A selective review of household energy studies in Southern African countries

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EDRC 1994

Executive summary

This paper looks at policies and experiences concerning energy supply to households in SADC countries; with few references to Tanzania. The objective is to see what implications these might have for the policies of a new South Africa for the supply of energy to households. Emphasis was given to recent experiences with programmes for peri-urban and rural electrification.

Central documents and reports published during recent years by or for the SADC Energy Sector Technical and Administrative Unit (TAU) have been examined. Information has been updated through field visits to Angola, Botswana, Namibia, Zambia and Zimbabwe; institutions visited were Departments of Energy, the electricity utilities and other institutions as required.

The woodfuel problem is still present. National woodfuel plans are still lacking. What seems to be new is Zambia's emphasis on charcoal as an important peri-urban and urban household fuel.

Main conclusions concerning supply of electricity to households are as follows: Peri-urban and rural electrification (RE) in Zambia and Zimbabwe have by and large come to a halt. Both countries seem to lack a government electrification policy, in particular with regards to rural electrification. The two electricity supply utilities, respectively ZESCO and ZESA, which have been expected to provide finance for such electrification from their current surpluses, have been unable to do so on account of operational deficits, resulting from, amongst other things, government policies of low tariffs. The Zambian and Zimbabwean governments have, on their side, provided little or no funding for RE over their budgets in recent years; some external funding has, however, supported RE programmes. ZESA and ZESCO are now on their way to financial recovery with substantial increases in electricity tariffs in the pipeline. Even this recovery will however, have a very limited, if any, effect on rural electrification in the short-to-medium term. Botswana and Namibia are executing cautious government RE programmes, electrifying primarily government institutions (schools, clinics, public administration) in rural centres and main villages. This is done according to government RE policies which require, inter alia, cost-reflective tariffs, but with some financial facilitation when it comes to sharing the finance for connection costs. Botswana's and Namibia's electricity utilities (BPC and SWAWEK) are financially healthy and do not require operational subsidies from the fiscus, as do ZESCO and ZESA. The Botswana and Namibian governments are providing support to RE within a long-term development planning perspective.

The energy supply situation for households in Angola continues to be difficult: prices of petroleum products and electricity are low, supply of superior fuels to households outside of the main coastal cities has ceased on account of the re-commencement of civil war, and supply of electricity to Luanda is irregular.

Most countries in the region seem to be involved with pilot projects for the introduction, with foreign support, of PV systems in off-grid rural areas. In some cases electricity utilities will be involved, in others the departments of energy.

The general tendency in the region is for prices of superior energy commodities (electricity, LPG and paraffin) to increase as a result of the introduction of cost-reflective tariffs, deregulation and the abolition of subsidies. Prices of these energy commodities will increase relative to woodfuels/biomass. It is expected that energy demand will be shifted downwards where possible; so that increasing prices of woodfuels must also be expected. In the face of falling or stagnant household incomes almost everywhere in the region, the consequence for overall energy demand will probably be a decline in volume, perhaps even in value. This must, however, be considered against the background of what was an unsustainable energy supply situation. The service supplied by electricity utilities declined to a

critical point where they were unable to connect new consumers, alrgely because of a lack of financial resources. The underlying negative tendencies are presently being 'consolidated' through proper pricing of household energy commodities in order to sustain their adequate supply in the longer term.

The lack of national woodfuel policies which might lower supply costs is, however, disturbing.

Implications for energy policies would be to persist in cost-reflective pricing/tariffs, deregulation and abolition of subsidies as necessary. The electricity utilities must set their tariffs with a view to covering their costs, including also a fair return to capital. Only in this way can new consumers be connected and receive a technically and financially sustainable supply, and only thus can government and utility contribute towards the expansion of supply in peri-urban and rural areas. Clear government policy on rural energy supply should be developed. A policy for rural electrification should be linked to an overall policy for rural development. Methods for financing, even subsidising, connection costs in peri-urban and rural areas will be required. In this respect, the utilities' retained surpluses/contributions to the fiscus through taxation would assist greatly in expanding the electricity supply industry.

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CHAPTER ONE

Introduction

1.1 Southern African linkages[1]

The new political dispensation in South Africa will require the formulation of coherent policies in various fields. Among these will be a household energy supply policy which, among other things, must address the question of appropriate energy delivery systems to bring about an optimal and equitable energy mix and concomitant pricing policies.

