FINAL REPORT

Energy Profile: Swaziland

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This report is one of a series summarizing the energy situation in sub-equatorial Africa. The purpose of the series is to analyze the energy position for those organizations trading or intending to trade with these countries, or for organizations entering into joint ventures with these countries. It is also the intention to use the individual reports to determine the possibility for energy interchange in the region and the potential for energy supply and demand in the region.

Use has been made of a number of sources for the statistical information and these do not always agree because of the definitions used for the various components. Therefore a perfect match in the resultant data should not be expected.

The energy statistics for Swaziland are not as thorough as those for a number of countries in the region because the International Energy Agency has classified Swaziland as a member of the South African Customs Union and does not produce separate statistics for Swaziland.

Substantial use has been made in the compilation of this report of data and information from the World Bank, whose permission to use the information and to reproduce their maps is gratefully acknowledged.

This series of reports has been solicited and sponsored by the National Energy Council and their assistance with the preparation of this report is gratefully acknowledged.

2. COUNTRY PROFILE

2.1 Introduction

Swaziland is one of the smallest political entities in Africa, with an area of 17 363 square kilometers, and is surrounded by South Africa on three sides and by Mozambique on the east.

Swaziland emerged as a coherent entity in the early 19th century. Following the signing of a treaty between the British and the Transvaal Republic, half of the Swazi territory was ceded to the Transvaal and Swaziland was administered by the Transvaal Republic until its defeat in the Anglo-Boer war in 1902. As a result of the war Swaziland became a British colony.

The late 19th century was marked by a large-scale granting of land and concessions by the Swazi king, Mbanzeni, to land speculators and hunters. In 1921 King Sobhuza II ascended the throne and began a process of trying to reclaim land ceded by Mbanzeni, a process which is going on to this day. Land was bought using taxes levied on each Swazi. By independence in 1968 nearly 50% of the land had been reclaimed and by 1989 approximately 66% had been recovered.

Swaziland was ruled as a kingdom under Sobhuza, with control based on traditional Councils. The 1960's saw the emergence of political parties and the growing militancy of workers. The decision of the British to give the country independence resulted in the traditional authorities forming a royalist political party which in the pre-independence elections won all 24 seats in the newly formed House of Assembly. The next few years saw a coalition of interests between the royalists and the settlers. Independence was granted to Swaziland in September 1968.

The 14 years of post-independence rule under Sobhuza was a period of stability. The reliance of Swaziland on South African capital produced an increasing reliance on South Africa but did result in growing economic well-being. At the same time as the economy was becoming mature, the Swazi ruling class was consolidating its political power base and by 1981, the year of Sobhuza's diamond jubilee, the authority of the Swazi king was absolute.

After the death of Sobhuza in 1982 the 18-year-old heir to the throne, Prince Makhosetive, was crowned as King Mswati III.

In September 1987 elections were held for parliament and the King's nominees in both Houses were appointed as cabinet ministers. The Swazi voters have come to realize that their vote has little impact on the eventual control of parliament and growing dissatisfaction to the political system has been building up.

In international affairs Swaziland has been largely neutral, a condition dictated by its being surrounded by South Africa, and because of its financial reliance on South Africa. The country has maintained strong links with the USA. In 1982 King Sobhuza signed a secret security treaty with South Africa. The result was the virtual expulsion of the African National Council from Swaziland, though it carried on working underground. The imposition of international economic sanctions against South Africa led to Swaziland being used as a channel for a number of sanctions-busting operations.

As a result of the civil war in Mozambique, large numbers of refugees have entered the country in search of food and employment, causing problems due to the shortage of land. Estimates of 134 000 refugees would represent 20% of the total population of Swaziland.

2.2 Demography

The population of Swaziland was 676 089 in the census of 1986 and has been growing to an estimated 750 000 in 1988, as shown in Figure 1. The population is rising by 3,4% per annum.

Half of the population live in the Middle Veld, an area which contains the best agricultural land in the country and which now has a population density of 50 inhabitants per square kilometer. (See Map A).

A complex system of land ownership is partly responsible for the great difference in population densities in the country. Half of the land was under the control of the Swazi nation at the time of independence and this has now risen to approximately 66%. The national land is under the patronage of the monarchy through a traditional land tenure system which has limited the ability to develop an affluent peasant group and has limited the move to urban areas.

2.3 Economy

Although Swaziland is the second smallest state in mainland Africa, it has one of the highest per capita incomes and has a well developed economy. Exports of goods and services account for 75% of GDP, whilst imports account for around 80% of GDP. Its Gross Domestic Product (GDP) has been increasing, in real

terms, as shown in Figures 2 and 3, although the GDP per capita has been approximately constant over the last 12 years (see Figure 4). The economic downturn during the 1980's resulted in a decrease of GDP growth from 6% in 1978-1980 to 2,4% in 1980-1983, but recovered to 5,7% in the period 1985-1987.

Agriculture is the main component of the economy, contributing 20% to GDP and employing three-quarters of the working population. Sugar is the dominant agricultural export crop providing, in 1988, 30% of export earnings. Other crops include maize, citrus, pineapples, and forestry products.

The contribution of mining and quarrying to the GDP has been declining from around 10% in the 1960's to 2,6% in 1986. However, it is the third largest source of export earnings, and exports of coal, gold, and asbestos provided about 6% of export earnings in 1987.

The contribution of the various sectors to GDP at market cost is shown in Figure 5 and in Table 1 for 1984.

Table 1: Sectorial contribution to GDP in 1984

Sector	Percent Contribution
Agriculture	20,0
Mining & quarrying	2,1
Manufacturing	16,6
Electricity, water	1,6
Construction	4,1
Services	55,6

The manufacturing sector is the second most important contributor to the GDP. The majority of Swaziland's manufacturing activity is based at the Matsapa industrial estate.

The ratio of the contribution to GDP from agriculture to that from manufacturing is shown in Figure 6.

In parallel with South Africa, inflation in the country has been high, as shown in Figure 7.

3. ENERGY GENERAL

3.1 Introduction

At present Swaziland depends on imported energy for 40% of its final demand. However, it has large potential energy resources and could become more independent if the economics were favourable. It has large coal deposits, significant hydro-power potential, and viable biomass resources, all of which could be used to substitute for imported energy.

There is no energy plan for the country, which is consistent with the Government policy of minimum intervention in the country's economy. This policy has resulted in a market-orientated economy with individual organizations which are cost-conscious and efficiency-minded. It is therefore considered that the purpose of an energy policy would be largely to determine the required level of energy self-sufficiency to be aimed at, and to determine what the cost of such a move would be.

The import of energy does not represent an inordinately high percentage of total exports or imports and they have therefore not placed a high burden on the economy. Of the value of energy imports, 90% of the value is represented by petroleum products.

Biomass energy sources provide some 50% of final energy demand and are used both for domestic consumption and for industrial use. Approximately 80% of urban households use commercial fuels because of the denudation of forest areas in close proximity to densely populated regions, resulting in wood being one of the most expensive energy options. In rural areas the conditions are reversed and approximately 80% of rural households use wood as the principle energy form.

3.2 Energy Institutions

The Government plays only a limited role in the energy sector, and planning is carried out in the various public institutions and private companies. Of the public agencies the ones concerned with energy are the Swaziland Electricity Board (SEB), the Geological Survey and Mines Department (GSMD), and the Forestry Department. These agencies are divided between a number of Government Departments, making co-ordination difficult and resulting in these agencies working with considerable independence. The only energy plan to have been carried out was the Energy Master Plan study which was carried out with financial support from the German Government and was completed in 1982. Arising out of this study, the Government brought most of the energy-related agencies under the control of one Ministry, that of Natural Resources, Land Utilization, and Energy. This Ministry also looks after national oil matters. It is the intention of the Government to form an Energy Branch in this Ministry.

The exploitation of coal resources is vested in the Head of State in trust for the Swazi nation. Decisions in this regard are based on the advice of a Minerals Committee which is appointed by the Head of State, but it is independent of the Government and its members usually consist of traditional leaders. Prospecting licenses issued by the State are typically for a 3-5 year period, whilst production leases are issued for 15 years. Whilst foreign investment is permitted, provision has to be made for the Swazi nation to acquire equity in the venture. The Government agency which deals with mining operations on a day-to-day basis is the GSMD.

The Swaziland Electricity Board (SEB) operates within an Electricity Act which stipulates that the SEB has authority to set tariffs subject to the condition that revenue must exceed expenditure. The SEB is also charged with the responsibility of developing and extending its area of supply, and of reducing the cost of power. Moreover it must make available electricity to any customer within 100 yards, though customers beyond that line may be required to pay for the link to them.

The SEB is run by a Board appointed by the Minister for Natural Resources, Land Utilisation, and Energy, though most of the dealings of the Board are with the Ministry of Finance. The Minister for Natural Resources, Land Utilisation, and Energy is entitled to give general direction to the Board, though in practice the

absence of a national energy plan and the lack of technical expertise in the Ministry has led to the Government being mainly concerned with the adequacy of supplies. However, recent financial problems in the SEB have led to the Government taking a more active part in the financial affairs of the SEB.

Control of the oil industry in Swaziland is concerned purely with the collection of taxes from the various oil companies. Liaison between the oil industry and the Government is handled on a rotational basis by each of the six oil companies operating in the country. Most of the imports for the country come from South Africa and the Government is associated only in the marketing exercise through its membership, together with the other countries in the South African Customs Union, of a committee which was set up after the 1970's oil crisis to co-ordinate the supply arrangements in the event of a shortage of petroleum products.

4. ENERGY RESOURCES

4.1 Fuelwood

No accurate estimate has been made of the forestry potential for providing fuelwood. The Forestry Section of the Ministry for Agriculture and Co-operatives has estimated that indigenous forests cover 52 000 hectares. The World Bank estimates that the potential is much higher and used a Figure of 120 000 hectares. The mean annual increment of the forests is low, with an estimated average of 3 m^3/ha. year. This gives a total sustainable yield of 360 000 m^3/ha. In addition to the indigenous forests there are approximately 7 500 hectares of black wattle forests which were introduced to supply bark for the tanning process. Two-thirds of these forests have been allowed to generate to a level where the sustainable yield is about 7 m^3/ha compared with 15-18 m^3/ha of the remaining wattle forests. Only some 50% of this wood is currently used for fuelwood. In addition there are various company forests utilized for fuelwood.

The World Bank estimate of the present sustainable fuelwood potential is given in Table 2.

Table 2: Existing fuelwood supply sources (1986)[3].

Source	Area (ha)	Mean Increase (m^3/ha /year)	Yield (m^3/ year)
Indigenous forest	120000	3	360000
Co. fuelwood plantation	1100	10	11000
Communal woodlots	155	15	2325
Wattle forests*			
Swazi National Land	5000	7	17500
Title Deed Land	2500	15	18750
Private forest residues			20000
TOTAL			429575

* Using an utilization factor of 50%.

The demand for fuelwood will be mainly influenced by demographic factors since, in keeping with other countries in Africa, there is a large population move from rural to urban areas. The urban population in Swaziland rose from 18% in 1980 to nearly 25% in 1985 and is expected[3] to rise to 45% by the year 2000. Using these estimates, the demand for fuelwood will reach the sustainable level by 1990, and by 2000 there will be a shortage of some 40% of demand. In order to meet this shortage, over-cutting of the forests would need to be carried out, leading to a deforestation of about 60% by the year 2000.

Even though there is currently no apparent shortage of fuelwood, there are in fact local shortages in some of the more populated regions. A study carried out jointly by the Ministry of Natural Resources, Land Utilization and Energy, and the Deutsche Geselschaft fur Technische Zusammenarbeit of the Federal Republic of Germany[2] showed that there is already a perceived shortage. Of the people sampled by the research workers, 59 complained that it was difficult to find fuelwood in their area. This shortage was recognised as a shortage of fuelwood within suitable gathering distances, but 20% of those reporting shortages said that they lived next to wooded areas but did not have legal access to them. Of those interviewed, 62% said that fuelwood was more difficult to get than five years previously.

There is therefore scope to adopt more efficient means of burning fuelwood and there appears to be a need to develop woodlots for areas with scarcities.

4.2 Petroleum

Swaziland is not considered to have any potential for petroleum production. One-third of the country is underlaid with very old rocks, some of the oldest in the world. Whilst there are shale areas in the rest of the country, their geological formation is not conducive for petroleum production.

4.3 Coal

Swaziland was known to have coal resources some one hundred years ago. However, little was known about the extent of the deposits until the formation of the Geological Survey and Mines Department in the late 1950's. The oil shocks in the 1970's increased interest in coal mining and significant surveys have now been carried out.

Coal-bearing strata underlie some one-sixth of Swaziland (see Map C). They lie in one continuous field with an average width of 15 km and forming part of the field which extends into South Africa. The coal is at depths of less than 200 m and dips gently towards the east. The geology is relatively complex, with inclusions of igneous dykes. In general, mining conditions are similar to those in the adjacent coalfields in South Africa.

The total resources have been assessed by the World Bank[3] at 549 million tons of mineable coal, of which 116 million are proven reserves and 92 million are proven saleable after washing. In addition, there is an estimated 450 million tons of potential reserves. Thus the total of demonstrated and potential coal reserves is 999 million tons.

Most of the exploration has to date been on the shallow western side of the coalfield and the Lower Coal Zone in particular (see Map C). The Upper Coal Zone is relatively unexplored because of its known poor quality compared with the Lower Zone. Only about 40% of the coal measures have been adequately explored. The World Bank estimates that, making assumptions of coal measures

in the unexplored areas, the total coal reserves are of the order of 1000 million tons. This should be compared with the present coal consumption of the country of about 240 000 tons per annum.

The Swaziland coal has some desirable qualities such as low sulphur and low volatiles, which make it a clean burning coal. However, it is an anthracitic coal, compared with the bituminous South African coals, which creates combustion problems which make it difficult to burn in conventional stoker boilers. A number of customers who had used Swazi coal have changed to using South African coals because of these problems.

The mineable reserves expressed on a run-of-mine basis are shown in Table 3.

Table 3: Mineable coal reserves on run-of-mine basis (million tons).

