# Household hydrocarbon fuels

Guy McGregor

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# Executive summary

## 1.0 Introduction

The hydrocarbon fuels, namely illuminating paraffin (IP), liquefied petroleum gas (LPG), candles and coal, are important household fuels in South Africa. They are likely to continue to play a big role, and this paper examines the contribution they can make toward meeting the energy needs of the urban and rural poor.

## 2.0 Problems experienced with current use

The principal problems surrounding the use of the hydrocarbon fuels are affordability, safety and access. Coal is available close to the coal mines, but because of its mass, transport costs limit its affordability the further the consumer is from the mine. There are serious pollution problems associated with conventional coal use. Suspended particulate levels in the PWV are around seven times higher than the World Health Organisation's safety levels. However, low smoke coal, although currently in the development phase, could help alleviate this problem.

There is a network of 178 oil company depots located around the country. The price of IP ex these depots is regulated by government. Oil companies are given a 15% return on their assets and various handling charges are incorporated on a cost recovery basis. This price build-up results in a wholesale price ex depot which excludes the fuel levy placed on petrol and diesel. This price is therefore relatively low. The price of LPG is not regulated.

The problem of affordability in respect of the hydrocarbon fuels arises because of the number of middle-men who make up part of a long distribution chain between the depot or coal mine and the consumer. Table 1 below highlights the average mark-up found in this distribution chain in 1992 by the Palmer Development Group.

| *Fuel* | *Wholesaler* | | | *Retailer* | | | *Total* |
|---|---|---|---|---|---|---|---|
| | Purchase price | % mark-up | Retail price | Purchase Price | % mark-up | Retail Price | % mark-up |
| IP c/l | 0.88 | 11.38 | 0.98 | 0.96 | 44.75 | 1.39 | 60.0 |
| LPG c/kg | 1.62 | 63.00 | 2.65 | 2.15 | 74.00 | 3.73 | 130.0 |
| Coal c/kg | 4.99 | 73.00 | 8.64 | 8.80 | 130.00 | 20.24 | 301.0 |

**TABLE 1 Hydrocarbon fuel distribution chain summary (1992)**
*Source: Palmer Development Group (1993)*

## 3.0 The petroleum and coal supply industries

The petroleum industry in South Africa is regulated by government in terms of agreements covering all aspects of operations from procurement to marketing. The nature of the current regulatory mechanism is complex as its aim is to achieve a balance between securing the future supply of a strategic commodity while ensuring a competitive environment. The principal regulation affecting the distribution of IP and LPG is a fixed maximum wholesale price for IP. This mechanism is used by the oil industry to determine the LPG price. The oil companies discount this price to distributors ex depot and this paper will focus on methods to ensure that these discounts are passed on to the consumer in the form of lower retail prices.

It is not anticipated that there will be a supply problem in respect of IP and LPG even though they account for relatively small outputs from each barrel of crude oil (3% and 2.1% respectively).

South Africa is well endowed with coal and has the fifth largest reserves in the world (Minerals Bureau 1992a). It is also the fifth largest producer and in 1992 produced 180.1 million tons. South Africa is also the third largest exporter.

The coal industry is supported by a big local market with 72% used domestically, primarily by Eskom at 40% of total coal production, and Sasol at 20%. Industry, comprising producers of cement, bricks, refractors, water supply utilities and the agricultural sector, uses 7%. The principal user of metallurgical coal is Iscor at around 3% of total South African coal production, with household consumption of around 3 million tons or 1.6% of total production.

The coal used by households is primarily nuts, the second largest of the four coal sizes. Coal ranges from grade A (highest energy content) to grade D (least energy content), with household coal generally at grade C (Palmer Development Group 1993). The calorific value of nuts is relatively high. However, so is the ash content. This results in particulates being given off which, in the confined space of a household, in a densely populated urban area, comprise a major pollution hazard and this report therefore proposes the substitution of conventional coal with low smoke coal.

Owing to its bulk and mass, and the long distances that it must be transported, coal is generally distributed by specialist coal merchants. This is contrary to the distribution of the other household hydrocarbon fuels. The Palmer Development Group (1993) found that IP retailers also sell LPG and vice versa. Another finding was the proliferation of IP retailers relative to coal and LPG, where 563 retailers of IP were found in the five black townships surveyed, (Alexandra, Mamelodi, Orange Farm, Sebokeng and Tumahole), while only 19 LPG and 45 coal retailers were found.

## 4.0 Consumption and demand for hydrocarbon fuels

IP and LPG sales growth was 5.5% per annum and 7.7% respectively during the period 1988 to 1992 compared to an average GDP growth of 0.3%. In addition, the persistence of multiple fuel use, even when electricity is available, suggests that there is a significant role for the hydrocarbon fuels in a developing economy such as South Africa's.

The EPRET database shows the continued importance of wood as the primary fuel used by the rural poor. However, IP, candles and LPG, become more important fuels once one moves out of the 'homelands'. The dominance of coal use in the vicinity of the coal fields is also apparent from the database.

The future demand for IP, candles and LPG will be determined largely by electrification and housing provision. Coal demand is unlikely to be affected to the same extent, given the role it plays in space heating and cooking, and the durability of the coal stove.

IP is favoured for its convenience and accessibility: it can be purchased in small quantities and its appliances are cheap. However, consumers have negative perceptions of IP, considering it to be dirty and smelly. Furthermore, there is a status factor in moving away from IP to fuels such as LPG and electricity.

The oil industry is attempting to counter these negative perceptions and constraints, and smokeless IP is being developed. IP is also dangerous owing to the possible ingestion of it by infants and small children, as small retailers and householders frequently place it in beverage bottles. Investigations are proceeding to produce a cheap reusable child-proof cap. However, the prototypes produced so far are expensive. Another initiative is to add colour to the paraffin so that it will not be mistaken for mineral water or water. Progress is being made using this idea.

While many consumers consider LPG to be dangerous and the appliances are expensive, it is in many ways a desirable fuel. Subsidising the cost of appliances should be considered. Advertising campaigns to promote LPG as a safe product are undertaken by the oil companies but this should be broadened.

Candles are widely used for light in the rural and urban areas in the absence of electricity. However, in some electrified households, particularly those with limited electricty provided by 'readyboards', the wiring stops in the kitchen, so that candles are still used in the bedrooms.

The EPRET project has developed two scenarios of future demand for household fuels, a 'business as usual' scenario, and an 'integrated energy planning' scenario. These scenarios focus largely on electricity provision. In the 'business as usual' scenario, current slow progress in electrification is expected to continue, while according to the 'integrated energy planning' scenario, the electrification programme is accelerated. In the 'business as usual' scenario, the volume of hydrocarbon fuels sold, particularly IP and LPG, does not decline by the year 2010. They remain important fuels, with IP playing a particularly important role in the rural areas. Sales of hydrocarbon fuels are projected to be affected negatively in the 'integrated energy planning' scenario.

## 5.0 Suggested policy interventions

IP and LPG attract no tax levy with the exception of the 7 cents per litre equalisation fund levy which applies only to IP, so that the maximum wholesale selling price ex oil company depot is relatively low. However, although there is an extensive network of oil company depots, delivery by oil companies in most cases, does not extend beyond the depot. There are three main reasons for this:

a) The 'drop' size, or amount of fuel delivered to a single IP or LPG retail outlet is small, and oil companies currently use routers, who are prepared to make small drops, and hawk the fuel at retail outlets. The IP market, in particular, is highly competitive so that oil industry discounts of around ten cents per litre, or 40% of the combined government controlled handling and delivery allowance (that is, the service differential) plus an oil industry wholesale margin, are not uncommon.

   The uncontrolled LPG price has a wholesale margin of 33 cents per kilogram and a distribution charge of 36.2 cents per kilogram. Most of the distribution cost differential is discounted, and where the market is a highly competitive one, oil companies will also discount a portion of the wholesale margin.

b) The turmoil in the townships discourages oil companies from using their own vehicles for deliveries. They will, however, use their bulk trucks to deliver to the bigger LPG retail outlets in relatively safe areas. These retail outlets will, however, be tied to that oil company by a sales agreement. An extension of oil company control of IP and LPG distribution would enable oil companies to decrease IP and LPG prices.

c) A third problem is credit collection. Township distribution is fraught with problems of bad debt. However, by limiting the number of middlemen in the distribution chain and initially delivering to the bigger retail outlets, bad debts could be overcome and prices more easily reduced.

Lower prices can be implemented through extending the oil company distribution network and by regulating prices at the larger retailers receiving these cheaper deliveries. Policing the implementation of lower prices could be achieved in two ways: firstly, by greater community involvement and secondly, by increasing regulation over IP and LPG distribution. The first option would work better in closely-knit rural communities. The second would be better suited to the urban environment. In both cases, however, the pricing advantages of bulk buying must be conveyed to the consumer, particularly as higher transport costs will be incurred by the consumer when transporting heavy fuels from the bigger retail outlet which may not be as conveniently placed as a more expensive spaza shop.

Low smoke coal is produced primarily by two methods. The ENERTEK Division of the Council for Scientific and Industrial Research, is developing a technology which uses a cement binder to produce coal briquettes out of duff coal. This process produces fewer particulates and consequently less smoke. A second technology has been developed by the University of the Witwatersrand in conjunction with United Carbon Producers. Coal mine discards are heated to between 500C to 600C to drive off the volatiles and produce low smoke coal. Both are slow to ignite and friable, and acceptance by the community and by the coal merchants of these low smoke coals is of pivotal importance. Here the higher cost will be a crucial factor.

In conclusion, the proposed policy intervention is to replace conventional coal with low smoke coal. This will require subsidies in order to gain acceptance by price-conscious households. There are cost advantages in the distribution of low smoke coal, but these are likely to be more than offset by higher costs of production. Nevertheless, as in IP and LPG, the costs of distribution can be decreased.

Table 2 summarises the benefits of these proposed policy interventions for the urban and rural poor.

| *Fuel* | *Wholesale price* | *Discount* | *Plus 33% retail mark - up* | *Estimated saving* | *Annual Saving (million)* |
|---|---|---|---|---|---|
| IP c/l | 83.23 | 8.9 | 99.0 | 40.0 | R270 |
| LPG c/kg | 212.25 | 36.2 | 233.0 | 140.0 | R210 |
| Coal | subsidy | R180m | (R1.00/ton tax on normal coal) | | |

**TABLE 2** Hydrocarbon fuel policy intervention summary

In summary, the cost of energy to the consumer can be decreased if households continue to use a range of fuels after electrification. The supply institutions should therefore cooperate in an open manner to achieve this. Eskom is currently initiating discussions with the oil companies through the Integrated Energy Planning Forum which should be encouraged.

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# CHAPTER ONE

# Introduction

This paper will outline the extent to which the hydrocarbon fuels, namely illuminating paraffin (IP), liquefied petroleum gas (LPG), candles and coal, are able to satisfy the energy needs of the urban and rural poor in South Africa. The paper concentrates on supply-side issues of pricing and distribution, with the end-use emphasis occurring in Williams (1993) 'Energy supply options for urban households'. The rural environment is being investigated in EPRET papers 6, 7, 8A, 8B and 10. Similarly, appliances will only be dealt with briefly. A more in-depth analysis can be found in Thorne (1993) 'Energy efficiency and conservation'.

## 1.1 Background

It has been estimated that 23 million people living in 3 million households do not have access to electricity (Eskom 1991). Similarly, firewood contributes, on average, about three quarters of rural primary energy consumption. Extensive consumption of wood is outstripping supply in many areas.

IP and LPG volume growth was 5.5% and 7.7% per annum respectively during the period 1988 to 1992. In addition, multiple fuel use, even when electricity is available, suggests that there is a significant role for the hydrocarbon fuels in a developing economy such as South Africa's. Availability of all fuels allows the user to choose the most convenient fuel based on their own personal criteria.

Low price and high income elasticities for IP and LPG in rural and newly urbanised communities also suggest that continued use of these fuels is likely for some time (McGregor 1992). A low price elasticity implies a less than proportional drop off in consumption in response to a specific price increase. A high income elasticity, on the other hand, indicates a more than proportional increase in consumption in response to an increase in income.

## 1.2 Objectives

The objective of this paper is to review current supply and demand for hydrocarbon fuels within the total energy matrix of the urban and rural poor, and to make policy recommendations that will ensure that the projected demand is optimally met.

## 1.3 Scope

The scope of this paper is to assess the potential of the hydrocarbon fuels, namely IP, LPG, candles and coal, in satisfying the household energy needs of the urban and rural poor. It will link with research reported in the other EPRET papers particularly those focusing on the role of the other energy carriers, such as electricity, afforestation and woodland management. Policy proposals are formulated to enhance the effectiveness of these fuels as determined by identified consumption and projected demand.

## 1.4 Research methodology

Current consumption data sourced from the EPRET's database (Trollip 1993) is checked against supply data from the oil companies in the case of IP and LPG. In the light of high and growing demand, continuity of supply is determined by assessing the potential growth of the main petroleum products, namely petrol and diesel, and the ability of domestic refining capacity to meet the demand for IP and LPG. Future hydrocarbon fuel demand is derived from EPRET's LEAP model. Policies based on the previous analyses are then made.

## 1.5 Outline of the report

The historical evolution of the petroleum industry is discussed. The report then focuses on the current supply structure and the regulations governing it. Here the ability of the industry to supply high and growing demand for IP and LPG within the constraints of the demand for other fractions of the barrel is analysed. The distribution facilities are outlined, and the efficacy of this network in supplying the needs of the urban and rural poor is assessed. The possibility of extending the oil company distribution network in order to keep prices down, is evaluated. An assessment of the desirability of distribution regulation or of increased competition, completes this analysis. The role of the coal industry is assessed using the same methodology.

Chapter 3 analyses current consumption of hydrocarbon fuels. Here the propensity to consume IP, LPG, candles and coal is assessed within the Development Bank of South Africa's (DBSA's) nine regions.

Chapter 4 projects the demand for IP, LPG, and coal based on the above review of current consumption. Candles are omitted owing to the inability of the EPRET LEAP model (see below) to forecast candles usage. The projections are executed on a regional basis in order to capture the impact of alternative fuel supplies such as electrification, afforestation and woodland management. The basic forecasts use the EPRET LEAP model as noted above. The two EPRET scenarios inform projections of hydrocarbon fuel demand.

Finally, Chapter 5 deals with policy interventions to optimise the supply of identified hydrocarbon fuels to the urban and rural poor. These include issues such as supply options, distribution regulation, the introduction of low smoke coal and retailer competition and the financing of these policies. The links with electrification, and afforestation and woodland management will also be assessed. Price reductions beyond the Government-regulated wholesale price for IP are envisaged, with the substantial mark-ups in the informal distribution sector being curtailed, and the larger retailers playing a more substantial role. The scope of this paper does not allow for an examination of policy options in the currently government-controlled oil industry regulatory mechanism. Wide-ranging investigations involving government, business and labour are looking at the efficacy of regulation versus deregulation. The various regulatory mechanisms outlined below are therefore under review, and could possibly lower IP and LPG prices further than the prices set out below.

# CHAPTER TWO

# Supply institutions

This chapter will describe the petroleum and coal industries as the supply institutions of hydrocarbon fuels to the household sector.

## 2.1 The petroleum industry

The petroleum industry in South Africa is regulated by government with agreements covering all aspects of operations from procurement to marketing. The nature of the current regulatory mechanism is complex as its aim is to achieve a balance between securing the future supply of a strategic commodity while ensuring a competitive environment. Much of this chapter has been drawn from the EDRC (1993) input to the Macro-Economic Research Group (MERG) on the macroeconomic effects of the petroleum industry.

In order to understand the current mechanisms and their interrelationships, consideration must be given to the history of the regulatory framework.

An outline of the chapter is given below:

- an historic overview;
- the current structure;
- IP and LPG pricing;
- the efficacy of IP and LPG distribution chains;
- availability of supply of household hydrocarbon fuels.

## 2.2 Historic overview

The first consignments of liquefied petroleum fuel were imported into the Cape in 1867. All initial demand was satisfied by imported refined product. By 1910, 39 megalitres of primarily IP and power paraffin were being consumed in South Africa. The petroleum products were received by the petroleum companies in packed containers for eventual retailing to the public. Petrol was retailed mainly through general dealers. Following the arrival of the petrol pump, garages or service stations appeared, which provided these fuels to the motoring public.

### *2.2.1 Oil companies*

International expansion and domestic ventures resulted in the arrival of the first six oil companies in South Africa:

- Shell Company of South Africa, Ltd (Shell)
- Vacuum Oil Company of South Africa, Ltd (Pegasus)
- Texas Company South Africa, Ltd (Texaco)
- African Russian Oil Products (Pty) Ltd (Arop)
- Union Petrol Corporation (Pty) Ltd (Victory)

By 1956 the market was supplied by the following companies:

- Shell
- BPSA
- Caltex
- Mobil (now Engen)
- Total

- Esso (now Zenex — entered the market in 1963)
- Sonap (entered the market in 1963)

The idea of building a synthetic fuel production unit was formulated after the Second World War, owing firstly, to the importance of transport fuel availability in deciding the outcome of the war, secondly, to South Africa's complete dependence on imported oil and the government's desire for greater self-sufficiency, and lastly, to the knowledge that, in spite of synfuel's higher cost, it had supplied half of Germany's wartime consumption.

Sasol was incorporated on 25 September 1950 as a result of the go-ahead given by government to produce oil from coal. Construction on the refinery at Sasolburg started in mid-1952 and the plant came on stream in 1954.

Trek, the second local oil company, was formed in 1968, after government had decided to promote local investments in the oil industry. Additional quotas to build new service stations were granted by government in terms of the Service Station Rationalisation Plan (RATPLAN) discussed below, as a result of local participation in the shareholding of the South African affiliates of overseas oil companies. Trek was established with Gencor owning 65%, Shell, 17.5% and BP, 17.5%. When Gencor took over Mobil in 1989, it also bought out the shareholdings of BP and Shell in Trek. The latter company is now fully owned by Gencor and incorporated within the Engen Group.

In the 1970s Mobil took over the administration and later the shareholding of Sonap (except for a minority shareholding). This company has also been incorporated into the Engen Group, making the Group the biggest oil company in South Africa.

Total also availed itself of the opportunity to obtain additional service station quotas by allowing domestic investors to acquire part of its shareholding. It sold a total of 42.4% of its equity: 34.4% to Rembrandt and 8.0% to Old Mutual. In the current RATPLAN both Trek and Total have obtained permission to build 10 additional new service stations for this local equity. This will, however, not happen in future RATPLANS.

Currently, the South African petroleum industry is made up of seven private-sector companies and nine brands. These can be segmented into the following three categories:

- The first category consists of the four large brands, Engen, Shell, Caltex and BP, whose individual share of the petroleum market varies between 15% and 20%. They also own refineries.
- The second category comprises the smaller brands. These include Total, Zenex, Trek and Sonap. These latter two brands are now owned by Engen, as mentioned above, since Gencor bought out Mobil when it disinvested in 1989.
- The third category of oil companies comprises the synfuel industry and is made up of two companies, Sasol and Mossgas. These two are primarily refiners, producing petroleum products to be marketed by the other oil companies, although Sasol does market petrol through the Blue Pumps situated on the forecourts of other petrol retailers. The two use different inputs to produce petroleum products: Sasol uses coal and Mossgas natural gas. Both currently need government tariff protection as synthetic production is more expensive than crude oil refining at prevailing world crude oil prices ($18 to $20 a barrel). Sasol, however, shares a crude oil refinery (Natref) at Sasolburg with Total (refer below). This is currently the third largest crude oil refinery in the country.

## 2.3 Crude oil

No significant reserves of petroleum have been discovered in South Africa, or its territorial waters, despite a sustained search by Soekor, the state owned oil exploration company established in 1965. About 200 holes have been drilled on land and off-shore. Limited natural gas deposits have been discovered off the south coast. All crude oil is imported and landed at Saldanha Bay or at Durban. The crude oil landed at Saldanha Bay is piped to the Caltex refinery in Cape Town. The discharging of crude oil in Durban takes place out at sea using a single buoy mooring (SBM) system as Durban harbour is too shallow for Very Large Crude Carriers (VLCC). Shell, BP, Sasol and Engen own the SBM and are charged 1,78% wharfage on crude imports. This is not justified as VLCCs do not use Durban harbour.

The Strategic Fuel Fund (SFF) under the auspices of Central Energy Fund (CEF) obtained most of South Africa's crude oil through intermediaries during the oil embargo which began in the late 1970s. However, Shell and Total managed to procure some of their own crude independently.

South Africa has a significant synthetic fuel industry supplying around 40% of the country's refined product. The larger, inland plant (Sasol) uses coal as its input, while Mossgas on the coast converts natural gas into liquid fuels.

## 2.4 The refining industry

Refining involves the procurement and refining of crude oil into a range of final petroleum products that typically comprise the following four groups:

| *Group* | *Main products* | *% of the barrel* |
|---|---|---|
| Gases | LPG | 2.0 |
| Light distillates | Petrol | 30.5 |
| Middle distillates | Paraffin<br>Jet fuel<br>Diesel | 2.9<br>6.7<br>31.7 |
| Residuals | Fuel oil<br>Bitumen | 13.0<br>2.0 |
| Other | | 5.0 |
| Fuel and loss | | 6.2 |

**TABLE 2.1** RSA crude oil refinery yield data (1991)

The synfuel industry produces more gases and light distillates than the crude oil refiners. This helps meet petroleum product demand as more petrol than diesel is sold in South Africa. As Sasol shares the crude oil refinery, Natref, it is able to produce a more balanced barrel of refined products. However, this is not the case with Mossgas, which does not provide a crude equivalent saving.

| *Group* | *Main products* | *% of the barrel* |
|---|---|---|
| Gases | LPG | 4.0 |
| Light distillates | Petrol | 65.0 |
| Middle distillates | Paraffin<br>Diesel | 5.0<br>26.0 |

**TABLE 2.2** Sasol synfuel refinery yield data (estimated 1993)

The Mobil refinery, the first in South Africa, was completed in January 1954 and is located in Wentworth, Durban. Now renamed Genref, it is, prior to current expansion, approximately 40% the size of Sapref (the BP/Shell refinery).

Sapref, jointly owned by BPSA (50%) and Shell (50%) is also located in Durban and is the biggest refinery in southern Africa. It came on stream in October 1963.

Calref, the Caltex refinery, was located in Cape Town at the request of government. The initial plan was to locate it in Durban. It is 58% of the size of Sapref and when it came on stream in July 1966, South Africa became completely independent of imported refined products for the first time.

The oil refineries, in order of current size, are listed below:

- Sapref's capacity will reach an approximate 165 000 barrels per day by 1994, up from 120 000 barrels per day.
- Sasol 1, 2 and 3, all owned by Sasol Ltd, are listed on the Johannesburg Stock Exchange and supply 39% of the petroleum products consumed in South Africa. Sasol's capacity is approximately 150 000 barrels per day.
- Calref's current capacity is approximately 100 000 barrels per day, increased by demothballing existing capacity in 1993 from an earlier 60 000 per day.
- Natref, owned by Sasol and Total, has a current capacity of approximately 95 000 barrels per day, increased during 1993 from 85 000 barrels per day.
- Genref's current capacity is approximately 90 000 barrels per day, up from 65 000, and is to be increased further to 128 000 barrels per day by 1995.
- Mossgas, owned by the state and located at Mossel Bay, is coming on stream and will supply around 10% of South Africa's demand. Mossgas's anticipated capacity is approximately 45 000 barrels per day.

The crude oil refinery expansions outlined above, entailed some R700 million in 1992 in capital investment. These investments have resulted from the ongoing increases in the demand for petroleum products, and the relatively stable environment existing in the petroleum sector as a result of government regulation. The total estimated oil industry capital expenditure (excluding the synfuel industry) for the period 1992 to 1995 is R6.6 billion. This includes R3.2 billion in refining and a further R3.4 billion in marketing assets such as service stations.

The synfuel industry is similarly investing on a large scale. R3.5 billion, which includes investment in petrochemicals, is currently being spent, with further capital expenditure of R2 billion under consideration. The most recent estimate of the Mossgas investment is R10.7 billion.

## 2.5 Distribution and marketing

Refining, is known as the upstream component of the oil industry. The other component is the distribution and marketing of refined products, and is known as the downstream side of the oil business.

### *2.5.1 Distribution*

The 1953 bottle-necks on the Durban-Reef supply chain, resulted in the construction of a 700 km pipeline, 30.5 cm in diameter, to transport the refined product to the Reef. It was commissioned in 1965 and is used to transport petrol, diesel, kerosene and naphtha. The products are pumped to eight pipeline terminals from where they are transported by rail and road to their final destination.

The oil companies, excluding Sonap and Zenex, market petroleum products throughout the country. To improve efficiencies and prevent transport duplication, products are exchanged between oil companies in certain areas. The Durban refineries (Genref and Sapref) normally supply the Natal area and neighbouring states, as well as parts of the Cape Province. Calref supplies most of the Cape Province, while Sasol and Natref supply the whole of the Transvaal and the Orange Free Sate and a portion of North Natal and North Cape.

Refined products are distributed through 178 oil company depots throughout South Africa. They receive the products via the Durban/Reef pipeline in Natal, the Orange Free State and the Transvaal, with road and rail transport extending the distribution chain to other depots. The products are then transported to their final destination, ie service stations, farmers, mines, corporate or government customers, by road and rail tanker (85% by road). Transnet, through Petronet, controls the pipeline, and the cost of moving refined products from the coast to the hinterland is based on Transnet rail tariffs.

### 2.5.2 Marketing

The refined product is marketed in two ways:

- indirectly through service stations (oil company retail stream); and
- directly to farmers, mines, corporate customers, government or third party distributors (oil company commercial stream). This stream comprises the wholesale activities of the oil industry.

***Retail***

There are 4 913 retail service stations in South Africa which sell petrol, diesel and lubricants. Petrol prices are controlled by government at the pump, while there is a maximum price for diesel at the wholesale stage. Lubricant prices are not controlled. No discounting of service station petrol pump prices is allowed. Service stations may not be run directly by oil companies. The dealers are paid a service station dealer margin, currently 15.1 cents per litre, or 9.2% of the pump price, on top of the oil company wholesale price, to enable them to run the service stations.

***Wholesale (oil company commercial marketing arm)***

Paraffin, diesel and illuminating paraffin (paraffin) have a maximum government controlled wholesale price in the commercial markets (ie there is no additional service station dealer margin). While no discounting of service station petrol pump prices is allowed, the oil company commercial marketers are allowed to compete for customers by discounting the price of their products.

*— Farmer diesel*

Diesel for farmers and silviculturists is treated as a special case by government. They are allowed a 20.6 cents per litre rebate on the diesel they purchase for in specific uses, (these uses are defined in Annexure A). From 1 July 1987 the levies on petrol and diesel were combined into a single fuel levy which is collected by Customs and Excise. Prior to this date there were numerous price structures for diesel. From November 1987 the diesel prices for agriculture and fishing were standardised and exempted from paying the full price inclusive of excise duty and fuel levy. Farmers and silviculturists were allowed to buy diesel at nett prices, provided such purchases were made at or through agricultural cooperatives or oil companies. These cooperatives have to be registered with the Department of Agricultural Economics and Marketing. The cooperative or oil company in turn claims the refund of excise duty and the fuel levy from the Commissioner for Customs and Excise. All other users have to buy diesel at the full price and submit their refund claims to the Commissioner for Customs and Excise.