The new South Africa will also have to consider its foreign economic relations with neighbouring countries and with organisations like the Southern African Development Community (SADC). In the energy sector, both physical and policy linkages will be matters for consideration. Physical linkages could be electricity interconnectors; policy linkages could be represented through formal or informal feed-back procedures in order to learn from successful and less successful energy policies in neighbouring countries. Policy linkages could also be represented through modifications to the present South African national energy policy (such as the pricing of petroleum products) emanating from a formal linkage to SADC and its organs.

South Africa today has several operational electricity interconnectors to neighbouring countries: to Botswana, Lesotho, Mozambique, Swaziland, Namibia and Zimbabwe (at Beitbridge). Others are under construction or being planned: for example, from Eskom's thermal power station at Matimba to Bulawayo via Selebi Phikwe in Botswana, and the rehabilitation of the war-damaged DC line from Cahora Bassa in Mozambique to Apollo. Such extensions of linkages complement the SADC Energy Sector's own thinking and are important contributions towards the creation of an interconnected grid in Southern Africa (SADC 1993b).

On the other hand, energy policy linkages between South Africa and some SADC countries, also have negative effects. South Africa's pricing policies in the field of petroleum products (the Sasol-Mossgas price-raising effects) result in high petroleum prices in neighbouring countries (Botswana, Lesotho, Namibia and Swaziland) who are members of the Southern African Customs Union, and also in Malawi.

The energy policies of a new South Africa are presently under discussion, and options are being evaluated. From this perspective, SADC's experiences in cooperation concerning the supply of energy to households could be of interest. This paper attempts to provide policy feedback between past and current policy experiences of some individual SADC member states, with respect to household energy supplies and the ongoing discussion of energy policy options for a new South Africa.

1.2 Purpose of paper

The purpose of this paper, therefore, is to assess and review:

- recent experience (successes and failures) of urban and rural energy supply programmes in SADC member states;
- possible linkages/networks between researchers and policy makers in SADC countries and South Africa; and
- energy policy training needs in the region.

1. This paper has been executed in cooperation with the Technical and Administrative Unit of the SADC Energy Sector (TAU) in Luanda, and financed through the Norwegian Government's support programme for TAU. The authors would like to thank Mr Antonio Guilherme, Head of TAU's Planning Department, for his constructive cooperation and valuable suggestions. The opinions expressed here remain those of the authors and not necessarily of TAU.

1.3 Approach

This paper reviews recent experiences in household energy supply programmes in SADC. The bulk of the paper contains concise descriptions of local experiences. Any conclusions are necessarily brief and cover areas which are more widely discussed in other papers with a specific focus on South Africa. Existing SADC country studies which sum up the experience in urban and rural energy supply programmes as of the end of the last decade have been drawn on. A special emphasis has been placed on the electricity sector, because of its importance in SADC energy cooperation.

Complementarily, more recent energy policy developments in selected SADC member states (Angola, Botswana, Namibia, Zambia and Zimbabwe) have been studied through short field visits to selected energy institutions in each of these countries. The information collected has been used, together with our accumulated insight into the region's economies, to sum up in broad macro terms the fuelswitching trends and related pricing framework operating in South Africa's neighbouring countries (see Chapter 3).

Botswana and Namibia were selected primarily because of their ongoing rural electrification programmes, and their energy pricing policies which emphasise financial sustainability. A further reason for selecting Namibia was that it was not covered in important SADC energy studies, due to its late (1990) entry into SADC.

Angola was visited for a dialogue with the Technical and Administrative Unit (TAU) of the SADC Energy Sector and to discuss energy supply policy options for a government in the midst of civil strife.

Zambia and Zimbabwe were chosen because of their longstanding commitments to energy supply programmes in circumstances of increasing economic difficulties, and for their recent electricity supply problems resulting from drought. Zambia is also of interest on account of its ongoing (energy) policy review. In addition, Zambia and Zimbabwe are in the midst of a process of increasing electricity tariffs to appropriate levels in order to improve electricity end-use efficiency and financial flows in the utilities. Increased efficiency in generation and distribution has also been targeted. Combined with appropriate tariffs this might provide the electricity supply utilities with independent finance for electricity supplies to peri-urban and rural households. The reformulation of electricity pricing in these countries is also accompanied by deregulation of other energy prices, particularly with regard to petroleum products.

