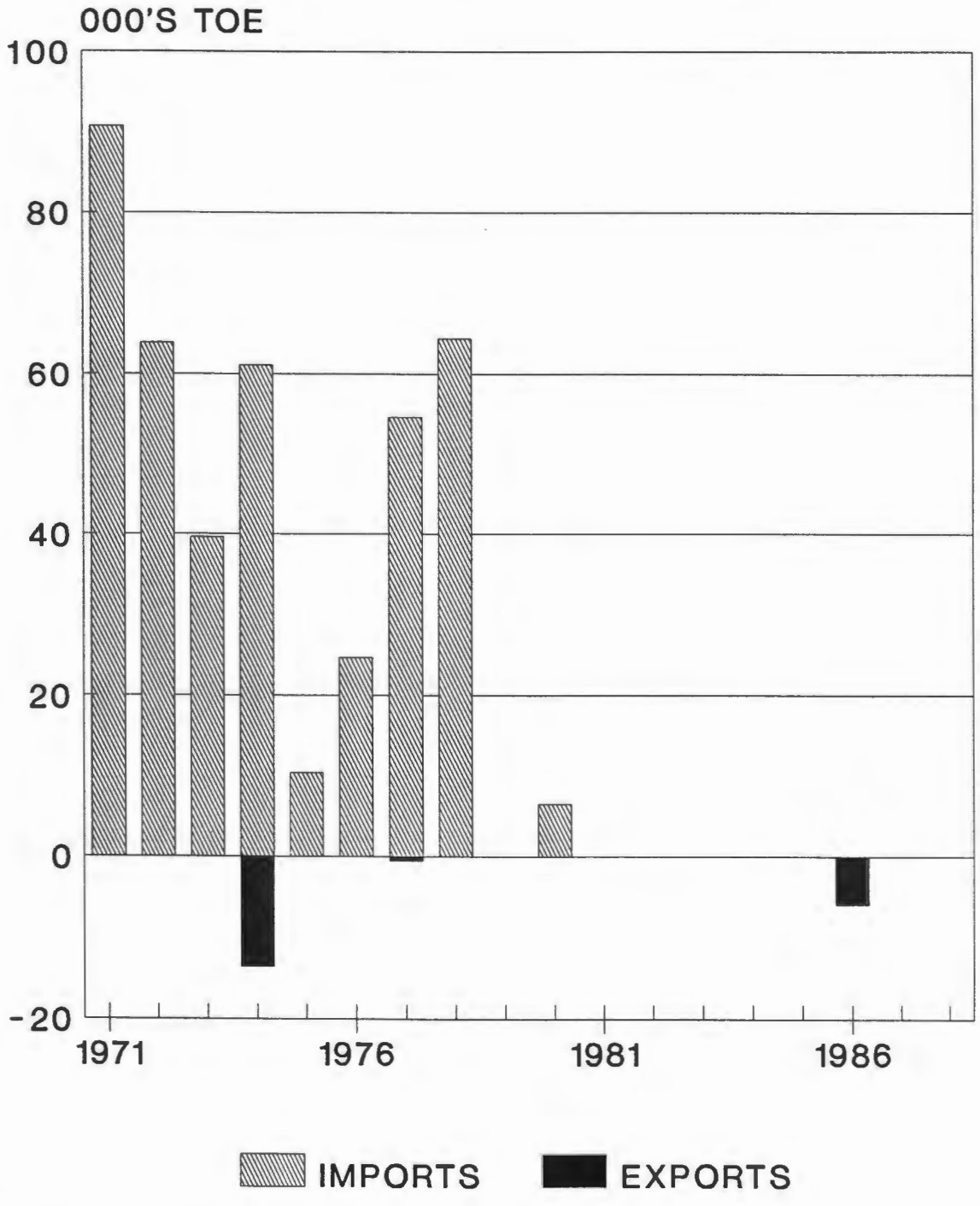
ZAMBIA/ELECKWH/2004

FIGURE 16. COAL: FINAL CONSUMPTION



ZAMBIA/COAL/2004

FIGURE 17. COAL IMPORTS AND EXPORTS



ZAM7188/COAL/2004

MAPS

IBRD 163
JUNE 19

ZAMBIA

FOREST ESTATE, URBAN POPULATION DISTRIBUTION IN "LINE OF RAIL" DISTRICTS

FOREST ESTATE:
- National Forest Reserves
- Local Forest Reserves
- Unreserved woodland