Small farmers have a further hurdle to overcome before obtaining the rebate. Oil companies will usually require a minimum delivery of 1500 litres. This means that a small farmer will have a lot of capital tied up in stocks of diesel. He may, however, form his own wholesale outlet and supply other small farmers from his oil company-supplied tank and reduce his stock turnaround.

The April 1993 diesel price build-up is given in Annexure B.

— *IP and LPG distribution*
Depots are shared by oil companies in order to minimise capital and administration costs. Unlike the structured oil company distribution for petrol and diesel, routers, who are prepared to make small drops and hawk the fuel at retail outlets, are used in the case of IP and LPG. The IP market, in particular, is highly competitive so that oil industry discounts of around ten cents per litre, or 40% of the combined government controlled service differential (delivery allowance), plus an oil industry wholesale margin, is not uncommon.

The uncontrolled LPG price also has a service differential of 9.7 cents per litre. (The price build-up for LPG is decided by the oil companies in conjunction with government, but is not explicitly controlled.) The LPG price structure is given in Table 2.7 below. The oil companies reduce the price to routers to help cover the costs of distributing the cylinders by pick-up truck. This incentive, the service differential, covers most of the incurred costs. Filling the cylinders is a labour-intensive process, and oil companies retain 9.7 cents per litre, ostensibly to recover filling, storage and handling costs. However 16.8 cents per litre is retained to provide and maintain the cylinders. The wholesale margin is 18.8 cents per litre and the distribution cost differential 25.5 cents per litre. Most of the distribution cost differential is discounted, and where the market is a highly competitive one, oil companies will also discount a portion of the wholesale margin.

There are other companies distributing LPG. The largest of these is AFROX, which at 27.8%, had the largest LPG market share in 1992. AFROX is associated with Caltex. Smaller distributors include Fedgas and Shell, which sells its LPG under the brand name of Easigas.

The turmoil in the townships discourages oil companies from using their own vehicles for deliveries. They will, however, use their bulk trucks for delivery purposes to the bigger LPG retail outlets in relatively safe areas. These retail outlets will, however, be tied to that oil company by a sales agreement. The retail outlets have large bulk tanks; 24 000 litres in the case of an LPG distributor, and 45 000 litres for a general dealer. The attached maps show the oil industry depots for farmer diesel, IP and LPG (Annexure C).

## 2.6 Regulation of the oil industry

The current regulatory framework around the oil industry evolved over the past fifty years.

Before 1931, the oil companies, together with the Motor Trade Association (currently the Motor Industries Federation — MIF), under the aegis of the government, regulated the market and consequently stabilised the profit accruing to retailers of petrol. This was achieved by withholding supplies to those retailers not adhering to the margin fixed at that time. In this manner, price cutting was virtually eliminated.

### *2.6.1 Introduction of Unlawful Determination of Prices Act, 1931 (UDOPA)*

This Act was introduced during the Depression in order to permit prices to find their own level and secure cheaper petrol to the consumer. The result, however, was severe cost-cutting which caused many bankruptcies and a country-wide deterioration in the standard of service.

### *2.6.2 Amendment of the Unlawful Determination of Prices Act, 1937*

Early in 1937, petrol was released by statutory enactment, from UDOPA and control of the wholesale price of petrol was shifted to the Department of Commerce and Industries. Under the aegis of government, the MIF become responsible for the maintenance of the retail price of petrol. This enabled the oil companies, with the knowledge and consent of government, to enter into an agreement with the MIF to withhold petrol supplies if price-cutting took place.

In conjunction with this, control was exercised over the opening of new retail sites, which the MIF considered an essential requisite to a price maintenance policy. This eventuated in a tendency towards a 'closed shop' in the retail market, and led to the Undue Restraint of Trade Act (1949).

### 2.6.3 Undue Restraint of Trade Act, 1949 (UROTA)

UROTA was promulgated in 1949. The Board of Trade recommended that petrol should be a controlled article under its provisions by stating: 'It could not accept the argument that new petrol selling sites should be refused on the grounds of the adequacy of existing sites, and that it believed that the introduction of a greater measure of competition would be the most effective means of improving services and reducing service rates'. The Board further recommended certain qualifying standards, such as the employment of a mechanic and the provision of a workshop and basic workshop equipment at every retail outlet, and that successful applicants should be entitled to receive supplies of petrol and pump equipment from oil companies.

A proliferation of UROTA qualifying sites emerged which were uneconomic, owing in many cases, to low petrol sales. Nevertheless, oil companies were obliged to supply pumps and petrol which greatly increased the costs of transportation, equipment and marketing. The policy of a 'site for one is a site for all' amongst oil companies, resulted in all oil companies being represented at nearly all retail outlets. Because of the high and wasteful cost of operation and unnecessary capital investment, the system of a single brand per service station was introduced in 1951.

### 2.6.4 Control mechanisms

The oil industry has been regulated since the 1950s primarily via five mechanisms:

a) obligatory marketing of the synfuel production;
b) price control of the major products, ie petrol, diesel and paraffin;
c) the allowable profitability of the oil industry (MPAR);
d) rationalisation of the number of new service stations (RATPLAN);
e) crude oil procurement and import control.

These five government regulations are detailed below.

*The synfuel industry*

The government decision to establish a synthetic fuel industry in 1947 has led to the production of substantial synthetic supply. The other members of the oil industry, excluding the synthetic refiners, are obliged to market the total synfuel production, and to allow Sasol a petrol pump at all their service stations to market fuel on its own account (Blue Pumps). This Sasol marketing is allowed up to a market share of around 9%. The oil industry may terminate the Sasol agreement, but excluding breaches of the agreement, there is a five year notice period. The Mossgas notice period is three years.

However, should the price be deregulated, the oil industry is entitled to renegotiate the handover price of synfuel product, and to reduce the notice period on the Mossgas contract to six months.

*Price control*

As mentioned above, the price of diesel, petrol and paraffin to the consumer is controlled by government. Table 2.5 sets out the price build-up of 93 octane petrol in April 1993. This price control forms the foundation for government's control of the oil industry.

By stipulating the extent of the margin in cents per litre that the oil industry is allowed, the government controls the profit the oil industry can make. This control therefore requires that a mechanism be agreed that regulates that profit. This regulation is known as the marketing petroleum activities return or simply MPAR. In the price build-up in Table 2.5 below, the oil company margin is the wholesale margin or 13.558 cents per litre on every litre of petrol sold by the particular oil company. The size of the wholesale margin on the other two controlled products, namely diesel and paraffin, is similar, and these three products made up 84% of total refined petroleum products sold in RSA in 1992.

The two biggest components of the price build-up are government taxes (49.5% of the pump price) and the in bond landed cost or IBLC (31.7% of the pump price). The IBLC reflects the cost of refined product landed in RSA from four major international export crude oil refineries. Three are located in Singapore and one in Bahrain. The posted petrol, diesel and paraffin prices of these refineries are the base for the prices of these South African petroleum products. They can thus not be manipulated by either government or the oil industry.

South African products are refined locally. Therefore the crude oil refineries' profitability derives from the difference between the cost of crude oil and the cost of refining versus the IBLC. Landed crude oil cost refiners an average of $20.4 per barrel in 1991 and represented 84% of their costs.

On top of the IBLC, are the costs for distribution in the form of the service differential (2.0% of the price, used to recover the cost of delivery from the depots) and zone differential. The zone differential increases, according to Transnet rail and pipeline tariffs, and is charged by the oil industry on a cost recovery basis, as the products are moved inland from the coast.

Seven cents per litre is recovered for what is known as the Equalisation Fund. This fund is primarily used for the following purposes:

- payment to the synfuel industry in tariff protection (3.4 cents per litre in 1992);
- payment of the synlevy to crude oil refineries for underutilisation of refining investment due to the obligatory purchase and marketing of the total synfuel production — applicable until crude capacity utilisation is back to pre-synfuel levels (approximately R100 million in 1992); and
- funding the over and under-recoveries by the oil industry due to the difference between the ongoing movements in the IBLCs and exchange rates, and less frequent changes in the petroleum product prices. This is known as the Slate.

Finally, there is a dealer margin of 15.1 cents per litre or 9.2% of the petrol price.This margin accrues the independent service station dealers to run their service stations.

***Marketing petroleum activities return***

MPAR is based on a benchmark 15% nominal return on marketing assets, before tax and interest, for the oil industry combined. The income comprises the net marketing income before tax and interest, adjusted by replacement cost depreciation, and expressed as a percentage of marketing assets, including distribution assets, based on historic cost. The wholesale margin is reviewed annually by external auditors, (Deloitte & Touche), and the industry is entitled to request a margin adjustment when the combined oil industry return on assets falls either below 10% or rises above 20%. As the calculation is based on industry results from the previous year, in an inflationary environment the 15% is not achieved.

***Retail Rationalisation Plan (RATPLAN)***

The retail rationalisation plan is an agreement between government, the oil industry and the service station dealer representatives (the Motor Industries Federation — MIF), which governs the supply of petrol to third parties, the addition to and removals from the South African service station network and the setting of minimum standards for these petrol outlets. It generally endures for a 5 year period and has been in operation since 1960.

Service station network growth has been limited to 17% since 1960 (4 200 sites in 1960 to 4913 in 1991) while petrol sales have increased by 320% over the same period. The result has been an increase in the average throughput of service stations, rising from 38 000 litres per month in 1960 to 137 000 litres per month in 1991, which has increased the viability of the service station industry.

In terms of the plan, oil companies may not operate service stations. The service station ownership pattern, as opposed to management, is: roughly one half owned by dealers, another quarter leased by oil companies from third parties and finally, one quarter actually owned by oil companies but in all cases run by dealers. Another rationale is to ensure a wider distribution network including the more remote rural areas.

A further stipulation of the RATPLAN is that full service will be provided at all service stations. This results in the employment of approximately 50 000 service station attendants countrywide.

***Crude oil procurement***

Due to the oil embargo, oil procurement was largely done by the government's Strategic Fuel Fund or SFF. This is currently under investigation and oil companies are beginning to purchase most of their own oil.

## 2.7 IP and LPG pricing

As noted above, petrol, diesel and IP prices fall under the direct control of government. Government determines the maximum wholesale prices for diesel and IP, whereas the pump price of petrol is governed by legislation, resulting in a prescribed wholesale and retail margin. The IP and petrol price build-ups are given in Tables 2.5 and 2.6 for comparison. The major items missing from the IP price build up are the fuel tax, duty and MMF. This results in the tax take representing only 7.0% of the estimated final consumer price relative to 49.5% in the case of petrol.

The other difference between the two prices is the build up in the relative service differentials. Petrol is delivered mostly to service stations and a depot storage, handling and delivery allowance, (service differential) of 3.3 cents/litre is allowed. However, the oil companies do not do the complete delivery of IP to the final retailer. Consequently, an additional 6.4 cents/litre is provided for to remunerate the routers (middlemen) for their storage, handling and delivery costs in getting IP to the final retailer.

The third difference lies in the fact that there is no uniform final IP consumer price. There is a legislated 33.3% mark up allowable to IP dealers on the controlled wholesale price, but this is not enforceable, given the informal and long distribution chains. In a recent study of five towns with some electrification in the Southern Transvaal/Northern Orange Free and one peri-urban area, Mmotong in the Northern Transvaal with no electricity supply, a large percentage of household expenditure went to IP (Palmer Development Group 1992a). The expenditure ranged from 64% in Alexandra to a low of 42% in Tumahole (located outside Parys).

The study assessed the cost structure and distribution chains of the three transitional fuels, namely, IP, LPG and coal. Price data for the three fuels was collected at three 'levels'. Level one was the price charged by the retailer to the consumer In the case of IP the retailer usually took the form of a 'spaza shop' (defined as a small retailer selling goods from his or her home, usually from a room converted into a small store of sorts. The exception was the peri-urban settlement of Mmotong, where the majority of people (74%), reported that they purchased their IP from depots. This difference in retailer was shown (Table 2.3 below) to have a significant effect on the final price paid for IP by the consumer. The report drew the conclusion that 'It seems ... that the price of paraffin is relatively inelastic. People tend to buy paraffin from the most accessible retailers, rather than buying it at a cheaper price from bulk-sellers further away. The exception to this rule (was) Mmotong'.

This finding is confirmed in econometric work done by McGregor (1992), where nationally the IP price was found to be inelastic (indicating relative consumer insensitivity to price). A price elasticity of negative 0.77 was found for IP. Similarly, price elasticities of negative 0.40 for Jouberton, negative 0.44 for Mamelodi, negative 0.55 for Tumahole and negative 0.87 for Mmotong applied to the towns studied in the Palmer Development Group (1992a) report.

Level two suppliers of IP are essentially middlemen, ie routers. They source the fuel from wholesalers and then sell to retailers. Level three suppliers (wholesalers) are the oil company depots which sell at the regulated wholesale price, less a portion of the service differential, as outlined in Table 2.6 below. Discounting of the wholesale price by the oil companies takes place and this is elaborated in Table 2.4 below.

The impact of middlemen on the final price paid for IP by the consumer is clearly shown by the percentage mark-up (129.3% to 59.0% — Table 2.3) between the oil company depot and the consumer. Similarly, the price is held down to a level lower than the legislated 33.3% ie 18.4%, when the consumer makes a direct purchase from a depot, where the price is controlled by government.

IP is a significant part of household expenditure and is price inelastic, suggesting it is an essential good. However, the price paid by the consumer is high. The Palmer Group report (1992a: 19) found that if the consumer is prepared to travel to an oil company depot, the average purchase across all towns surveyed is R1.04 while the average price at a spaza is higher at R1.37. They conclude that the consumer is prepared to pay more for the convenience of having IP readily available. The mark-up in Mmotong, shown in Table 2.3 below, was only 18.4%. Here the availability of a cheaper source of IP only 1 kilometre to 1.5 kilometres from the settlement led to around 75% of IP being bought at this router 'depot'.

| *Depot/town* | *Wholesaler price (c/l)* | *Retailer price (c/l)* | *% mark - up* |
|---|---|---|---|
| Klerksdorp/Jourberton | 75 and 85 | 133 | 66.3* |
| Pretoria/Mamelodi | 75 | 172 | 129.3* |
| Parys/Tumahole | 79 and 87 | 132 | 59.0* |
| Pietersburg/Mmotong | 85 and 94 | 106 | 18.4* |

** The mean of the level one price is used to calculate the mark-up.*

**TABLE 2.3** IP pricing along the distribution chain
*Source: Palmer Development Group (1992a)*

A comparison between actual wholesale prices to the routers, and the maximum regulated wholesale price (in the last half of 1991) — when the data for the Palmer Development Group study was collected — is made in Table 2.4. The prices paid for IP by the routers are slightly lower than the bulk wholesale prices for IP from oil company depots located in the towns adjacent to the study areas, indicating the prevalence of discounting by oil companies. Packed IP prices, as represented by a twenty-litre tin, were much higher and range from 113.33 cents per litre for Klerksdorp, Pretoria and Parys to 116.33 cents per litre for Pietersburg.

| Depot/town | Wholesaler price (c/l) | Retailer price (c/l) | % mark - up |
|---|---|---|---|
| Klerksdorp/Jourberton | 75 and 85 | 133 | 66.3* |
| Pretoria/Mamelodi | 75 | 172 | 129.3* |
| Parys/Tumahole | 79 and 87 | 132 | 59.0* |
| Pietersburg/Mmotong | 85 and 94 | 106 | 18.4* |

* *The mean of the level two price is used to calculate the difference.*

**TABLE 2.4** IP price comparisons at the wholesale level
*Sources: Palmer Development Group (1992a)*
*BP Southern Africa (1993)*

There are negative consequences of the non-taxation of IP:

- a tendency to mix IP with higher priced diesel and then sell it as diesel; and
- a movement to use IP with a lubricant additive as an off-road traction fuel.

These tendencies could jeopardise the current favourable pricing of IP to the poor consumer. The answer is to isolate industrial users of IP and introduce distribution regulation of lower priced, domestic IP. This strategy is developed in the policy interventions described in Chapter 5.

The LPG price is not controlled by government but the oil industry wholesale price is derived in a very similar way to that of IP. The current price structure is outlined in Table 2.7. The similarities to the price structures of petrol and IP are obvious except for the additional element of cylinders filling and maintenance. LPG is a premium fuel to IP and its distribution network is not as pervasive as IP. In addition the ex-depot mark-ups are significantly higher as shown in Table 2.13.

| | Price c/litre | % of total |
|---|---|---|
| **In bond landed cost**<br>— Product prices set by four major export refineries (3 Singapore and 1 Bahrain)<br>— Plus internationally determined freight insurance and loss costs and local landing charges of moving product to South African ports from Singapore and Bahrain. | 51.794 | 31.7 |
| Service differential<br>— Cost recovery of storage handling and delivery costs | 3.3 | 2.0 |
| government taxes and levies<br>— Fuel tax, duty, MMF and Equalisation Fund Levies | 81.1 | 49.5 |
| **Wholesale margin**<br>— Determined by Marketing Par Formula | 13.558 | 8.3 |
| **Zone differential**<br>— Based on transport tariffs as determined by Transnet | 0.2 | 0.1 |
| **Slate under / over recovery**<br>— Differential between actual wholesale price and required price based on price build up. | (1.252) | (0.8) |
| **Wholesale price**<br>— Oil Industry selling price to dealers. | 148.7 | 90.8 |
| **Dealer margin**<br>— Motivated by MIF based on survey of service station costs. | 15.1 | 9.2 |
| **Pump price** | 164.0 | 100.0 |

**TABLE 2.5** Price build up — April 1993 (Petrol 93, at the coast)

| | *Price (cents per litre)* | *% of total* |
|---|---|---|
| **In bond landed cost**<br>— Product prices set by four major export refineries (3 Singapore and 1 Bahrain)<br>— Plus internationally determined freight insurance and loss costs and local landing charges of moving product to South African ports from Singapore and Bahrain. | 57.898 | 53.0 |
| **Service differential**<br>— Cost recovery of storage handling and delivery costs. | 9.7 | 8.9 |
| **Government taxes and levies**<br>— Equalisation Fund Levy — Fuel tax, duty and the MMF levies applicable to petrol are not imposed on IP. | 7.0 | 6.4 |
| **Wholesale margin**<br>— Determined by Marketing Par Formula. | 13.672 | 12.5 |
| **Zone differential**<br>— Based on transport tariffs as determined by Transnet. | 0.2 | 0.2 |
| **Slate under / over recovery**<br>— Differential between actual wholesale price and required price based on price build up. | (6.430) | (5.9) |
| **Wholesale price**<br>— Oil Industry selling price to dealers. | 81.93 | 75.0 |
| **Legislated dealer margin**<br>— The dealer/router margin is legislated to be a mark-up of 33.3% on the wholesale price but this is unenforceable in practice. | 27.3 | 25.0 |
| **Legislated price to consumer**<br>— This is an indicative price. The price to the consumer varies considerably between areas. | 109.24 | 100.0 |

**TABLE 2.6** Price build up — April 1993 (IP, at the coast)

| | Price cents/litre | % of Total |
|---|---|---|
| **In bond landed cost**<br>— Product prices set by four major export refineries (3 Singapore and 1 Bahrain)<br>— Plus internationally determined freight insurance and loss costs and local landing charges of moving product to South African ports from Singapore and Bahrain. | 40.418 | 34.3 |
| **Railage equalization**<br>— Recovery in price to avoid adjustment in prices arising from changes in rariffs. | 1.1 | 0.9 |
| **Service differential**<br>— Cost recovery of storage and handling costs. | 9.7 | 8.2 |
| **Distribution cost differential**<br>— Cost of distributor network. | 25.3 | 21.5 |
| **Government taxes and levies**<br>— Equalisation Fund Levy – Fuel tax, duty and the MMF levies applicable to petrol are not imposed on LPG. | 3.6 | 3.1 |
| **Wholesale margin**<br>— Determined by Marketing Par Formula. | 18.8 | 15.9 |
| **Zone differential**<br>— Based on transport tariffs as determined by Transnet. | 7.5 | 6.4 |
| **Cylinder differential**<br>— Cost of providing and maintaining cylinders. | 16.8 | 14.3 |
| **Safety levy**<br>— Funds collected to cover costs of promoting safety. | 0.3 | 0.3 |
| **Slate under / over recovery**<br>— Differential between actual wholesale price and required price based on price build up. | (5.718) | (4.9 |
| **Wholesale price**<br>— Selling price to consumers. | 117.8 | 100.0 |

**TABLE 2.7** Price build up - April 1993 (LPG resellers, at the coast)

## 2.8 Availability of supply

The supply of any petroleum product is constrained by the demand of other fractions. The detailed output in terms of refined product of a representative barrel of crude oil is outlined in Table 2.8 below. IP and LPG are small fractions of the barrel and growth in the demand for these fuels must be matched by growth in demand for the major fuels such as petrol and diesel. However, there is room to extract more IP from the middle distillate, diesel. On the other hand, there is little that can be done in making more LPG from a crude oil refinery. But there are significant reserves of gas with could be extracted from Mossgas, the Kudu gas field off the coast of Namibia and the Pande gas field in Mozambique. Transport of the gas and domestic piping networks would then become issues.

| | Product | Volumes (ML) | % of total |
|---|---|---|---|
| Group 1 | Butane | 5.1 | 0.6 |
| | Propane | 0.7 | 0.1 |
| | Propene | 4.4 | 0.6 |
| | LPG | 17.0 | 2.1 |
| Group 2 | Avgas | 4.7 | 0.6 |
| | Petrol (97 Octane) | 101.4 | 12.8 |
| | Petrol (93 Octane) | 124.1 | 15.7 |
| Group 3 | IP | 23.9 | 3.0 |
| | Jet | 61.2 | 7.7 |
| | Automotive diesel | 239.7 | 30.3 |
| | Bunker diesel | 44.8 | 5.7 |
| | Marine diesel | 9.9 | 1.2 |
| Group 4 | Fuel oil | 155.0 | 19.6 |

*(Sapref quarter one 1993 output — minor speciality products have been excluded from the table ie solvents, lubricants, waxes)*

**TABLE 2.8** Output of major refined product across the barrel of crude oil

Group 1 form the gases, while group 2 headed by Avgas are the light distillates. Group 3, including IP, are known as the middle distillates and the final group as the residuals.

## 2.9 The coal industry

South Africa is well endowed with coal and has the fifth largest coal reserves in the world (Minerals Bureau 1992a). It is also the fifth largest producer and in 1992 produced 180.1 million tons. However the ratio of production to reserves is relatively low by world standards. South Africa's ratio is half that of the world's largest producer, China, but is marginally greater than that of emerging producers such as Columbia. South Africa is also the third largest exporter, as shown in Table 2.9.

The coalfields and major coal mines in South Africa are shown in Figures 2.1 and 2.2.