During the field visit, typical institutions visited were government Departments of Energy and the national electricity utilities – Botswana Power Corporation (BPC), Zimbabwe Electricity Supply Authority (ZESA), Zambian Electricity Supply Corporation (ZESCO) and South West African Water and Electricity Corporation (SWAWEK)). In both Namibia and Zambia urban/peri-urban household electrification activities close to the capital cities were visited. In Zambia, where biomass has increased in importance in household energy supply policy, a charcoal-producing site, about 50km north of Lusaka, was visited.

In Namibia, the Ministry of Local Government and Housing, and the Electrical Engineering Department of the City of Windhoek were visited, in connection with their operational responsibilities in ongoing urban and rural electrification programmes. In Zimbabwe a visit was paid to the Zimbabwe Environment Research Organisation (ZERO), a non-governmental organisation (NGO) engaged in environmental studies from a developmental perspective. ZERO is also part of the SADC Regional Energy NGO Network.

Table 1.1 gives information which we gathered on the size of the 'energy departments' visited.

Country	Comments
Angola	State Secretariat for Energy and Water: about 30 professionals. A comparable number is found in the Ministry of Petroleum. Note, however, that the Angolan state oil company, SONANGOL also has regulatory tasks.
Botswana	The Energy Unit of the Ministry of Mineral Resources and Water Affairs: about eight to ten professionals. Petroleum matters fall under Ministry of Commerce and Industry (five professionals).
Namibia	The Directorate of Energy in the Ministry of Mines and Energy: 18 professional positions with five vacancies. In addition: the National Petroleum Corporation of Namibia (NAMCOR), with de facto ministerial functions with respect to petroleum exploration, and the national utility South West African Water and Electricity Corporation (SWAWEK) which also has de facto policy-making responsibilities in the power sector.
Zambia	The Department of Energy of the Ministry of Energy and Water Development: about 15-20 posts with some vacancies.
Zimbabwe	The Department of Energy, Ministry of Transport and Energy: about 40 professionals, mainly in research and development.

TABLE 1.1 Staffing of energy units in ministries responsible for energy in five SADC countries.

The institutions visited covered the supply of a wide spectrum of energy supplies to households. We were interested in obtaining information on how these organisations went about preparing new supply programmes and projects. Typical information sought from the institutions visited included:

- programme objectives and target groups;
- capital requirements;
- programme financing and duration;
- fixed and variable costs;
- number of households actually covered;
- unit cost of supply;
- pricing;
- revenue collection practices where applicable;
- operational problems/successes;
- organizational characteristics;
- subsidies.

Developments which could be seen to have a clear bearing on possible rural energy supply policies in a new South Africa were considered to be of special interest.

It is fair to say, however, that the information supplied/collected was less comprehensive than sought. In some cases one had to rely mainly on verbal representations.

Finally, a note on terminology. The organisation now known as SADC (Southern African Development Community), changed its name from SADCC (Southern African Development Coordination Conference) during the second half of 1992. In this paper, the abbreviation 'SADCC' is used when referring to documents prepared *before* September 1992; 'SADC' is used for later documents.

CHAPTER TWO

SADC urban and rural energy supply programmes: a brief overview based on SADC Energy Sector documentation

2.1 SADC Energy Sector strategies

The SADC Energy Sector established its first strategy document in 1985, encompassing the entire spectrum of energy carriers. Subsequently this strategy was supplemented by *subsector strategies*:

- SADCC woodfuel five-year implementation strategy 1988-92 (1987).
- SADCC petroleum supply strategy (1989).
- Strategy and programmes to promote activities in new and renewable sources of energy (NRSE) in the SADCC Region (1990).
- SADCC electricity strategy (1991).
- SADCC regional rural electrification strategy (1991).
- SADCC energy conservation strategy (1991).
- SADCC strategy for the promotion and use of NRSE technologies by power utilities (1992).

Presently work has started to develop a new overall energy strategy for the SADC region, based on the subsector strategies and experience gained since the mid 1980s.

2.2 Biomass

Because of the difficulty in drawing clear-cut universal policies concerning woody biomass fuels, individual projects/programmes will not be discussed in detail here. Their success or failure rests mainly on site-specific factors.