POPULATION DISTRIBUTION:
- One dot represents 500 persons
- Urban centers of more than 10,000 persons (1980 Census estimate)

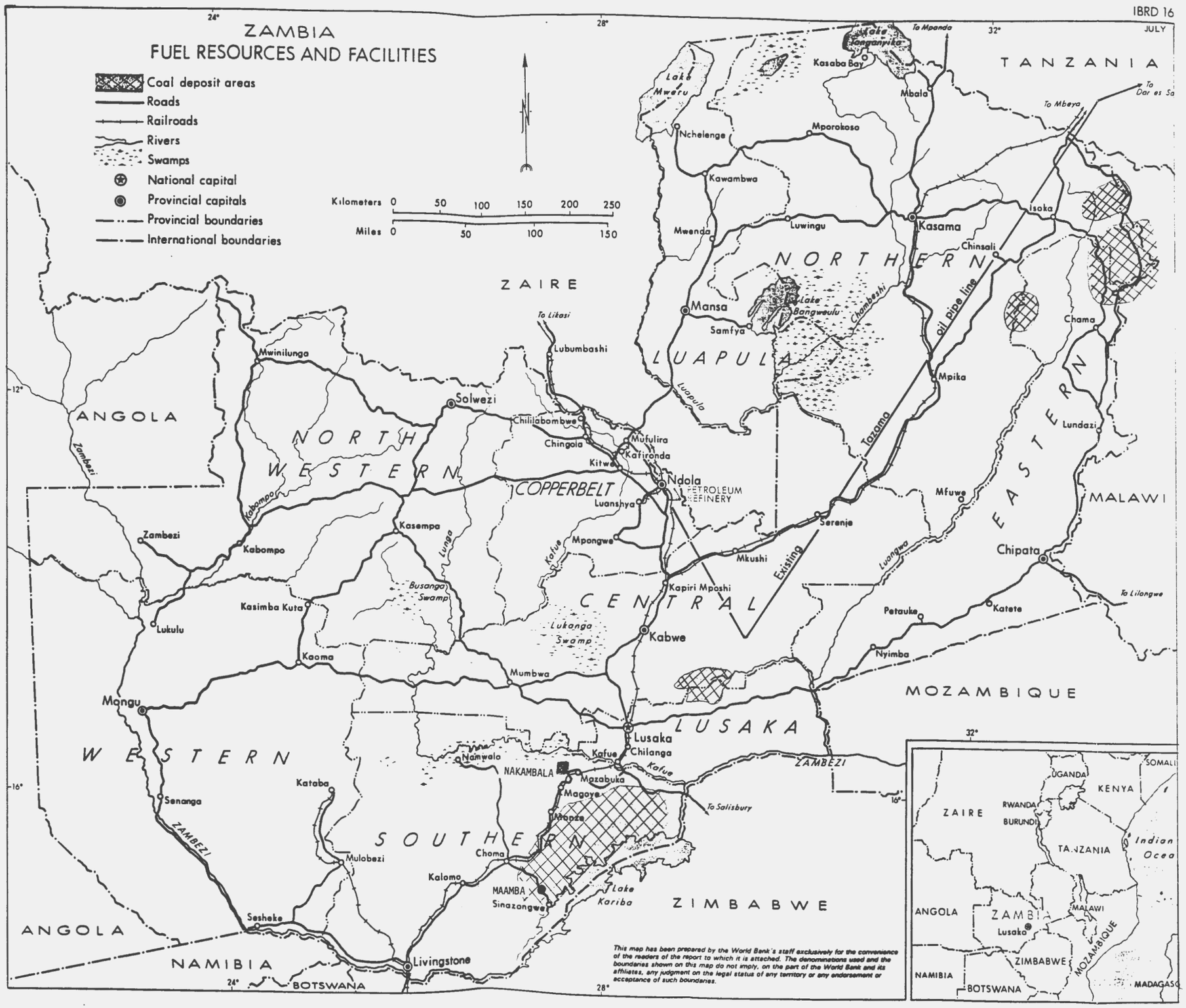