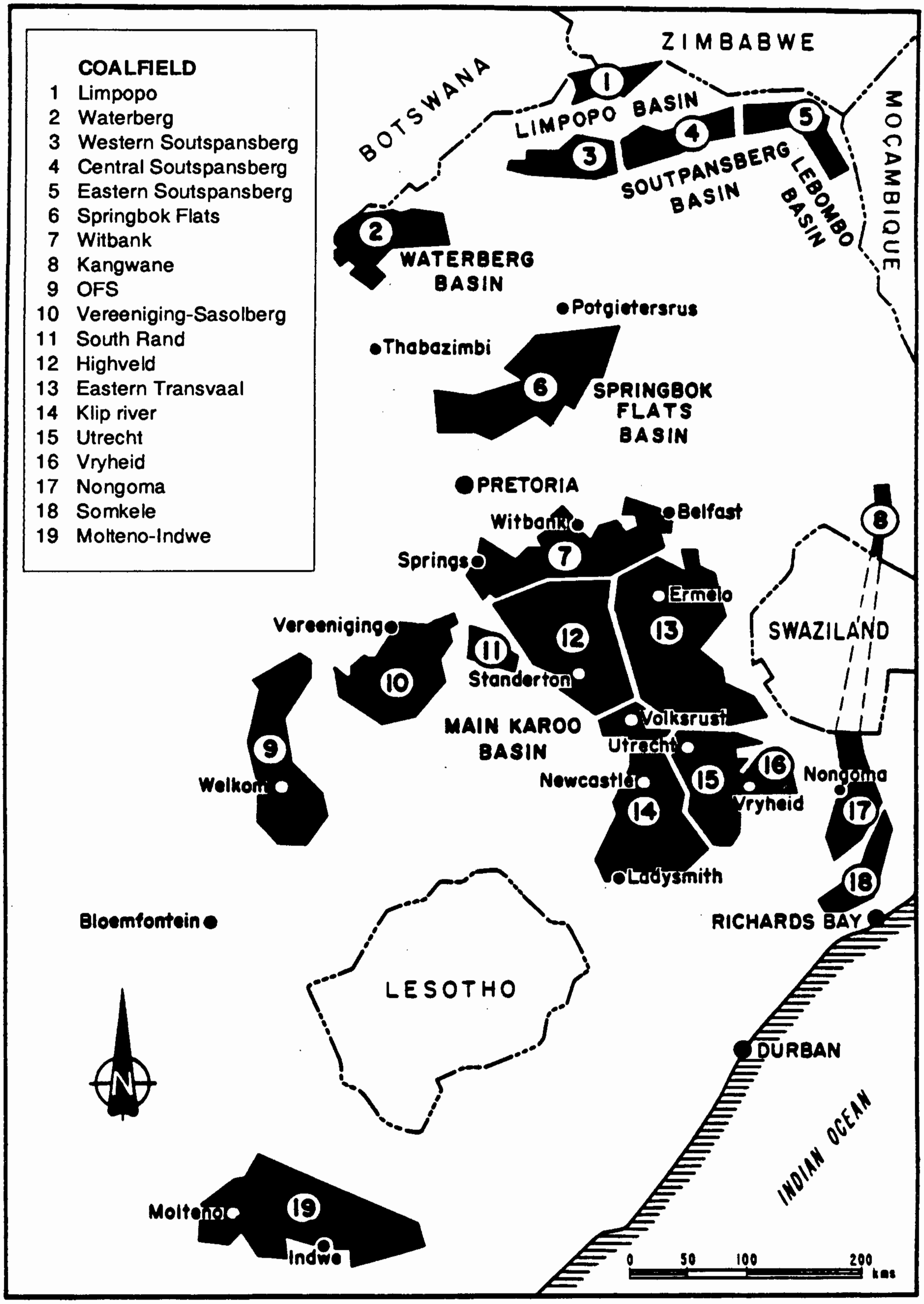


**FIGURE 2.1** Coalfields of South Africa

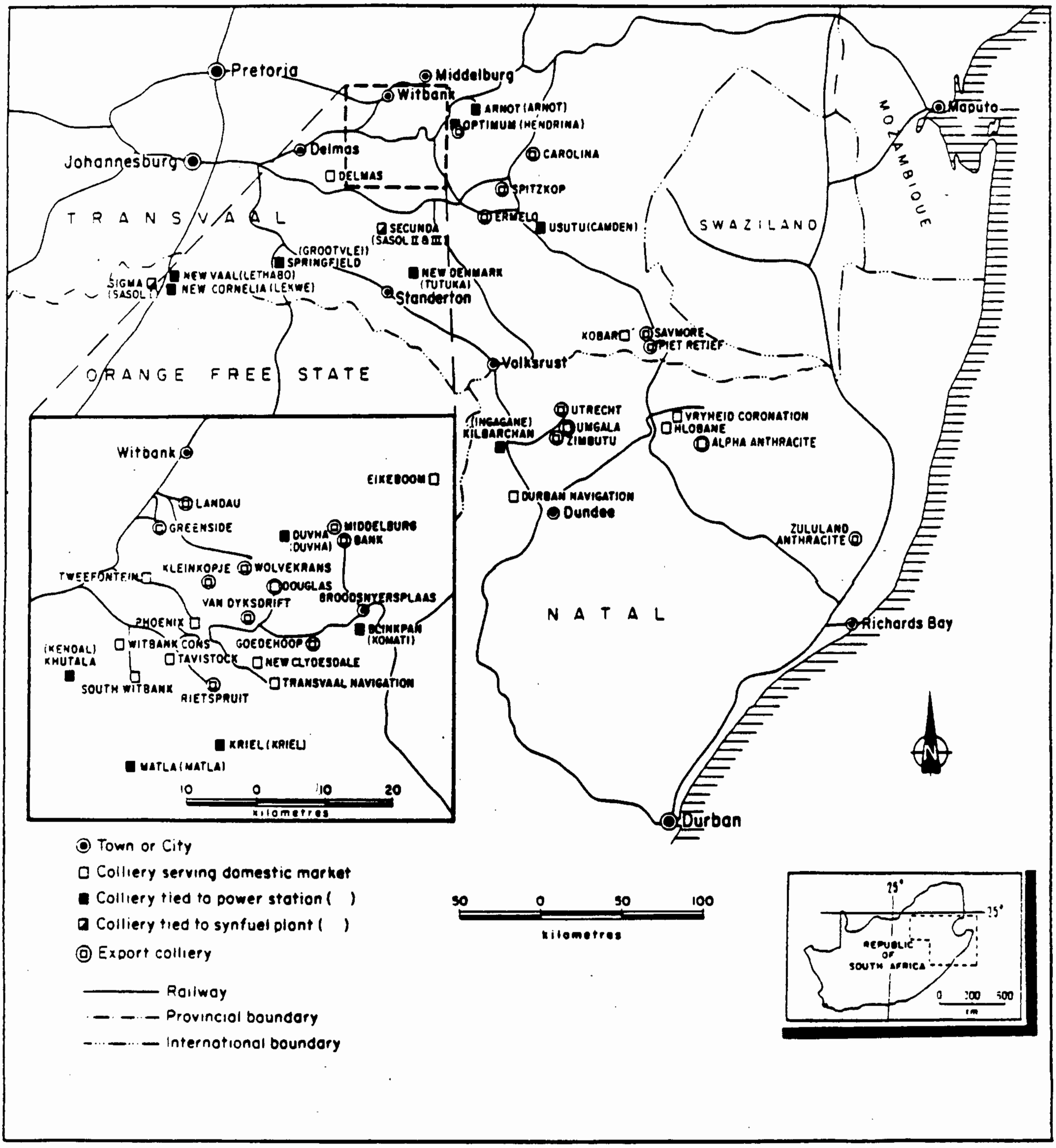


**FIGURE 2.2** Major coalmines in South Africa

| Country | Reserves | | | Production | | | Exports | | |
|---|---|---|---|---|---|---|---|---|---|
| | Mt | % | Rank | Mt | % | Rank | Mt | % | Rank |
| China | 154 000 | 24.7 | 1 | 980.0 | 27.6 | 1 | 17.7 | 4.6 | 7 |
| USA | 114 000 | 18.3 | 2 | 933.6 | 26.3 | 2 | 96.0 | 24.7 | 2 |
| USSR | 103 000 | 16.5 | 3 | 537.0 | 15.1 | 3 | 35.0 | 9.0 | 4 |
| India | 60 000 | 9.6 | 4 | 194.0 | 5.4 | 4 | — | — | — |
| RSA | 55 000 | 8.8 | 5 | 174.8 | 4.9 | 5 | 49.6 | 12.8 | 3 |
| Australia | 45 000 | 7.2 | 6 | 163.0 | 4.6 | 6 | 106.1 | 27.3 | 1 |
| Poland | 28 000 | 4.5 | 7 | 147.4 | 4.1 | 7 | 28.0 | 7.2 | 6 |
| Germany | 24 000 | 3.8 | 8 | 76.6 | 2.2 | 9 | 5.1 | 1.3 | 9 |
| Columbia | 1 000 | 1.6 | 9 | 20.5 | 0.6 | 13 | 11.4 | 2.9 | 8 |
| UK | 9 000 | 4.4 | 10 | 89.3 | 2.5 | 8 | 2.3 | 0.6 | 10 |
| Canada | 4 000 | 0.6 | 11 | 37.7 | 1.1 | 11 | 30.6 | 7.9 | 5 |
| Czechoslovakia | 2 000 | 0.3 | 12 | 22.4 | 0.6 | 12 | 0.3 | 0.1 | 12 |
| Korea, DPR | <1 000 | 0.1 | — | 55.0 | 1.5 | 10 | 0.5 | 0.1 | 11 |
| Korea, R | <1 000 | 0.1 | — | 19.0 | 0.5 | 15 | — | — | — |
| Spain | <1 000 | 0.1 | — | 19.6 | 0.6 | 14 | — | — | — |
| Other | 15 000 | 2.4 | | 84.6 | 2.4 | | 6.0 | 1.5 | |
| TOTAL | 624 000 | 100 | | 3554.5 | 100 | | 388.6 | 100 | |

**TABLE 2.9** World hard coal reserves, production and exports, 1990
*Source: Minerals Bureau (1992a)*

South African coal is principally bituminous, thermal grade, with only 2% anthracite and 1.6 % of metallurgical quality (Minerals Bureau 1992a). Bituminous coal has a lower carbon content and therefore lower heat producing ability than the other two. Anthracite is a more mature coal which has been subjected to more heat and or been in the ground longer. More volatiles have been driven off and it usually has a carbon content of between 85% to 95% compared to approximately 70% to 85% in bituminous coal.

South African coal is generally found in thick, shallow-lying seams in 18 principal coalfields found in Northern Natal, Orange Free State and the Transvaal, with the isolated, younger Molteno-Indwe field in the Eastern Cape. The carbon content of the coal generally increases eastward, but the number of seams and their thicknesses decrease. Consequently, Transvaal coals are usually bituminous in thick seams while Natal coal is found in shallower seams but has a greater proportion of anthracite.

Southern hemisphere coal formation is considerably younger than that found in the northern hemisphere and was not the result of the dense tropical forests that produced northern hemisphere coal. Southern coal was formed in shallow, ice scoured basins and associated river and swamp systems. Consequently southern hemisphere coal has less sulphur, is less reactive and contains more ash than that found in the northern hemisphere.

South African coal production is dominated by three mining houses, namely Anglo American, Rand Mines and Genmin. The fourth major producer is Sasol, which consumes most of its production. These four groups, of similar size, produce almost 80% of South African coal. South Africa's run-of-the-mine coal production (ie total coal mined, saleable and discard), amounted to 227.9 million tons in 1991 of which saleable coal totalled 178.2 million tons. The discard coal, the residual after the crushing and washing of newly mined coal, is of particular relevance to this paper as the policy recommendations will promote the use of smokeless coal by the domestic sector, and current smokeless coal technology centres around the use of this discard coal. Forty million tons of discard coal is produced per annum, and 10%

of this is usable. One such technology is to devolatilise the coal at high temperatures resulting in coal with increased carbon content and lower smoke emissions. However, the coal then becomes less combustible.

The coal industry is supported by a big local market with 72% used domestically, primarily by Eskom at 40% of total coal production, Sasol at 20% and the other industries at 7%. The principal user of metallurgical coal is Iscor at around 3% of total South African coal production, and residential consumption is around 3 million tons or 1.6% of total production.

28% of South African saleable coal production is exported. The rise in the price of oil in the seventies stimulated the interest in coal as an alternative energy source. South African coal exports grew by 16.3% in mass and 29.9% in value from 1976 to 1990. The rise in US$ prices and the depreciation of the rand accounted for this trend. The Richards Bay coal terminal handles most of the exports. The FOB (Free on Board) export price of bituminous coal amounted to R86.01 per ton in 1991, while anthracite fetched R100.39 per ton. This compares to R33.47 per ton and R93.65 per ton FOR (Free on Rail, ie ex-mine) respectively, on the domestic market. However, average rail costs of R27.92 per ton must be added to the domestic FOR prices to arrive at the export FOB prices.

Nevertheless, the South African coal industry is driven by the export market, which accounts for less than 30% of total sales, but accounts for almost 50% of revenue (von Glehn 1993). The current oversupply on world markets with the increased production from low cost producers such as Indonesia, Venezuela and Columbia is depressing the coal industry outlook, in spite of increased demand from fast growing countries in the Pacific Rim and in Japan. The coal industry is deregulated and increased exports are governed by the world price outlook, the exchange rate and the capacity of the Richards Bay coal terminal. The terminal and the railway line have been upgraded to handle 54.5 million tons. The feasibility of a new 10 million ton per annum terminal at Richards Bay is being examined.

## 2.10 Coal price regulation

On the inland market, pit-head prices of coal were, until 1/4/1987, controlled by the state.

They were divided into four categories, based on calorific values determined on an air dried basis. The Natal prices were generally twice as high as those for the Transvaal and O.F.S. This reflected high cost of production and the higher quality of coal mined in Natal. The prices of the anthracite, metallurgical coal, coal with a calorific value higher than 28.5 MJ per kg, or coal used in chemical processes in the country, were not controlled.

Price control has now been abolished, and the only restriction remaining is on the sale of Transvaal coal in Natal.

## 2.11 Household coal consumption

Household coal consumption comprises around 1.6% of total production. Consumption estimates vary between 7.4 million tons according to the government Department of Mineral and Energy Affairs (DMEA), to 1.5 million tons (Borchers & Eberhard 1991). For the purposes of this report a consumption of 3.1 million tons is used, similar to the figure derived by LHA Management Consultants (1987). The prime use of coal by black households is for heating and, owing to its mass and associated high transport costs, it is mainly used in the Transvaal and Northern Natal.

A range of coals sold on the domestic market are identified in Table 2.10:

| Product | Size mm | CV* MJ/kg | Ash % | Volatiles % |
|---|---|---|---|---|
| Cobbles | 100*31.5 | 21 - 31 | 11 - 27 | 20 - 31 |
| Nuts | 40*22.4 | 22 - 30 | 10 - 36 | 20 - 31 |
| Peas | 25*6.3 | 21 - 29 | 12 - 27 | 20 - 32 |
| Duff | <6.3 | 19 - 29 | 10 - 24 | 21 - 32 |

** CV means calorific value*

**TABLE 2.10** Quality range of bituminous coals used in the domestic market (air-dried basis)
*Source: Minerals Bureau (1990)*

The coal used by households is primarily nuts. Coal is graded and ranges from grade A (highest energy content) to grade D (least energy content, with household coal generally grade C (Palmer Development Group 1993). It can be seen from Table 2.10 that the calorific value and ash content of nuts is relatively high. The volatiles given off in the confined space of a household in a densely populated urban area comprise a major pollution hazard and this report will argue for the substitution of regular coal with low smoke coal.

Due to coal's bulk, and mass and the transport distances from coal fields, it is generally distributed by specialist coal merchants. This is contrary to the distribution of the other household hydrocarbon fuels, where the Palmer Development Group (1993) found IP retailers also selling LPG and vice versa. Another finding was the proliferation of IP retailers relative to coal and LPG, where 563 retailers of IP were found in the five black townships surveyed, of Alexandra, Mamelodi, Orange Farm, Sebokeng and Tumahole, while only 19 LPG retailers were found and 45 for coal.

Table 2.11 gives the mark-ups found in the Palmer Development Group 1992 report. However, the authors expressed misgivings about these findings and the later survey results of 1993 are given in Table 2.12.

| Depot/town | Bulk price level one (c/kg) | End user price (c/kg) | % mark up |
|---|---|---|---|
| Pretoria/Mamelodi | 4.55 | 50 | 998.90 |
| Pietersburg/Mmotong | 8.8 | 27 | 206.82 |

**TABLE 2.11** Coal pricing along the distribution chain
*Source: Palmer Development Group (1992a)*

The more detailed 1993 survey results are given in Table 2.12.

| Township | Purchase price (c/kg) | Retail price (c/kg) | % mark-up |
|---|---|---|---|
| Alexandra | 8.4 | 31.98 | 280.0 |
| Mamelodi | 9.58 | 15.78 | 66.0 |
| Tumahole | 8.64 | 19.00 | 120.0 |
| Sebokeng | 7.57 | 16.29 | 114.0 |
| Orange Farm | 9.14 | 19.87 | 117.5 |

**TABLE 2.12** Coal pricing along the distribution chain (retailers)
*Source: Palmer Development Group (1993)*

The retailer selling prices found in this later, more comprehensive study suggest that the mark-ups registered in Table 2.11 may be too high. However, the necessary comparison is between wholesaler purchase price, ie the price at the mine of

4.99 c/kg, and the average end-user price in Table 2.12 of 20.24 c/kg. This mark-up along the entire distribution chain amounts to 246.5%.

This is higher than any of the IP mark-ups reported in Table 2.3. However, transport costs from source of supply, (ie refinery), in the case of IP are excluded. They are included prior to the wholesaler purchase price in the form of the zone and service differential (see Table 2.6 above), whereas coal transport costs from the mine are included in the above mark-ups.

## 2.12 Conclusion

A summary of the hydrocarbon distribution chain as surveyed at the end of 1991 and in 1992 by the Palmer Development Group (1993), is given in Table 2.13. The initial purchase point for IP and LPG was primarily oil company depots, whose April 1993 wholesale prices are given in Tables 2.6 and 2.7 respectively, while it is the coal mines in the case of coal. An average railage price of 2 cents per kilogram can be added to arrive at the cost included in the price of the wholesaler.

The wholesale, retail purchase and retail prices are averages of the reported prices by the respondents to the survey. The wholesale retail price does not correspond to the retail purchase price as retailers were generally not willing to divulge their buying prices in the surveys. The obvious reason is that their actual mark-ups could then be calculated. In addition, bulk selling prices, or trade discounts which are given off the IP and LPG wholesale prices by oil companies, may not have been included (Palmer Development Group 1993). Nevertheless, the total mark-up shown in Table 2.13, is felt to be reasonably accurate owing to the extent of the survey.

| Fuel | Wholesaler | | | Retailer | | | Total |
|---|---|---|---|---|---|---|---|
| | Purchase price | % mark-up | Retail price | Purchase Price | % mark-up | Retail price | % mark-up |
| IP c/l | 0.88 | 11.38 | 0.98 | 0.96 | 44.75 | 1.39 | 60.0 |
| LPG c/kg | 1.62 | 63.00 | 2.65 | 2.15 | 74.00 | 3.73 | 130.0 |
| Coal c/kg | 4.99 | 73.00 | 8.64 | 8.80 | 130.00 | 20.24 | 301.0 |

**TABLE 2.13** Hydrocarbon fuel distribution chain summary
*Source: Palmer Development Group (1993)*

## CHAPTER THREE

# Consumption profile of hydrocarbon fuels in the household sector

This chapter analyses current consumption of hydrocarbon fuels. Here the propensity to consume IP, LPG and coal is assessed and the influence of various parameters are determined. These parameters are relative fuel prices, income, availability of substitute fuels, the prices of appliances, safety of different fuels, trends in urbanisation and the availability of free fuel (biomass) in the rural and peri-urban areas.

Much of the data has been drawn from McGregor (1992) and Trollip (1993).

## 3.1 Introduction

The household hydrocarbon fuels, namely, IP, LPG and coal are also known as the transitional fuels. In terms of energy transition theory, households use hydrocarbon fuels once woodfuel, or more generally, biomass, is no longer available or becomes expensive, and before the more amenable fuel, electricity, can be used. This theory is criticised as being too deterministic and failing to reflect what happens in practice.

McGregor (1992) found that the fuel transition process may not be as deterministic as the energy transition model of Viljoen (1990) suggests. Low price elasticities in particular suggested that IP was still used even when electricity was available, (elasticities measure the sensitivity of the quantity demanded of a particular good when a variable which determines that decision changes, in this case the price of the good). Multiple fuel use, rather than exclusive transitions between different fuels appears to be more the norm. As Hoets et al (1992) remark on the question of fuel preference, 'The simplest criterion which seems to apply is whether a fuel is available and whether it is easily usable or ubiquitous, given that such a choice must be made within a given household budget'.

The experience of several developing countries with fuel preferences or fuel switching will initially be highlighted before the experience of South Africa is presented. In assessing the variables influencing fuel preference, emphasis will also be placed on the sensitivity of consumers to price and income levels. The concluding sections will deal with hydrocarbon fuel consumption data, formulated by the South African Development Bank's development regions, and according to housing type.

## 3.2 The experience of energy preferences

In a study of six rural villages and five peri-urban areas (all of which were unelectrified) in South Africa in 1985, Eberhard (1986: 106) found that wood and dung were used largely by people in the villages compared to those living in peri-urban and other urban areas. Similarly, as Table 3.1 below highlights, there was a much greater consumption of IP and LPG by populations in the peri-urban areas as a result of the scarcity of biomass in these areas.

| *Mean annual household domestic energy consumption in total sample* | | | | | | | |
|---|---|---|---|---|---|---|---|
| | *Fuelwood (kg)* | *Dung (kg)* | *Paraffin (litres)* | *Candles (no)* | *Coal (kg)* | *Gas (kg)* | *Total (GJ)* |
| Villages | 3 212 | 685 | 127 | 171 | 129 | 5 | 73 |
| Peri-Urban | 2 078 | — | 270 | 298 | 905 | 8.8 | 71 |
| *Mean annual per capita domestic energy consumption in total sample* | | | | | | | |
| | *Fuelwood Kg* | *Dung Kg* | *Paraffin litres* | *Candles No* | *Coal Kg* | *Gas Kg* | *Total GJ* |
| Villages | 604 | 118 | 23 | 27 | 20 | 0.66 | 13.8 |
| Peri-Urban | 334 | — | 46 | 51 | 156 | 1.90 | 12.0 |

**TABLE 3.1** Fuel consumption in a developing economy
*Source: Eberhard (1986:106)*

Leach (1987) states that the energy transition process is probably severely constrained by limited availability of premium ('non traditional') fuels. Price is found not to be a major constraint in India and Pakistan, where IP and LPG are much cheaper than firewood on a useful heat basis.

## 3.3 The influence of income on fuel preference

In two surveys Leach conducted in the urban areas in India in 1979 and 1984, he found a massive transition from biomass to hydrocarbon fuels as income increased. Overall, the share of biomass for cooking and heating (on useful heat basis), fell from 42% to 27% while the shares of IP and LPG rose from 19% to 36% and 7% to 12% respectively. All income groups (range of income not disclosed) were included in these changes. As Table 3.2 shows, as urban households earned more income there was a decline from 60% to 12.1% in fuelwood use, a rise from 13.2% to 18.9% in IP use and a rise from 0.8% to 32.9% in LPG use in a 1979 survey. A later 1984 survey showed a greater shift from firewood to IP and LPG as income increased.

| *Fuel shares for cooking and heating in urban India by household income: 1978 -1979 and 1983 -1984 (percent)* | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | *Low to high income* | | | | | *Average* |
| Firewood | 1978-79<br>1983-84 | 60.0<br>53.5 | 40.9<br>30.8 | 25.1<br>17.9 | 17.4<br>9.9 | 12.1<br>9.6 | 42.4<br>27.4 |
| Kerosene | 1978-79<br>1983-84 | 13.2<br>23.8 | 21.3<br>36.9 | 21.5<br>40.2 | 22.0<br>38.2 | 18.9<br>32.8 | 18.7<br>35.7 |
| LPG | 1978-79<br>1983-84 | 0.8<br>1.2 | 4.6<br>4.6 | 14.2<br>15.7 | 26.9<br>27.9 | 32.9<br>39.3 | 6.6<br>11.5 |
| Percent Households | 1978-79 | 31.5 | 42.8 | 20.7 | 2.6 | 2.4 | 100 |

**TABLE 3.2** The effect of income on the type of fuel used in urban households in India
*Source: Leach (1987: 2.5)*

## 3.4 South African hydrocarbon fuel consumption data — 1990

McGregor (1992) outlined the consumption of IP and LPG by aggregated Urban Foundation regions (UFRs) using oil industry supply data. These 37 regions with data on Gross Geographic Product (GGP) per capita, IP consumption per capita and LPG consumption per capita, are shown in Table 3.3. The GGP (the total production of all the inhabitants of the region) is divided by the total population to arrive at a per capita figure. However, IP and LPG volumes have only been divided by the black population as they are the prime users of these fuels. There may be some leakages of supply volumes between areas, ie the volumes shown below as sold in East London, may well be consumed in the Transkei.

The Durban/Pinetown UFR consumes the most IP and LPG per capita, while producing only the seventh highest GGP per capita. The poor rural areas of the Northern Transvaal and Natal consume the lowest amount of IP and LPG per capita. Specifically these are the homelands of Venda, Lebowa, Gazankulu and KwaZulu. KwaNdabele has the lowest LPG per capita consumption. However, this area consumes more IP per capita than the Northern Transvaal and Natal homelands. Similarly, Thabanchu and KaNgwane in the OFS and Eastern Transvaal respectively, have very low IP consumption, but higher LPG consumption.

| *Urban Foundation Region* | *GGP* per capita (1985 Rand)* | *IP per capita (litres)* | *LPG per capita (litres)* |
|---|---|---|---|
| AOM1: W Cape — Metro | 354 | 5.2 | 5.2 |
| AOUO: Balance of region A | 296 | 9.5 | 9.5 |
| BOUO: N Cape — RSA | 251 | 4.1 | 1.4 |
| BSUO: N Cape — BOP | 14 | 1.1 | 0.1 |
| COM1: OFS — BFN | 289 | 4.2 | 2.6 |
| COM3: OFS Goldfields | 461 | 2.3 | 0.2 |
| CQM1: Botshabelo | n/a | 0.3 | 0.2 |
| CQUO: Balance of QwaQwa | 75 | 2.3 | 0.0 |
| CSM1: Thabanchu | 8 | 11.8 | 0.1 |
| COUO: Balance of region C | 344 | 2.6 | 0.4 |
| DOM1: PE/Uitenhage | 257 | 4.2 | 2.1 |
| DOM2: East London | 204 | 4.9 | 4.3 |
| DXUO: Ciskei | 31 | 1.9 | 0.0 |
| DOUO: Balance of region D | 224 | 5.9 | 0.9 |
| EOM1: DBN/Pinetown | 512 | 27.2 | 12.7 |
| EOM2: PMB | 256 | 6.9 | 4.5 |
| EZM1: DBN/KwaZulu | 7 | 0.2 | 0.0 |
| EZUO: Balance of KwaZulu | 43 | 0.4 | 0.0 |
| EOUO: Balance of region E | 656 | 6.3 | 1.6 |
| FNUO: KaNgwane | 17 | 0.3 | 0.0 |
| FOUO: Balance of region F | 733 | 2.7 | 0.7 |
| GLUO: Lebowa | 17 | 0.4 | 0.0 |
| GVOU: Venda | 15 | 0.4 | 0.0 |
| GYUO: Gazankulu | 28 | 0.1 | 0.0 |
| GOUO: Balance of region G | 356 | 8.6 | 2.0 |
| HOM1: JHB/Randburg | 595 | 2.2 | 0.7 |
| HOM2: East Rand | 488 | 1.9 | 1.5 |
| HOM3: West Rand | 442 | 1.2 | 0.6 |
| HOM4: Pretoria | 1107 | 3.3 | 3.6 |
| HOM5: Vereeniging + | 431 | 1.7 | 0.4 |
| HOM6: Brits + | 290 | 3.0 | 0.8 |
| HOM8: Cullinan + | 187 | 0.8 | 0.6 |
| HSM6: Odi\Bafokeng | 36 | 1.4 | 0.2 |
| HWM8: KwaNdabele | 12 | 1.0 | 0.0 |
| JSUO: W TVL — BOP | 20 | 1.3 | 1.0 |
| JOUO: Balance of region J | 660 | 1.9 | 0.4 |
| TTUO: Transkei | 26 | 1.5 | 0.0 |
| TOTAL | 280 | 2.1 | 0.7 |

**Gross Geographic Product per capita*

**TABLE 3.3** IP and LPG consumption data per Urban Foundation Region (per month) — 1990
*Source: McGregor (1992)*

The above oil company supply side data (Table 3.3), is matched by the demand data from EDRC's database (Trollip 1993). Table 3.4 shows that QwaQwa is the only homeland showing a lower percentage use of IP than the Northern Transvaal homelands of Gazankulu and Venda. Similarly, Table 3.5 shows that Lebowa, and the other Northern Transvaal homelands consume very little IP per month and consumption exceeds only that of the Ciskei.

| *Percentage of households using fuel in South Africa* | | | | | | |
|---|---|---|---|---|---|---|
| *Reg HMLD* | *Name* | *No of households* | *Coal* | *Candles* | *Gas* | *IP* |
| 1 | Bop | 281 757 | 13 | 89 | 12 | 92 |
| 2 | Ciskei | 77 975 | 0 | 45 | 0 | 100 |
| 3 | Gazankulu | 116 006 | 7 | 76 | 14 | 87 |
| 4 | KaNgwane | 81 242 | 10 | 63 | 0 | 100 |
| 5 | KwaNdebele | 56 173 | 13 | 65 | 14 | 100 |
| 6 | KwaZulu | 604 424 | 13 | 65 | 14 | 100 |
| 7 | Lebowa | 361 597 | 10 | 63 | 0 | 100 |
| 8 | QwaQwa | 42 104 | 66 | 76 | 29 | 68 |
| 9 | Transkei | 459 126 | 10 | 79 | 7 | 97 |
| 10 | Venda | 81 441 | 7 | 76 | 14 | 87 |
| *RSA* | | | | | | |
| A | W Cape | 95 244 | 0 | 54 | 27 | 35 |
| B | N Cape | 42 612 | 6 | 90 | 43 | 89 |
| C | OFS | 176 404 | 76 | 90 | 19 | 94 |
| D | E Cape | 70 544 | 2 | 56 | 2 | 50 |
| E | Natal | 127 375 | 98 | 98 | 26 | 90 |
| F | E Tvl | 130 236 | 33 | 38 | 2 | 52 |
| G | N Tvl | 45 872 | 33 | 38 | 2 | 52 |
| H | PWV | 95 644 | 33 | 38 | 2 | 52 |
| J | W Tvl | 95 021 | 2 | 58 | 2 | 15 |