Area	Mineable Total	Saleable Proven	Proven (washed)
Mhlume	18,4	18,4	14,7
Area 1	128,0	9,1	5,4
Area 2	55,0	41,2	39,1
Area 3	36,1	20,6	12,1
Maloma	44,2	7,8	5,8
Lubukhu Block (N)	132,5	18,9	14,7
Lubukhu Block (S)	70,8		
Lower Coal Zone	485,2	116,0	91,8
Upper Coal Zone	64,1		
Additional Potential	450,0		
TOTAL	999,3		

4.4 Hydro-electricity

In 1970 the United Nations financed a study of the hydro-potential of Swaziland. This study identified 21 possible sites with a total energy potential of 3000 GWh.

The same study tried to estimate the likely abstraction of water by South Africa from the rivers before entering Swaziland. The study came to the conclusion that due to water abstraction the potential energy would decline by 40% to 1800 GWh. An energy study carried out in 1982 by the Federal Republic of Germany re-assessed these Figures to take account of actual river flows recorded in the intervening period and to eliminate some uneconomic sites. This survey came up with a hydro-potential of between 550 and 700 GWh, of which 30-40% has already been developed.

The hydro-potential is summarized in Table 4.

Table 4: Swaziland hydropower potential[3] - 1980 estimate (GWh/annum).

	Current situation	Allowing for South African abstraction
Total potential	1200-1500	800-1000
Total excluding uneconomic systems	900-1100	550-700
Existing stations	(220)	(220)
Unexploited	(670-870)	(330-480)

4.5 OTHER ENERGY SOURCES

4.5.1 Bagasse

With the large sugar industry in Swaziland there is potential for generating power at the sugar mills for feeding into the national grid. A World Bank study on sugar mills in various countries estimated that the maximum recovery of energy from a sugar mill would be 50 kWh per ton of cane crushed. Using this Figure, the sugar mill's surplus capacity, i.e. surplus to their own needs, would amount to about 110 GWh or about 30% of total electricity generated by the Swaziland Electricity Board.

However, the same study estimated that capital investment would result in electricity production costs of US cents 6/kWh, which is higher than the present cost of imported power.

Whilst there is currently no great incentive to develop this potential, it is one of the more promising options for power generation.

4.5.2 Ethanol

One of Swaziland's most promising alternative energy options is ethanol. Having to import all its petroleum products, the use of ethanol as a substitute for gasoline is an attractive means of becoming less dependent on imported energy.

Considèration has already been given to ethanol production from surplus molasses. At present the three sugar mills produce 127 000 tons of molasses per year. The main outlet for this is export, but this has been difficult because of problems with railing through Mozambique and with the cost of railage. Molasses therefore has a nuisance value only and is stored in tanks and in open pits which lead to environmental problems. The World Bank has estimated potential alcohol utilization based on a 20% blend in gasoline. This level is possibly too high under normal conditions and a 15% blend might be more acceptable. With this assumption there could be a market for 8,0 million litres per year at present gasoline consumption rates, and it could grow to 10,7 million litres by 2000. The required molasses production, based on 4 tons of molasses per kilolitre of alcohol, would be 32 000 tons/year at present and 43 000 tons/year in the year 2000. These Figures are summarized in Table 5 using World Bank estimates for gasoline and sugar demands in 1990 and 2000.

Table 5: Ethanol production potential

		1990	2000
Gasoline sales	- Megalitres	53,0	71,2
Ethanol demand	- Megalitres	8,0	10,7
Required molasses	- '000 tons	32,0	42,8
Sugar production	- '000 tons	424	468
Molasses production	- '000 tons	127	140

It is evident that this level of ethanol production is within the capability of the industry.

4.5.3 Other renewable sources

Swaziland is situated between the 25 and 28 south latitudes and therefore in common with other countries in Africa has good solar potential. However, it is doubtful whether solar power can make any significant contribution to the energy demand in the short or medium term. A number of demonstration programmes have already been instituted but without any wide acceptance.

Little is known about the potential for wind energy, but having no exposed coastline, it is likely that wind velocities will be similar to those in South Africa and thus not suitable for any large-scale application. Swaziland is also a small country and therefore electricity grid extension is likely to be cheaper than the introduction of wind generators.

5. ENERGY SUPPLY AND DEMAND

5.1 General

Unlike the situation in other African countries, the contribution of traditional energy to the total energy demand is relatively small at around 19%. This does not however include the use of crop residues, and especially bagasse, as a fuel in industrial applications. The breakdown of the contribution of the various energy forms to total final demand is shown in Table 6.

Table 6: Energy final demand by energy source (1985)[3]

Energy source	Percent contribution
Coal	18,9
Oil	22,6
Bagasse	31,2
Woodwaste	0,1
Electricity	8,0
Total commercial	80,8
Traditional	19,2
	100,0

This is shown pictorially in Figure 8.

The largest user of energy is the sugar industry which in 1985 used 35% of total final energy demand. The next largest user was the domestic sector which relied largely on fuelwood.

The energy demand balance for Swaziland in 1985 is given in Table 7.

All petroleum products are imported, a large proportion of coal is imported from South Africa, and some electricity is imported. In order to become less dependent on imported energy more electricity could be produced either from hydro or from thermal power plant based on coal. In addition, much more indigenous coal could be used. However, most of these steps imply higher costs as the move to produce more hydro-power has already demonstrated.

Table 7: Final demand energy balance for 1985 (percentages)

Sector	F/wood	Coal	Waste	Bagasse	Elec	Oil	Total
Households	18,6	3,6	-	-	1,1	1,4	24,7
Commercial	-	0,7	-	-	0,5	0,1	1,3
Transport	-	3,5	-	-	-	18,0	21,5
Irrigation	-	-	-	-	1,5	-	1,5
Sugar	-	1,0	-	31,2	1,1	1,3	34,6
Industry, of which:	-	10,0	0,8	-	3,8	1,8	16,4
Usutu Pulp	-	6,7	-	-	1,4	1,8	9,9
Peak Timbers	-	-	0,8	-	0,1	-	0,9
Havelock Asb.	-	0,4	-	-	0,7	-	1,1
Other	-	2,9	-	-	1,6	-	4,5
TOTAL	18,6	18,8	0,8	31,2	8,0	22,6	100,0

5.2 Fuelwood

Fuelwood is the main source of energy for households in the rural areas where some 74% of the population live. In urban areas some 10-20% of the population use fuelwood. Fuelwood is becoming scarce in the urban areas and is also expensive. The World Bank gives the following relationship for comparative energy costs in the domestic sector in 1986:

Table 8: Relative domestic energy costs (1986)[3]

Fuel	Unit	Cents/ unit	MJ/ unit	Effic.	Cents per MJ
Coal	kg	10,0	29,0	25	1,38
Wood	kg	25,0	14,6	10	17,10
Kerosene	litre	103,0	36,7	36	7,80
LPG	litre	155,0	25,1	55	11,23
Electricity	kWh	7,8	3,6	65	3,33

It is obvious that fuelwood is the most expensive energy source in the urban areas, though in rural areas it is still available as a free good. However, in the rural areas fuelwood is not uniformly available. Gajo[2] shows that the gathering rate varies from 9 kg/hour in the Middleveld through 14,9 in the Highveld to 19,6 in the Lowveld. Consumption of fuelwood varies with season and region. Typically, consumption is in the range 1 to 4,5 kg per day per person.

Fuelwood is already scarce and the scarcity will increase unless some effort is made to plant fuel crops. In the medium term cutting into the standing stock of trees will be required, which will compound the shortage in future years. This requires a decision by Government on its tree-planting programme and the allocation of funds.

5.3 Petroleum

All Swaziland's petroleum products have to be imported since Swaziland does not have any indigenous oil supply, nor does it have a refinery. Supply is carried out by seven international companies - BP, Caltex, Mobil, Shell, Sonap, Total, and

Trek. These companies are based in South Africa and supply Swaziland as part of their Southern Africa operation.

The market is relatively simple, with gasoline and diesel fuel accounting for 87% of total supply. Kerosene and LPG account for around 6% of total consumption and are used mostly in the household sector.

The breakdown in product mix in terms of energy utilization is shown in Table 9.

Table 9: Petroleum product mix in 1985 (percent of energy supplied)

Product	Percent Contribution
LPG	2,1
Avgas	0,3
Avtur	1,1
Kerosene	4,3
Fuel oil	5,1
Gasoline	44,3
Diesel	42,7

5.4 Coal

The coal potential of Swaziland (see Map C) has been fairly well explored with sufficient work having been carried out over approximately 40% of the coalfield. Coal properties vary over the field and one-quarter of the coal is semi-anthracitic or low-volatile bituminous, the remainder being anthracitic. Ash content is high and beneficiation would be required for most applications and especially if export coal is required. The coal properties of Area 2 coal, which is the site of the only operating mine, is given in Table 10.

Table 10: Coal properties in Area 2

	Run-of-mine	Washed
Moisture (%)	1,6	1,3
Ash (%)	24,9	14,1
Volatile matter (%)	13,1	12,7
Fixed carbon (%)	60,4	72,0
Sulphur (%)	0,2	0,3
Ash fusion (°C)	1260	1250
Calorific value (MJ/kg)	25,6	29,0

With the low volatile content there are problems with burning the coal in the conventional stoker boilers used in South Africa and many users have changed over to South African imported coal because of these problems. Whilst it is easier to use South African coals in the present boilers, in the future it would be of benefit if boilers designed to operate on the specific Swaziland coals were to be developed. One possible method of burning the coal efficiently is to use fluidized bed systems.

Whilst international sources[4] quote Swaziland production of coal as starting in 1959, the only operating mine, located at Mpaka, was opened in 1964. It was originally developed as a subsidiary of Anglo-American to provide coal for the locomotives servicing the iron-ore mine at Ngweya. The mine was operated on a lease system on a ten-year basis until 1985 when it was taken over by a Swaziland based company, Emaswati Holdings Ltd. An important consideration of the new arrangement is the equity participation by the Swazi nation, which gives it a 10% share at the moment but increasing eventually to 50%.

The Mpaka mine is an underground operation using bord-and-pillar extraction techniques. Only the main seam is mined, which varies from 3,5 to 4,2 metres in thickness. The production capacity is 17 500 tons per month (210 000 tons per year). Coal is screened and washed to give four size fractions: washed cobbles (38-75 mm), nuts (25-38 mm), peas (9-25 mm), and duff (less than 9 mm). Production has increased steadily from 30 000 tons in 1965 to 166 000 in 1985. Since 1985 the output has been constant at an average of 167 000 tons per year.

A large percentage of the coal has been exported, with Mozambique and Kenya being the main destinations in the 1970's, and now the main customers are Kenya and Korea, though some sales have been made to France, Italy, Belgium, and the Scandinavian countries. Transport is a problem with the export sales due to the unreliability of the Mozambique link.

Because of combustion problems being experienced with the Swaziland coal, coal is also being imported from South Africa. The quantities of production, export, and import over the period 1980 to 1985 are shown in Table 11.

Table 11: Coal production, import, and export (000's tons).

	Production	Local Sales	Export	Import
1980	176	174	140	85
1981	158	149	119	n/a
1982	115	98	77	n/a
1983	102	103	76	n/a
1984	125	110	83	n/a
1985	166	129	101	172

Figure 9 shows the pattern of coal production in Swaziland.

Serious fluctuations have occurred in the export and domestic markets and the mine has stock-piled coal in order to keep operation an a uniform level. This is reflected in Table 11 which shows the export fluctuations and the differences between production and sales.

The destination of imports during 1985 is shown in Table 12.

Table 12: Coal imports utilization in 1985

	Quantity '000's Tons	Percent
Direct imports		
Usutu Pulp Company	64,9	37,6
Swaziland Railway	30,0	17,4
Havelock Asbestos	45,8	26,5
Langa Brickworks	4,0	2,3
Agent imports		
Industry		
Sugar mills	3,3	1,9
Food & Beverage	9,2	5,3
Other	6,5	3,8
Commercial	7,0	4,1
Households	2,0	1,1
Total	172,8	100,0

Swaziland has a potential to export anthracitic coal on a world basis. Much of the world market is however for low-ash coal, normally less than 10%. At present the beneficiation of Mpaka coal reduces ash to 14%, and further beneficiation would be required for the world market. There are however segments of the world trade where ash is not a primary consideration and Swaziland coal might be suitable for this sector. The Far East is the main market for this sector, with Korea being the single largest importer of anthracite. The Swaziland coal has a low sulphur content which will make it attractive for countries with strict pollution legislation. The World Bank estimates that Swaziland could export some 4 million tons of coal per year, though this would not be realized until after 2000.

5.5 Electricity

Electricity in Swaziland is distributed by the Swaziland Electricity Board (SEB) which was formed in 1963 as a government-owned entity. Only the SEB is

allowed to generate and distribute electricity, although it may grant licenses to others to generate, especially if it is from by-product material. In Swaziland this group of self-generating utilities is large and accounts for around 34% of total electricity consumption. Before the formation of SEB there was a public utility which had an installed capacity of 0,6 MW in 1954.

Sales of electricity have been increasing, as shown in Figure 10. The growth rate in sales has followed closely the economic activity in the country, and Figure 11 shows the correlation between electricity growth rate and the growth rate of GDP. The largest users of electricity are industry and irrigation, as shown in Figure 12. Between 1970 and 1980 electricity demand grew by 13,.2%, but has been down to 4,5% in the period 1980 to 1989, reflecting the downturn in the economy.

The SEB transmission system covers approximately 80% of the country. It is estimated, however, that only 10% of households are provided with electricity. Some of the larger bulk consumers reticulate electricity to their own workers and therefore the percentage of households with access to electricity is likely to be nearer 20% rather than the 10% quoted. There has not been a policy of trying to provide electricity to all and this would be difficult anyway in Swaziland where there is no strong village system but mainly a large number of individual households.

Prior to 1973 the SEB had been self-sufficient in generating capacity, but by 1973 a decision had to be made whether to build new plant, either hydro or thermal using Mpaka coal. The most economic alternative turned out to be the importation of power from ESKOM in South Africa and a 132 kV line capable of 31 MW was constructed. A second 31 MW transmission line was constructed from South Africa in 1979. By 1980 Swaziland was importing 62% of its requirement from ESKOM and in 1989 it was still 60%. The other generating capacity consists of hydro-power and some diesel units. Figure 13 shows the various generating components on the SEB system.