500,000
300,000
150,000
50,000
15,000

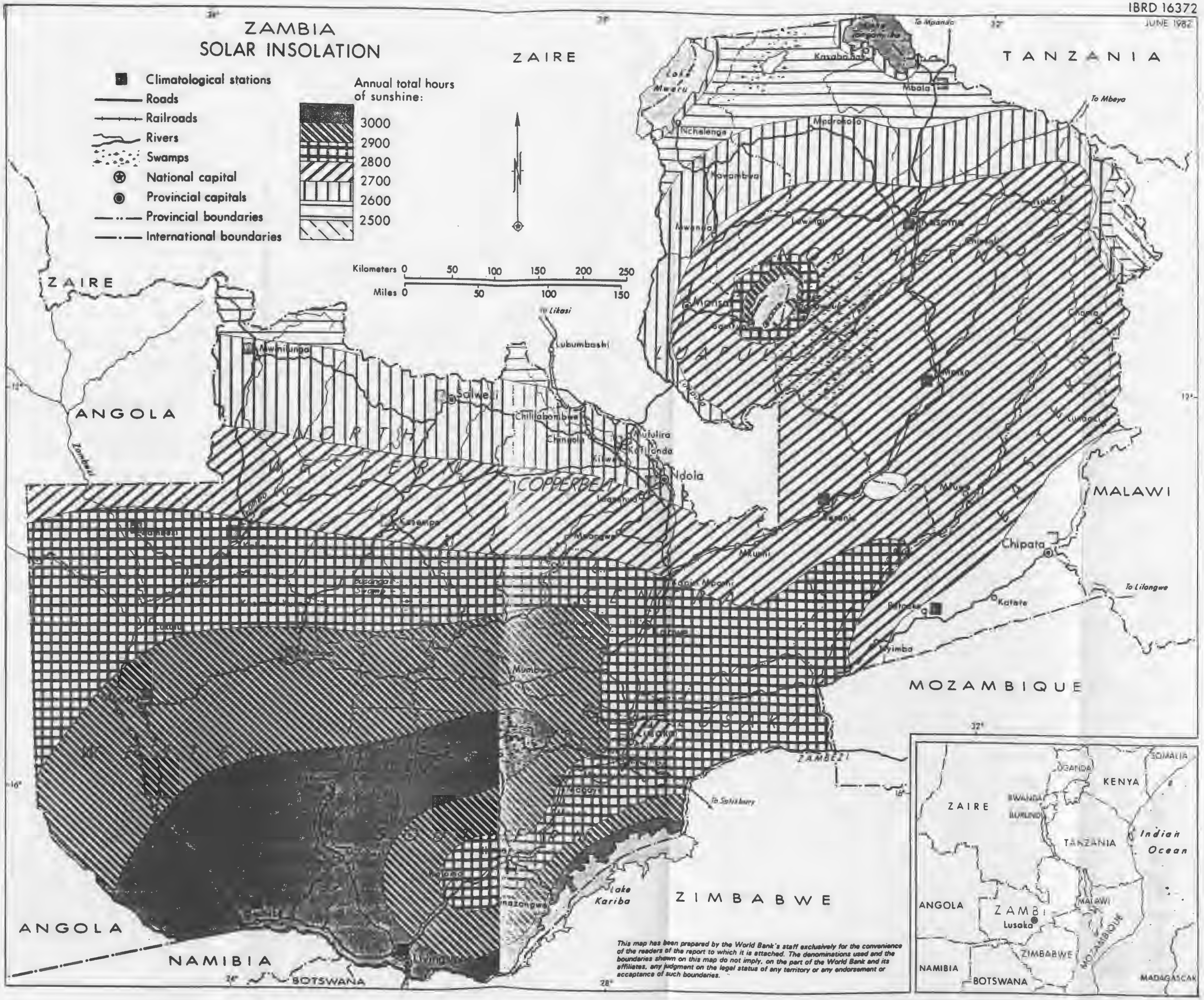
- Roads
- Railways
- Rivers
- International boundaries