**TABLE 3.4** Percentage of households using different fuels
*Source: EPRET database, Trollip (1993)*

| Consumption per household of all fuels (per month) | | | | | |
|---|---|---|---|---|---|
| Reg HMLD | Name | Coal kg | Candles pkt | Gas kg | IP litres |
| 1 | Bop | 8 | 4 | 1 | 14 |
| 2 | Ciskei | 0 | 0 | 0 | 11 |
| 3 | Gazankulu | 6 | 3 | 2 | 13 |
| 4 | KaNgwane | 1 | 2 | 0 | 10 |
| 5 | KwaNdebele | 25 | 3 | 1 | 15 |
| 6 | KwaZulu | 25 | 3 | 1 | 15 |
| 7 | Lebowa | 1 | 2 | 0 | 10 |
| 8 | QwaQwa | 192 | 4 | 2 | 16 |
| 9 | Transkei | 7 | 2 | 1 | 13 |
| 10 | Venda | 6 | 3 | 2 | 13 |
| RSA | | | | | |
| A | W Cape | 0 | 2 | 23 | 11 |
| B | N Cape | 3 | 6 | 7 | 17 |
| C | OFS | 68 | 2 | 1 | 27 |
| D | E Cape | 0 | 2 | 23 | 11 |
| E | Natal | 239 | 9 | 6 | 15 |
| F | E Tvl | 0 | 2 | 23 | 11 |
| G | N Tvl | 68 | 2 | 1 | 27 |
| H | PWV | 68 | 2 | 1 | 27 |
| J | W Tvl | 0 | 2 | 23 | 11 |

**TABLE 3.5** Fuel consumption per household per month
*Source: EPRET database, Trollip (1993)*

The total consumption of IP and LPG match the supply side data relatively well. Based on 90% IP household use relative to industrial use, in 1990 the national South African supply of IP amounted to 650 Ml. This compares to the 522 Ml estimated from the demand side. LPG consumption is similarly comparable, with supply at 138 tons (445.5 Ml multiplied by 0.555 to get tons and then multiplied by 0.56 to separate out household use (Borchers & Eberhard 1991)), compared to demand at 151 tons.

| Total consumption (per month) | | | | | |
|---|---|---|---|---|---|
| *Reg HMLD* | *Name* | *Coal (thousand tons)* | *Candles (million pkts)* | *Gas (tons)* | *IP (million litres)* |
| 1 | Bop | 2.37 | 1.09 | 0.36 | 3.83 |
| 2 | Ciskei | 0.00 | 0.03 | 0.00 | 0.84 |
| 3 | Gazankulu | 0.73 | 0.35 | 0.21 | 1.47 |
| 4 | KaNgwane | 0.12 | 0.19 | 0.00 | 0.81 |
| 5 | KwaNdebele | 1.39 | 0.14 | 0.08 | 0.84 |
| 6 | KwaZulu | 14.93 | 1.53 | 0.90 | 9.01 |
| 7 | Lebowa | 0.54 | 0.87 | 0.00 | 3.62 |
| 8 | QwaQwa | 8.07 | 0.17 | 0.07 | 0.68 |
| 9 | Transkei | 3.38 | 1.10 | 0.26 | 6.03 |
| 10 | Venda | 0.51 | 0.24 | 0.15 | 1.03 |
| *RSA* | | | | | |
| A | W Cape | 0.00 | 0.17 | 2.22 | 1.03 |
| B | N Cape | 0.13 | 0.26 | 0.28 | 0.73 |
| C | OFS | 12.07 | 0.40 | 0.24 | 4.71 |
| D | E Cape | 0.00 | 0.13 | 1.65 | 0.76 |
| E | Natal | 30.43 | 1.11 | 0.74 | 1.85 |
| F | E Tvl | 0.00 | 0.23 | 3.04 | 1.41 |
| G | N Tvl | 3.14 | 0.10 | 0.06 | 1.23 |
| H | PWV | 6.54 | 0.22 | 0.13 | 2.56 |
| J | W Tvl | 0.00 | 0.17 | 2.22 | 1.03 |
| *Total consumption* | | | | | |
| *Monthly (units)* | | 84.35 | 8.51 | 12.60 | 43.46 |
| *Annual (units)* | | 1 012.15 | 102.07 | 151.18 | 521.56 |
| *Annual (MJ)* | | 27 328.03 | 2 112.76 | 7 407.80 | 19 297.72 |

**TABLE 3.6** Total household fuel consumption in South Africa
*Source: EPRET database, Trollip (1993)*

## 3.5 Region A — Western Cape

Region A comprises the south-western parts of the Cape Province and extends from Namaqwaland, bordering on Namibia to Knysna along the south coast of South Africa. It contains the metropole of greater Cape Town. The aggregation of magisterial districts from Somerset West, False Bay to Malmesbury up the West Coast comprise the Urban Foundation Region AOM1 (Western Cape — Metro). This UFR contributes 9.3% to the GDP of South Africa and can be compared to the other UFR, AOUO, which contributes 2.17% to the GDP of RSA and makes up the balance of region A. Maps of all the regions are given in Appendix D.

Per capita income in region A in 1985 was 27.7% higher than the national average. However, the population growth rate, principally due to immigration from the Ciskei and Transkei, was higher than the national average during the period 1980 – 1985. The population is furthermore relatively highly urbanised, and this has significant implications for the consumption of the hydrocarbon fuels, particularly IP.

There is no homeland in the Western Cape, and the relevant data in the Tables 3.3 to 3.6 can be read easily. UFR AOUO, balance of region A, has a particularly high consumption per capita of both IP and LPG, as does the Cape Town metropole. Both these consumption levels are higher than their relative GGP per capita. Coal consumption is negligible, as shown in Table 3.6 above. However, Borchers and Eberhard (1991) show coal usage in region A at 12 788 tons per annum in 1989 or 3.2% of total domestic consumption in South Africa. The latter estimate could be high given the high price of coal due to railage from the reef. It must be stressed that the accuracy of domestic coal consumption figures are difficult to assess.

The demand data amounts to 2.2 tons of LPG and 1 Ml of IP per month in 1990. The LPG data equals the supply data exactly. However. the amount of IP supplied was 3.5 Ml. LPG has the highest contribution in total fuel usage of any region.

Candles are an important source of light in unelectrified homes. Over 50% of the households in this region use candles, with an average consumption of around 2 packets per month. This makes candle consumption in region A the fifth highest of all the regions (excluding the homelands), alongside the Western Transvaal.

## 3.6 Region B — Urban Foundation regions BOUO and BSUO

Region B comprises the Northern and Central Cape, bordering on Namibia, the Transvaal and Orange Free State. The principal city in the region is Kimberley in the East. It is the largest development region and is remote from most inland markets and harbours in South Africa. Consequently transport costs affect economic activities in the region. The largest economic sectors in 1985 were mining and transport.

Agriculture (comprising mainly extensive farming) has declined in importance due to adverse climatic conditions. The area has low rainfall and it is necessary to rely heavily on the available underground water potential. Agriculture provides 33% of the job opportunities in the region, and GGP per capita in agriculture in 1985 was similar to RSA as a whole. The principal sector is mining. This sector provides 52.6% more GGP per capita than the average for RSA but only provides 10.5% of the region's employment. Most of the other economic sectors have lower GGP per capita than the national average and consequently the region's overall GGP per capita, in 1985, was 22.7% below that of RSA. It is a poor region and only contributes 1.6% to the national GDP.

The population growth in the region between 1980 and 1985 was well below the national average. This is mainly the result of migration out of the region.

The poverty and depopulation of the region is reflected in a relatively high per capita consumption of IP and LPG in proportion to its GGP per capita in RSA. This is shown in the demand data where the contribution of IP and LPG to fuel usage is high. As in region A, the LPG supply and demand data match well. However, IP supply statistics reflect consumption at 60% more than demand at 1.17 Ml per month in 1990. Trollip (1993) estimates domestic coal consumption at 1 560 tons per annum in 1990 which is lower than the 1989 Borchers and Eberhard (1991) estimate of 61 143 tons. Candle consumption is relatively high in this region with 90% of households using candles (see Table 3.4 above). This is a reasonable estimate given the relatively high corresponding IP consumption of 4.1 litres per capita per month and the relative lack of electrification.

## 3.7 Region C — Urban Foundation regions COM1, COM3, CQM1, CQUO, CSM1 AND COUO

Region C occupies the total area of the Orange Free State with the exception of Sasolburg in the north. Sasolburg is incorporated in region H. Region C occupies up to 10.5% of RSA and is the fourth largest. However, it is a relatively poor region with the 6th highest per capita income out of the nine development regions. It contributes only 6.5% to the RSA GDP. Its main sectors are mining and agriculture. Mining made up 36.5% of the region's GGP in 1985 and was the biggest employer at 25.5%.

Agriculture was the second largest sector in 1985, making up 11% of the GGP and providing 24.1% of the region's employment. However, both the mining and agricultural sectors declined between 1975 and 1985 and overall per capita GGP was 8% less than the country average in 1985. This relative poverty occurred in spite of better per capita GGP in mining and agriculture in 1985. The region grew at 0.9% per annum between 1987 and 1991, well below the country average of 1.6%. The region has a relatively low level of urbanisation.

Coal makes a big contribution to fuel usage in this region given the close proximity of coal mines. Table 3.6 estimates region C coal consumption at 241 680 tons per annum. This compares to a lower 1989 estimate of 71 580 tons per annum made by Borchers and Eberhard (1991). IP's contribution, at 24%, is amongst the highest in South Africa. This is reflected in the supply data where IP consumption per capita in Thabanchu is the second highest of the 37 UFR's making up RSA. The supply and demand data match in the case of IP (supply 4.98 Ml per month in 1990). However, demand data for LPG is less than half the 0.529 tons supplied per month in 1990.

In region C 90% of the households use candles, second only to region E (Natal). This relatively high consumption is borne out by Table 3.6, where it is estimated that region C has the highest household consumption of 400 000 packets per month. Similarly, the small QwaQwa homeland has relatively high total consumption and the highest consumption per household.

## 3.8 Region D — Urban Foundation regions DOM1, DOM2, DOUO and DXUO

Region D is situated in the Eastern Cape and includes the metropolitan areas of Port Elizabeth/Uitenhage (Urban Foundation region DOM1) and East London (Urban Foundation region DOM2). It is the third largest development region covering 12.5% of the RSA. It houses 6.4% of the population but only contributes 5.0% to the national GDP. The region's per capita income was 16.5% less than the national average in 1985 and GGP fell further between 1987 and 1991. However, the region's economy is well diversified and could consolidate if the current drought is broken.

Coal makes little contribution to the household energy usage in this region. However, the development of the newly discovered Molteno/Indwe coalfields in the North East of the region could change this. The Borchers * Eberhard (1991) study also showed low coal consumption in region D of 23 000 ton per annum or 1.6% of total domestic consumption.

The non-Ciskei areas of region D feature prominently in terms of IP and LPG consumption per capita. However, in comparing IP supply consumption of 4.5 Ml with demand of 6.0 Ml, there is clearly a leakage of IP from East London to the Transkei. Supply data is gathered at oil company depots and does not necessarily reflect consumption. This point is more obvious in the discussion of consumption in Natal versus Kwazulu in region E below. LPG demand data in region D amounts to 1.65 tons per month in 1990 (see Table 3.6), which equates well with supply data of 1.26 tons.

56% of households are estimated to use candles in this region. Only 45% of households in the Ciskei are estimated to use candles which is the lowest percentage usage of all the homelands.

## 3.9 Region E — Urban Foundation regions EOM1, EOM2, EOUO and EZUO

Region E covers the whole of Natal including KwaZulu (UF Region EZUO), the metropolitan areas of Durban/Pinetown (UF Region EOM1) and Pietermaritzburg (EOM2). Although the area covers about 7.5% of the total area of the RSA it carries 25% of the total river run-off of the Republic. The region has a relatively well developed economy and agriculture only contributed around 7.1% of the GGP of the region in 1985.

Manufacturing is by far the largest sector and it contributed 29.9% of the GGP in the same year. However, manufacturing only provided 21.7% of the employment opportunities in that year while agriculture employed 20.9% of the workforce. The region's economy grew relatively slowly between 1987 and 1991.

The population growth rate of 2.3% per annum between 1988 and 1991 was the third highest of the UFR's, in the country. The resultant dependency ratio will retard economic growth per capita. Similarly, the low level of urbanisation indicates the relatively underdeveloped nature of the region.

Coal plays a surprisingly big role in region E's energy consumption, given that the coal mines are only situated in Northern Natal. Table 3.6 shows coal consumption at 544 320 tons per annum in 1990. This compares to the 1989 estimate of 335 870 tons per annum made by Borchers and Eberhard (1991). Supply data has UFR EOM1, Durban/Pinetown, with the highest IP and LPG consumption per capita of all UFRs. Similarly, EOM2, Pietermaritzburg, and EOUO, balance of region E excluding KwaZulu, both have high IP and LPG consumption per capita and these three UFR's comprise 88% of region E volumes. The problem with supply data is that it is captured at oil company depots which are situated out of homelands where significant consumption of IP takes place. The resultant leakages across boundaries mean the supply data does not necessarily reflect the UFR where consumption takes place.

This is clearly shown in the comparison of supply and demand data for IP in Natal and KwaZulu. The total consumption in region E for demand and supply are similar, 10.85 Ml per month in 1990 versus 11.29 Ml per month in 1990 respectively. However, supply data shows 9.9 Ml per month in 1990 for Natal and 1.39 Ml per month in 1990 for KwaZulu versus 1.85 Ml (Natal) and 9.0 Ml (KwaZulu) for demand. The LPG skew is not as bad with supply data showing 2.4 tons per month in 1990 for Natal and 0.04 tons per month in 1990 for KwaZulu versus 0.74 tons and 0.9 tons for demand respectively.

Candle consumption is high in region E with an estimated 98% of households using the fuel. 65% of those in KwaZulu are estimated to use candles which is also relatively high. With a consumption of 1.53 million packets per month, the large KwaZulu homeland has the highest total consumption in all of South Africa including the homelands.

## 3.10 Region F — Urban Foundation regions FNUO and FOUO

Region F is bounded by Swaziland and Mozambique to the East, Lebowa and Gazankulu to the North, the PWV and KwaNdebele to the West and the Orange Free State and Natal to the South. The region contains no metropoles. However it has some of the highest quality agricultural soil in the RSA with 16% of the Republic's arable soil and 13% of its irrigable land, although the total area of the region covers only 6% of the country.

Electricity and water is the region's largest economic sector and 73% of the country's electricity is generated here. Mining follows closely behind, contributing 23.7% of the region's GGP and providing employment for 17.8% of the workforce. The region supplies around 80% of the country's coal output and 66% of coal exports. The manufacturing sector also makes a large contribution to the region's GGP and incorporates Sasol 2 and Sasol 3, the largest coal processing plants in the world. The region had the fastest growing GGP during the period 1987 to 1991 as coal exports became prominent.

While KaNgwane (FNUO) had one of the lowest GGPs per capita in 1990, the balance of the region had the second highest (out of 37 regions). The age distribution is marginally younger than the average for the country. However, the population growth was 1.2% per annum during the period 1988 to 1991, well below the country average of 2.6% (Urban Foundation, 1990).

According to supply data, both UFRs in this region had low IP and LPG consumption per capita. LPG is not used in KaNgwane and this corresponds with supply data with negligible per capita consumption. In spite of the prominence of coal in the region's economy, coal plays a small role in household energy consumption with Table 3.6 above estimating coal consumption in KaNgwane at 1.440 tons per annum. Borchers and Eberhard (1991) have a higher estimate of 45 000 tons per annum or 3.0% of total domestic consumption in 1989.

Supply and demand data match reasonably well for UFR FOUO although demand data is too high for LPG, (supply consumption for LPG is 0.459 tons per month compared to demand at 3.037 tons per month, both in 1990. IP supply data is 2.826 Ml per month compared to demand at 1.406 Ml per month). For KaNgwane the match is better with both sets of data showing negligible LPG usage and IP supply at 0.149 Ml per month compared to demand at 0.812 Ml per month.

Although a low 38% of region F is estimated to use candles, total consumption of 230 000 packets per month is the third highest of all the regions. This suggests relatively intensive usage. KaNgwane has a relatively low total consumption per month with a relatively low 63% of households using candles.

## 3.11 Region G — Urban Foundation regions GLUO,GOUO,GVUO and GXUO

Region G is situated in the most northern part of the RSA. It includes the self governing states of Lebowa (Urban Foundation region GLUO) and Gazankulu (Urban Foundation region GYUO) as well as the independent homeland of Venda (Urban Foundation region GVUO). The balance of the region comprises Urban Foundation region GOUO. The area is poor with a GGP per capita of around 20% of the national average. Mining is the largest economic sector making up 23.1% of the GGP in 1985. The second largest sector is agriculture which comprised 10.5% in the same year. Agriculture is by far the largest employer, at 40.2% of the workforce, but only produces around 40% of the national GGP per capita for this sector. Surface water is scarce and large parts of the area rely on underground water which is under threat.

Population growth did not exceed the national average in the period 1988 to 1991. The region's population is predominantly rural with only 8% of the black population urbanised. This indicates the high level of underdevelopment of the area, particularly as 96% of the region's populations is black. The age structure is young and this is indicative of the fact that there is a large amount of migration of people of working age to seek employment. The area relies significantly on migrant remittances for income and has a high total fertility figure.

As mentioned above, the UFRs in this region have some of the lowest per capita consumptions of IP and LPG of all 37 UFRs. Wood and coal provide relatively large contributions to energy usage in this region compared to the rest of South Africa. Coal consumption is estimated at 59 040 tons per annum in 1990 in Table 3.6 above. Borchers and Eberhard (1991) have this figure at 120 000 tons in 1989. The poverty of the region and its predominantly rural nature can be ascribed as reasons for this.

Supply data records IP consumption of 0.71 Ml per month for Lebowa, 0.189 Ml per month for Venda and 0.048 Ml per month for Gazankulu all in 1990. This corresponds to the respective demand figures of 3.6 Ml, 1.03 Ml, and 1.47 Ml per month in the same year which in all cases is higher. McGregor (1992) produced inelastic price coefficients for all three areas which corresponds with the high percentage of households using IP as shown in Table 3.6 above. In addition the problem of leakages from supply depots in RSA for consumption in the homelands could play a significant role. LPG consumption is similarly low from both demand and supply data.

A low 38% of households in region G are estimated to use candles. The approximate 10 000 packets consumed per month is the lowest of all the development regions. Similarly, total consumption in the three homelands in the region is relatively low. The poverty of the region could be ascribed as a cause of this.

## 3.12 Region H — Urban Foundation regions, HOM1, HOM2, HOM3, HOM4, HOM5, HOM6, HOM8, HSM6, and HWM8

Region H is located in the central southern Transvaal and includes the most eastern parts of Bophuthatswana (UF region HSM6), the whole of KwaNdebele (UF region HWM8) as well as the Pretoria—Witwatersrand—Vaal Triangle metropolitan area (PWV). The region is the smallest in the RSA covering 2.5% of the land area. However, it houses 28.5% of the total RSA population and produces 40.8% of the country's GDP. Economically, the area was one of the fastest growing regions in the period 1987 to 1991 and is also expected to grow at a faster rate than the national average in the forecast period of 1992 to 1995.

Manufacturing is the largest sector providing 26.3% of the region's GGP in 1985 and produced more than 50% of the national manufacturing output in the same year. The region is also the most important mineral producing region in the RSA contributing 11.2% of the region's GGP in 1985, but 34.0% of the national mining output in the same year. The financial and trade sectors are similarly well developed, contributing almost 50% respectively to the country's GDP in these two economic sectors. The area is highly urbanised. A large number of migrants from other regions find employment in region H. In the case of black people there is a relatively large percentage of the population group in the 15-64 working age group. As a result of immigration, region H had the highest population growth rate of all the development regions in the period 1988 to 1991. The region is wealthy and had the highest per capita GGP in 1985.

Due to relatively extensive electrification, the region's consumption of IP and LPG is relatively low. Most of the UFRS consume less than the average for the country as a whole. However coal is important to the region's energy usage. Table 3.6 above has coal consumption at 95 160 tons in 1990. This figure seems low and this is borne out by the 1989 Borchers and Eberhard (1991) estimate of 450 000 tons or 30% of the national total in 1989. This region has the highest incidence of household coal pollution and the proposed introduction of low smoke coal will focus on this region.

Supply statistics have IP consumption at 8.53 Ml per month in 1990 compared to demand at 2.55 Ml. There may be leakage to surrounding regions but it is more likely, given the high level of population concentration, that IP and LPG play a more important role in energy consumption in this region than demand figures suggest.

The region's relatively high level of electrification is shown in the low 38% of households using candles. Similarly, in spite of the high concentration of population in the region, total consumption of candles is estimated at a low 220 000 packets per month which is the only the fourth highest regional consumption. The percentage of households using candles is higher in KwaNdebele, but it has the lowest total consumption per month of all the homelands.

## 3.13 Region J — Urban Foundation regions JOUO and JSUO

Region J covers the south western part of the Transvaal and includes Urban Foundation Region JSOU (the bulk of Bophuthatswana) and JOUO (balance of region J). Region J is the second smallest development region, covering around 5.2% of South Africa. However, it contributes around 7% of the countries GDP. The region grew strongly in the period 1987 to 1991.

The region's largest sector is mining, contributing some 58.7% of the regional GGP in 1985. 26% of South Africa's gold production originates here and 23 mineral commodities, including 97% of the country's nickel production and 51% of the total chrome ore production, originate here. Rustenburg Platinum and Impala Platinum are the world's biggest producers of platinum-group metals, producing 98% of the country's production. Agriculture is the next biggest employer at 22.3% of the region's employed labour. However, serious droughts have reduced its contribution to the region's GGP from 12.2% in 1975 to 0.4% in 1985.

The GGP per capita in agriculture in 1985 was only 9% of the country's average while mining contributed six times more GGP per capita than the average for the country. These extremes have an important influence on the affordability and therefore consumption of fuels. The area's population is relatively rural. The age structure indicates a relatively low dependency burden, however, and this is borne out by the lower total fertility figures for 1987 compared to RSA.

UFR JOUO is shown in the demand data to be one of the four regions which does not use coal. The supply data indicated that LPG per capita consumption is above the national average. Demand data shows that IP is not a significant fuel in either of the UFRs in this region and this is borne out by the supply statistics. Coal is used in Bophuthatswana but the figure in Table 3.6 is low at 28 440 tons in 1990. Borchers & Eberhard (1991) estimate consumption at 250 000 tons in 1989, with a further 80 000 tons being consumed in UFR JOUO.

Candle consumption in this region is also estimated to be low. However estimated consumption in Bophuthatswana is relatively high with an estimated 89% of households using this fuel and over one million packets being consumed per month.

## 3.14 Transkei — Urban Foundation region TTUO

The Transkei is bordered by Natal, Eastern Province and Lesotho and comprises Urban Foundation region TTUO. The Transkei is a very poor region with a GGP per capita of R26 per month in 1990. This compares to a country average of R280 in the same year. IP consumption per capita is also below the national average at 1.5 litres per capita per month in 1990 compared to 2.1 for the country as a whole according to supply data. The region's population is mostly rural.

Demand data shows that wood and paraffin made the most significant contribution to energy usage in 1990. Demand data has IP consumption at 6.0 Ml per month in 1990 compared to supply statistics of 4.5 Ml. However demand data is more likely to be correct than supply data due to some supply statistics possibly being captured in East London. Coal consumption is relatively low with demand data at 40 560 tons in 1990 which compares to the 1989 estimate of 1 800 tons made by Borchers & Eberhard (1991).

Candle usage is high in Transkei and this can be explained by the low level of electrification and the poverty of the region. 79% of households are estimated to use candles with over one million packets being consumed per month — second only to KwaZulu.

## 3.15 Conclusion

The hydrocarbon fuels are clearly important in satisfying the energy needs of the urban and rural poor. Future demand will be dealt with in the following chapter and policy interventions to increase the useability of these fuels will follow in Chapter 5.

## CHAPTER FOUR

# Demand analysis

Future demand for IP and LPG will be influenced by electrification and housing provision. Coal demand is unlikely to be affected to the same extent, given the role it plays in space heating and cooking, and the durability of the coal stove.

IP in particular, is a fuel used for its convenience. It can be purchased in small quantities and its appliances are cheap. However, consumers have negative perceptions of IP as being dirty and smelly. Furthermore, there is a status factor in moving away from IP to fuels such as LPG and electricity.

The oil industry is attempting to counter these negative perceptions and constraints, and smokeless IP is being developed. IP is also considered dangerous due to ingestion by infants, as it is normally bought in colddrink bottles. Investigations are proceeding to produce a cheap reusable child-proof cap. However, prototypes produced so far are expensive. Another initiative is to colour the paraffin so that it will not be mistaken for colddrink or water.

LPG is considered dangerous and appliances and cylinders are expensive. It is, however, a desirable fuel in many ways and the policy proposals below recommend that consideration be given to subsidising the cost of appliances. Advertising campaigns to promote LPG as a safe product are undertaken by the oil companies but these should be broadened.

The type of fuel used reflects individual priorities. Cost, convenience, access, knowledge, safety, health risk, pollution, status and external pressure all play a part. Detailed demand analysis could attempt to understand these factors and predict future demand. Policies can manipulate prices and supply information. They cannot force change where there are good individual reasons not to.

## 4.1 Housing projections

The EPRET housing projections are outlined in Table 4.1 below. Housing has been divided into six urban and three rural categories. 57.9% of houses are estimated to be in urban areas while the balance of 42.1% are assumed to be rural.

| | *Dwellings 1990* | *New dwellings 1990-2010* | *Shifts in type* | *Change* | *Dwellings 2010* |
|---|---|---|---|---|---|
| Midhigh income | 1 949 931 | 100 000 | 98 855 | 198 855 | 2 148 786 |
| Formal electrified | 395 419 | 200 000 | 421 758 | 621 758 | 1 017 177 |
| Formal non-electrified | 520 612 | — | (520 612) | (520 612) | — |
| Planned shack | 518 840 | 2 400 000 | | 2 400 000 | 2 918 840 |
| Unplanned shack | 399 705 | 174 577 | — | 174 577 | 574 282 |
| Backyard | 634 582 | 89 933 | — | 89 933 | 724 516 |
| Rural | 3 185 807 | — | — | (381 407) | 2 804 400 |
| Total | 7 604 897 | 2 964 510 | — | 2 583 103 | 10 188 000 |

**TABLE 4.1** EPRET housing projection: 1990 — 2010
*Source: EPRET database, Trollip (1993)*

## 4.2 Energy planning scenarios

The EPRET demand projections are based on two scenarios. The base scenario is 'business as usual' with a continuation of relatively modest projects currently in progress. Here the 1988 to 1992 IP and LPG growth rates of 5.5% and 7.7% respectively, are likely to continue in the future. The integrated energy planning scenario represents the desired scenario of energy provision to the urban and rural poor. The thrust of the scenario is greater electrification and the introduction of smokeless fuels. Currently 65% of all South African dwellings do not have electricity. Only 7.8% of the 'independent' TBVC countries and self-governing homelands (SGT) have electricity.