In 1981 a new hydro-plant, the Luphohlo-Ezulwini station, was started in the Ezulwini Valley. The project was completed in 1985[5] and added 20 MW to the SEB system. This Luphohlo-Ezulwini power station has however been an expensive addition with cost over-runs amounting to 45%, resulting in large tariff increases. The decision to construct the station was based on a desire to

become less dependent on imported power, since on economic grounds the importation of more power from ESKOM would have been the most cost-effective.

Private electricity generating capacity amounts to 57 MW, of which 43 MW is thermal plant burning bagasse or wood-waste, 8 MW is coal-burning plant, 5 MW is diesel capacity, and 1 MW is hydro capacity. Total generation is about equal to SEB sales. There have not been any significant additions to this private capacity since 1980 and the various owners are adopting energy conservation measures to boost energy self-reliance.

Whilst the SEB is a reliable system, outages do occur mainly due to lightning since the system is located in one of the most lightning-prone areas in the world. At present the reserve capacity on the system is inadequate in terms of accepted margins. The system should be able to meet the maximum demand with the largest "unit" on the system out of commission. In the case of the SEB the largest unit is one of the ESKOM grid lines from South Africa, which are rated at 30 MW each. Table 13 shows that this cannot be met in practice.

Table 13: Swaziland Electricity Board maximum demand and installed capacity (MW)

	Max Demand	ESKOM Link	SEB generation	Total	Reserve
1985	81	60	50	110	-1
1986	84	60	50	110	-4
1987	97	60	50	110	-17
1988	87	60	50	110	-7
1989	92	60	50	110	-12

"Reserve" in the Table refers to the difference between the maximum capacity with the largest unit out of commission and the maximum demand on the system. In this case the maximum capacity is taken to be one of the two ESKOM link lines with a capability of 30 MW. It will therefore be seen that over the last five years the amount of the capacity on the system does not give it the required amount of safety and any improvement in the economic situation, and the resulting growth

associated with it, could lead to serious shortages. However, this situation is no different from that which has been going on for the last ten years and therefore no greater problems are expected. But continuing increase in maximum demand will need to be catered for by an increase in capacity.

The relationship between maximum demand and generating capacity (including the ESKOM link) is shown in Figure 14. The difference between installed capacity and maximum demand is shown in Figure 15 which indicates that from a maximum reserve in 1978 the reserve capacity has been slowly declining and is currently at about 20 MW. With one of the ESKOM 30 MW links out of service this would translate into an approximately 10 MW shortage, as shown in Table 13.

Customers on the SEB system complain of frequent outages[3]. Most of the outages are of the order of 30 minutes, but several outages can occur in one day. Also a cause for complaint are voltage fluctuations on the system. The SEB therefore needs to increase its security both from the point of additional generating capacity as well as from the point of outages.

5.6 Ethanol

The surplus of molasses and the environmental aspects associated with its storage make the manufacture of ethanol as a transport fuel an attractive proposition. Ethanol blend usage is now an accepted technology and has been used on a small scale in South Africa in Natal since 1945, and more recently in Brazil. Ethanol blends are also used in Malawi and Zimbabwe. South Africa uses a 10% blend of ethanol and higher alcohols in all its gasoline on the Highveld and therefore there would not be any problem in cross-border travel as long as the blend levels were not very different.

Gasoline is imported into Swaziland from South Africa and the Swazi market is so small compared with that of South Africa that it is doubtful whether the refiners would produce a blend stock specifically for the Swazi market. Blending would therefore have to be splash blending with conventional feedstock. A blend level of 10%, or at most 15%, could be achieved leading to production of 8 million litres of ethanol at present, rising to 11 million litres by the turn of the century, as discussed in Section 4.5.2.

6. PRICING

6.1 General

The Government has largely adopted a hands-off approach to industry and to pricing policy. Even the Government-owned SEB has to set tariffs to meet its expenditure. Financial problems have arisen because of the high inflation rate and the sharp depreciation of the Lilangeni.

6.2 Oil products

Since the distribution of oil products is an extension of the activities of the oil companies in South Africa, the pricing system mirrors that in South Africa. Certain of the prices are subject to regulation, i.e. gasoline, diesel, and kerosene, whilst the oil companies are free to set the prices of the other products.

The Government does not subsidize any product costs and has attempted to ensure that the cost of regulated products reflects the economic cost. However, the tax component on the products is adjusted to allow for perceived social needs. Thus gasoline is taxed much higher than kerosene which is a fuel used extensively as a household fuel.

The prices of diesel depends on its use. Government use is exempt from tax, agricultural use has a low tax, whilst bus operators pay more tax than agriculture but less than that paid by small users. The World Bank[3] has recommended that the tax-free fuel to Government Departments should be eliminated in order to put public use of liquid fuels on a par with private use. Eliminating the multi-price tax system would also greatly simplify the tax collection procedure.

6.3 Electricity

The SEB operates under the Electricity Act of 1963 which gives it the power to set its own tariffs on condition that revenue exceeds expenditure. The SEB rates have increased by a factor of three since 1980, reflecting the need to achieve its real rate of return of 8%. Prices have gone up sharply over the last five years because of the financial burden associated with the construction of the Luphohlo-

Ezulwini power station and increases in tariffs by ESKOM. The financial situation of the SEB deteriorated in late 1985 and though it could cover its operating cost, the real rate of return has been 4% which is not sufficient to cover debt repayment nor to contribute to investment. The Government had to step in to cover part of SEB's obligations since it was concerned about the effect that a tariff increase of the size required would have on consumers. The Government has undertaken to cover that part of the cost associated with the depreciation of the Lilangeni and it would provide loans to SEB to repay those which it could not meet from its own resources(3).

A preliminary internal assessment of its tariff structure has shown that some of the tariffs are not meeting the incremental cost of supply. It was decided that a reassessment of tariffs, especially of those to large consumers, was warranted. An assessment of off-peak rates was also to be carried out.

6.4 Coal

Coal pricing is left to the private sector though it is not a competitive market. An arrangement exists whereby coal imports from South Africa are handled by one agent. The cost of local coal from Emaswati Coal Ltd is fixed by the company with reference to the price of South African coal together with an additional price premium to reflect the transport cost of South African coals.

The emphasis of Emaswati is on export coal which in 1986 was selling at approximately 60% above that of local sales.

7. DISCUSSION

Swaziland has a well developed energy sector with a great deal of diversification. It has potential for further developing its coal and hydro-power, and also to make more use of its biomass.

The industry is remarkably free of institutional control and is therefore able to develop in an economic manner. At present the SEB has financial problems because of its commitment to the Luphohlo-Ezulwini power station and because of the depreciation in the Lilangeni, which affect its foreign debt repayments. However the Government is supporting the SEB with loans.

One area of growing concern is the shortage of fuelwood for household use and the high cost of commercially sold fuelwood. The problem is not yet critical, but cutting into standing forests will have to take place, making the potential shortage much greater in the future.

Swaziland is largely reliant on South Africa for the supply of oil products and for imported electricity. As long as the political climate of the area carries on improving, this arrangement will be the lowest-cost one, and additional electricity capacity is most probably best served by additional transmission links from South Africa.

8. REFERENCES

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9. APPENDICES

APPENDIX A

TABLE A: ECONOMIC DATA (MILLIONS OF NATIONAL CURRENCY UNLESS INDICATED)

YEAR	POPULATION MILLIONS	GROSS DOMESTIC PRODUCT AT MARKET PRICES (EMALENGENI)						GDP AT MARKET PRICES	GDP DEFLATOR	GDP AT 1985 MARKET PRICES	EXCHANGE RATE EMALENGENI PER $	GDP IN MILL. US$		GDP PER CAPITA US$
		AGRICULTURE	MINE & QUARRY	MANUFACTURE	ELEC,WTR GAS	CONSTRUCTION	OTHER SERVICES					CURRENT PRICES MARKET	AT 1985 PRICES MARKET	
1955	0,25	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,7	NA	NA	NA
1956	0,28	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,7	NA	NA	NA
1957	0,30	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,7	NA	NA	NA
1958	0,31	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,7	NA	NA	NA
1959	0,31	NA	NA	NA	NA	NA	NA	NA	NA	NA	0,7	NA	NA	NA
1960	0,32	NA	NA	NA	NA	NA	NA	21,7	NA	NA	0,7	31,0	NA	96,9
1961	0,33	NA	NA	NA	NA	NA	NA	25,0	NA	NA	0,7	35,0	NA	106,0
1962	0,33	NA	NA	NA	NA	NA	NA	30,7	NA	NA	0,7	42,9	NA	130,1
1963	0,34	NA	NA	NA	NA	NA	NA	32,8	NA	NA	0,7	45,9	NA	134,9
1964	0,35	NA	NA	NA	NA	NA	NA	38,6	NA	NA	0,7	54,0	NA	154,2
1965	0,36	16,6	11,0	4,1	0,7	1,8	12,2	46,4	NA	NA	0,7	64,9	NA	180,3
1966	0,37	NA	NA	NA	NA	NA	NA	50,2	NA	NA	0,7	70,2	NA	189,8
1967	0,39	NA	NA	NA	NA	NA	NA	54,9	18,8	292,3	0,7	76,8	408,9	196,9
1968	0,40	NA	NA	NA	NA	NA	NA	53,4	19,2	277,5	0,7	74,7	388,2	186,7
1969	0,41	NA	NA	NA	NA	NA	NA	57,0	19,8	287,4	0,7	79,7	402,0	194,4
1970	0,42	18,1	8,3	9,1	1,6	1,8	37,2	76,1	20,7	366,9	0,7	106,4	513,2	253,4
1971	0,44	21,3	4,2	11,9	0,8	2,6	40,2	81,0	22,4	361,0	0,7	113,3	504,8	257,5
1972	0,45	23,5	6,5	18,6	1,6	2,8	44,7	97,6	23,5	415,3	0,8	127,1	540,8	282,4
1973	0,46	25,8	7,9	26,4	1,5	3,3	48,0	112,9	26,1	433,4	0,7	162,9	625,4	354,2
1974	0,48	32,1	10,7	33,5	1,7	2,8	71,7	152,5	30,1	506,5	0,7	224,6	745,9	467,9
1975	0,49	39,6	14,5	48,3	2,0	3,5	105,4	213,3	35,2	605,8	0,7	291,8	828,7	595,5
1976	0,50	45,6	14,8	56,8	2,3	5,3	110,5	235,1	39,7	591,9	0,9	270,2	680,3	540,5
1977	0,51	56,8	14,6	62,5	2,8	8,0	118,8	263,5	47,5	554,7	0,9	302,9	637,6	593,9
1978	0,53	67,9	14,4	68,2	3,4	10,8	130,6	295,2	48,5	608,7	0,9	339,3	699,6	640,2
1979	0,53	79,1	14,3	73,9	3,9	13,5	161,6	346,2	50,0	692,4	0,8	411,7	823,3	776,7
1980	0,55	90,2	14,1	79,6	4,4	16,2	217,6	422,1	63,5	664,7	0,8	542,5	854,4	986,4
1981	0,57	104,7	15,1	89,1	7,2	21,4	263,4	500,9	70,4	711,5	0,9	575,7	817,8	1010,1
1982	0,59	102,1	14,4	100,8	10,3	26,9	292,2	546,7	76,5	714,6	1,1	505,7	661,1	857,2
1983	0,61	111,2	15,7	89,7	9,3	25,3	336,5	587,7	82,0	716,7	1,1	528,5	644,5	866,4
1984	0,63	131,0	14,3	108,5	10,3	26,9	364,5	655,5	90,9	721,1	1,4	455,8	501,5	723,6
1985	0,65	NA	NA	NA	NA	NA	NA	743,3	100,0	743,3	2,2	339,3	339,3	521,9
1986	0,67	NA	NA	NA	NA	NA	NA	955,9	118,1	809,2	2,3	421,5	356,8	629,1
1987	0,71	NA	NA	NA	NA	NA	NA	1132,8	132,9	852,3	2,0	556,7	418,8	784,0
1988	0,74	NA	NA	NA	NA	NA	NA	1384,2	NA	NA	2,3	612,2	NA	827,3
1989	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	2,6	NA	NA	NA
1990	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

TABLE B: ELECTRICITY DATA

YEAR	INSTALLED CAPACITY (MEGAWATTS)									IMPORT CAPACITY ESKOM	PUBLIC +ESKOM CAPACITY	MAX DEMAND	RESERVE CAPACITY
	PUBLIC			SELF PRODUCERS			TOTAL HYDRO	TOTAL THERMAL	TOTAL INSTALLED				
	HYDRO	DIESEL	TOTAL	HYDRO	DIE/STM *	TOTAL							
1964	7,5	1,5	9,0	NA	NA	NA	NA	NA	NA	0,0	9,0	7,4	17,44
1965	10,0	2,5	12,5	NA	NA	NA	NA	NA	NA	0,0	12,5	9,8	21,92
1966	10,0	2,5	12,5	NA	NA	NA	NA	NA	NA	0,0	12,5	10,8	13,36
1967	10,0	7,0	17,0	NA	NA	NA	NA	NA	NA	0,0	17,0	11,7	31,29
1968	16,5	7,0	23,5	NA	NA	NA	NA	NA	NA	0,0	23,5	15,8	32,85
1969	21,5	7,0	28,5	1,0	30,3	31,3	22,5	38,3	60,8	0,0	28,5	19,8	30,53
1970	21,5	11,5	33,0	1,0	30,3	31,3	22,5	42,8	65,3	0,0	33,0	19,6	40,61
1971	21,5	11,5	33,0	1,0	30,3	31,3	22,5	42,8	65,3	0,0	33,0	17,0	48,48
1972	21,5	11,5	33,0	1,0	40,5	41,5	22,5	53,0	75,5	36,0	69,0	27,2	60,58
1973	21,5	9,5	31,0	1,0	40,5	41,5	22,5	51,0	73,5	36,0	67,0	28,4	57,61
1974	21,5	9,5	31,0	1,0	40,1	41,1	22,5	50,6	73,1	36,0	67,0	28,5	57,46
1975	20,5	9,5	30,0	1,0	39,3	40,3	21,5	49,8	71,3	36,0	66,0	33,2	49,70
1976	20,5	9,5	30,0	NA	NA	NA	NA	NA	NA	36,0	66,0	42,0	36,36
1977	20,5	9,5	30,0	NA	NA	NA	NA	NA	NA	36,0	66,0	43,2	34,55
1978	20,5	9,5	30,0	NA	NA	NA	NA	NA	NA	67,0	97,0	53,1	45,26
1979	20,5	9,5	30,0	NA	NA	NA	NA	NA	NA	67,0	97,0	57,2	41,03
1980	20,5	9,5	30,0	NA	NA	NA	NA	NA	NA	67,0	97,0	65,9	32,06
1981	20,5	9,5	30,0	NA	NA	NA	NA	NA	NA	67,0	97,0	72,0	25,77
1982	20,5	9,5	30,0	NA	NA	NA	NA	NA	NA	67,0	97,0	70,0	27,84
1983	20,5	9,5	30,0	NA	NA	NA	NA	NA	NA	67,0	97,0	78,0	19,59
1984	40,5	9,5	50,0	NA	NA	NA	NA	NA	NA	60,0	110,0	78,0	29,09
1985	40,5	9,5	50,0	NA	NA	NA	NA	NA	NA	60,0	110,0	81,0	26,36
1986	40,5	9,5	50,0	NA	NA	NA	NA	NA	NA	60,0	110,0	84,0	23,64
1987	40,5	9,5	50,0	NA	NA	NA	NA	NA	NA	60,0	110,0	97,0	11,82
1988	40,5	9,5	50,0	NA	NA	NA	NA	NA	NA	60,0	110,0	87,0	20,91
1989	40,5	9,5	50,0	NA	NA	NA	NA	NA	NA	60,0	110,0	92,0	16,36
1990	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