KILOMETERS 0 20 40 60 80 100 120 140 160
MILES 0 20 40 60 80 100

ZAIRE
ZAIRE
ZIMBABWE
MOZAMBIQUE

Lubumbashi
To Likasi
To Manso
Luapula
To Mwinilunga
Chililabombwe
Chingola
Mufulira
Kitwe
Kalulushi
Ndola
To Zambezi
Luanshya
Masaiti
Mpongwe
To Kasama
Serenje
Kasempa
Mkushi
To Mongu
Kapiri Mposhi
Busanga Swamp
Kafue
Lukanga Swamp
Kabwe
To Chipata
To Mongu
Mumbwa
Keembe
Mukulaikwa
Chalimbana
Lusaka
Luangwa
Kafue
Kafue
Zambezi
Namwala
Mazabuka
Ngoma
Monze
Kanchomba
Choma
Chipepo
Lake Kariba
To Livingstone
To Salisbury


IBRD 16
JULY
ZAMBIA
FUEL RESOURCES AND FACILITIES
Coal deposit areas
Roads
Railroads
Rivers
Swamps
National capital
Provincial capitals
Provincial boundaries
International boundaries
Kilometers 0 50 100 150 200 250
Miles 0 50 100 150
24°
28°
32°
12°
16°
TANZANIA
ZAIRE
ANGOLA
NAMIBIA
BOTSWANA
ZIMBABWE
MALAWI
MOZAMBIQUE
Lake Tanganyika
To Mpanda
Kasaba Bay
Lake Mweru
Mbala
To Mbeya
To Dar es Sa
Nchelenge
Mporokoso
Kawambwa
Mwenda
Luwingu
Kasama
Isoka
Chinsali
NORTHERN
Mansa
Lake Bangweulu
Samfya
Chambeshi
oil pipe line
Chama
LUAPULA
Mpika
To Likasi
Lubumbashi
Mwinilunga
Solwezi
Luapula
Tazama
Lundazi
EASTERN
Chililabombwe
Chingola
Mufulira
Kafironda
Kitwe
Ndola
PETROLEUM REFINERY
COPPERBELT
Luanshya
Mfuwe
Serenje
Zambezi
Kabompo
Kasempa
Lunga
Mpongwe
Kafue
Mkushi
Existing
Luangwa
Chipata
Busanga Swamp
Kapiri Mposhi
CENTRAL
To Lilongwe
Kasimba Kuta
Lukulu
Lukanga Swamp
Kabwe
Petauke
Katete
Kaoma
Nyimba
Mumbwa
Mongu
LUSAKA
Lusaka
Chilanga
Namwala
Kafue
ZAMBEZI
WESTERN
NAKAMBALA
Mazabuka
Kataba
Magoye
Senanga
To Salisbury
Monze
SOUTHERN
Choma
Mulobezi
Kalomo
MAAMBA
Sinazongwe
Lake Kariba
Sesheke
Livingstone
This map has been prepared by the World Bank's staff exclusively for the convenience of the readers of the report to which it is attached. The denominations used and the boundaries shown on this map do not imply, on the part of the World Bank and its affiliates, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.
SOMALI
UGANDA
KENYA
RWANDA
BURUNDI
Indian Ocea
ZAMBIA
Lusaka