In this scenario 98% of 2 918 840 planned shacks are assumed to be electrified by the year 2010. All services except water heating (geysers) are assumed to be powered by electricity. 86% of the 574 282 unplanned shacks are assumed to be electrified and use electricity for media, lights and some cooking. 74% of backyard shacks will be electrified and will use electricity in the same way as the unplanned shacks.

It is assumed that, in the rural areas, 73% of farmworker dwellings, 70% of those in dense settlements, and 30% of those in remote rural areas will be electrified by the year 2010. Further, it is assumed that the percentage population in these three rural categories changes to 37.5% in dense settlements, the percentage of farmworkers remains the same, but the number of households in remote rural areas falls from 31.25% in 1990 to 25% in the year 2010.

This scenario will reduce the demand for hydrocarbon fuels. The projected fall in demand for IP and LPG and slight increase in the demand for coal over the period 1990 to 2010 is shown in Figures 4.1 to 4.6 below.

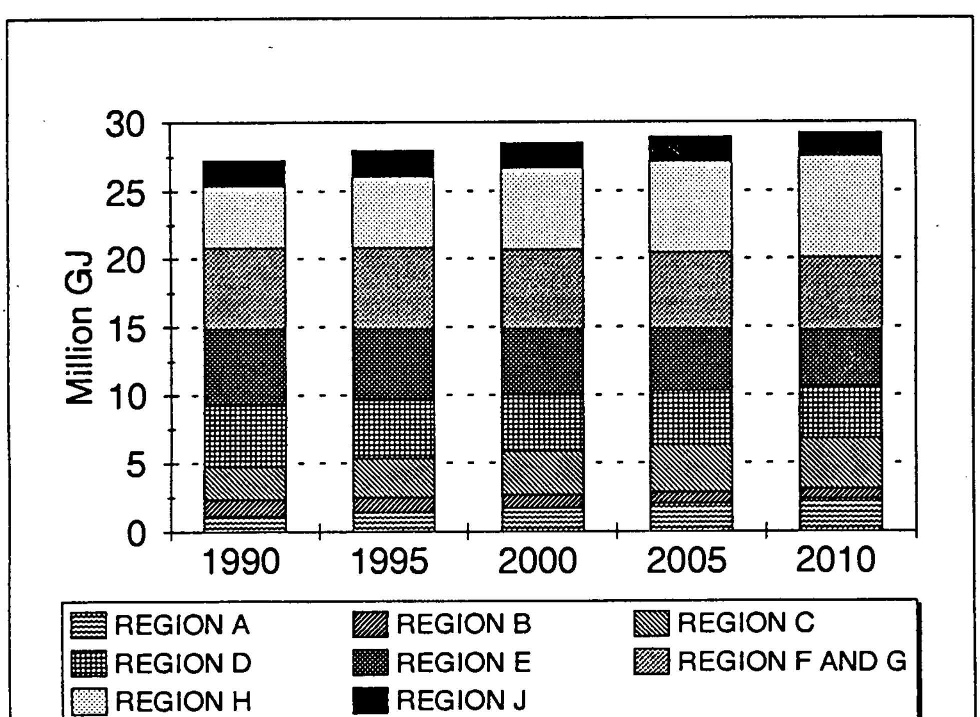


**FIGURE 4.1** Business as usual scenario — IP

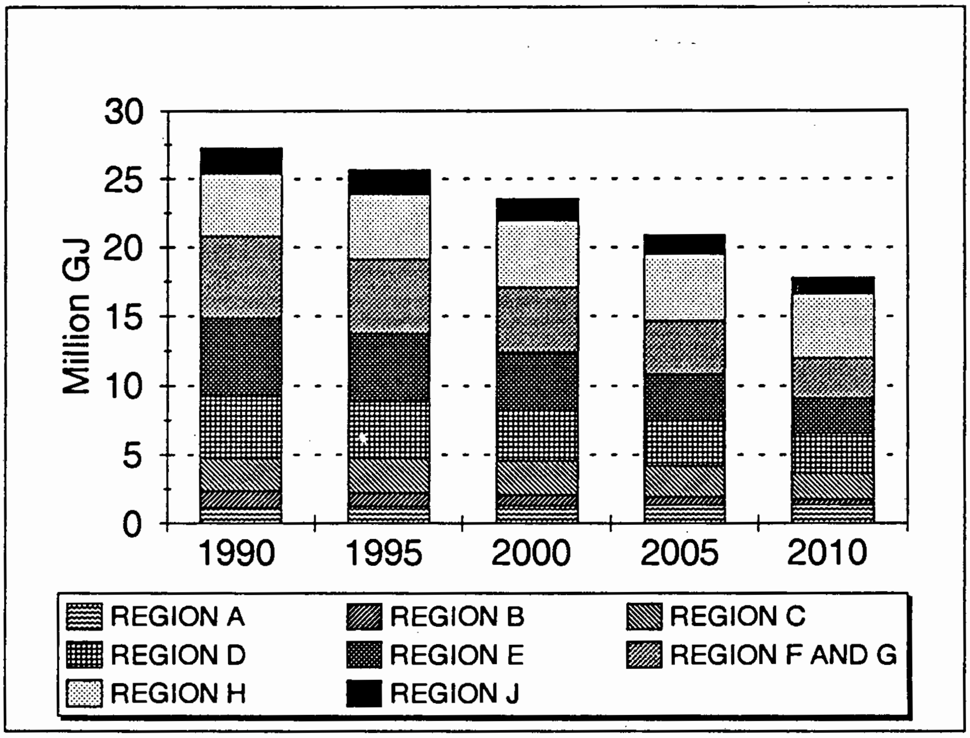


**FIGURE 4.2** Integrated energy planning (IEP) scenario — IP

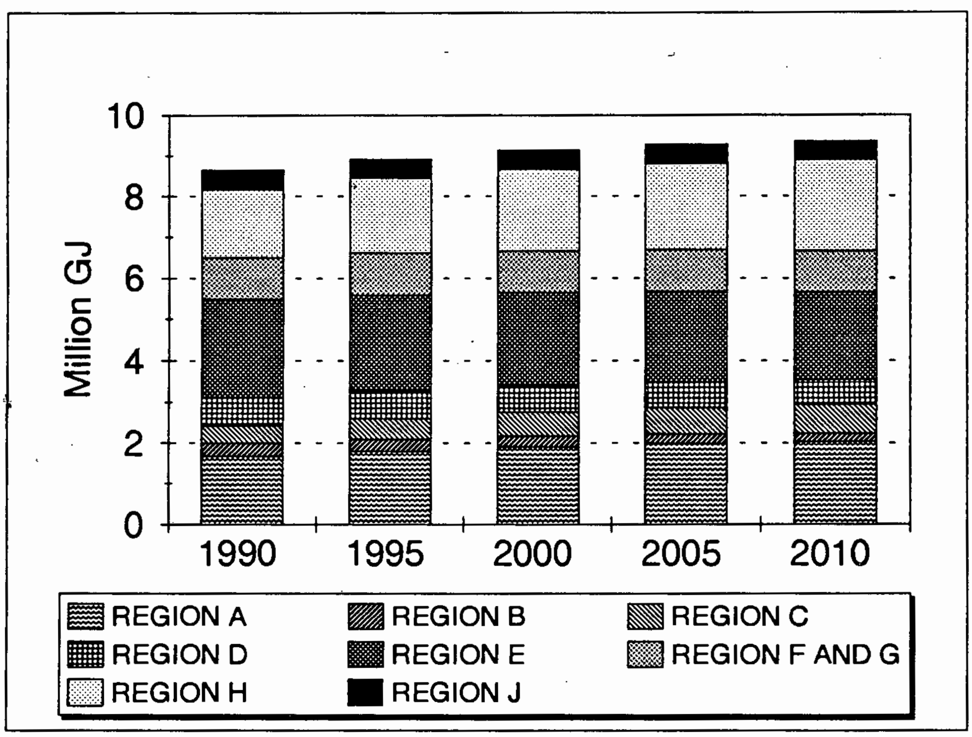


**FIGURE 4.3** Business as usual scenario — LPG

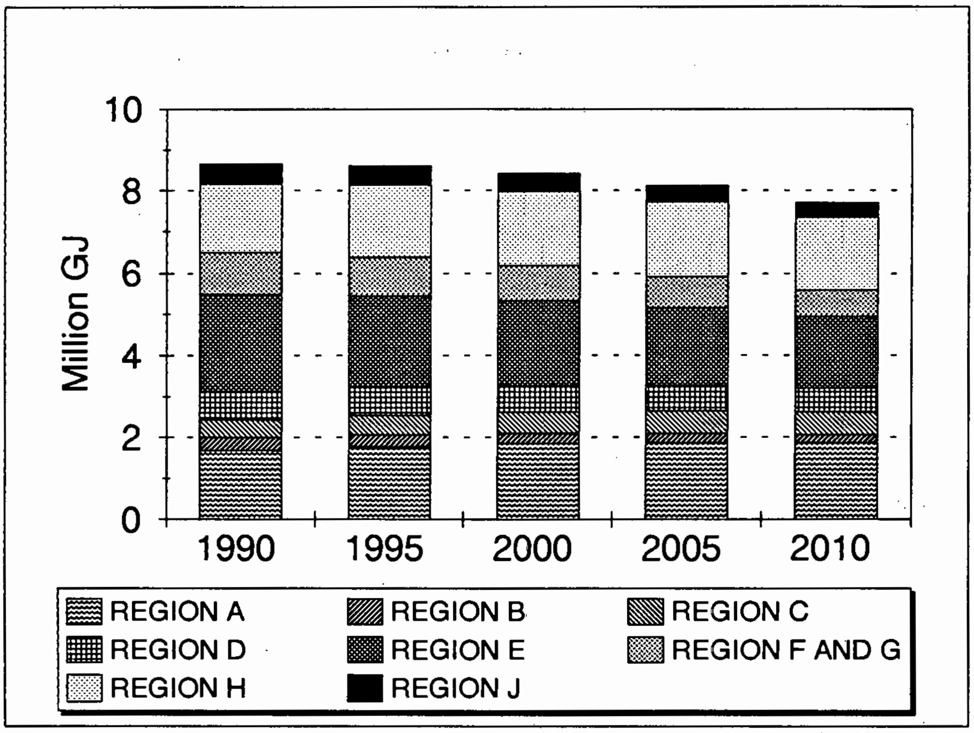


**FIGURE 4.4** Integrated energy planning (IEP) scenario — LPG

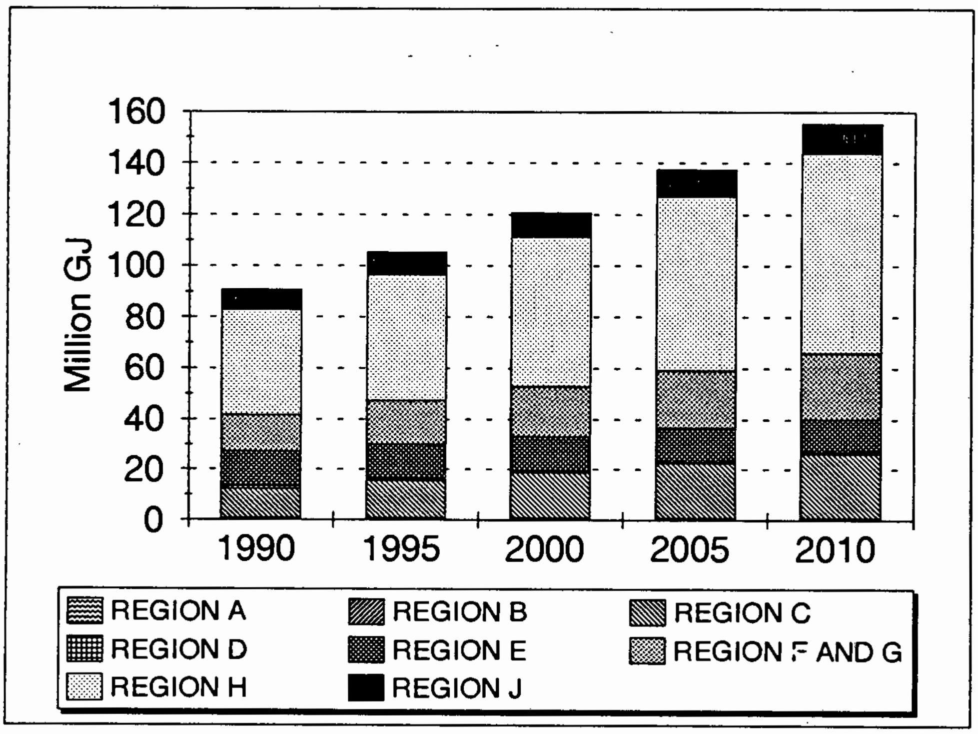


**FIGURE 4.5** Business as usual scenario — Coal

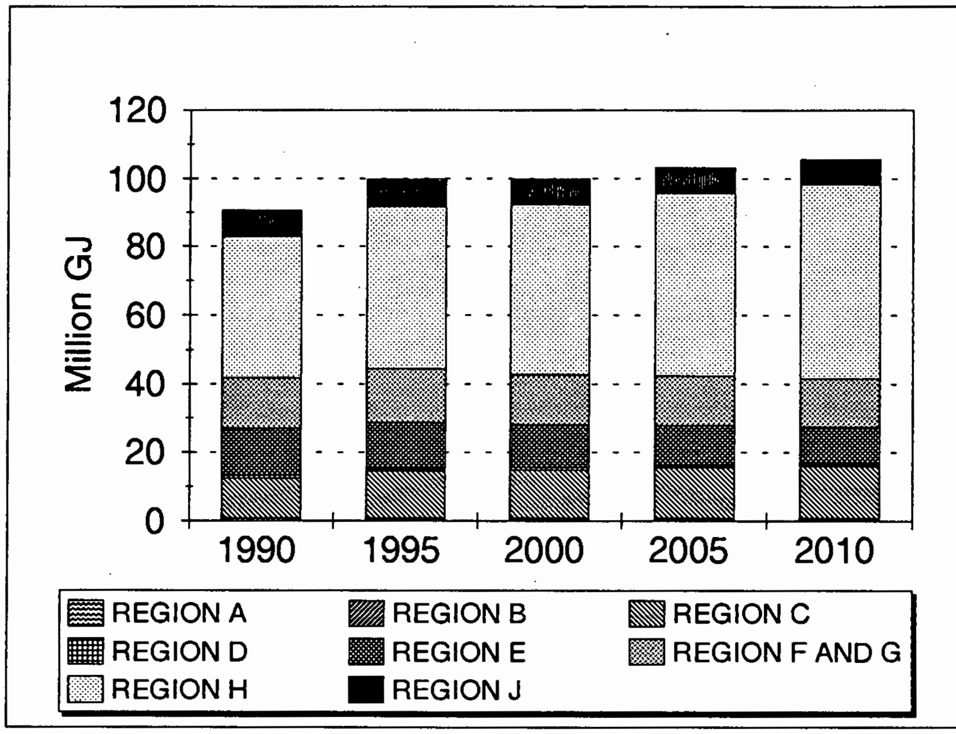


**FIGURE 4.6** Integrated energy planning (IEP) scenario — Coal

## CHAPTER FIVE

# Policy interventions

As indicated in Chapter 4, hydrocarbon fuel use by households will continue for some time. The aim of this paper is to indicate ways in which end-use efficiency such as the optimising of price, availability and safety of hydrocarbon fuels, can be achieved.

Chapter 2 discussed the problems of high mark-ups in the urban areas — increases which ranged from 60% ex oil company depot to the consumer in the case of IP, to 130% and 301% for LPG and coal respectively (Palmer Development Group 1993).

In rural areas such as Mmotong, the mark-up for IP ex-depot is relatively low. Note that this is a router depot, not an oil company depot. The price is regulated ex-oil company depot, but discounted to routers. Mmotong is a peri-urban area, which raises the issue of population concentration, as the larger the market, the easier it is to keep the mark-up low. Conversely, if the volume sold is small and the distance from the oil company depot or coal mine is large, the higher the price.

Another issue is that of government involvement. The IP price is controlled to the wholesale level. The LPG prices are similarly determined, although not explicitly regulated. The retail IP mark-up is legislated at 33.3% above the controlled maximum legislated, wholesale price. It is, however, impossible to police, and is generally ignored by distributors. The possibility of extending state-controllable, maximum hydrocarbon fuel prices will be investigated below.

Safety, the environmental impact and the social implications of the use of hydrocarbon fuels must also be considered. It is proposed that smokeless coal be introduced into coal consuming areas.

The aim is to suggest policy interventions where these are appropriate and practical and where they can result in lower prices to consumers, improve accessibility and reduce pollution and health risks.

## 5.1 Interventions to limit IP and LPG mark-ups

IP and LPG attract no tax levy with the exception of the 7 cents per litre equalisation fund levy which applies only to IP, so that the maximum wholesale selling price ex oil company depot is relatively low. However, although there is an extensive network of oil company depots, delivery in most cases does not extend beyond the depot. There are three main reasons for this:

a) The 'drop' size, or amount of fuel delivered to a single IP or LPG retail outlet is small which does not make for the economies of scale that the oil companies are used to. There is a fixed delivery cost allocation or service differential allowed in cents per litre in the price build-up on a cost-recovery basis. If oil companies could distribute more cost effectively, more money could be made at the depots. Depots are shared by oil companies in order to minimise capital and administration costs. As it is, they use routers, who are prepared to make small drops, and hawk the fuel at retail outlets. The IP market, particularly, is highly competitive so that oil industry discounts of around ten cents per litre, or 40% of the combined government controlled service differential plus an oil industry wholesale margin, are not uncommon.

   The uncontrolled LPG price also has a service differential of 9.7 cents per litre (see Table 2.7). However, almost all domestic LPG router distribution is made by means of cylinders on trucks. Prices, as outlined in section 2.5.2, are heavily discounted by the oil companies if markets are competitive, trading reduced unit profit for increased volume of sales. There is clearly scope for such flexibility in oil company profit margins.

b) The turmoil in the townships discourages oil companies from using their own vehicles for deliveries. They will, however, use their own bulk trucks for delivery purposes to the bigger LPG retail outlets. These retail outlets are usually tied to that oil company by a sales agreement.

   An extension of oil company IP and LPG distribution would enable oil companies to police IP and LPG prices. The current policy creates competition amongst oil companies for routers to deliver their products. This results in high discounts, low oil company margins and other incentives to routers such as financing the purchase of a delivery vehicle through discount, or even a grant, in the case of established routers.

c) A third problem is credit collection. Township distribution is fraught with problems of bad debt. Credit can be extended in the case of IP and LPG, but not petrol. Credit is also extended to routers, but not (further down the distribution chain) to retail outlets, (except in the case of tied distributors) for fear of bad debt. However, the retail prices of IP and LPG are excessive in comparison with the wholesale price. It seems, therefore, that by limiting the number of middlemen in the distribution chain, prices could be lowered.

This could be achieved in two ways: firstly, by greater community involvement and secondly, by increasing state regulation over IP and LPG distribution and prescribing a retail price in cents per litre. The first option would work better in closely-knit rural communities. The second would be better suited to the urban environment. In both cases, however, the pricing advantages of bulk buying must be conveyed to the consumer.

In the rural areas this could be achieved by establishing co-operatives, such as agricultural co-operatives, which would be owned by the community, and used, not only as a venue for bulk deliveries from the oil companies, but also as a more easily accessible distribution point, thereby achieving not only the goals of safety and availability, but qualifying also for low price mark-ups. These bulk delivery points need not be restricted to such rural cooperatives. Existing large trading stores and rural service stations also provide opportunities providing the community maintains control over the supplies There is a danger of the owners of such establishments increasing prices for personal profit once the distribution point is established. There are service stations in the Transkei which sell more IP than petrol. This is an important area where more information is needed. Existing outlets for IP and LPG in rural areas, the distribution networks and pricing need to be assessed if this policy intervention is to be successful. The Palmer Development Group reports (1992 and 1993) have been used extensively in this study and are comprehensive. However, further follow up studies which investigate other metropolitan areas are needed.

The convenience of proximity to home and extended buying hours, is an important factor in increasing purchases of IP. Anneke (1993) reports that women in Canaan near Durban spent, on average, 20% of their income on IP. The cost of the fuel was an important but not a determining factor. The women in the survey purchased small quantities of the relatively expensively priced fuel according to their variable daily income. Convenience as well as the physical and emotional well-being of the women and their households were equally important. The physically demanding and time consuming collection of wood and fire making, coupled with the desire to cook a meal that satisfied the household swayed the decision about fuels in favour of IP even though it consumed a considerable portion of income. Easy access to reasonably priced IP and, to a lesser extent, LPG, would reduce the enormous workload faced by women throughout the country, reducing the time spent on essential daily tasks and improving the household's standard of living.

Surveys (Price 1992) indicate that there is a broad awareness that IP and LPG bought from 'warehouse' depots and garages is cheaper than that bought from local stores. The inhibiting factor here is the need for transport to carry the large weight of these fuels from the garage/depot to home. Similarly, the mean distances of these outlets from homes is relatively large and very few poor people have ready access to suitable transport.

If the price benefit could be increased, the propensity to overcome these problems could grow. However, convenience is still a major factor that will force many people to buy locally even at considerably higher prices.

The most important factor in lowering mark-ups through extended price regulation, would be improved security in the townships, to encourage oil companies to extend their influence over the distribution chain. Here a policy proposal for immediate implementation would be for oil companies to install underground bulk IP tanks and bulk LPG tanks, at all service stations in and around townships, with the necessary staff to dispense the fuels. In order not to hinder transport fuel sales and to ensure safety, additional facilities for selling IP and LPG could be installed.

The government could also reduce the equalisation levy of 7 cents per litre in the case of IP to the more appropriate 3.6 cents per litre applied to LPG, to reduce the price of IP from service stations and cover the additional transport costs of the consumer.

Once these oil company delivery methods have been established, the discounts previously given to routers could be passed on to the retail outlets. Some of this discount, ie the 3.3 cents per litre service differential (as in the case of petrol), would be retained for delivery. However, this leaves the 13.672 cents per litre oil industry wholesale margin and the remaining 6.4 cents per litre of the service differential. Part of these could be discounted to 'tied' dealers. Section 5.3 deals with the loss of earnings to local people who are removed from the distribution chain.

The Palmer Development Group reported (1992a) that a router depot in Mmotong in the Northern Transvaal, was selling IP for 106 cents per litre. This is 20.87 cents per litre above the regulated wholesale price. If the oil companies were to discount the wholesale price by the amount of the remaining service differential, ie 6.4 cents per litre, it would allow a retail outlet selling at, say, R1.00 per litre, to put a 21.27 cents per litre or 27% mark-up on the product, thus increasing the oil industries margin to the full wholesale margin, or 12.5% of the IP price. The state, through the oil companies, could monitor the tied retail outlet's mark-up through the consumer/community and the oil company representative.

If the drop size diminishes and causes oil industry delivery costs to rise, the service differential could be increased. This is regulated by the State in the case of IP and this regulation could be extended to LPG. If this policy is successful the service differential could be further increased to encourage oil companies to service all retail outlets to a minimum drop size such as 1500 litres in the case of farmer diesel.

This service differential increase could be large enough to increase the margin the oil industry have to play with and increase their incentive to follow this route thereby creating a distribution chain similar to that of petrol service stations, with a single delivery from the depot to the retail outlet, which then onsells directly to the public.

The detailed price benefits are shown below in section 5.6 on pricing policy. In summary, however, these policy proposals could lead to price decreases to the consumer of around 30% in the case of IP and 37% in the case of LPG.

## 5.2 Safety of IP and LPG distribution

The objective of safety could be addressed if there was more state control over distribution.

Paraffin poisoning is a relatively common incident amongst children in paraffin using households, especially infants between 12 and 36 months of age. Van Horen (1994a) reports that paraffin ingestion results in severe poisoning, and in some cases, death. Child proof IP containers could be introduced by supplying sealed containers to retail outlets. The cost at the depots would rise, but market research surveys (Price 1992) indicate that this is a consumer requirement. There appears to be a preference for 5-litre containers. These could be prepacked at the depot and delivered to retail outlets. This would cut out the capital cost of bulk tanks at retail outlets and enable the oil industry to market their own brands, as they do in the case of lubricants. There is, however, the additional cost of manufacture and disposal of reduntant containers. A shorter distribution chain would help to cover the costs of this innovation and encourage state support due to the resultant decreased health costs ie fewer container related accidents.

Concomitantly, there should be better policing of the safety regulations. For instance, it could be mandatory that there are separate filling and storing cages, and that these are three metres apart.

## 5.3 Availability of IP and LPG

IP is already fairly widely distributed but LPG could be made more widely available at better prices, if distribution chains were curtailed. As mentioned above, although IP and LPG are relatively small products in volume terms from a barrel of crude oil, no shortage of these fuels is expected in the foreseeable future.

However, the above proposals do not take cognisance of the fact that many township residents earn a living thanks to the current extended distribution chain. There would undoubtedly be a reduction in total earnings and the number of people employed locally, whilst oil company revenue would increase. The support of the consumers would be essential to the success of such changes. Another impediment is the vested interests of powerful cartels in the hydrocarbon fuel distribution business who could bring substantial pressure to bear on any proposed changes to the system — particularly in an unstable socio/political environment.

However, the benefits are that the stated objectives of the EPRET programme (to widen access to basic energy services for the urban and rural poor), would be realised. Furthermore, this is seen to be a gradual extension of price regulation to some bigger retail outlets. As discussed above, convenience is a crucial requirement in the purchase of IP. Spazas are likely to continue selling IP for this reason. Not all consumers would be able to make the trip to obtain the lower prices at bigger retail outlets or service station. Unfortunately, it would be mostly the poorer members of the community who would be unable to take advantage of these opportunities. However, the option would be available to the majority, and the objective of the EPRET programme largely realised, by lowering prices, increasing availability and increasing safety.

## 5.4 Low smoke coal policy intervention

As indicated above, multiple fuel use is likely to continue for some time, in spite of electrification initiatives. Coal has been identified as an important fuel, now and in the future, particularly in the populous PWV area of region H.