* DIESEL AND STEAM

TABLE C: SWAZILAND ELECTRICITY BOARD STATISTICS

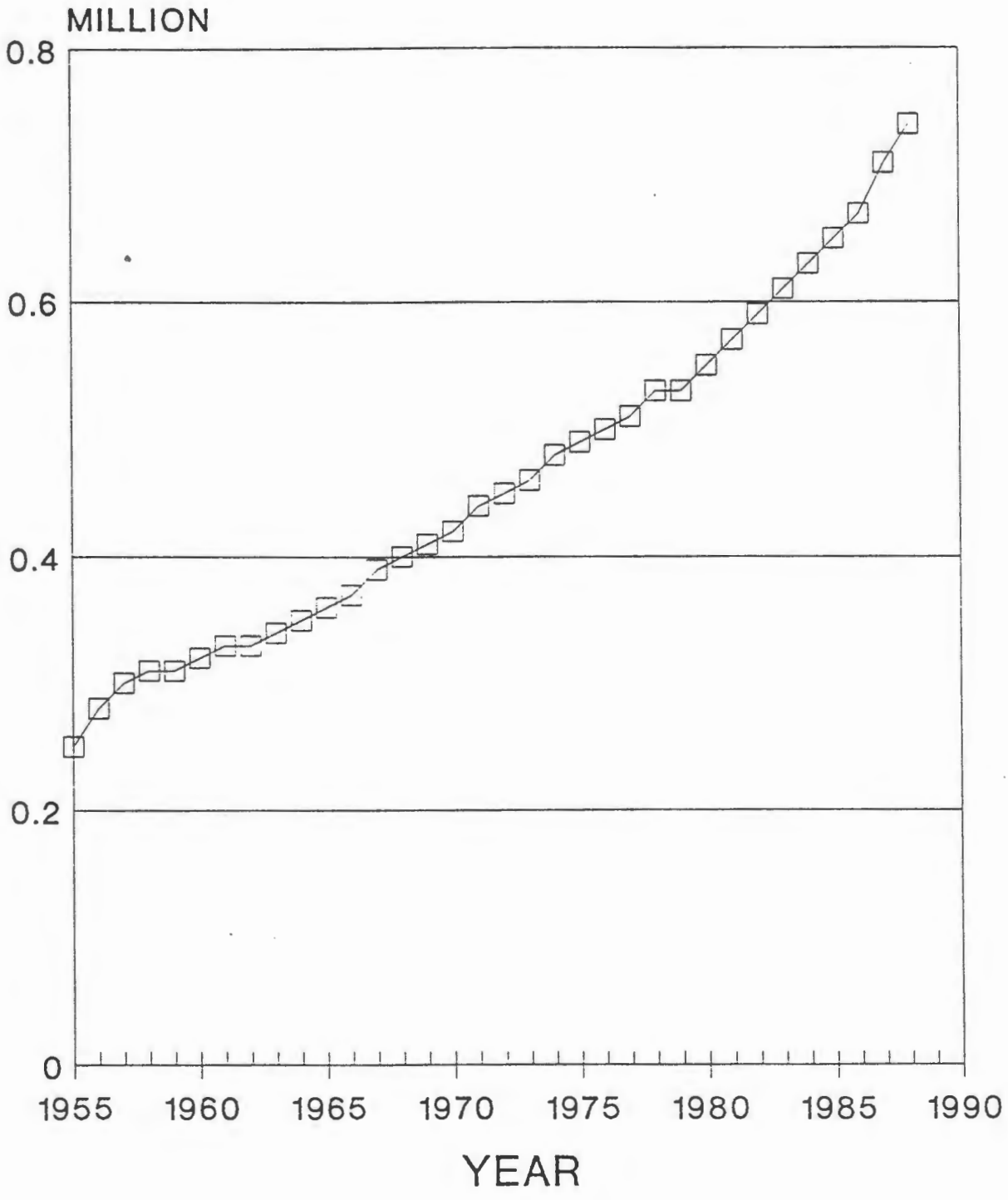
YEAR	ENERGY GENERATED GWh			ENERGY GWh PURCHASED FROM	ELECTRICITY SENT OUT INCLUDING IMPORTS	LOSSES & OWN USE	ELECTRICITY SOLD	INT.USE & LOSSES
	HYDRO	DIESEL	TOTAL	ESKOM	GWh	GWh	GWh	% OF S.O
1964	17.8	0.7	18.5	0.0	18.5	1.3	17.2	7.0
1965	33.8	0.1	33.8	0.0	33.8	3.0	30.8	9.0
1966	39.8	0.1	40.0	0.0	40.0	2.9	37.1	7.2
1967	50.0	0.3	50.3	0.0	50.3	5.3	45.0	10.6
1968	64.4	6.3	70.7	0.0	70.7	7.0	63.7	9.8
1969	89.3	1.0	90.3	0.0	90.3	8.6	81.7	9.5
1970	93.7	2.6	96.3	0.0	96.3	10.1	86.2	10.5
1971	91.5	0.8	92.3	0.0	92.3	8.6	83.7	9.3
1972	124.9	5.7	130.6	0.0	130.6	10.5	120.1	8.0
1973	121.1	0.9	122.0	11.8	133.9	12.6	121.3	9.4
1974	121.7	0.5	122.2	18.2	140.4	14.1	126.2	10.1
1975	126.4	2.1	128.6	40.6	169.2	15.9	126.3	9.4
1976	144.8	1.6	146.4	58.9	205.3	21.4	183.9	10.4
1977	120.6	1.3	121.9	102.1	224.0	22.4	201.6	10.0
1978	139.6	4.7	144.3	104.2	248.4	25.6	222.8	10.3
1979	114.4	2.9	117.3	187.9	305.2	29.5	275.7	9.7
1980	123.0	2.0	125.0	209.0	334.0	35.7	298.3	10.7
1981	126.6	2.7	129.3	227.2	356.5	33.0	323.5	9.3
1982	70.4	4.8	75.2	330.6	405.8	40.7	365.1	10.0
1983	79.1	1.0	80.1	309.2	389.3	41.5	347.8	10.7
1984	152.1	2.0	154.1	236.5	390.6	46.2	344.4	11.8
1985	172.2	1.9	174.1	243.1	417.2	51.1	366.1	12.2
1986	150.5	2.3	152.8	282.0	434.8	52.0	382.8	12.0
1987	181.1	1.2	182.3	269.7	452.0	55.8	396.2	12.3
1988	209.9	0.8	210.7	254.6	465.3	52.3	413.0	11.2
1989	198.7	0.8	199.5	298.0	497.5	53.4	444.1	10.7
1990	NA	NA	NA	NA	NA	NA	NA	NA
1991	NA	NA	NA	NA	NA	NA	NA	NA

DATA OBTAINED FROM : INTERNATIONAL HISTORICAL OATA, AFRICA AND ASIA

SWAZILAND ELECTRICITY BOARD ANNUAL REPORTS 1989 AND 1990

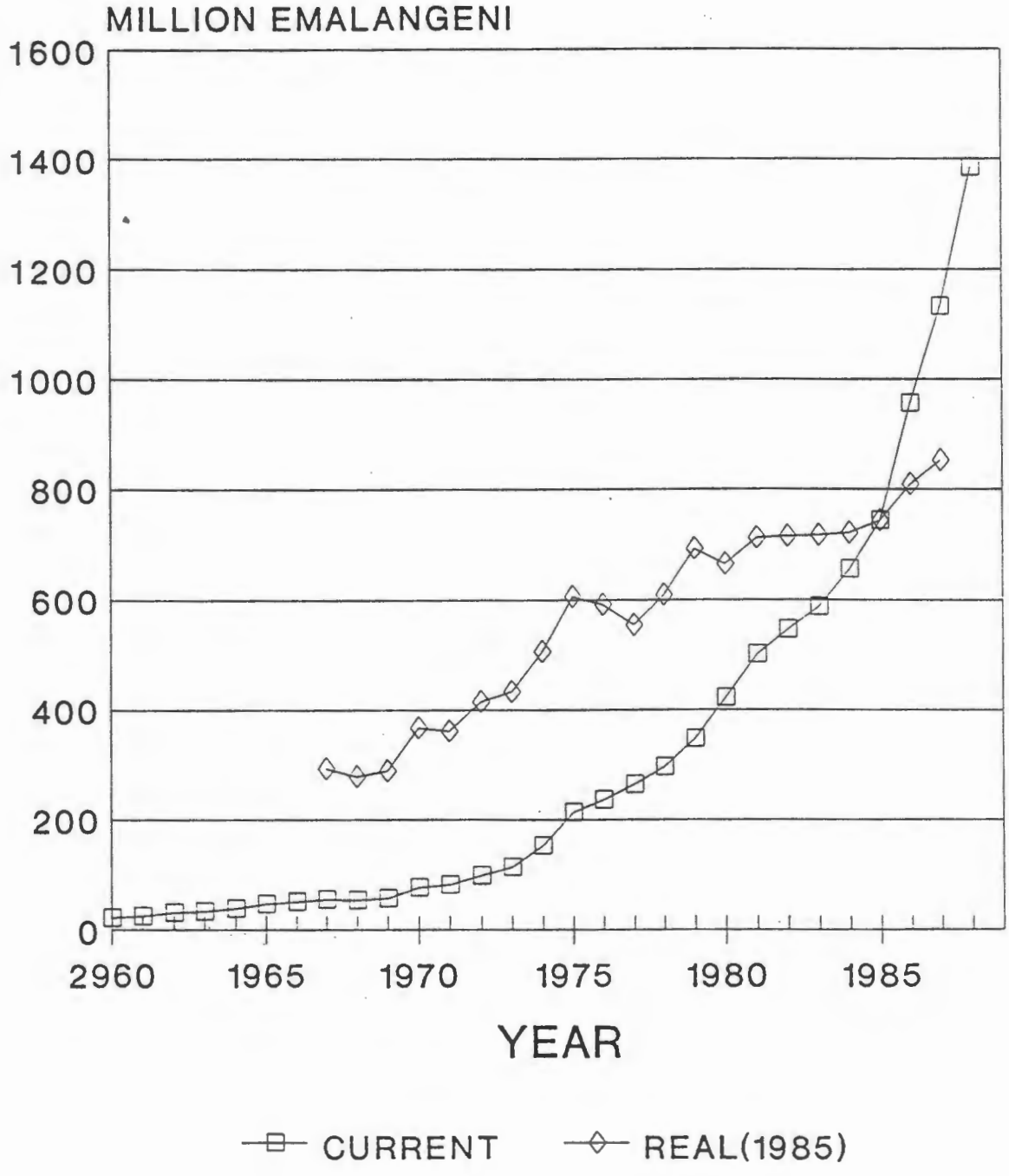
FIGURES

FIGURE 1. POPULATION



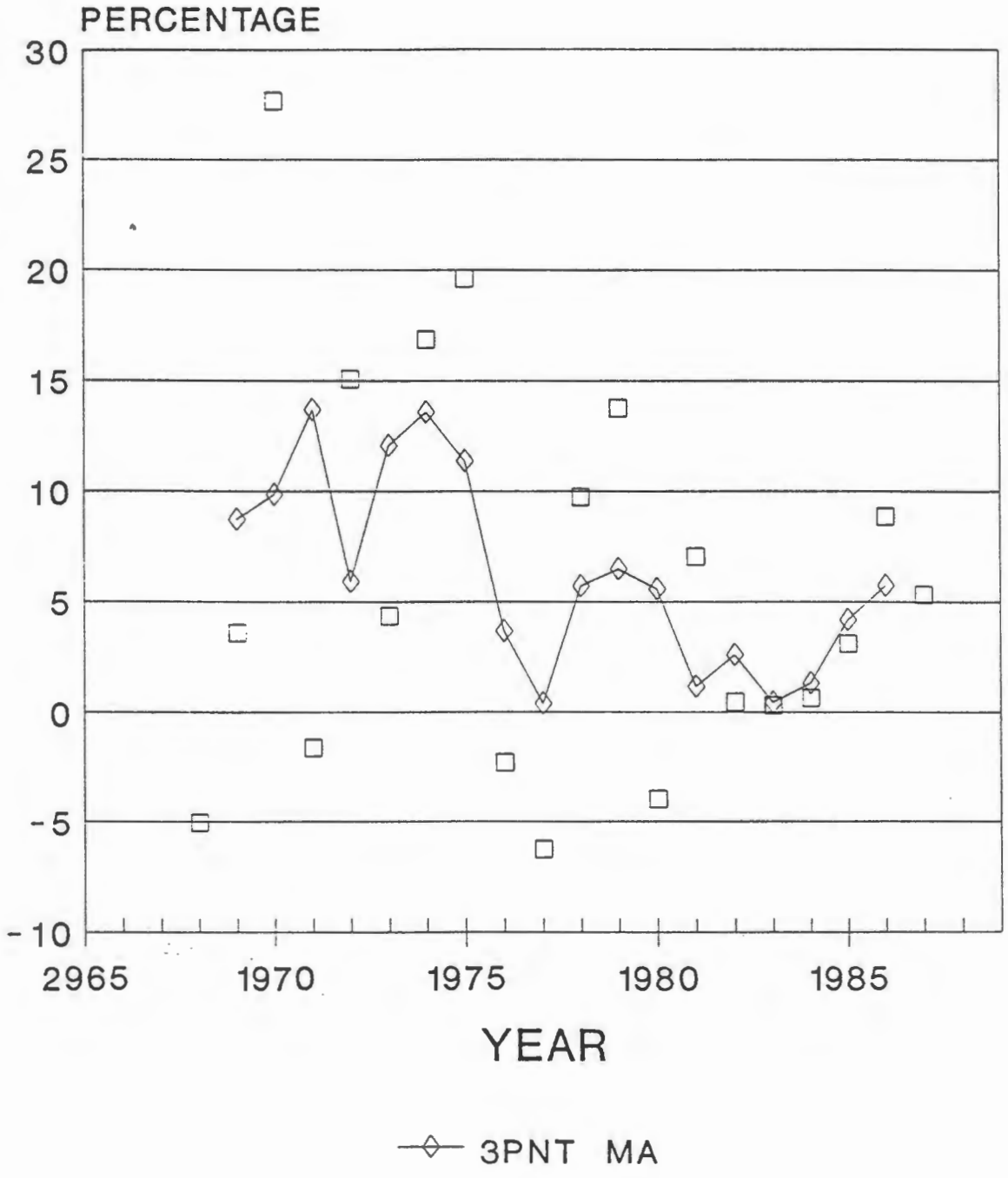
SWAZI/POPULATION/2008

FIGURE 2. GROSS DOMESTIC PRODUCT (MARKET)