The Technical and Administrative Unit (TAU) of the SADC Energy Sector has executed a comprehensive woodfuel survey for nine member states (but not for Namibia, who was not member in 1989, the time of survey). In SADC countries final consumption of biomass fuels (mostly wood and charcoal), mainly for cooking, amounts to about 77% of total energy use measured in comparable energy terms. When it comes to households, woodfuels account for more than 90% of energy consumption (SADC 1993a: 41). It is even possible that backward fuel switching takes place in some areas (SADC 1993a: 23). The debate on the scarcity of woodfuel and the environmental consequences of excessive reliance on woodfuels in the SADC region is well documented (Munslow et al 1988: Ch.1). The current situation might be described as follows: scarcity of woodfuel is site specific; clearing of woodlands and shrublands is done mainly for agricultural purposes or to obtain building materials (construction timber, poles and thatching material), and not specifically for the purpose of harvesting wood for fuel – fuelwood is often simply what is left over from other uses. Woodlands also provide medicines, dyes, clothing, soap, weapons, fibres, perfumes, insecticides, water coagulants, fodder, fruits, adhesives, poisons, tannin, oil/lubricants, and more (Munslow et al 1988: 79).

In most cases, but not always, wood is freely available in rural areas, but not in urban areas or in areas with major settlements (villages). Few national woodfuel policies have been formulated in SADC countries (except Malawi and, possibly, Tanzania), let alone for the entire SADC region. The project design of publicly owned woodfuel plantations (in Blantyre and Maputo, for example) tends to be very cost heavy, to have insufficient local financial support, overly reliant on

external funding, and thus not independently sustainable. It has been suggested that a possible way to remedy the situation 'is to improve the management of woody biomass within existing production systems based upon the innovations and responses already occurring among smallholder-farmers' (Simoes 1988: foreword). Munslow et al stress that the management of woody-biomass resources is not a new phenomenon in Africa and is also practised to this day:

A survey undertaken in Zimbabwe in 1984, found that 70% of the households questioned, indicated that they planted trees. Two-thirds of the trees grown were to provide fruit and almost one-third were of eucalyptus, primarily for the provision of building poles. Interestingly, well over half the seedlings were either self-grown or collected wild, indicating a very active woody-biomass management. Of the households planting trees, 66% did so on their own initiative. The evidence from this survey confirms that there is a hitherto untapped potential of woody-biomass management existing within the rural community (Munslow et al 1988: 39).

One of the main problems preventing large-scale implementation of woodfuel programmes in SADC member states seems to be the lack of comprehensive woodfuel policies and strategies. It has been commonly recognised in all these states that government agencies and NGOs can play only a catalytic role in sustaining biomass supply and environmental protection. People themselves must manage their natural woodlands, plant the necessary trees, take effective measures to prevent soil degradation and protect their environment as part and parcel of their daily efforts (SADC 1993a: 22-3). This would also be the most cost effective way of providing biomass. A major Energy Sector project ('Development of national woodfuel strategies and plans') is looking at national woodfuel planning from this point of view, initially in two SADC member states; Lesotho and Tanzania. Awareness of *woodfuel* problems seems to be satisfactory both among the general public and decision makers. Nevertheless, woodfuel scarcity in some regions, particularly in urban and peri-urban areas of most SADC countries, continues to increase.

Several other important woodfuel projects are about to be launched under the umbrella of TAU (SADC 1992a: 228-98):

- 'Identification and support of non-governmental organisations and women's groups dealing with woodfuel and environmental protection'.
- 'Identification of suitable tree species for energy production in the SADC region'.
- 'Rural energy planning and environmental training programme and intensification of people's participation in tree growing and environmental protection in the SADC region'.

The problem encountered by TAU is that member states themselves are not normally willing to finance more than a very small part of projects, so that finance has to be sought from the outside. The implication is that, despite the existence of a number of sub-sector strategies, limited experience has been gained from actual implementation of any coordinated large-scale programmes and projects. The European Community, Netherlands and Norway have been active in support of TAU's woodfuel programme. It should, however, also be recognised that a large number of small-scale projects have been implemented by NGOs.

Consumption of other biomass fuels – dung, charcoal and agricultural crops residues – has been estimated (1990) as 12% of household consumption of energy commodities (SADC 1993a: 41). It should be noted that the figures are uncertain. The situation of charcoal (8%) is discussed in Chapter 3.