However, coal use has severe health side-effects due to air pollution. The primary cause of coal air pollution are the smoke-causing volatiles such as hydrocarbons, tars and oils, emitted on combustion. Horsfall (1992b) reports that it has been estimated that in parts of Soweto, smoke pollution is as high as during the infamous 'killer smog' occurring in the UK in the nineteen fifties. This observation is backed up by van Horen (1994a) in quoting Turner and Lynch (1992), where it was found that air pollution levels (especially particulates) in Soweto are very high. They support this by stating that the annual mean concentration of fine particulate matter (FPM) in Soweto during the period August 1990 to July 1991 was more than double the USA standard. Terblanche, Danford and Nel (1993) report that 12 hour average levels of total suspended particulate matter were 750 micrograms per square metre in coal cooking areas compared to a World Health Organisation no-effect- exposure limit of 180. Recent epidemiological data have indicated that acute respiratory infections (ARI) are one of the leading causes of death in black South African children, with a mortality rate of ARI 270 times greater than for children in Western Europe.

Concentrations of FPM were around eight times higher in winter than in summer, when coal stoves were used for heating as well as cooking (LHA Management Consultants (1987) estimate that 260 000 smoky coal stoves exist in the PWV region). Furthermore, Wells (1992) adds the problem of atmospheric stability. He states that air pollution emitted by coal stoves is trapped near ground level in the stable air of temperature inversions. Radiation from the earth's surface after sunset leads to a dense cold layer of air that may be a few hundred metres deep. Such inversions are not just a winter phenomenon and Highveld surface temperature inversions can occur at 01:30 hours for 60% to 70% of the year. The CSIR has attempted to introduce smokeless coal stoves with limited success.

The probable continued use of coal and the health hazards posed by this require the attention of policy makers. Fortunately, the production of smokeless coal is being investigated. This is a far cheaper option than trying to replace coal stoves with smokeless models. The two products being produced currently, are reconstituted coal, formulated by Enertek of the CSIR, and heat devolatilised coal, produced by the University of the Witwatersrand (Wits) in association with United Carbon Producers (UCP). Both are sponsored by the Department of Mineral and Energy Affairs. These two smokeless coals are discussed below.

### *5.4.1 Reconstituted coal — Enertek*

During 1992 Enertek of the CSIR began the production of low cost, low smoke coal using cement to produce coal briquettes from discard duff coal. Enertek (1993) states that no pressure is required for the binding action, so that the commercialisation of the process requires a far smaller capital outlay when compared to classical roll briquetting. This is important in the attempt to gain acceptance of this product amongst income-constrained consumers with readily available alternatives. High pressure roll briquetting would result in a more usable product but would require subsidies.

The process involves mixing duff coal, cement and water in the ratio of 100:15:21, ie 100 kg of duff coal would be mixed with 15 kg of cement and 21 kg of water until a homogeneous mixture is obtained. The mixture is then poured onto a plastic sheet, within a wooden frame and covered to dry for seven days. During this period the slab must be kept wet to gain strength, and once dry it can be broken up into lumps similar to conventional coal and packed into 60 kg bags for distribution. Adding lime is also being investigated to reduce sulphur emissions.

An analysis of the effectiveness of agglomerated coal showed it to be more friable than conventional lump coal. It took longer to ignite, but burnt for longer. A survey by the Palmer Development Group (1992b), found that lump coal was used together with it initially to enable it to burn, and that the agglomerated coal blocks in this study were too big for stoves but used in braziers. Enertek (1993) found in laboratory studies that the agglomerated coal produced less sulphur than lump coal, had a lower calorific value and produced more ash — primarily because of the cement binder. However the volatiles emitted were around a third less than conventional lump coal, exhibiting its quality as a low- smoke fuel. There are clearly problems associated with the manufacture and use of reconstituted coal. The viability needs to be rapidly improved if such coal is to become accepted on a large scale.

### 5.4.2 Heat devolatalised coal — Wits, UCP

Volatiles or smoke from coal can be extracted by exposing the coal to heat at specific temperatures for specific lengths of time. Professor Horsfall (1992b) states that rewashed discards are rendered smokeless by subjecting them to heat at between 500 to 600°C for approximately two hours.

These discard coals are residuals, substantially from export mines, during the washing process. Here, after the newly mined coal is crushed and sized, it is washed in liquids of suitable density to eliminate low grade coal, ie coal with a high ash or non-carbon content. This coal, together with true discards such as stone and shale, is then rewashed as part of the Wits process and results in coal of a relatively high calorific value, similar volatiles to premium coal, but with around double the ash content.

Discards are obviously substantially cheaper than conventional, low ash coal and approximately 40 million tons of discard and duff coal is produced annually. This input cost benefit, is combined in the Wits process with waste heat, to further cut the costs of this smokeless coal.

A source of waste heat is being supplied by UCP at the old Vaal power station. UCP is a supplier of industrial char, (also a form of smokeless fuel), which is produced by a coking stoker. Horsfall (1991) describes that when the coking stoker is used as a combustion unit, the aim is to introduce as much primary and secondary air as necessary, to completely combust the material on the grate in the stoker, so that only ash is discharged from the end. When it is adapted to produce the UCP devolatalised coal, ie char, used extensively as a reductant in the electro-metallurgical industry, the supply of air is reduced, only burning the volatiles emitted in the space above the grate. Consequently the coal on the grate is 'toasted', further devolatalising it.

However, these stokers are not well suited to making smokeless fuel as the temperatures are too high. Waste heat from the stokers is above 1000°C in the form of flue gases. The solution to the problem is to convert an adjacent stoker to that on which the char is being produced, and allow the flue gases to pass over the rewashed discards in the adjacent stoker to produce smokeless fuel. UCP has undertaken these stoker modifications at the Vaal power station and heat devolatalised smokeless coal is being produced from rewashed discards.

The calorific value is similar to that of conventional, lump coal, there is more ash, and the volatiles are even lower than in Enertek coal, and half that of lump coal. The Palmer Development Group (1992b) survey of the facilitation of the delivery of the two smokeless fuels, found that this smokeless coal was also more friable than conventional coal and also required conventional coal to get it to burn.

In conclusion, the acceptability by the community and by the coal merchants of these smokeless coals is of pivotal importance. Here cost will be the most crucial factor. Preliminary estimates of the Enertek slab casting option, (Williams 1993), suggest that at a cost of R35 per ton for duff coal, R30 per ton for the binder and R90 per ton (R30/day) for labour, the wholesale price of agglomerated fuel would be R155 per ton. This compares to R64 per ton for conventional coal (R48 per ton ex-mine, plus R16 per ton for delivery to the merchant). Clearly, these preliminary cost estimates indicate problems in marketing this coal. No clear costs for the Wits/UCP smokeless coal are as yet available. Preliminary findings by the Palmer Development Group survey (1992b) from merchants, suggest that R10.00 per 70 kilogram bag or R143 per ton would be acceptable to township residents.

This would involve gaining the confidence of the current network of coal merchants to facilitate distribution. The length of the distribution chain, which will depend on the place of manufacture, is likely to be shorter than that of conventional coal. Consequently, the high transport costs of conventional coal could be undercut. This point of variable place of manufacture is made more relevant by the fact that township residents are already making their own briquettes, using the Enertek methodology and clay as a binder. It is left in the sun to dry but cannot be used in a coal stove as it causes the plates to crack. It is used in braziers, however, and produces less smoke.

In conclusion, the proposed policy intervention to replace conventional coal with low smoke coal will require subsidies in order to gain acceptance by price conscious households. There are cost advantages to low smoke coal in distribution, but this is likely to be more than offset by higher costs of production. Nevertheless, as in IP and LPG the costs of distribution can be lowered. Potential health improvements are considerable. Securing a comprehensive policy to replace conventional coal would greatly improve many peoples's lives, but will take time as neither process is ready for large-scale production.

## 5.5 Financing implications

The financing implications of policy intervention can either be met by the fiscus or the private sector. Fiscal finance revolves around subsidising the proposed policy intervention and raising other taxes to meet this expenditure. Using the private sector to provide the shortfall between how the market allocates the relevant goods and the more expensive, desirable policy intervention, requires regulation.

In the case of IP and LPG, it was proposed that in order to optimise the objectives of the EPRET project, prices of these fuels needed to be lowered and their availability and safety ensured. The policy intervention outlined above, was to extend price regulation by more extensive distribution on the part of oil companies. This would reduce the high mark-ups prevalent in the current distribution system and, through regulation, lower the price, improve availability and increase safety at no cost to the fiscus.

The estimated cost savings to the consumer of the proposed increased regulation on IP and LPG is detailed in section 5.6 below. These amount to around 40 c/l in the case of IP and R1.40 per kg for LPG. Based on 1992 volumes, this would increase the disposable income of IP and LPG consumers by around R270 million in the case of IP and R213 million for LPG or R85.00 per household per annum in 1992 money. These estimated cost savings apply to total household IP and LPG consumption, ie it assumes all potential domestic consumers will get the benefit of the price decreases.

Low smoke coal requires price support, however, due to the relatively high cost of production. Van Horen (1994b) proposes that a tax be levied on conventional coal to raise income to subsidise the production of low smoke coal. How much will be required is not yet clear as the low smoke coal technology is not yet fully developed. However, a subsidy of R60 per ton for low smoke coal (conservatively high estimate), would require in the region of R180 million per annum. This could be met by a 4.1% or R1.36 per ton price increase on domestic coal. If export coal volumes were also taxed, the increase could be kept to around R1.00 per ton or 3.0%.

On the other hand, a tax could be levied only on household coal so as not to push up the costs of industry (eg Eskom, Sasol). A tax of R10.00 a ton would raise R31 million and require a state subsidy from other sources of R150 million per annum. There is a possibility that the domestic coal industry could be reregulated and it could be legislated that only low-smoke coal could be distributed. However this would create more bureaucracy and a black market in conventional coal is likely to emerge.

Clearly, financing hydrocarbon fuels is not likely to be onerous on the fiscus. The administration of the taxes and subsidies could also be simplified as there are few coal mines and they are controlled by large companies, and secondly, there are currently only three producers of low smoke coal which require subsidisation.

## 5.6 Pricing policy proposals for hydrocarbon fuels

Pricing policy proposals for hydrocarbon fuels are made within the framework of the policy interventions outlined in sections 5.0 to 5.4. Consequently, IP and LPG pricing proposals will be made within the context of current price regulation. The pricing policy proposals for coal, on the other hand, will be determined once low smoke coal is introduced and the consequent higher costs and the taxes on conventional coal are introduced.

## 5.7 Pricing policy proposals for IP and LPG

The current mark-ups for the hydrocarbon fuels as established by the Palmer Development Group (1993) and reported earlier in Table 2.13, are abbreviated below in Table 5.1.

| *Fuel* | *Wholesaler purchase price* | *Retailer selling price* | *Percentage mark - up* |
|---|---|---|---|
| IP c/l | 88 | 139 | 60.0 |
| LPG c/kg | 162 | 373 | 130.0 |
| Coal c/kg | 4.99 | 20.24 | 301.0 |

**TABLE 5.1** Hydrocarbon fuel distribution chain summary (1992)
*Source: Palmer Development Group (1993)*

The Palmer Development Group surveys which produced the above summarised results, took place in late 1991 and 1992. In order to establish the kind of reductions in price which might be passed on to the consumer under extended regulation and the proposed shorter distribution chains, Table 5.2 shows the relation between what wholesalers reported purchasing IP and LPG for, and the actual depot wholesale bulk list price. These depot prices are as at the 1/4/1992 (the time of the Palmer Development Groups surveys), and reflect Zone O9C for IP, while the LPG is a bulk reseller price in Zone 07L. These zones encompass the areas in which the Palmer Development Group's surveys took place.

| *Fuel* | *Wholesaler price – oil company depot* | *Wholesaler selling price* | *Difference* |
|---|---|---|---|
| IP c/l | 88.23 | 88 | 4.77 |
| LPG c/kg | 212.25 | 162 | (50.25) |

**TABLE 5.2** IP and LPG price comparisons at wholesale level (1992)
*Source: Palmer Development Group (1993)*

The wholesaler is presumably supplied by a router and it appears from Table 5.2 there are significant oil company discounts.

The possible savings in the case of oil company delivery (1992 money), would be as follows:

*In the case of IP:*

- 5.5 cents per litre service differential
- 3.4 cents per litre lower equalisation fund levy
- Total:8.9 cents per litre delivered to retail outlets.

This would imply that, within the parameters of security of delivery, and no credit problems for the oil companies and within the legislated 33.3% mark-up, consumers would be able to buy IP from these retailers at 83.23 c/l minus 8.9 c/l, plus 33.3%. The price would then be 99 c/l or 40 c/l (30%) cheaper than those reported by the Palmer Development Group (ibid,1993).

*In the case of LPG:*

- 36.2 cents per kilogram distribution cost differential

This would imply that again, within the same parameters with a similar 33.3% mark-up, consumers would pay the lower wholesale price of 212.25 c/kg, less 36.2 c/kg (for the distribution cost differential), plus a 33.3% mark-up. The consumer price, allotted by the Palmer Development Group survey would be R2.33 per kg instead of the R3.73 average reported or R1.40 (37%) less.

The cost of appliances in the case of LPG, is high — usually over R100.00. However, this cost could be incorporated in a marginally higher regulated LPG price and passed on to consumers. Once they have the appliance, it would be reasonable to expect that it would be used and paid for by the higher LPG price.

In electrified areas, another possibility exists. Eskom has an extensive computer network for monitoring electricity accounts. If supplying the appliance for free is not an option, consumers could pay for it by having their electricity bill increased until the appliance was paid off.

The above pricing policy proposals depend on the extension of pricing regulation. This policy will take time to implement, particularly if it is to cover the entire distribution chain. However, once the benefits of these tied retail outlets become apparent to the consumer, it is likely that the extension of regulated retail outlets will grow rapidly.

## 5.8 Pricing policy proposals for coal

As outlined in section 5.4 above, the policy proposal of this paper with respect to coal, is to introduce low smoke coal for the health and environmental reasons given in section 5.4.

As shown in Table 5.1 above, the cost of coal is relatively low. Furthermore, a similar regulatory system as that which applies to IP and LPG does not exist to encourage lower coal prices. However, given the desirability of low smoke coal which needs to be subsidised it is not appropriate to lower the cost of conventional coal. In order to ensure the acceptance of low smoke coal, measures should be adopted to shorten the distribution chains of low smoke coal, by producing low smoke coal as close to the market as possible.

The amount of cross subsidisation of low smoke coal by taxes on conventional coal, will determine the pricing policy for low smoke coal. However, it should be ensured that the consumer pays a lower price for low smoke coal than conventional coal. A beneficial price differential in favour of low smoke coal, will be necessary during its introduction, together with a major information campaign. The problems associated with the use of smokeless coals will hinder their adoption. People using coal for cooking and heating will only switch to smokeless coal if they are informed of the health benefits and the cost is reasonable.

## 5.9 Institutional issues between energy suppliers

The goal of the EPRET project is to widen the access of the urban and rural poor to basic energy services. This can be achieved through Integrated Energy Planning, which aims to satisfy the consumer's energy requirements in the most efficient manner. The supply institutions such as Eskom and the oil companies can play a big role in achieving this objective.

A case can be made for the supply institutions to cooperate to achieve an improved supply of energy to the urban and rural poor. Electricity is the best form of energy to supply light and to power media appliances such as television. However, the hydrocarbon fuels could continue to be used for cooking and heating. This would cut down the cost of electricity, which becomes expensive when the load factor shows high peaks. These high peaks are likely to be exacerbated with the rapid extension of household supply because electricity in households is consumed mainly in the morning and at night. This is particularly so in winter when households use electricity for heating.

Eskom has to ensure it has the capacity to meet peak demand. This is inefficient when peak demand only occurs for short periods of the day. Estimates indicate Eskom would have to start building a new power station in the near future to cope with increased household peak demand. The additional capital cost of a new power station would have to be built into tariffs, causing them to go up.

To keep the cost of electricity down, other fuels should continue to be used for energy intensive applications such as heating. Furthermore, many households already have the appliances for hydrocarbon fuels.

In summary, the cost of energy to the consumer can be lowered and accessibility improved if households continue to use a range of fuels after electrification. The supply institutions should therefore cooperate in an open manner to achieve this. It is in their mutual interest. Eskom is currently initiating discussions with the oil companies through the Integrated Energy Planning Forum. This should be encouraged.

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# ANNEXURE A

## Existing provisions for refunds of excise duty and fuel levy as from 89.04.14 (Extracts from schedule 5 and 6)

| *agriculture forestry and fishing* | *extent of refund* | | |
|---|---|---|---|
| | *excise duty* | *fuel levy* | *total* |
| **Category 1 (road transport hire services in agriculture/forestry)**<br>Used as fuel for road transport in agriculture or forestry by any person other than the person carrying on agriculture or forestry (excluding such fuel used in passenger vehicles such as motor cars, station wagons and minibuses. | 3.634 c/l | 16.966 c/l | 20.6c/l |
| **Category 2 (agriculture production and fishing vessels)**<br>Used as fuel in machinery and implements for the production of agricultural products (excluding such fuel for use for road transport in agriculture or in passenger vehicles such as motor cars, station wagons and minibus) or as engine fuel in whalers, trawlers and other ocean-going fishing vessels. | 3.634 c/l | 16.966 c/l | 20.6 c/l |
| **Category 3 (transport in agriculture)**<br>Used as fuel for road transport in agriculture by the person carrying on agriculture (excluding such fuel used in passenger vehicles such as motor cars, station wagons and minibuses. | 3.64 c/l | 16.966 c/l | 20.6 c/l |
| **Category 4 (forestry)**<br>Used as fuel in forestry (excluding such fuel for use for road transport in forestry or in passenger vehicles such s motor cars, station wagons and minibuses. | 3.64 c/l | 16.966 c/l | 20.6 c/l |
| **Category 5 (transport in forestry)**<br>Used as fuel for food transport in forestry by the person carrying on forestry (excluding such fuel used in passenger vehicles such as motor cars, station wagons and minibuses. | 3.64 c/l | 16.966 c/l | 20.6 c/l |

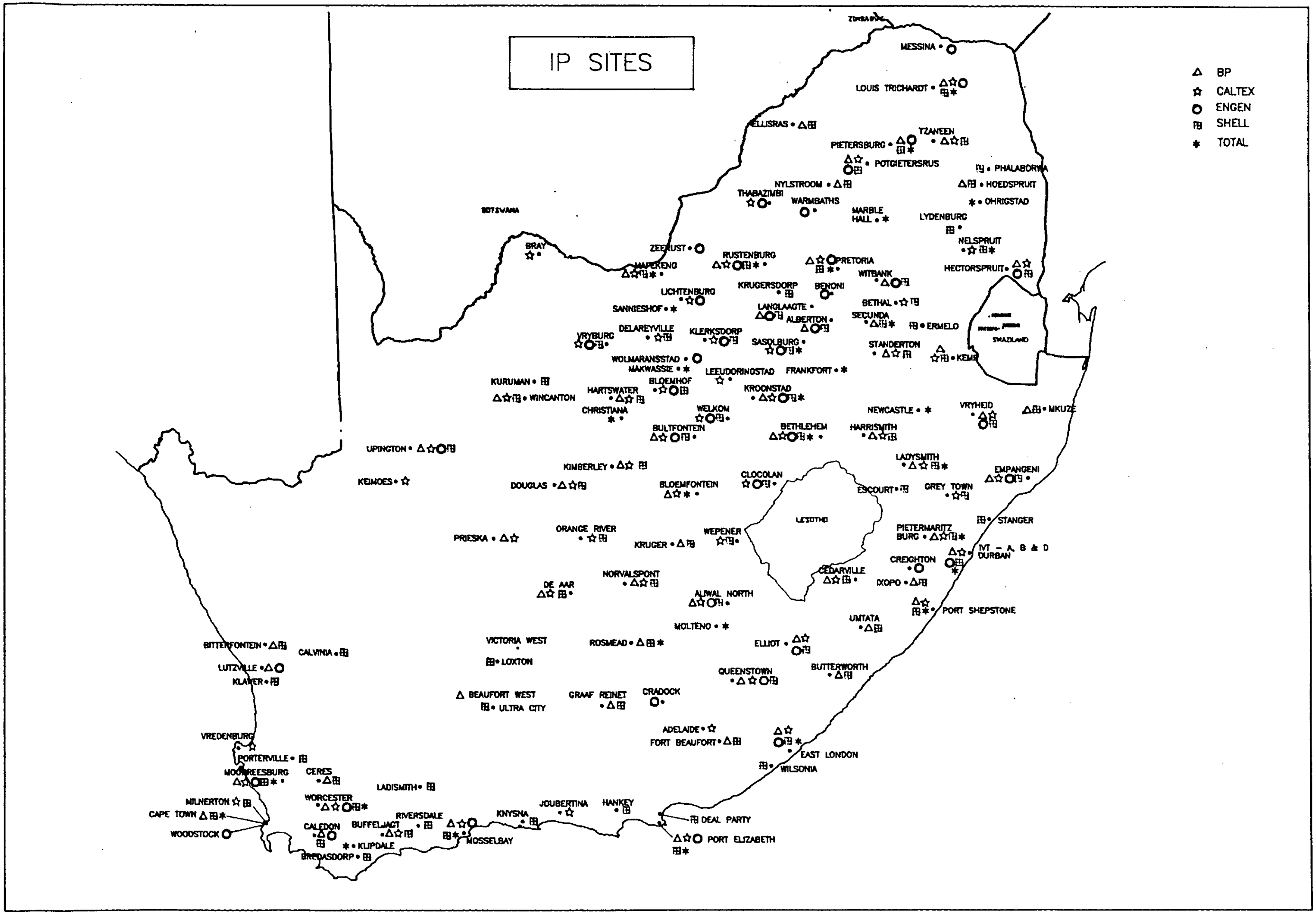
# ANNEXURE B

## Price build up - April 1993 (Diesel, at the coast)

| | *price c/litre* | *% of total* |
|---|---|---|
| **In bond landed cost**<br>● Product prices set by four major export refineries (3 Singapore and 1 Bahrain)<br>● Plus internationally determined freight insurance and loss costs and local landing charges of moving product to South African ports from Singapore and Bahrain. | 57.389 | 37.8 |
| **Service differential**<br>● Cost recovery of storage handling and delivery costs. | 3.5 | 2.3 |
| **Government taxes and levies**<br>● Fuel tax, duty, MMF and Equalisation Fund Levies. | 70.4 | 46.4 |
| **Wholesale margin**<br>● Determined by Marketing Par Formula. | 13.550 | 8.9 |
| **Zone differential**<br>● Based on transport tariffs as determined by Transnet. | 0.1 | 0.1 |
| **Slate under / over recovery**<br>● Differential between actual wholesale price and required price based on price build-up. | (4.539) | (3.0) |
| **Wholesale price**<br>● Oil industry selling price to dealers. | 140.3 | 92.6 |
| **Dealer margin**<br>● Motivated by MIF based on survey of service station costs. | 11.4 | 7.5 |
| **Pump price** | 152.0 | 100.0 |