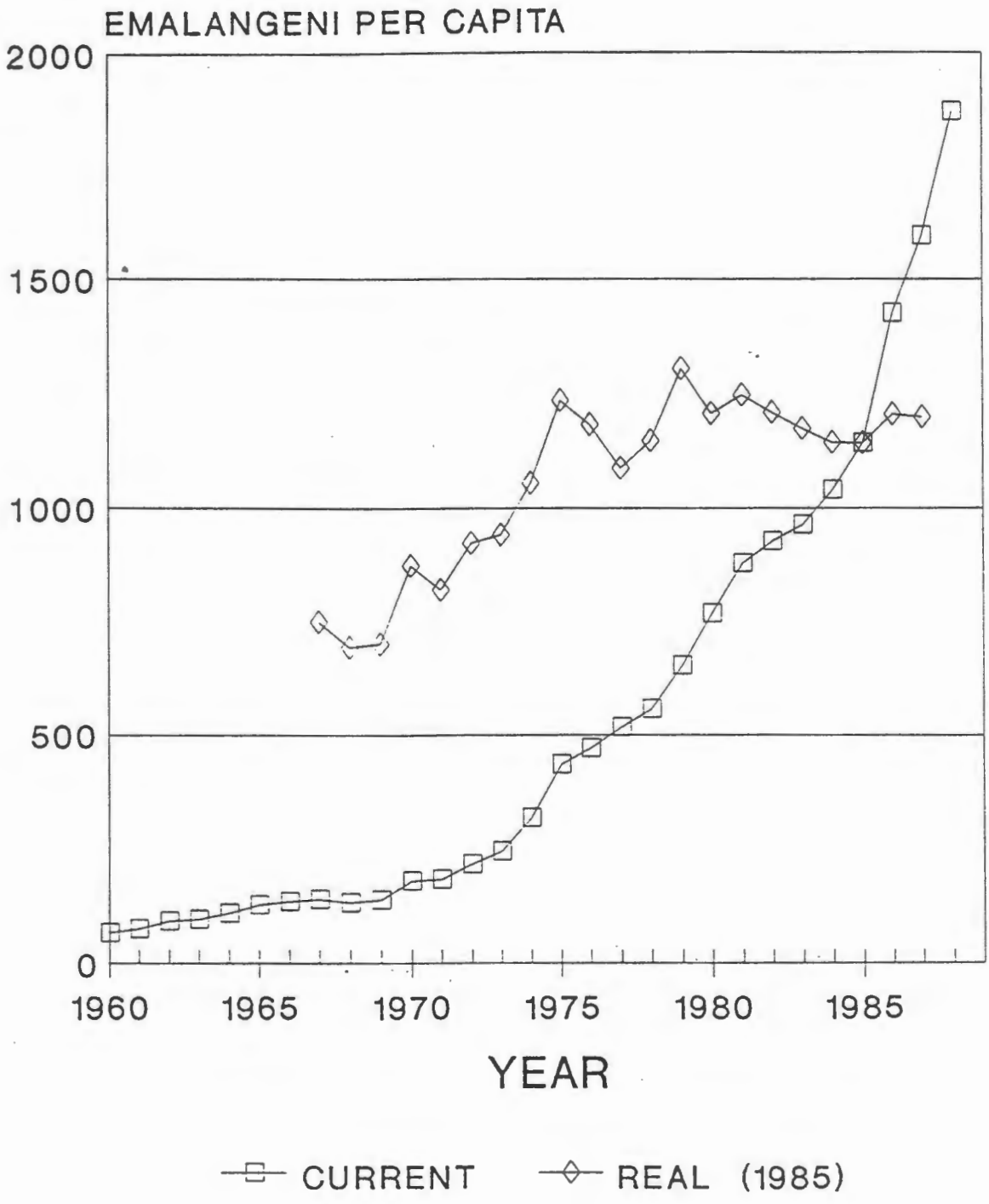
SWAZI/GDP1/2008

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



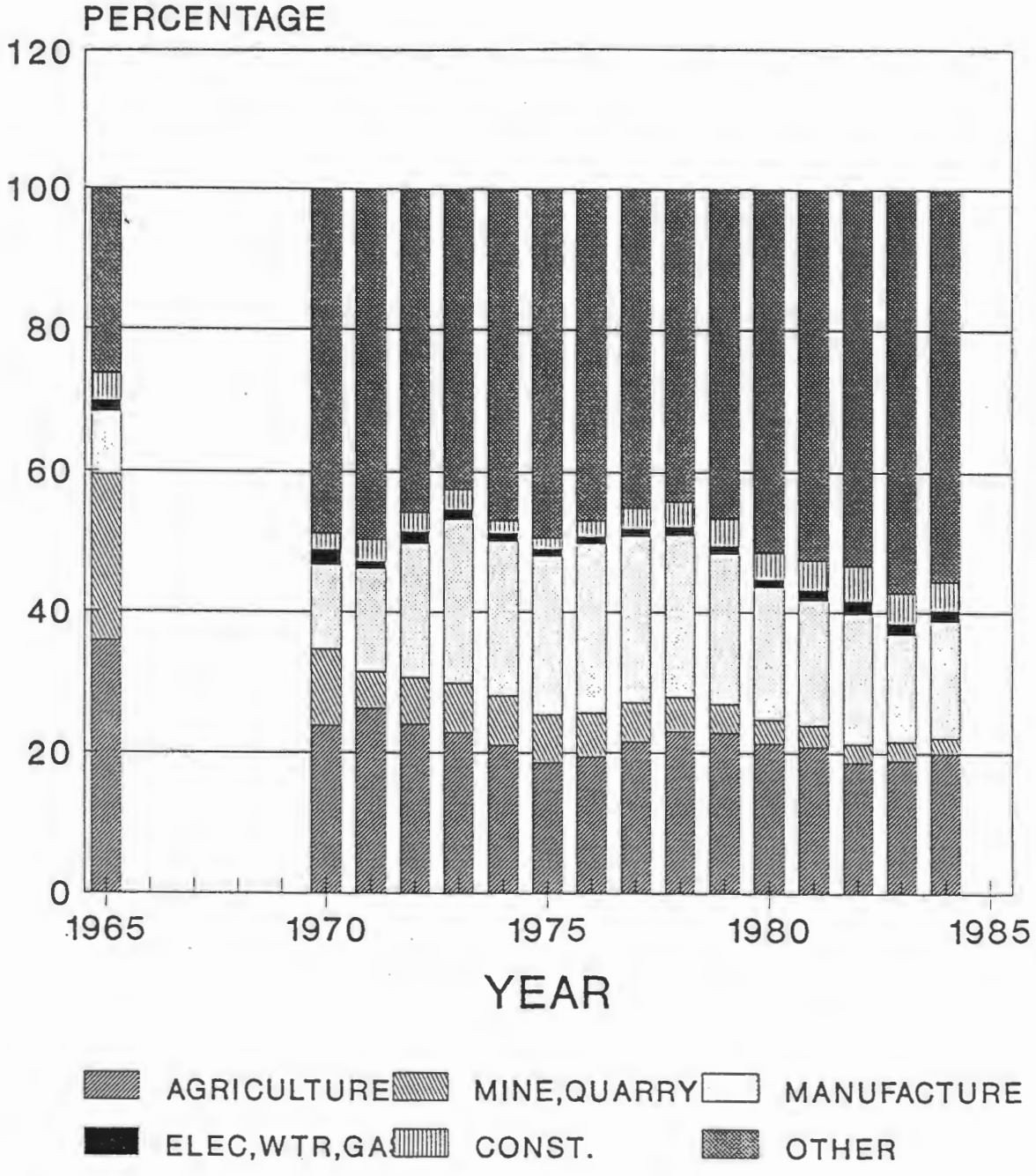
SWAZI/GDP7/2008

FIGURE 4. GDP PER CAPITA



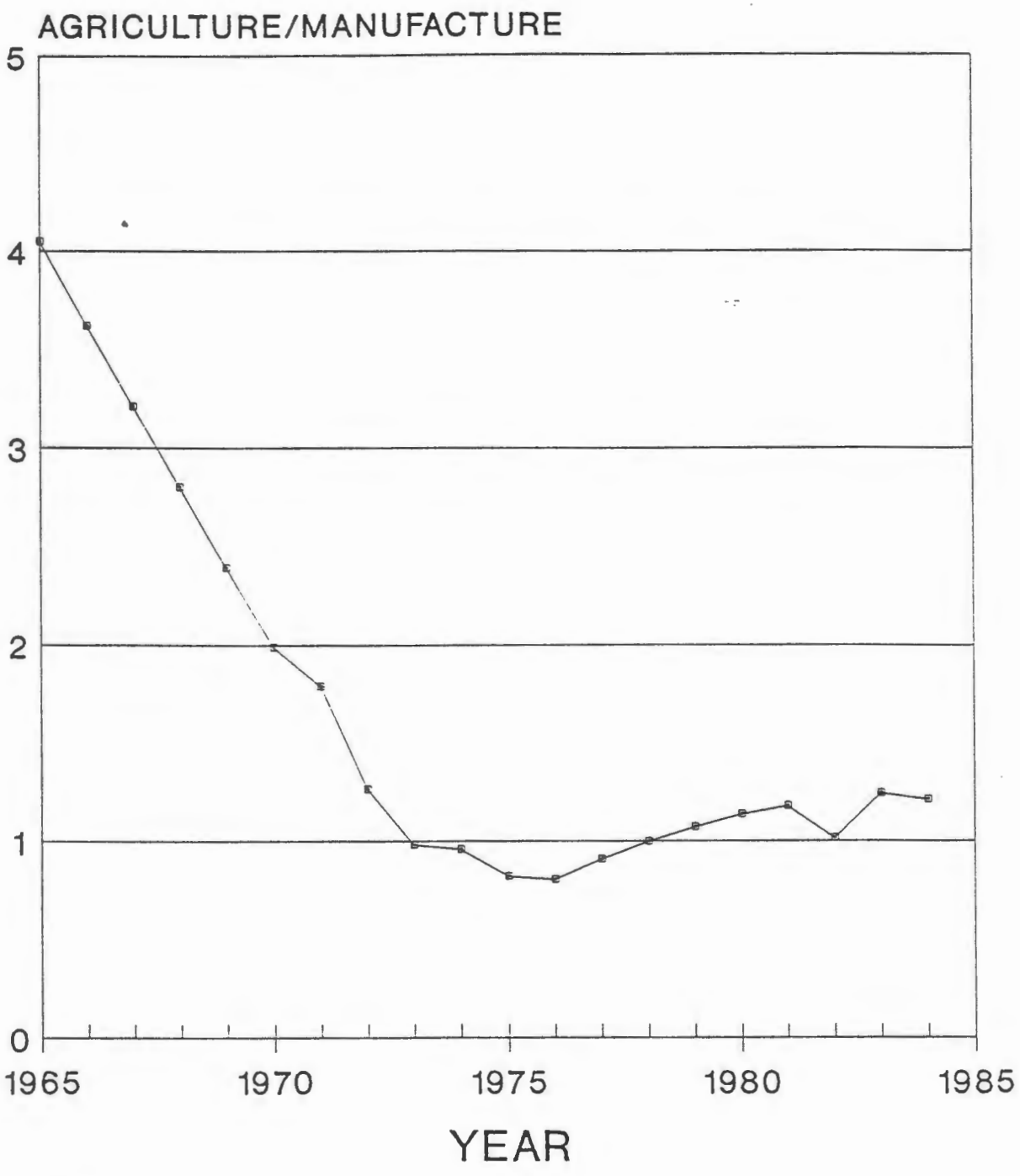
SWAZI/GDP3/2008

FIGURE 5. GDP COMPONENTS AS % OF TOTAL.