2.3 Electricity

Electrification in countries bordering South Africa has a long history. The technological and organisational developments leading to the hydropower station and dam at Kariba and the establishment of the Central African Power Corporation is even today considered a possible long-term role-model for electricity cooperation. However, both Zambia and Zimbabwe currently face an energy shortage because of drought in the upper catchment area of the Zambezi and in the Kafue sub-basin. Botswana, Lesotho, Mozambique, Namibia, Swaziland and Zimbabwe cover their normal shortfalls by imports from Eskom. Zimbabwe will do so to a much larger extent when the new line between South Africa (Matimba) to Bulawayo, via Selebi Phikwe in Botswana, has been commissioned. In addition to the above energy transactions, Zambia and Zimbabwe are currently importing from Societé National d'Electricité of Zaire. As can be seen, considerable power cooperation/linkages already exist in the Southern African region. The interconnectors represent mostly bilateral agreements between Eskom and national utilities. Discussions of pricing principles for intercountry trade in power were, however, discussed at a SADC meeting in Malawi in August 1993, with Eskom as technical observer.

During 1992-93, power consultants executed the project 'SADC regional generation and transmission capacities including interregional pricing policies' (SADC 1993b). The report shows how the ten member states can be interconnected to better utilise existing generating capacity; how South Africa and Zaire best fit into such an interconnected grid; and when and where new interconnectors and generating capacities need to be established. One scenario is that the first new power station need only be commissioned (at Batoka in Zimbabwe) by 2004. This is based on given load forecasts and certain hydrological assumptions, and assumes that the following interconnectors are upgraded/built to certain specifications: Songo-Lilongwe, Serenje-Lilongwe: to connect Mozambique via Malawi to Zambia; and Kolwezi-Luano: to connect Zambia to Zaire; *and* that South Africa actually takes Cahora Bassa power by 2000. The above gives an exciting perspective of closer cooperation in the region, incorporating both Zaire (with its immense hydropower potential and substantial excess capacity at the Inga site on the Zaire River) and South Africa. Whether or not these developments will take place can be seen as a test of the political will to cooperate regionally at a supra-national level. Should cooperation with Zaire not take place, either South Africa shall have to give up 500 MW of Cahora Bassa power from the year 2000, or new generating capacity needs be added much earlier. The latter option would be uneconomic. An alternative to extended regional power cooperation would be to plan for complete self-sufficiency in power. The report also analyses such a possibility. The net benefits of extensive electricity cooperation compared with national independent developments of new generating capacity have been estimated to be about US$1 billion in economic real terms over the period up to the year 2010.

Table 2.1 provides information relating to the power sectors of the five SADC countries visited.

(Rural electrification (RE) is included in the load forecasts mentioned above, based on the perceived RE situation and future developments. From a comprehensive survey of RE in nine SADC member states (not Namibia; see Table 2.2) it is evident that rural electrification everywhere is extremely sparse, except for Malawi (SADCC 1991a: 31-6). The extent of electrification of urban households varies: 85% in Malawi, 70% in Swaziland, 60% in Zimbabwe, 40% in Angola, 20% in Mozambique and 2,8% in Zambia (SADCC 1991a: 32). (It should be noted, however, that imprecise definition of the term 'rural household', as well as uncertain demographic information, will affect the reported numbers.)

Country	Population (Millions)[1]	Nominal capacity (MW)	Electricity sold (GWh)	No. of customers
Angola	9.7	523	–	–
Botswana	1.2	204	1 194	31 232
Namibia	1.7	360	1 722	1 111[2]
Zambia	7.8	1 632	8 924	–
Zimbabwe	9.6	1 965	9 286	334 869

TABLE 2.1 Power sector information, for five SADC countries
Sources: Eskom statistical yearbook 1992
African development indicators, UNDP/World Bank

Country	No of customers	Load as % of total	Off-grid load as % of national total	Hseholds served as % of total	Km of MV lines built past 5 years	New customers past 5 years	US$ mill RE capital expend. past 5 years
Angola	No data	No data	No data	–	No data	No data	No data
Botswana	2 934	6.89	0.89	–	186	910	1.10
Lesotho	266	1.27	0.38	4.00	86 (2 yrs)	No data	No data
Malawi	2 736	2.50	0.40	15.00	439	1 414	1.55
Moz'bique	20 529	30 (est)	4.00	0.50	500	8 000	No data
Swaziland	No data	No data	No data	1.00	No data	No data	No data
Tanzania	16 539	No data	No data	–	800	No data	No data
Zambia	3 049	0.76	3.10	0.33	190	245	No data
Zimbabwe	2 000	5 (est)	–	Neg.	800	2 000	7.90