IBRD 16372
JUNE 1982
ZAMBIA
SOLAR INSOLATION
Climatological stations
Roads
Railroads
Rivers
Swamps
National capital
Provincial capitals
Provincial boundaries
International boundaries
Annual total hours of sunshine:
3000
2900
2800
2700
2600
2500
Kilometers 0 50 100 150 200 250
Miles 0 50 100 150
ZAIRE
TANZANIA
ANGOLA
MALAWI
MOZAMBIQUE
ZIMBABWE
NAMIBIA
BOTSWANA
Lake Mweru
Kasaba bay
Mbala
To Mpanda
To Mbeya
Mporokoso
Nchelenge
Kawambwa
Mwense
Kasama
Mansa
Mpika
Serenje
Mwinilunga
Solwezi
Likasi
Lubumbashi
Chililabombwe
Chingola
Mufulira
Kitwe
Ndola
COPPERBELT
Luanshya
Mumbwa
Chipata
To Lilongwe
Katete
Petauke
Nyimba
ZAMBEZI
To Salisbury
Lake Kariba
Livingstone
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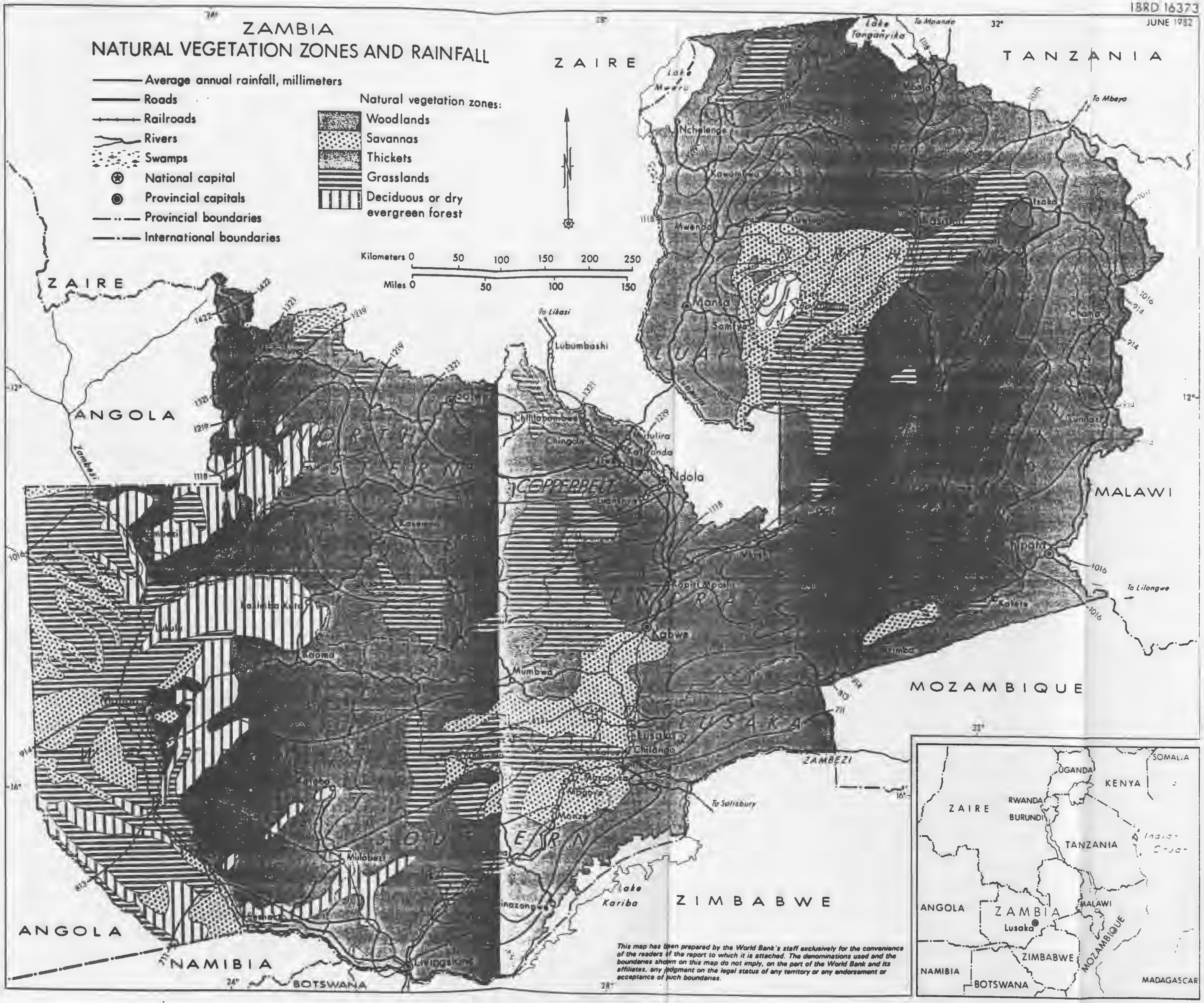
ZAIRE
UGANDA
KENYA
SOMALIA
RWANDA
BURUNDI
TANZANIA
Indian Ocean
ANGOLA
ZAMBIA
Lusaka
MALAWI
MOZAMBIQUE
ZIMBABWE
NAMIBIA
BOTSWANA
MADAGASCAR