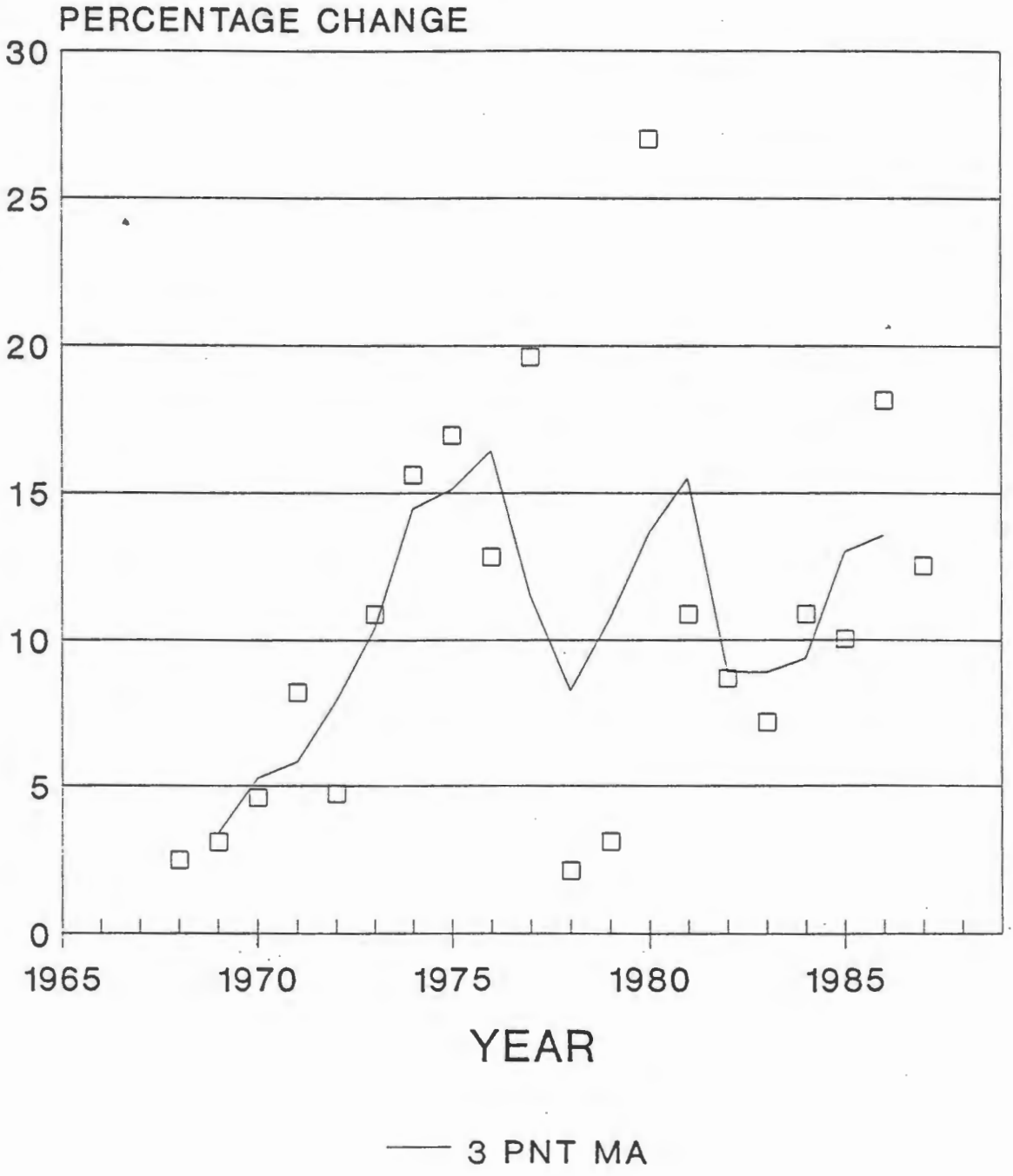
SWAZI/GDP4/2008

FIGURE 6. RATIO OF CONTRIBUTION TO GDP BY AGRICULTURE AND MANUFACTURE



SWAZI/GDP1/2008

FIGURE 7. % CHANGE IN GDP DEFLATOR OVER PREVIOUS YEAR



SWAZI/GDP6/2008

FIGURE 8. TOTAL FINAL CONSUMPTION PERCENTAGE BREAKDOWN (1985)

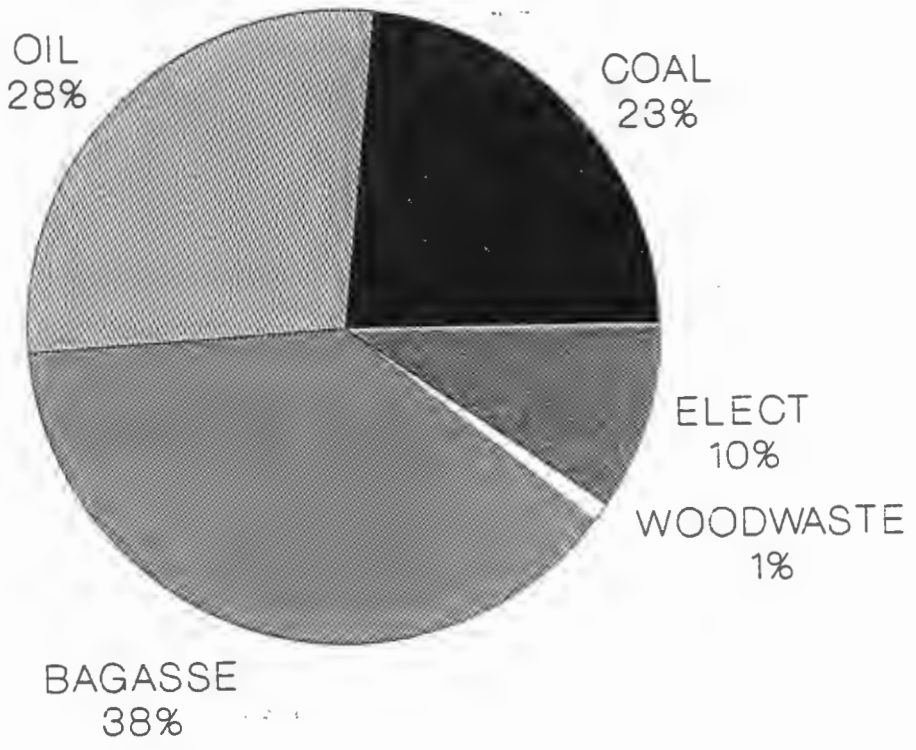
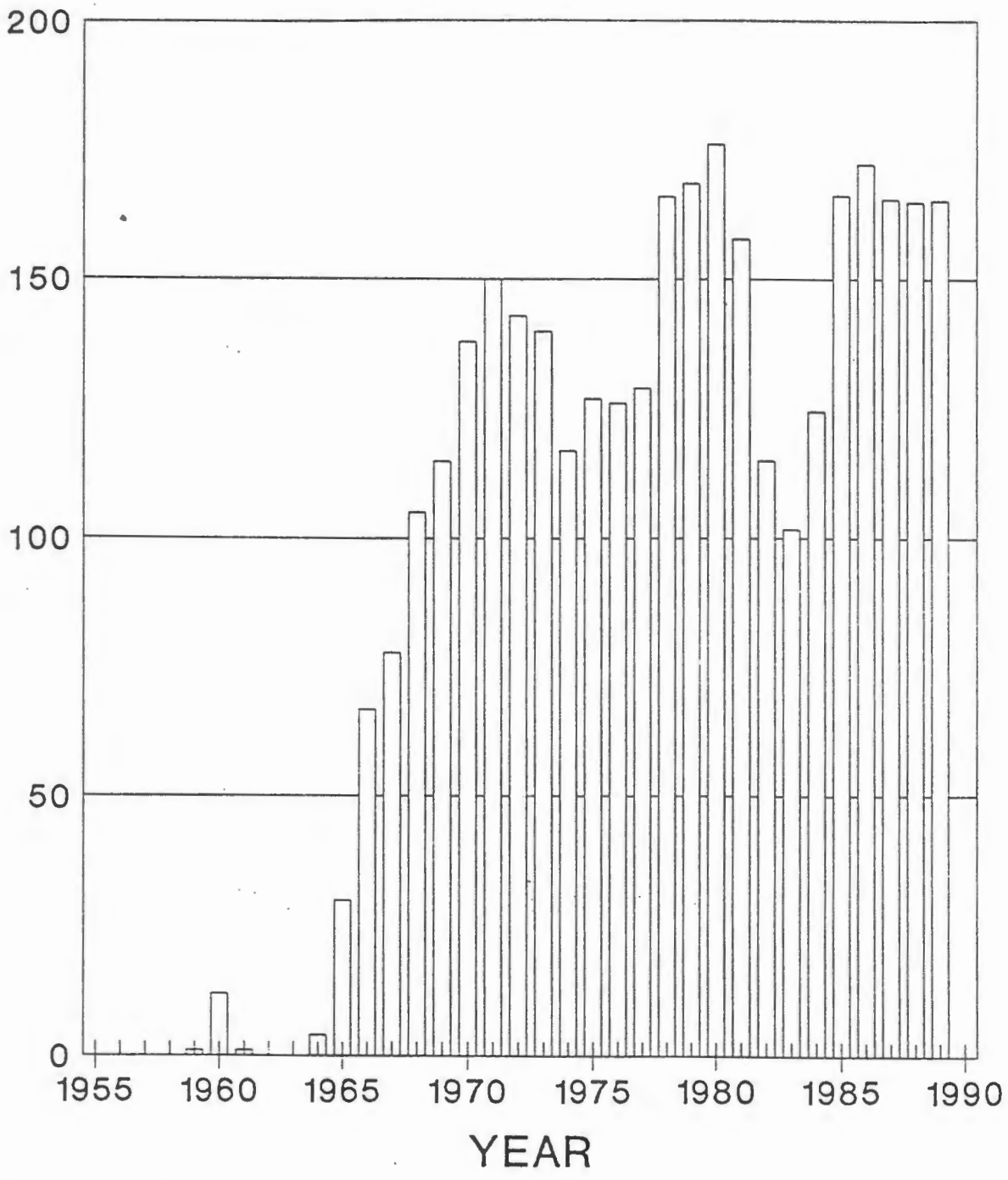
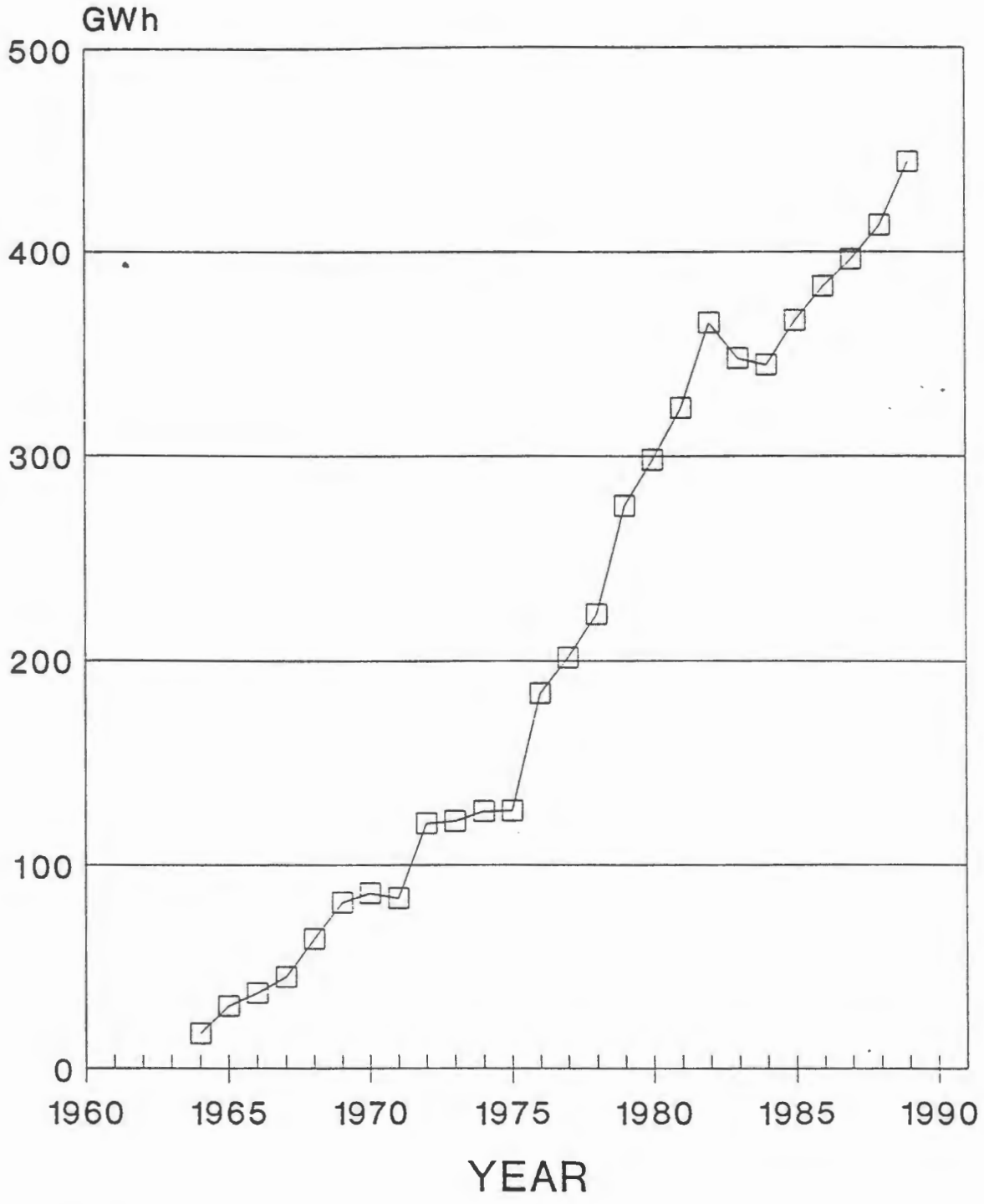