TABLE 2.2 Status of rural electrification in SADC around 1990
Source: SADCC 1991a: 31-6

While electrification in urban areas can be regarded as an accumulated reflection of the economic situation in years past, successful RE is dependent both on the overall economic situation and on the political will to allocate budget resources to rural areas. It seems that RE is more successful when linked with broader rural development programmes with definable energy loads and job creation. Thus, one of the objectives of SADC's Rural Electrification Strategy (SADCC Energy 1991b) is: 'To increase the rate at which rural electrification is taking place, where this electrification has the potential to support rural development' (Jordanger 1992: Appendix 1). The same idea comes through from earlier Zimbabwean experiences, and the current situation in Botswana and Namibia. RE objectives stated in the SADCC RE survey are 'stimulus to rural development', 'enhanced urban/rural equity', 'commercial/industrial needs', 'social development', 'improved nutrition and health' and 'environmental protection' (SADCC 1991a: 37).

More coherent arguments regarding RE, both for and against, are also quoted in the SADCC RE study (SADCC 1991a: 38). To some extent they both complement and contrast with the information summarised in the table and, in particular, more recent information (see Chapter 3).

- Government objectives are concerned with securing energy supply for all sectors and all regions at minimum social and economic costs. The provision of electricity in rural areas merits high priority rating in order to improve the quality of life in these areas. (Lesotho).

- [RE] is in line with [the] ... government's ongoing program of rural development, whose objective it is to bring about diversification of economic activities in the country. (Malawi).
- Rural electrification is considered as a priority now because we have cheap hydro power and construction of transmission lines is practically completed. Now our first priority is to extend the network to rural areas to take advantage of infrastructure already installed. (Mozambique).
- Electricity improves the quality of life and raises the productivity levels of the rural sector. (Tanzania).
- [RE] plays a pivotal role in stimulating development in rural areas and improving standards of living. It also enhances regional political stability. As such electrification is high on the agenda of provincial councils and the central government. (Zambia).
- In the first Five Year National Development Plan the government ... made a policy [of increasing] the use of indigenous energy resources for the benefit of the rural population. (Zimbabwe).
- There is likely to be some environmental disruption, especially where construction of power lines results in extensive tree cutting. Other environmental effects are associated with power generation, e.g. loss of agricultural land where storage dams are required.
- Rural electrification can have perverse distributional effects, with benefits favouring mainly the rich rather than the poor.
- Undesirable social effects can include displacement of traditional activities and impacts associated with extended opening hours for beer halls/night clubs.

2.4 Petroleum products

Consumption of petroleum products (paraffin and liquefied petroleum gas (LPG)) for energy purposes in SADC amounts to about 1-2% of energy consumption as measured in comparable energy units. In the Oshakati/Ondangwa area in Namibia, where few households have access to electricity, bottled gas is the most widely used cooking fuel next to fuelwood, and is used as the main cooking fuel by almost 30% of households. In Katutura (in Windhoek), LPG is used by about 10% of households (World Bank 1993: 9). Paraffin is, nevertheless, probably the most important commercial fuel for poor households as it is the major fuel for lighting. It can be purchased in small quantities almost everywhere and appliances are affordable. In Namibia, it has been estimated that about 50% of Owambo households use paraffin for lighting, while only 6% use it for cooking. The average annual consumption per household was 67.5 litres. Candles are the other major source for lighting in Namibian rural areas (World Bank 1993: 9). (See also Chapter 3).

Until recently the paraffin price has been subsidised in virtually all SADC countries. Non-economic fuel prices (as in Angola and Mozambique) have stimulated excessive use of paraffin and LPG in areas with easy availability - particularly urban areas.

Private autogeneration (diesel) has been used quite extensively in both urban and rural areas in most SADC countries, because of the poor quality and reliability of electricity supply, as well as lack of access to grid electricity.