# ANNEXURE C

## IP, LPG and farmer diesel oil company depot maps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CALTEX
ENGEN
SHELL
TOTAL
ZIMBABWE
BOTSWANA
LESOTHO
SWAZILAND
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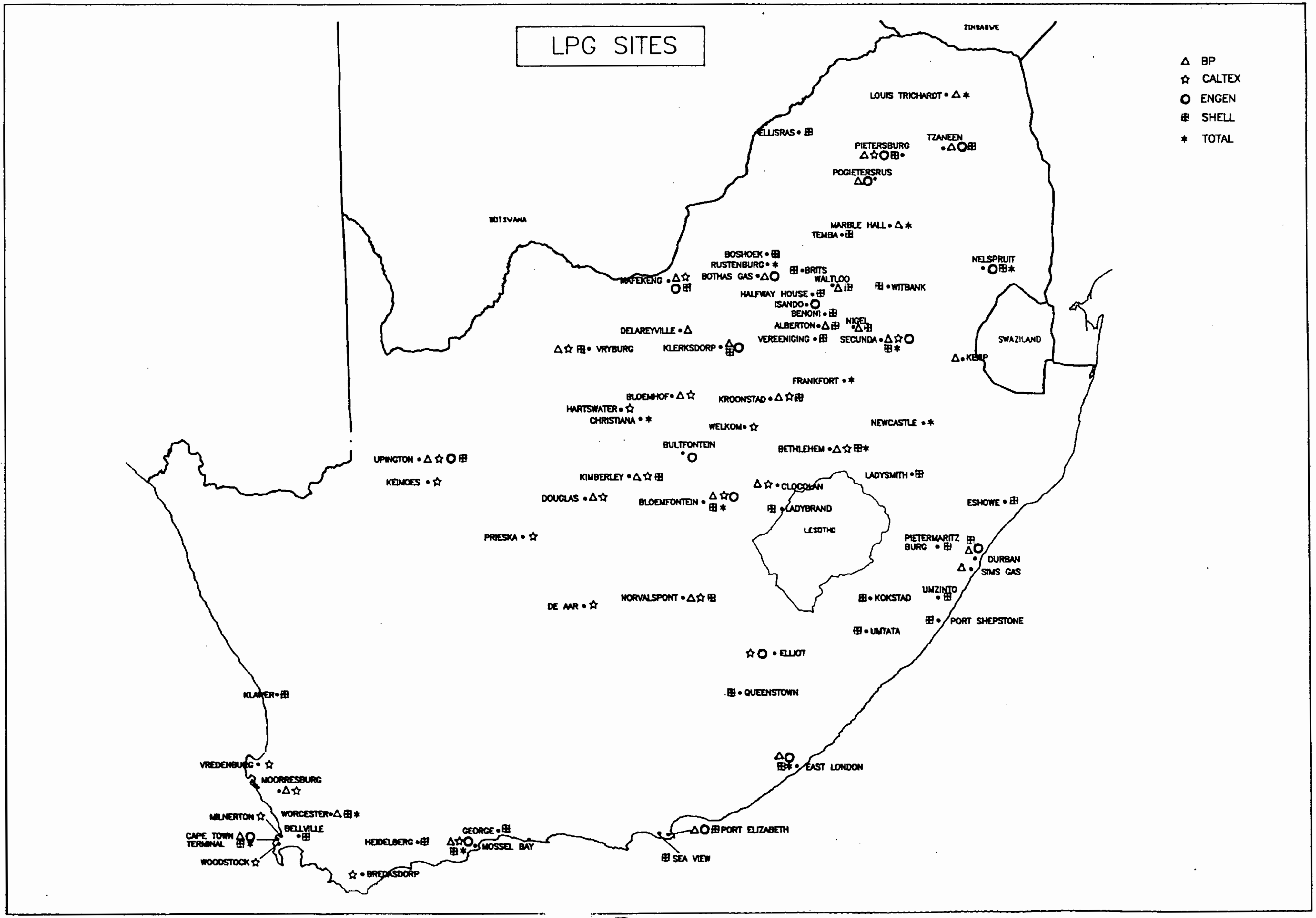
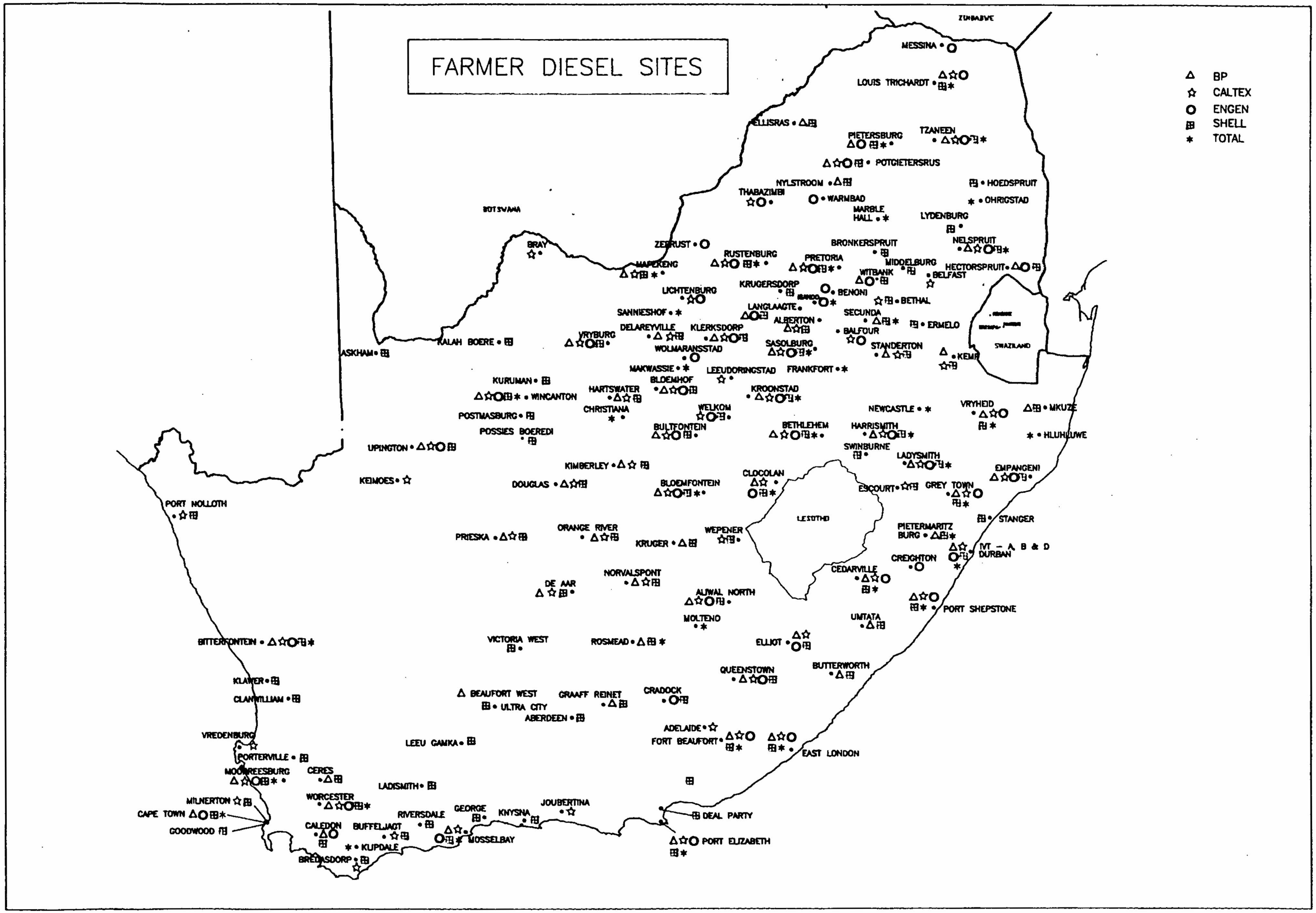
LOUIS TRICHARDT
ELLISRAS
PIETERSBURG
TZANEEN
POTGIETERSRUS
PHALABORWA
NYLSTROOM
HOEDSPRUIT
THABAZIMBI
WARMBATHS
OHRIGSTAD
MARBLE HALL
LYDENBURG
NELSPRUIT
BRAY
ZEERUST
RUSTENBURG
PRETORIA
MAFEKENG
HECTORSPRUIT
WITBANK
KRUGERSDORP
BENONI
LICHTENBURG
SANNIESHOF
LANGLAAGTE
BETHAL
ALBERTON
SECUNDA
ERMELO
DELAREYVILLE
KLERKSDORP
VRYBURG
SASOLBURG
STANDERTON
KEMP
WOLMARANSSTAD
MAKWASSIE
LEEUDORINGSTAD
FRANKFORT
KURUMAN
BLOEMHOF
HARTSWATER
KROONSTAD
WINCANTON
CHRISTIANA
WELKOM
NEWCASTLE
VRYHEID
MKUZE
BULTFONTEIN
BETHLEHEM
HARRISMITH
UPINGTON
LADYSMITH
KIMBERLEY
EMPANGENI
KEIMOES
DOUGLAS
BLOEMFONTEIN
CLOCOLAN
ESCOURT
GREY TOWN
STANGER
PRIESKA
ORANGE RIVER
KRUGER
WEPENER
PIETERMARITZ BURG
IVT – A, B & D DURBAN
CREIGHTON
CEDARVILLE
IXOPO
DE AAR
NORVALSPONT
ALIWAL NORTH
PORT SHEPSTONE
UMTATA
MOLTENO
BITTERFONTEIN
CALVINIA
VICTORIA WEST
ROSMEAD
ELLIOT
LOXTON
LUTZVILLE
KLAWER
QUEENSTOWN
BUTTERWORTH
BEAUFORT WEST
GRAAF REINET
CRADOCK
ULTRA CITY
VREDENBURG
ADELAIDE
FORT BEAUFORT
EAST LONDON
PORTERVILLE
WILSONIA
MOORREESBURG
CERES
LADISMITH
MILNERTON
WORCESTER
CAPE TOWN
RIVERSDALE
KNYSNA
JOUBERTINA
HANKEY
DEAL PARTY
WOODSTOCK
CALEDON
BUFFELJAGT
MOSSELBAY
PORT ELIZABETH
KLIPDALE
BREDASDORP

# LPG SITES

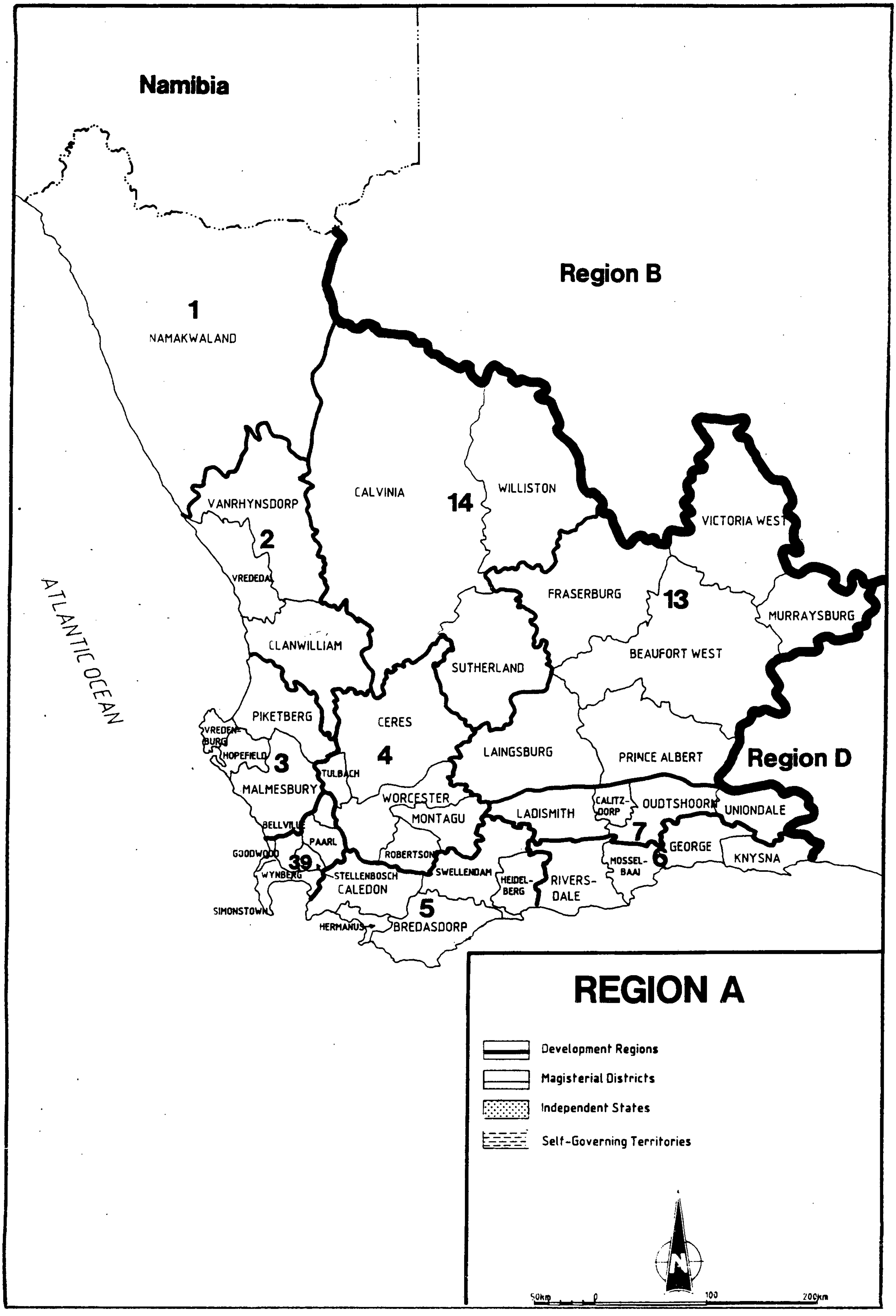


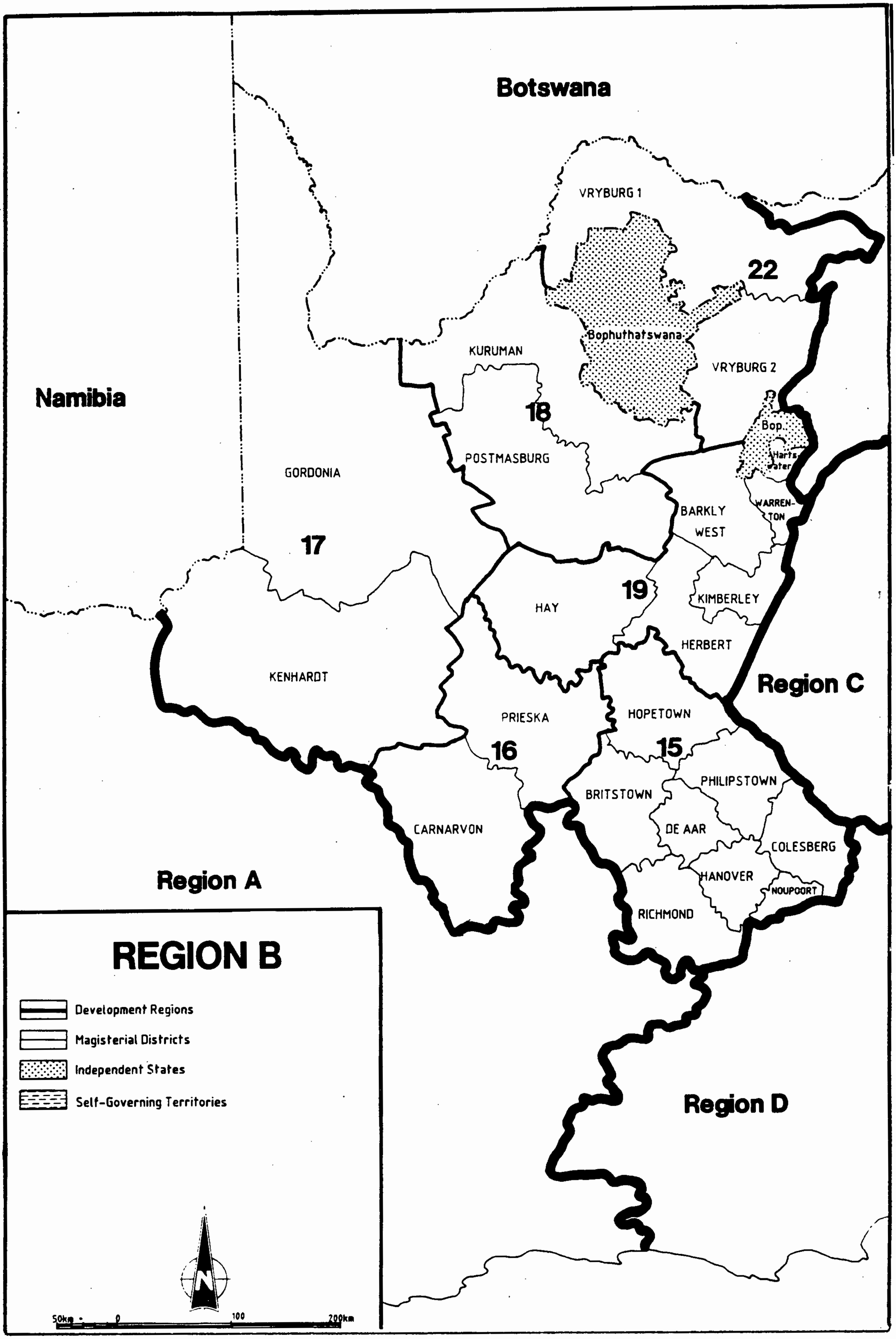
BP
CALTEX
ENGEN
SHELL
TOTAL
ZIMBABWE
BOTSVANA
SWAZILAND
LESOTHO
LOUIS TRICHARDT
ELLISRAS
PIETERSBURG
TZANEEN
POGIETERSRUS
MARBLE HALL
TEMBA
BOSHOEK
RUSTENBURG
BRITS
BOTHAS GAS
WALTLOO
WITBANK
NELSPRUIT
MAFEKENG
HALFWAY HOUSE
ISANDO
BENONI
ALBERTON
NIGEL
VEREENIGING
SECUNDA
DELAREYVILLE
VRYBURG
KLERKSDORP
KEMP
FRANKFORT
BLOEMHOF
KROONSTAD
HARTSWATER
CHRISTIANA
WELKOM
NEWCASTLE
BULTFONTEIN
BETHLEHEM
UPINGTON
KEIMOES
KIMBERLEY
LADYSMITH
CLOCOLAN
DOUGLAS
BLOEMFONTEIN
LADYBRAND
ESHOWE
PRIESKA
PIETERMARITZ BURG
DURBAN
SIMS GAS
DE AAR
NORVALSPONT
KOKSTAD
UMZINTO
PORT SHEPSTONE
UMTATA
ELLIOT
QUEENSTOWN
EAST LONDON
VREDENBURG
MOORRESBURG
MILNERTON
WORCESTER
BELLVILLE
CAPE TOWN TERMINAL
WOODSTOCK
HEIDELBERG
GEORGE
MOSSEL BAY
PORT ELIZABETH
SEA VIEW
BREDASDORP

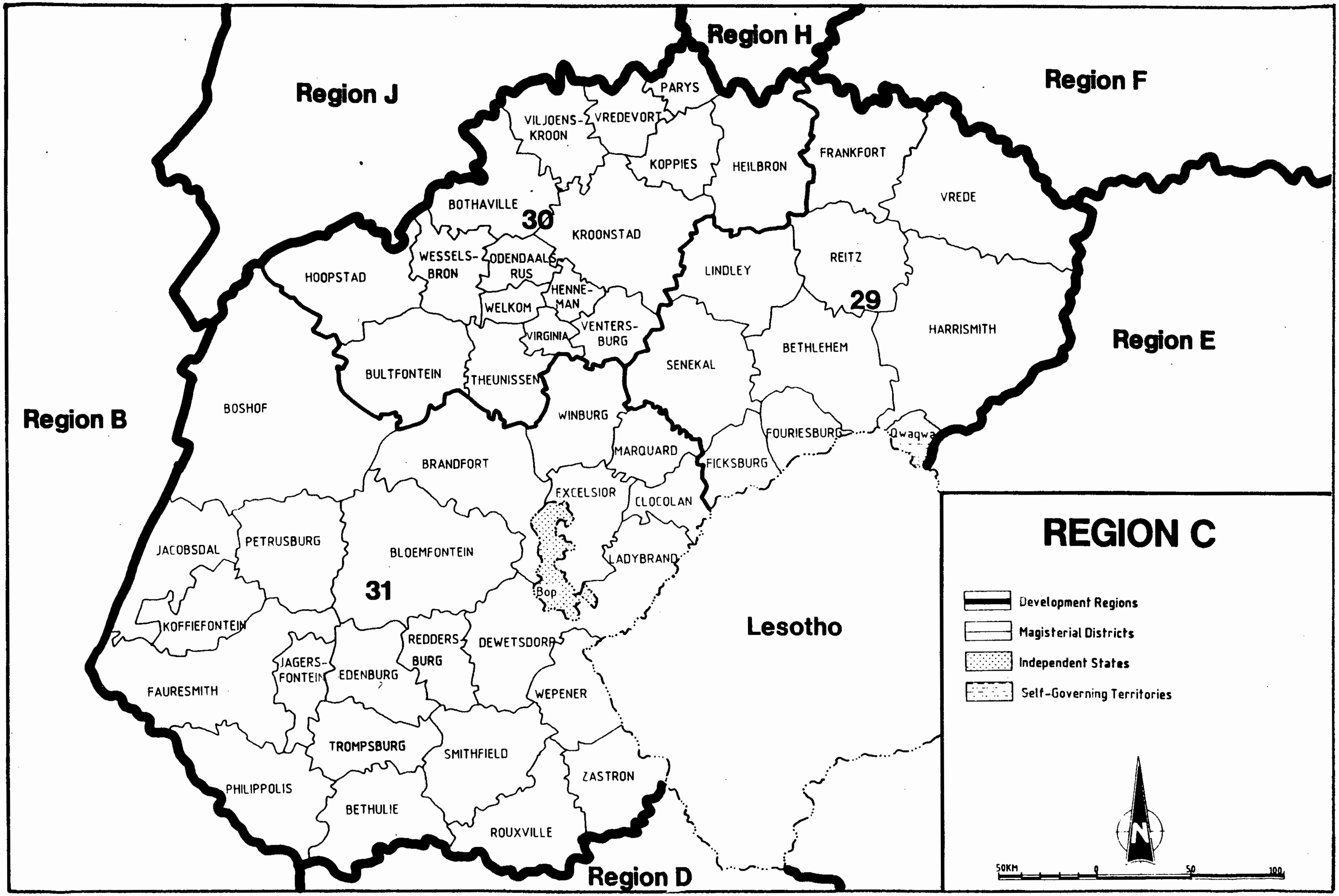

FARMER DIESEL SITES
BP
CALTEX
ENGEN
SHELL
TOTAL
ZIMBABWE
BOTSWANA
LESOTHO
SWAZILAND
MESSINA
LOUIS TRICHARDT
ELLISRAS
PIETERSBURG
TZANEEN
POTGIETERSRUS
NYLSTROOM
HOEDSPRUIT
THABAZIMBI
WARMBAD
OHRIGSTAD
MARBLE HALL
LYDENBURG
ZEERUST
RUSTENBURG
BRONKERSPRUIT
NELSPRUIT
BRAY
MAFIKENG
PRETORIA
MIDDELBURG
HECTORSPRUIT
WITBANK
BELFAST
LICHTENBURG
KRUGERSDORP
BENONI
BETHAL
SANNIESHOF
LANGLAAGTE
SECUNDA
ALBERTON
ERMELO
DELAREYVILLE
KLERKSDORP
BALFOUR
VRYBURG
KALAH BOERE
ASKHAM
WOLMARANSSTAD
SASOLBURG
STANDERTON
KEMP
MAKWASSIE
LEEUDORINGSTAD
FRANKFORT
BLOEMHOF
KURUMAN
HARTSWATER
KROONSTAD
WINCANTON
WELKOM
CHRISTIANA
POSTMASBURG
NEWCASTLE
VRYHEID
MKUZE
POSSIES BOEREDI
BULTFONTEIN
BETHLEHEM
HARRISMITH
HLUHLUWE
UPINGTON
SWINBURNE
LADYSMITH
KIMBERLEY
KEIMOES
EMPANGENI
CLOCOLAN
DOUGLAS
BLOEMFONTEIN
ESCOURT
GREY TOWN
PORT NOLLOTH
STANGER
ORANGE RIVER
WEPENER
PIETERMARITZ BURG
PRIESKA
KRUGER
IVT – A B & D
DURBAN
CREIGHTON
NORVALSPONT
CEDARVILLE
DE AAR
ALIWAL NORTH
PORT SHEPSTONE
MOLTENO
UMTATA
BITTERFONTEIN
VICTORIA WEST
ROSMEAD
ELLIOT
BUTTERWORTH
QUEENSTOWN
KLAWER
CLANWILLIAM
BEAUFORT WEST
GRAAFF REINET
CRADOCK
ULTRA CITY
ABERDEEN
ADELAIDE
VREDENBURG
LEEU GAMKA
FORT BEAUFORT
PORTERVILLE
EAST LONDON
MOORREESBURG
CERES
LADISMITH
MILNERTON
WORCESTER
JOUBERTINA
GEORGE
CAPE TOWN
RIVERSDALE
KNYSNA
DEAL PARTY
GOODWOOD
CALEDON
BUFFELJAGT
MOSSELBAY
PORT ELIZABETH
KLIPDALE
BREDASDORP

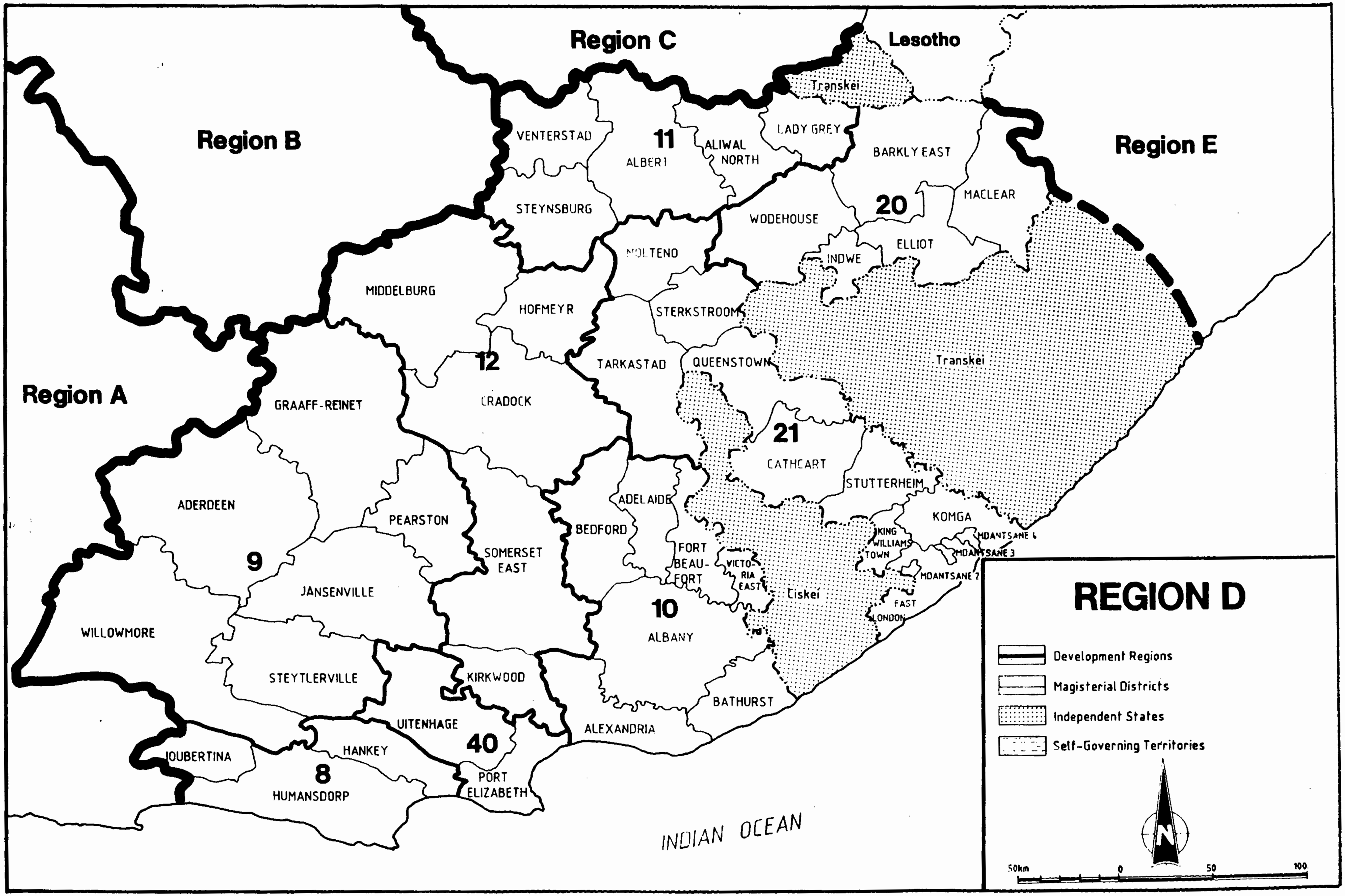
# ANNEXURE D

## South African Development Bank development region maps

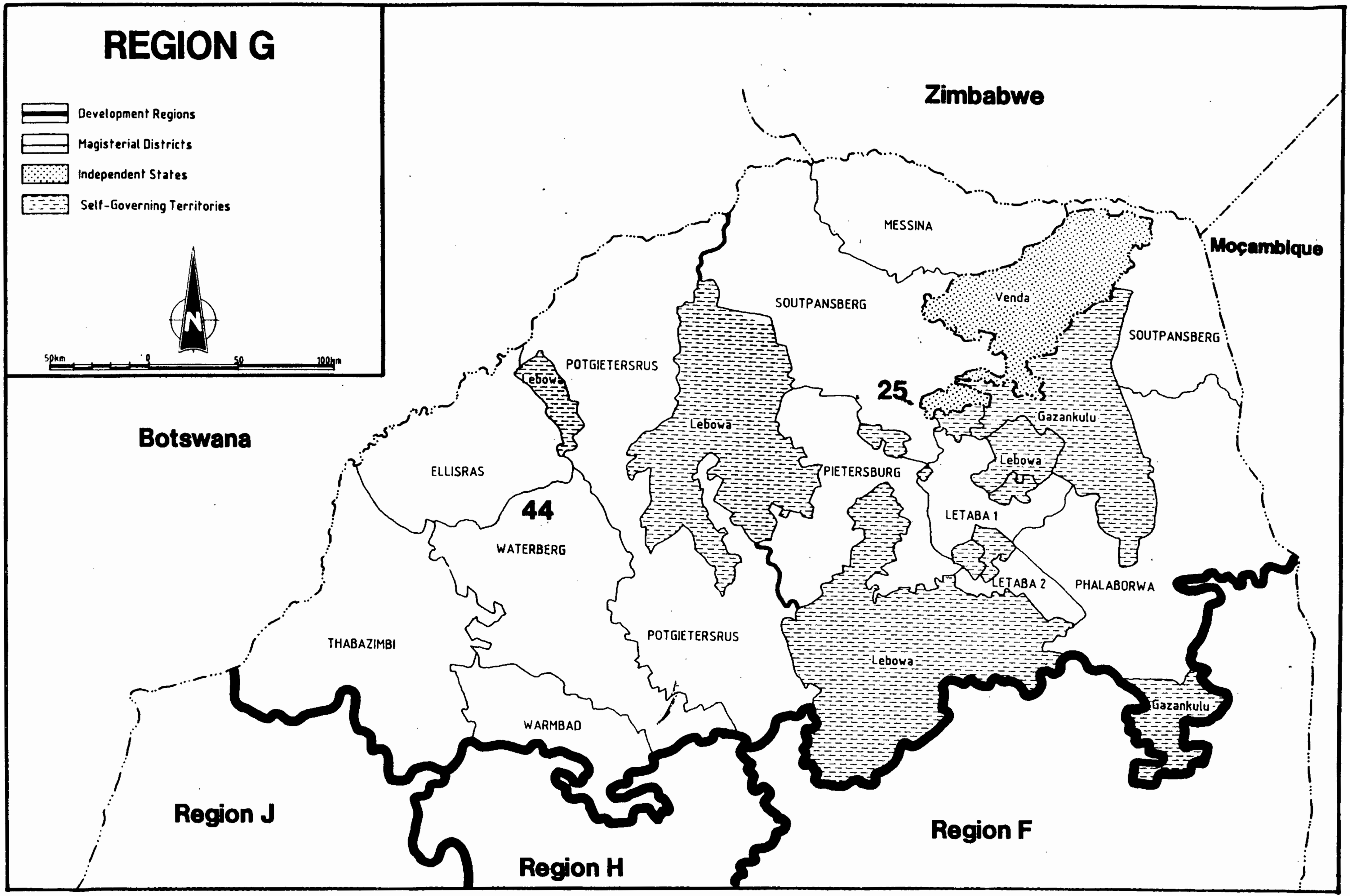

Namibia
Region B
Region D
ATLANTIC OCEAN
1
NAMAKWALAND
VANRHYNSDORP
2
VREDEDAL
CALVINIA
14
WILLISTON
VICTORIA WEST
FRASERBURG
13
MURRAYSBURG
CLANWILLIAM
SUTHERLAND
BEAUFORT WEST
PIKETBERG
CERES
VREDENBURG
HOPEFIELD
3
4
LAINGSBURG
PRINCE ALBERT
TULBACH
MALMESBURY
WORCESTER
LADISMITH
CALITZDORP
OUDTSHOORN
UNIONDALE
MONTAGU
BELLVILLE
PAARL
7
GEORGE
GOODWOOD
ROBERTSON
MOSSEL-BAAI
6
KNYSNA
39
WYNBERG
STELLENBOSCH
SWELLENDAM
HEIDELBERG
RIVERSDALE
CALEDON
SIMONSTOWN
5
HERMANUS
BREDASDORP
REGION A
Development Regions
Magisterial Districts
Independent States
Self-Governing Territories
N
50km
0
100
200km