FIGURE 9. COAL PRODUCTION
000'S OF TONS



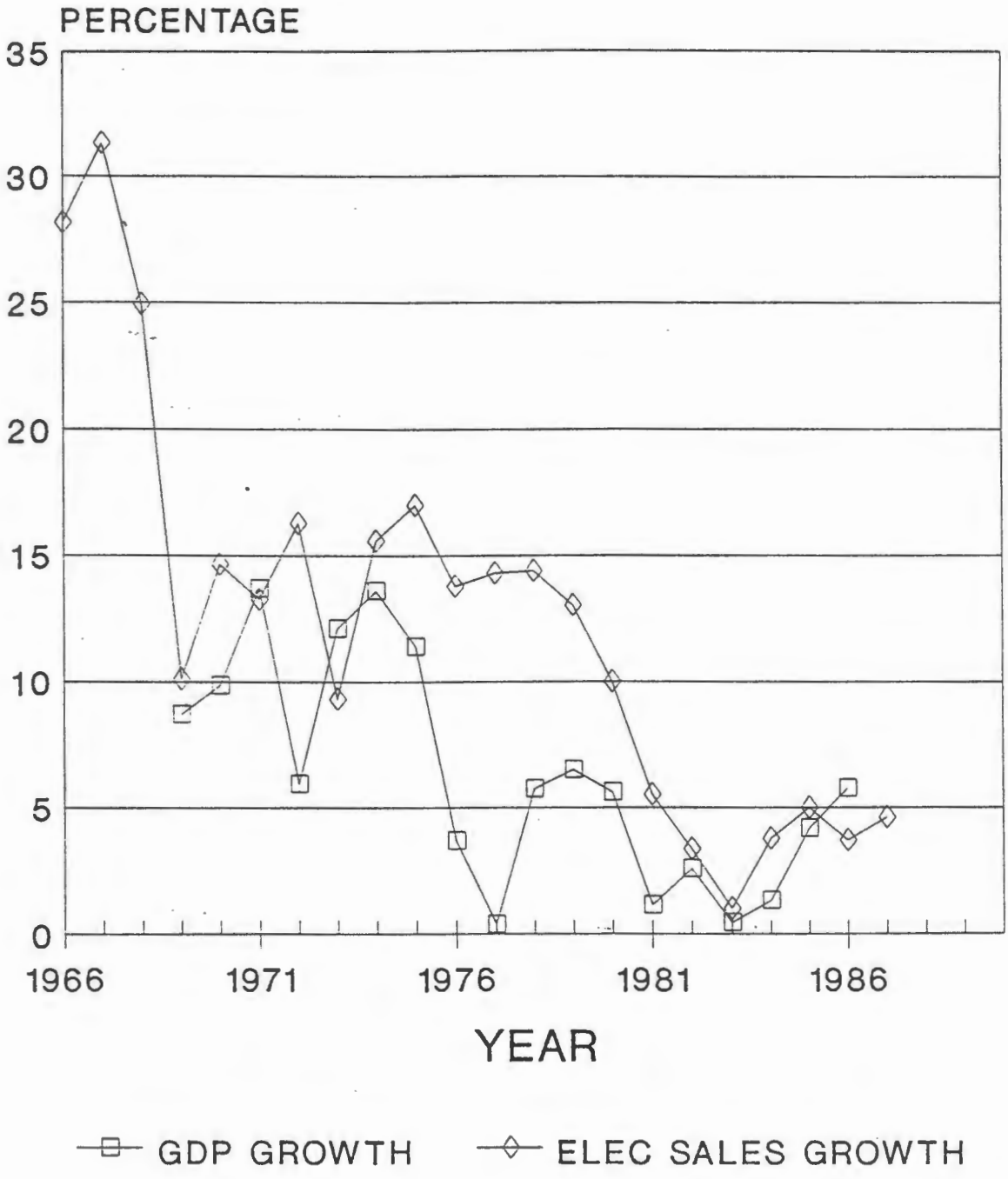
SWAZI/COAL/2008

FIGURE 10. ELECTRICITY SALES BY SEB



SWAZI/ELEC9/2008

FIGURE 11. GDP AND ELEC GROWTH RATE 3 PT M.A.



SWAZI/ELEC6/2008

FIGURE 12. BREAKDOWN OF SEB ELECTRICITY AS % OF TOTAL

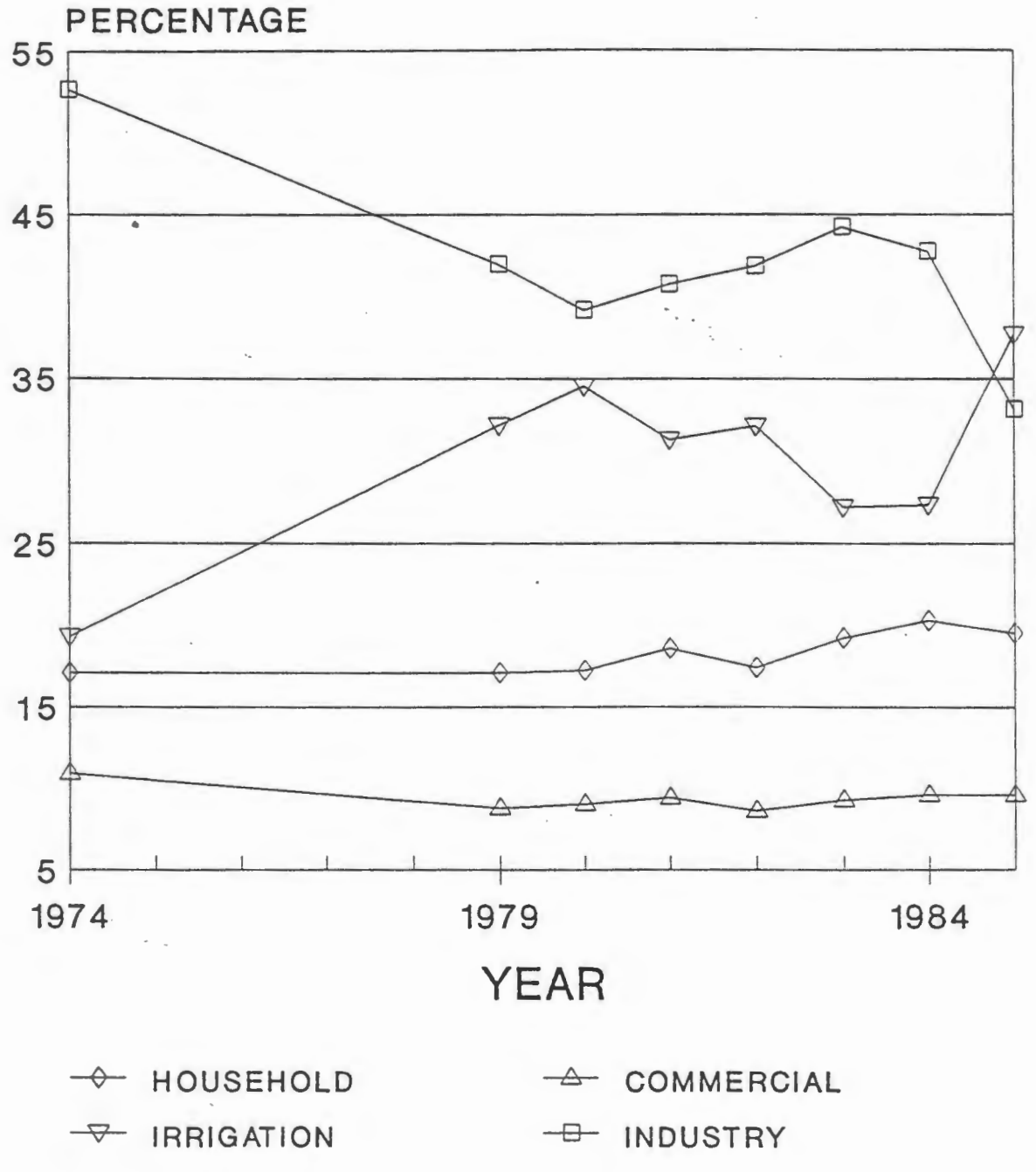
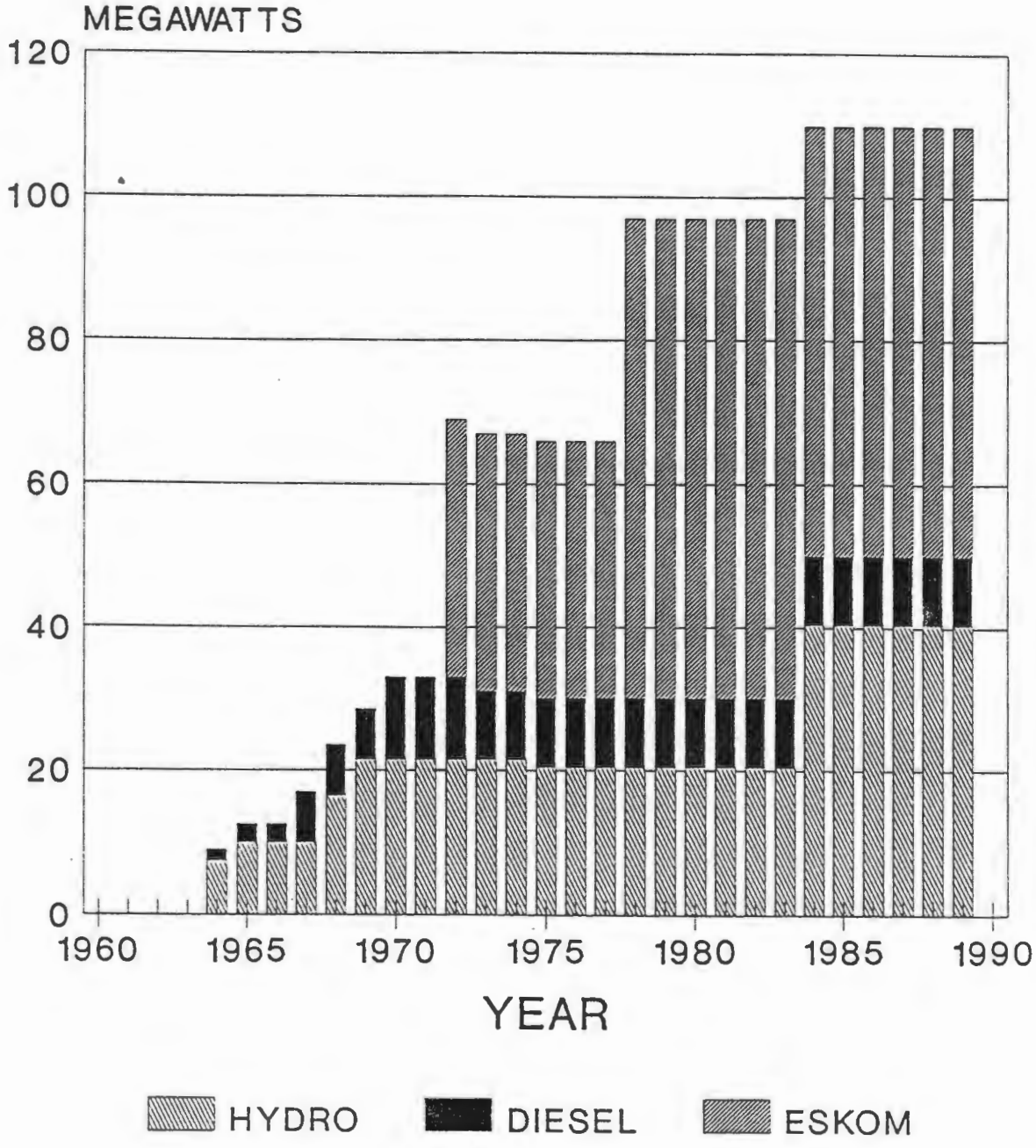
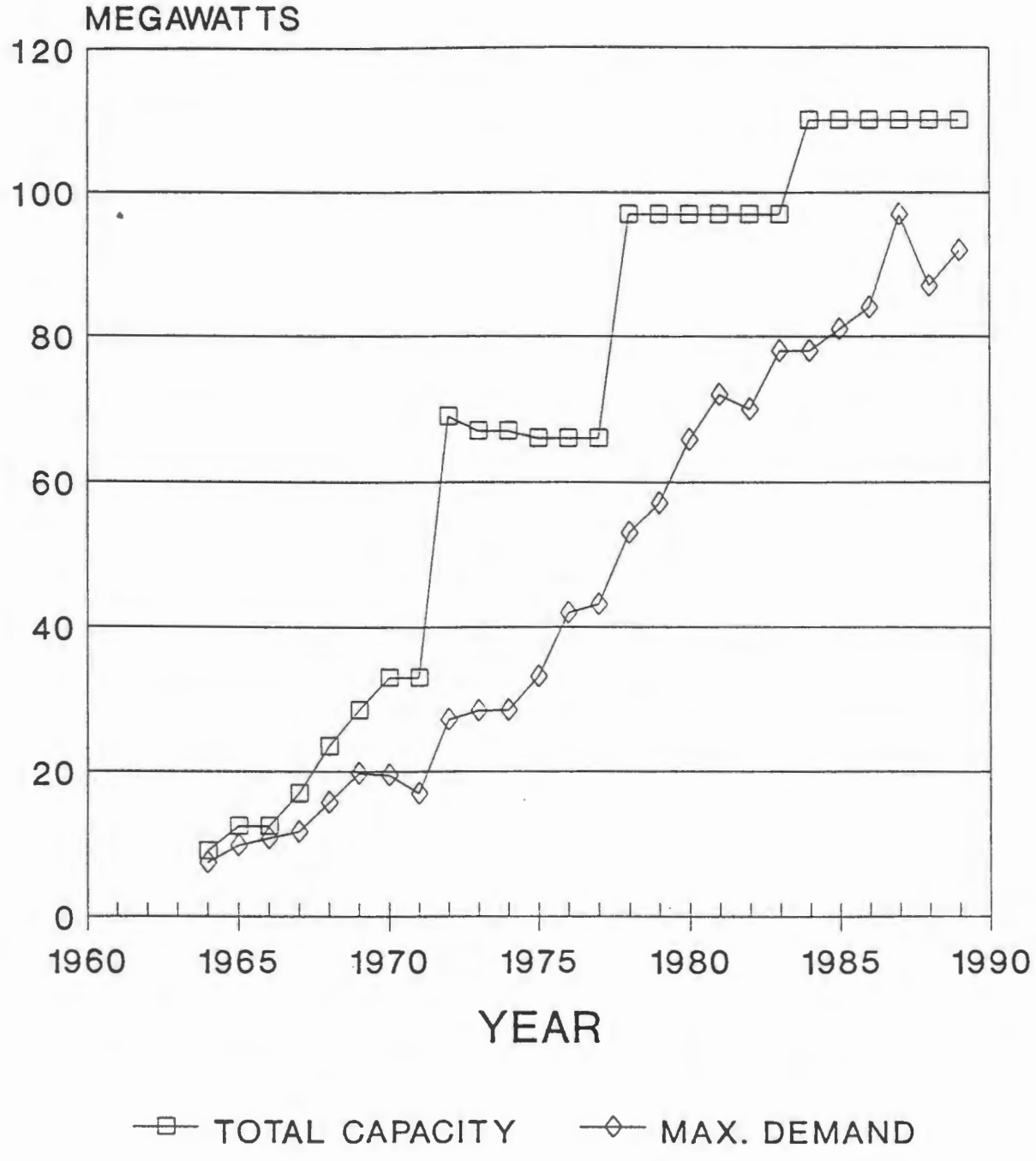