IBRD 16373
JUNE 1982
ZAMBIA
NATURAL VEGETATION ZONES AND RAINFALL
Average annual rainfall, millimeters
Roads
Railroads
Rivers
Swamps
National capital
Provincial capitals
Provincial boundaries
International boundaries
Natural vegetation zones:
Woodlands
Savannas
Thickets
Grasslands
Deciduous or dry evergreen forest
Kilometers 0 50 100 150 200 250
Miles 0 50 100 150
ZAIRE
TANZANIA
ANGOLA
MALAWI
MOZAMBIQUE
ZIMBABWE
NAMIBIA
BOTSWANA
Lake Tanganyika
Lake Mweru
To Mbeya
To Likasi
Lubumbashi
To Lilongwe
To Salisbury
Lake Kariba
ZAMBEZI
COPPERBELT
NORTHERN
LUAPULA
CENTRAL
LUSAKA
SOUTHERN
Nchelenge
Kawambwa
Mwense
Mansa
Kasama
Isoka
Chama
Lundazi
Chipata
Katete
Chingola
Mufulira
Ndola
Kapiri Mposhi
Kabwe
Mumbwa
Lusaka
Chilanga
Mongu
Kalabo
Livingstone
Ndola
Solwezi
Kaoma
Zambezi
Lukulu
Senanga
Mulobezi
Feira
Chililabombwe
Luanshya
Mpika
Serenje
Mbala
Samfya
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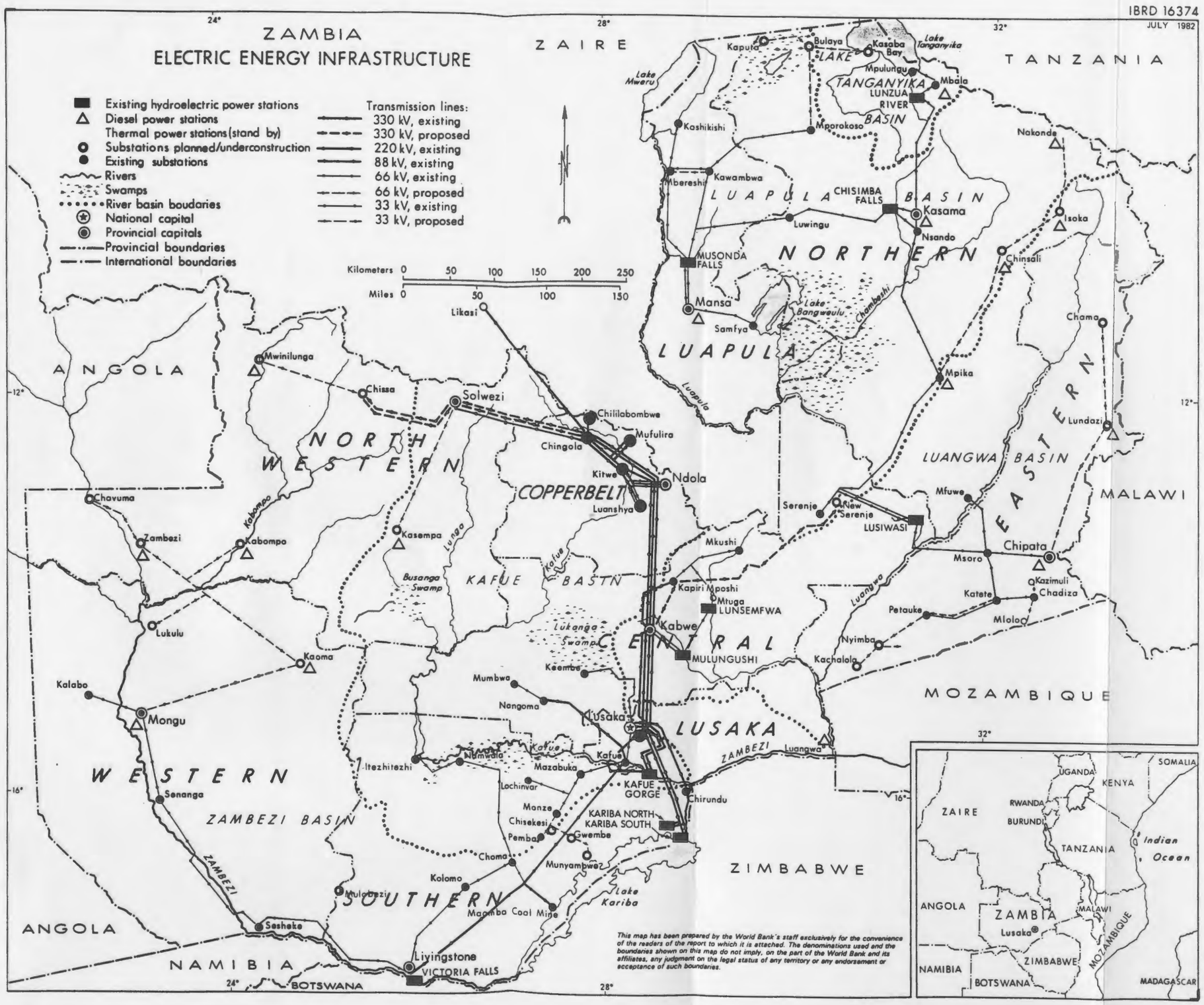
SOMALIA
UGANDA
KENYA
RWANDA
BURUNDI
TANZANIA
ZAIRE
ANGOLA
ZAMBIA
Lusaka
MALAWI
ZIMBABWE
MOZAMBIQUE
NAMIBIA
BOTSWANA
MADAGASCAR
Indian Ocean