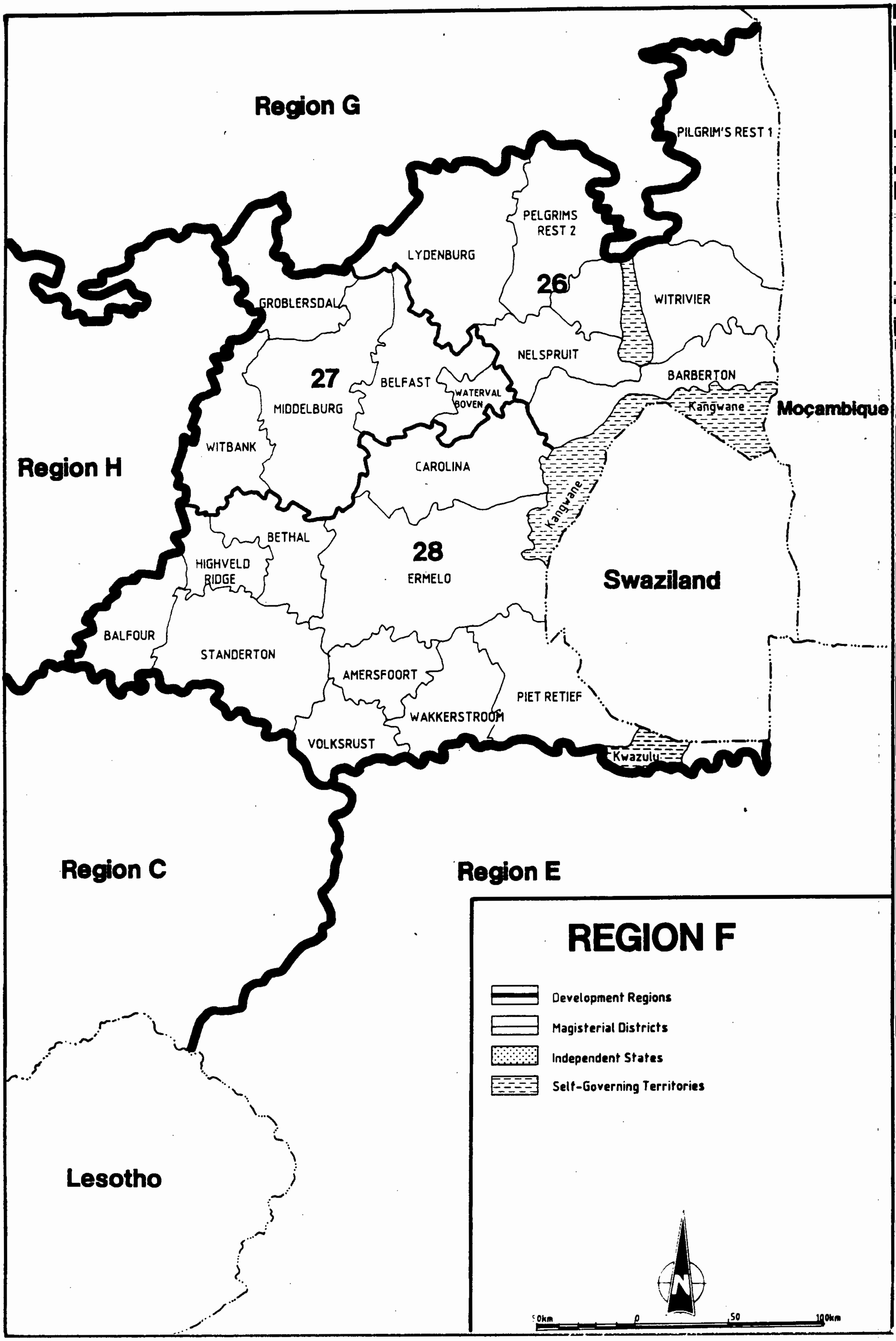

Botswana
Namibia
VRYBURG 1
22
Bophuthatswana
KURUMAN
VRYBURG 2
18
Bop.
Harts-water
POSTMASBURG
GORDONIA
WARREN-TON
BARKLY WEST
17
19
HAY
KIMBERLEY
HERBERT
KENHARDT
Region C
PRIESKA
HOPETOWN
16
15
PHILIPSTOWN
BRITSTOWN
DE AAR
CARNARVON
COLESBERG
HANOVER
NOUPOORT
Region A
RICHMOND
REGION B
Development Regions
Magisterial Districts
Independent States
Self-Governing Territories
Region D
N
50km
0
100
200km

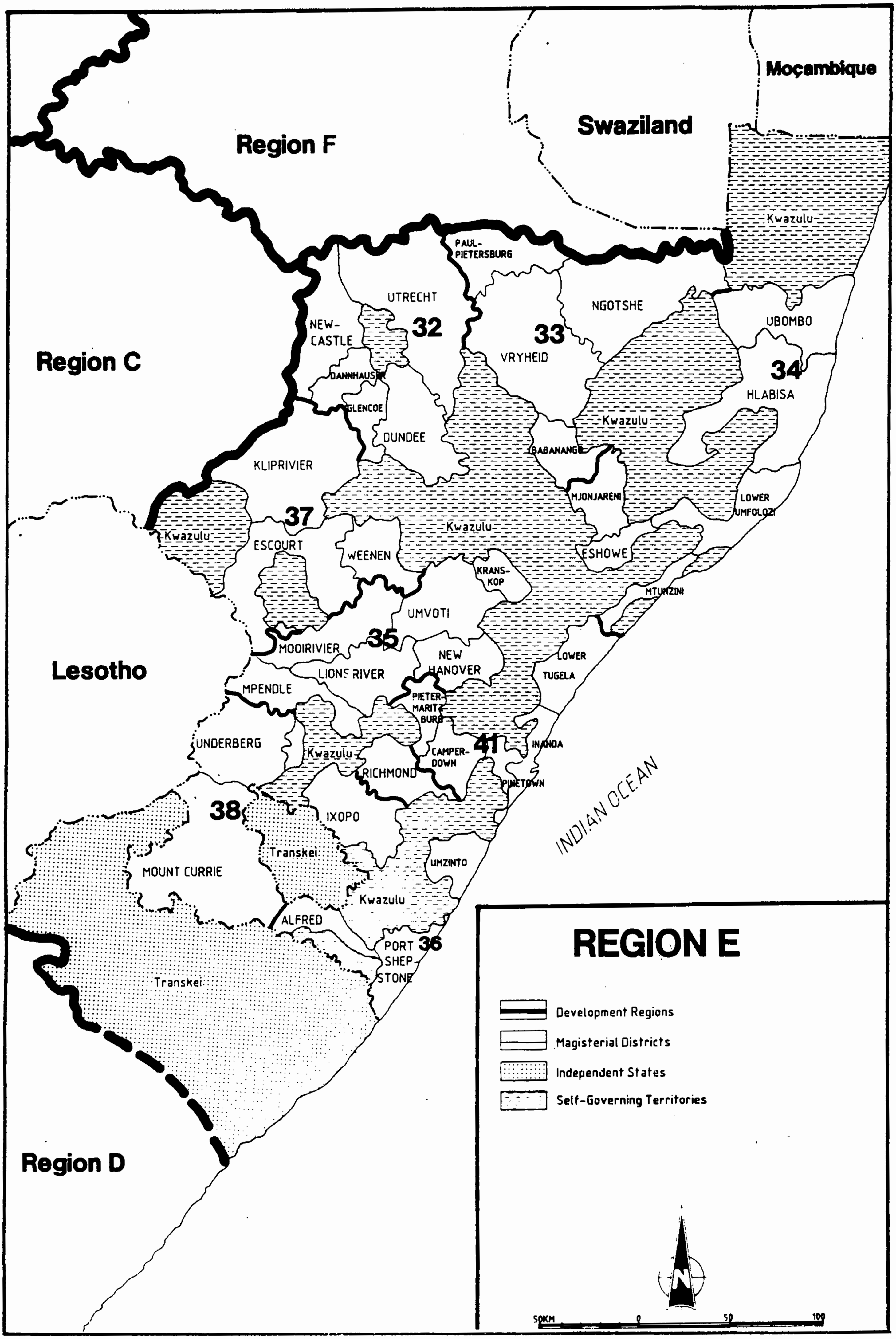

Region H
Region J
Region F
Region E
Region B
Region D
PARYS
VILJOENS-KROON
VREDEVORT
KOPPIES
HEILBRON
FRANKFORT
VREDE
BOTHAVILLE
30
KROONSTAD
HOOPSTAD
WESSELS-BRON
ODENDAALS-RUS
HENNE-MAN
WELKOM
VIRGINIA
VENTERS-BURG
LINDLEY
REITZ
29
HARRISMITH
BETHLEHEM
SENEKAL
BULTFONTEIN
THEUNISSEN
WINBURG
BOSHOF
BRANDFORT
MARQUARD
FICKSBURG
FOURIESBURG
Qwaqwa
EXCELSIOR
CLOCOLAN
JACOBSDAL
PETRUSBURG
BLOEMFONTEIN
31
LADYBRAND
Bop
KOFFIEFONTEIN
REDDERS-BURG
DEWETSDORP
JAGERS-FONTEIN
EDENBURG
FAURESMITH
WEPENER
TROMPSBURG
SMITHFIELD
ZASTRON
PHILIPPOLIS
BETHULIE
ROUXVILLE
Lesotho
REGION C
Development Regions
Magisterial Districts
Independent States
Self-Governing Territories
N
50KM
0
50
100



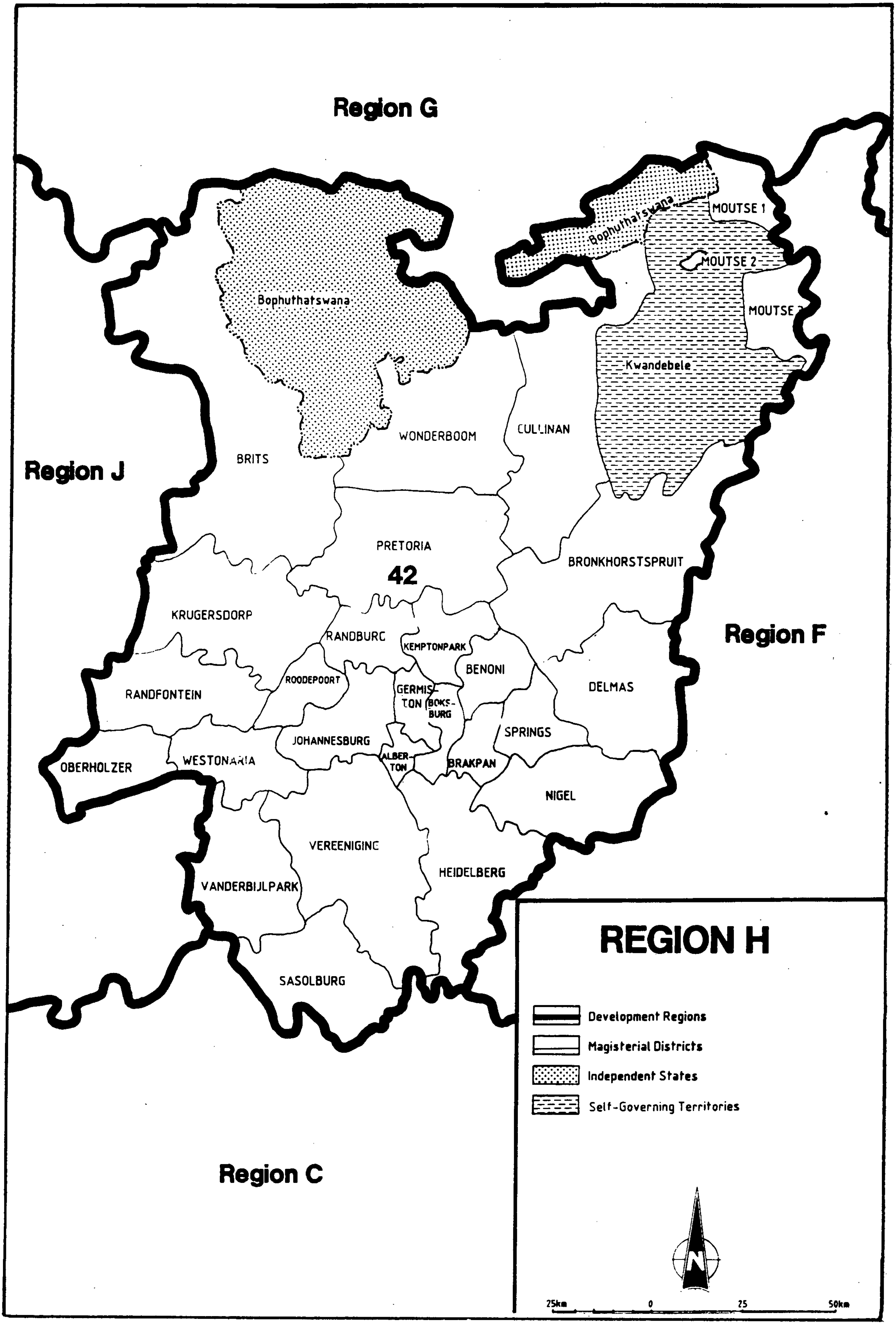
Region C
Lesotho
Transkei
Region B
Region E
Region A
VENTERSTAD
11
ALBERT
ALIWAL NORTH
LADY GREY
BARKLY EAST
MACLEAR
20
STEYNSBURG
WODEHOUSE
ELLIOT
MOLTENO
INDWE
MIDDELBURG
HOFMEYR
STERKSTROOM
12
TARKASTAD
QUEENSTOWN
Transkei
GRAAFF-REINET
CRADOCK
21
CATHCART
STUTTERHEIM
ADERDEEN
PEARSTON
ADELAIDE
KOMGA
SOMERSET EAST
BEDFORD
KING WILLIAMS TOWN
MDANTSANE 4
MDANTSANE 3
9
FORT BEAU-FORT
VICTORIA EAST
MDANTSANE 2
JANSENVILLE
Ciskei
10
EAST LONDON
WILLOWMORE
ALBANY
STEYTLERVILLE
KIRKWOOD
BATHURST
UITENHAGE
ALEXANDRIA
40
JOUBERTINA
HANKEY
8
HUMANSDORP
PORT ELIZABETH
INDIAN OCEAN
REGION D
Development Regions
Magisterial Districts
Independent States
Self-Governing Territories
N
50km
0
50
100


REGION G
Development Regions
Magisterial Districts
Independent States
Self-Governing Territories
N
50km
0
50
100km
Zimbabwe
Moçambique
Botswana
MESSINA
SOUTPANSBERG
Venda
SOUTPANSBERG
POTGIETERSRUS
Lebowa
25
Lebowa
Gazankulu
PIETERSBURG
Lebowa
ELLISRAS
44
LETABA 1
WATERBERG
LETABA 2
PHALABORWA
THABAZIMBI
POTGIETERSRUS
Lebowa
Gazankulu
WARMBAD
Region J
Region F
Region H

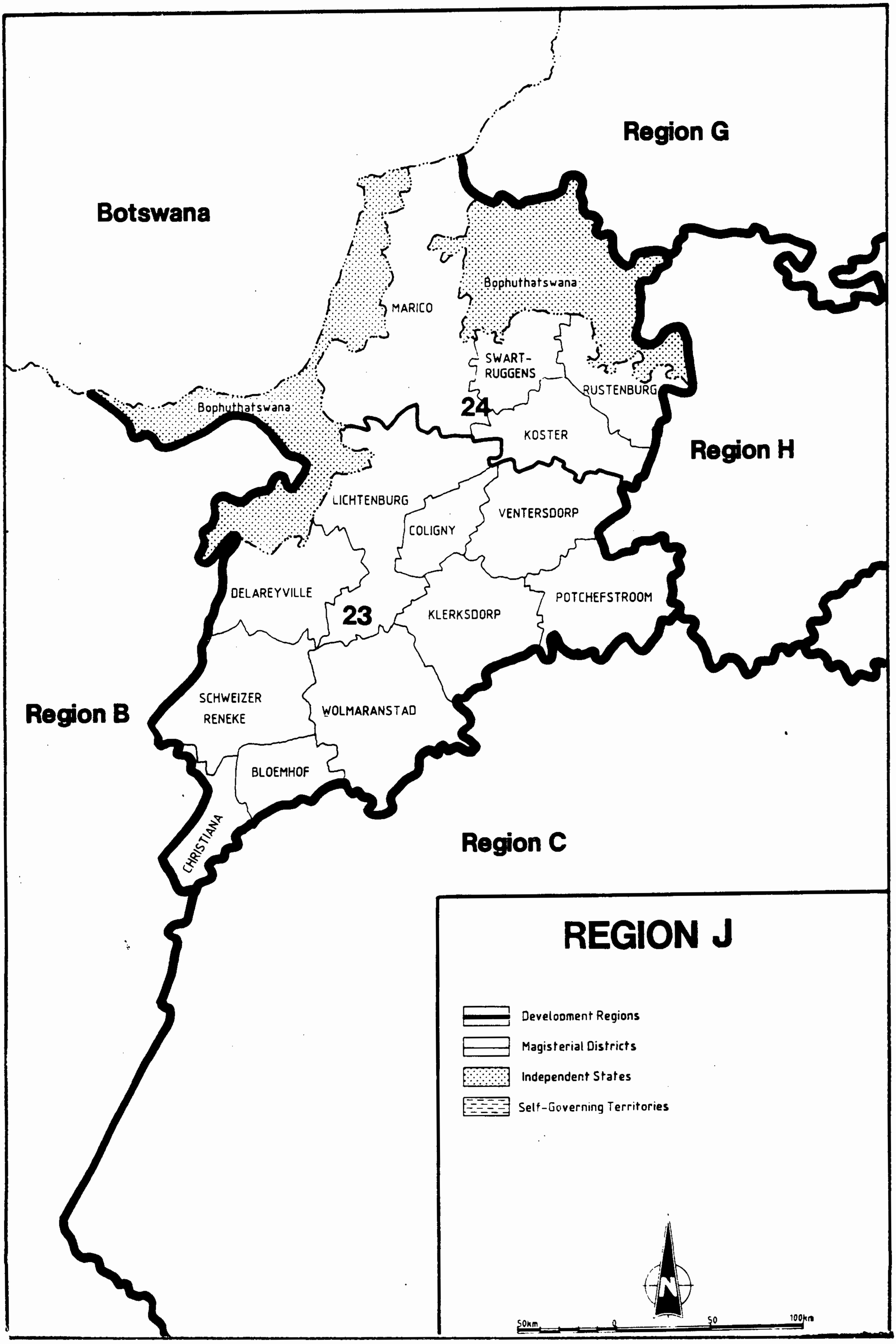

Region G
Region H
Region C
Region E
Lesotho
Swaziland
Moçambique
PILGRIM'S REST 1
PELGRIMS REST 2
LYDENBURG
26
WITRIVIER
GROBLERSDAL
NELSPRUIT
27
BELFAST
WATERVAL BOVEN
BARBERTON
Kangwane
MIDDELBURG
WITBANK
CAROLINA
Kangwane
BETHAL
28
HIGHVELD RIDGE
ERMELO
BALFOUR
STANDERTON
AMERSFOORT
PIET RETIEF
WAKKERSTROOM
VOLKSRUST
Kwazulu
REGION F
Development Regions
Magisterial Districts
Independent States
Self-Governing Territories
N
50km
0
50
100km



Region F
Swaziland
Moçambique
Region C
Lesotho
Region D
Kwazulu
PAUL-PIETERSBURG
UTRECHT
NGOTSHE
UBOMBO
NEW-CASTLE
32
33
VRYHEID
34
HLABISA
DANNHAUSER
GLENCOE
DUNDEE
Kwazulu
BABANANGO
KLIPRIVIER
MJONJARENI
LOWER UMFOLOZI
37
Kwazulu
ESCOURT
WEENEN
Kwazulu
ESHOWE
KRANS-KOP
MTUNZINI
UMVOTI
35
MOOIRIVIER
NEW HANOVER
LOWER TUGELA
LIONS RIVER
MPENDLE
PIETER-MARITZ-BURG
UNDERBERG
Kwazulu
CAMPER-DOWN
41
INANDA
RICHMOND
PINETOWN
INDIAN OCEAN
38
IXOPO
Transkei
MOUNT CURRIE
UMZINTO
Kwazulu
ALFRED
PORT SHEP-STONE
36
Transkei
REGION E
Development Regions
Magisterial Districts
Independent States
Self-Governing Territories
N
50KM
0
50
100



Region G
Region J
Region F
Region C
Bophuthatswana
Bophuthatswana
MOUTSE 1
MOUTSE 2
MOUTSE
Kwandebele
WONDERBOOM
CULLINAN
BRITS
PRETORIA
42
BRONKHORSTSPRUIT
KRUGERSDORP
RANDBURG
KEMPTONPARK
BENONI
DELMAS
ROODEPOORT
RANDFONTEIN
GERMISTON
BOKSBURG
SPRINGS
JOHANNESBURG
OBERHOLZER
WESTONARIA
ALBERTON
BRAKPAN
NIGEL
VEREENIGING
HEIDELBERG
VANDERBIJLPARK
SASOLBURG
REGION H
Development Regions
Magisterial Districts
Independent States
Self-Governing Territories
N
25km
0
25
50km



Region G
Botswana
Bophuthatswana
MARICO
SWART-
RUGGENS
RUSTENBURG
Bophuthatswana
24
KOSTER
Region H
LICHTENBURG
COLIGNY
VENTERSDORP
DELAREYVILLE
POTCHEFSTROOM
23
KLERKSDORP
SCHWEIZER
RENEKE
Region B
WOLMARANSTAD
BLOEMHOF
CHRISTIANA
Region C
REGION J
Development Regions
Magisterial Districts
Independent States
Self-Governing Territories
N
50km
0
50
100km

## PROJECT DESCRIPTION

A major two year research project was launched by the Energy for Development Research Centre in April 1992. It aims to investigate policy options for widening access to basic energy services for the urban and rural poor in South Africa. Research papers are being produced in the following areas:

*Background papers*
Research outline
Integrated energy planning: a methodology for policy analysis and research
Development context for energy planning in South Africa
Background on South African energy system

*Energy demand analysis*
Energy demand in underdeveloped urban and rural areas

*Rural areas*
Energy for rural development: an introduction and overview
Energy and small-scale agriculture
Rural household energy supply options
Afforestation and woodland management
Remote area power generation options

*Urban areas*
Household energy supply in formal and informal urban settlements
Energy and informal sector production

*Ancillary sector*
Energy and mass transportation*

*Key supply sector*
Electricity distribution sector*

*Cross-sectorial studies*
Energy efficiency and conservation*
Energy and environment*
Southern Africa linkages*
Investment requirements and financing mechanisms*
Pricing policy*
Institutional analysis*

*Policy options*
A concluding document will draw together key policy conclusions
** The scope of these studies is restricted to energy issues concerning the urban and rural poor.*

## EDRC

The Energy for Development Research Centre is located at the University of Cape Town. Its objectives are to study energy related problems of developing areas in Southern Africa, and possible ways to address them.

EDRC seeks to achieve its objectives by:

- undertaking research projects;
- running a specialist postgraduate programme to support research projects and to train personnel to contribute to this field;
- transferring relevant information to user groups by offering consulting services and running workshops, and through publishing books, journal papers, reports, leaflets and design and user manuals.

**Energy for Development Research Centre**
Energy Research Institute
University of Cape Town
Private Bag
Rondebosch 7700
South Africa

*Contact persons:* Dr Anton Eberhard / Paul Theron
*Tel:* (021) 650 3230    *Fax:* (021) 650 2830

PAPER Nº 14b

# Household hydrocarbon fuels

*Guy McGregor*

SOUTH AFRICAN ENERGY POLICY RESEARCH AND TRAINING PROJECT

widening access to basic energy services for the urban and rural poor

ENERGY FOR DEVELOPMENT RESEARCH CENTRE
University of Cape Town