FIGURE 13. ELECTRICAL INSTALLED CAPACITY BY TYPE (SEB) AND IMPORT CAPACITY (ESKOM)



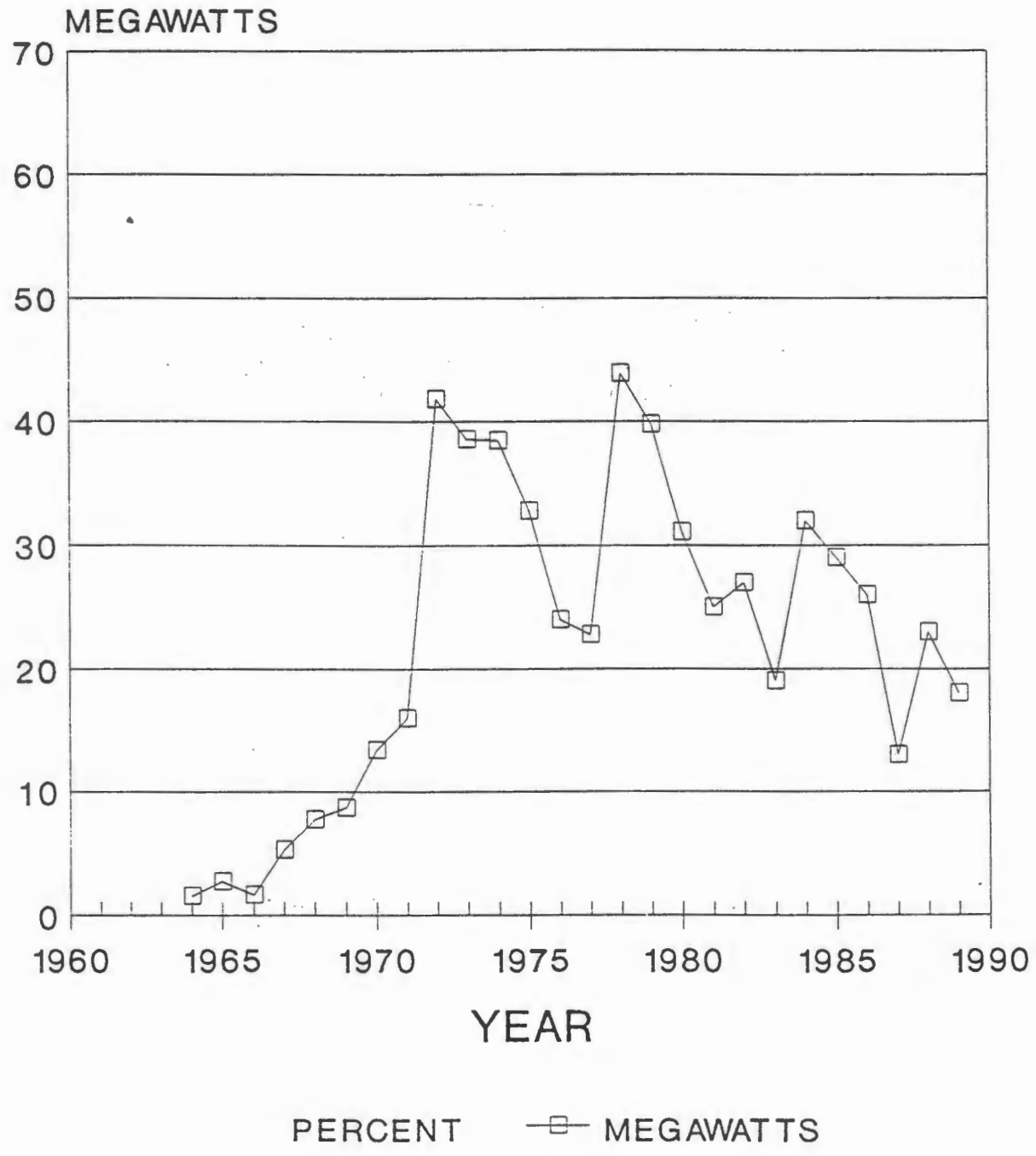
SWAZI/ELEC/2008

FIGURE 14. INSTALLED CAPACITY (INC. ESKOM) AND MAXIMUM DEMAND



SWAZI/ELEC1/2008

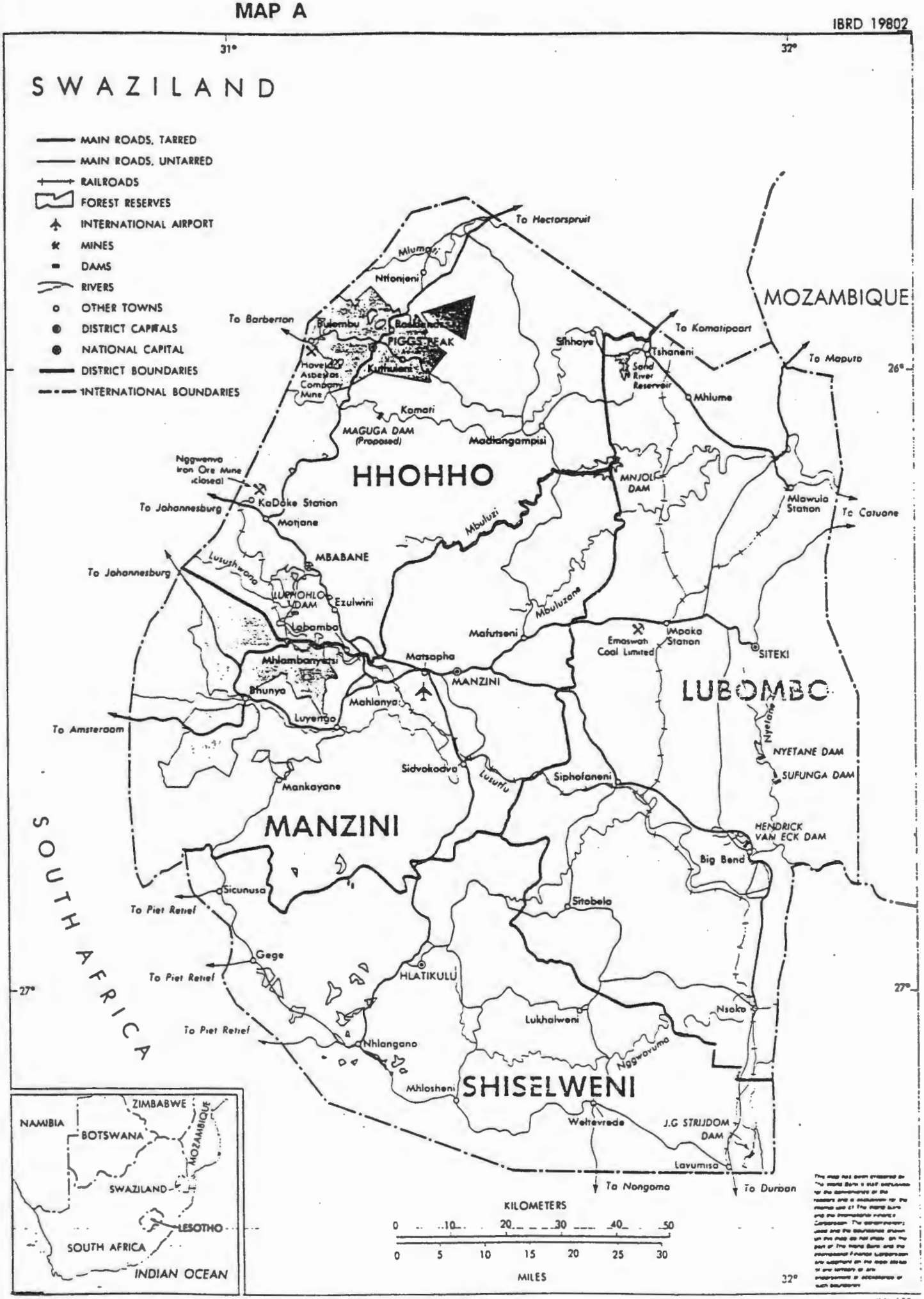
FIGURE 15. SYSTEM RESERVE CAPACITY (INCLUDING ESKOM LINK)



SWAZI/ELEC1A/2008

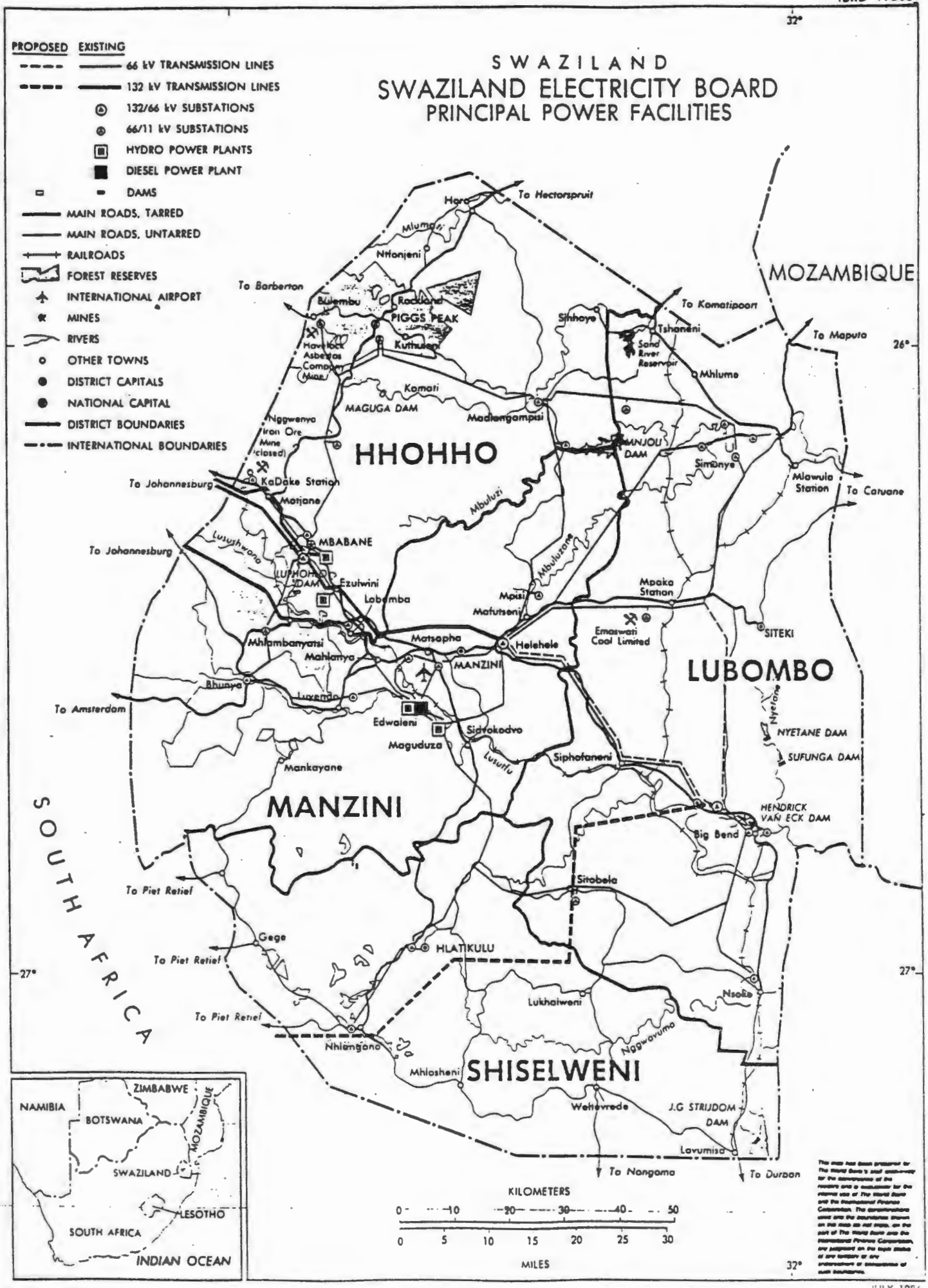
MAPS

MAP A


IBRD 19802
31°
32°
SWAZILAND
MAIN ROADS, TARRED
MAIN ROADS, UNTARRED
RAILROADS
FOREST RESERVES
INTERNATIONAL AIRPORT
MINES
DAMS
RIVERS
OTHER TOWNS
DISTRICT CAPITALS
NATIONAL CAPITAL
DISTRICT BOUNDARIES
INTERNATIONAL BOUNDARIES
MOZAMBIQUE
SOUTH AFRICA
To Hectorspruit
To Barberton
To Komatipoort
To Maputo
To Johannesburg
To Amsterdam
To Piet Retief
To Nongoma
To Durban
To Catuane
Mlumati
Ntfonjeni
Bulembu
Ngwenya
PIGGS PEAK
Havelock Asbestos Company Mine
Kuthuleni
Shhoye
Tshaneni
Sand River Reservoir
Mhlume
Komati
MAGUGA DAM (Proposed)
Madlangampisi
Nggwenya Iron Ore Mine (closed)
KaDoke Station
Motjane
HHOHHO
MNJOLI DAM
Mbuluzi
Mlawula Station
MBABANE
Lusushwana
LUPHOHLO DAM
Ezulwini
Lobamba
Mbuluzane
Mafutseni
Emaswati Coal Limited
Mpaka Station
SITEKI
Mhlambanyatsi
Matsapha
MANZINI
LUBOMBO
Bhunya
Mahlanya
Luyengo
Nyetane
NYETANE DAM
SUFUNGA DAM
Sidvokodva
Lusutfu
Siphofaneni
Mankayane
MANZINI
HENDRICK VAN ECK DAM
Big Bend
Sicunusa
Sitobela
Gege
HLATIKULU
Lukhalweni
Nsoko
Nhlangano
Ngwavuma
Mhlosheni
SHISELWENI
Weltevrede
J.G STRIJDOM DAM
Lavumisa
KILOMETERS
0 10 20 30 40 50
0 5 10 15 20 25 30
MILES
27°
26°
NAMIBIA
ZIMBABWE
BOTSWANA
MOZAMBIQUE
SWAZILAND
LESOTHO
SOUTH AFRICA
INDIAN OCEAN

MAP B

IBRD 19803



JULY 1984

MAP C

IBRD 19804