IBRD 16374
JULY 1982
ZAMBIA
ELECTRIC ENERGY INFRASTRUCTURE
Existing hydroelectric power stations
Diesel power stations
Thermal power stations (stand by)
Substations planned/underconstruction
Existing substations
Rivers
Swamps
River basin boudaries
National capital
Provincial capitals
Provincial boundaries
International boundaries
Transmission lines:
330 kV, existing
330 kV, proposed
220 kV, existing
88 kV, existing
66 kV, existing
66 kV, proposed
33 kV, existing
33 kV, proposed
Kilometers 0 50 100 150 200 250
Miles 0 50 100 150
ZAIRE
TANZANIA
ANGOLA
ZAMBIA
ZIMBABWE
NAMIBIA
BOTSWANA
MOZAMBIQUE
MALAWI
Kaputa
Bulaya
Kasaba Bay
Lake Tanganyika
Lake Mweru
LAKE TANGANYIKA
Mpulungu
Mbala
LUNZUA RIVER BASIN
Kashikishi
Mporokoso
Nakonde
Mbereshi
Kawambwa
LUAPULA
CHISIMBA FALLS
BASIN
Kasama
Luwingu
Nsando
Isoka
MUSONDA FALLS
NORTHERN
Chinsali
Mansa
Lake Bangweulu
Chambeshi
Samfya
Likasi
Mwinilunga
Chama
LUAPULA
Luapula
Mpika
Chissa
Solwezi
Chililabombwe
Mufulira
Chingola
NORTH WESTERN
Kitwe
Ndola
COPPERBELT
Luanshya
LUANGWA BASIN
EASTERN
Lundazi
Chavuma
Zambezi
Kabompo
Kasempa
Lunga
Busanga Swamp
Kafue
KAFUE BASIN
Mkushi
Serenje
New Serenje
LUSIWASI
Mfuwe
Msoro
Chipata
Kapiri Mposhi
Mtuga
LUNSEMFWA
Kazimuli
Chadiza
Katete
Petauke
Mlolo
Luangwa
Lukulu
Kabwe
Lukanga Swamp
CENTRAL
MULUNGUSHI
Nyimba
Kachalola
Kaoma
Keemba
Kalabo
Mongu
Mumbwa
Nangoma
Lusaka
LUSAKA
Zambezi
Luangwa
Namwala
Kafue
Itezhitezhi
Mazabuka
Lochinvar
KAFUE GORGE
Chirundu
WESTERN
Senanga
Monze
Chisekesi
KARIBA NORTH
KARIBA SOUTH
Pemba
Gwembe
ZAMBEZI BASIN
Choma
Munyambwe
Kolomo
Mulobezi
SOUTHERN
Lake Kariba
Maamba Coal Mine
Sesheke
Livingstone
VICTORIA FALLS
This map has been prepared by the World Bank's staff exclusively for the convenience of the readers of the report to which it is attached. The denominations used and the boundaries shown on this map do not imply, on the part of the World Bank and its affiliates, any judgment on the legal status of any territory or any endorsement or acceptance of such boundaries.
SOMALIA
UGANDA
KENYA
RWANDA
BURUNDI
Indian Ocean
Lusaka
MADAGASCAR