2.5 Photovoltaic systems

SADC has reviewed the regional use of photovoltaic (PV) systems and their potential, and has adopted a PV strategy as part of a strategy for new and renewable sources of energy (NRSE) (SADCC 1990). One of the ideas issuing from the strategy, and from the SADC Electricity Strategy (SADCC 1991b), is to promote diffusion of PV systems through SADCC electricity utilities. Terms of reference for two pilot projects have been drawn up, one for solar photovoltaic power generation in rural areas in Lesotho (SADC 1992a: 196-201) and one for solar water heating in Zimbabwe (SADC 1992a: 222-7).

In its endeavour to promote NRSE technologies, the SADC Energy Sector has carried out two studies: a study on NRSE pricing, including pricing of PV panels and systems (SADCC 1992b) and a study of regional PV markets and applications (SADCC 1992c). The conclusion is that the price of PV systems in the region is high. There is also a considerable differential in the prices of PV systems among SADC countries on account of mark-ups and because of substantial differences between rates of import and sales duties and of surcharges. If these are combined, we have a range from Zimbabwe at 45%, Zambia 35%, Malawi 30% and Namibia 30%, Lesotho 18%, Botswana 5% and Tanzania 0% (SADCC 1992b: 63-4). High mark-ups on a commodity would normally decline when competition and sales increase. High commodity taxes, on the other hand, may be reduced only through changes in government policy. PV cells are not manufactured in the region and commodity taxes are levied on the imported components. It is important to reduce such commodity taxes in order to increase PV market penetration. Zambia is considering this and Tanzania already has a zero rate.

The main objectives of the PV markets and applications study were to determine the conditions under which PV systems are technically, economically and financially viable, and to determine the SADC internal PV market size. The study concludes that 'plug-in lanterns, small and large four light systems with a DC outlet, low-volume water pumping, and village electrification through dissemination of individual PV systems' are all technically viable, and also economically and financially viable - although not for every member State (SADCC 1992c: 65, 75, 77). It should be noted, however, that village electrification through PV is compared *only* to a 10km extension of the grid, without testing the sensitivity of the results for – say – 15 or 20km. When the economic analyses are concerned, the discount rate used has not been stated and the sensitivity to different assumptions have not been reported. It should be noted that PV vaccine refrigeration would be neither economically nor financially viable when compared to kerosene refrigeration, although the PV solution is the preferred one among medical personnel on account of its higher operational reliability. (Had proper benefits been built into the economic analyses, the PV solution would have come out as the preferred one (SADCC Energy 1992c: 29, 51, 75)). Concerning rural (village) electrification, in South Africa it has been found that 'PV generation (is placed) on a competitive basis for meeting small electricity requirements in remote off-grid areas, where other options for supplying electrical power can be even more expensive' (Cowan 1992).

The size of the SADC PV systems market, has been given in terms of potential installed capacity (MWp) for systems deemed viable at 269 MWp, of which the potential for rural (village) electrification was estimated at around 220 MWp (SADCC Energy 1992c: 76). This seems a bit optimistic however, as by the end of 1991, only about 100 MW of photovoltaic systems had been installed in the whole world (Jones, G 1991: 132).

CHAPTER THREE

Some recent energy supply programme developments in selected SADC countries

3.1 The biomass road: Zambia

Wood is expensive to transport over longer distances, so that production close or closer to areas of dense settlement must be encouraged. Such production might take place in state- or municipal-run woodfuel plantations (as is done, for example, in Blantyre and Maputo), by private producers for profit, or by households themselves in woodlots, or in combination with crops. The experience gathered from woodfuel plantations in the SADC region, however, is of substantial inefficiencies, and large (foreign) grants have been needed over long periods in order to secure their financial survival. Hence, unit costs of wood production are high. Theft would also contribute to this, as would control costs. There have also been difficulties in locating appropriate species, as in Maputo, although some research was carried out in Tanzania in the early 1970s (SADC 1992a: 237). An important question is whether the opportunity costs of subsidies required exceed the negative environmental externalities of not having woodfuel plantations. It has also been found (in Maputo) that the building materials component tends to be the main product, not woodfuel – much as happens in rural areas. It seems that the only sustainable plantation programmes are based on social agroforestry schemes – that is, combining fuelwood production with agricultural and social objectives.

Charcoal is a substitute for the direct use of wood and other biomass fuels for energy purposes. It has the advantage of being light in comparison to its energy content, transport costs per unit of energy are low. Charcoal is predominantly an urban/peri-urban woodfuel. There are two disadvantages to its use: first, the inefficiency of traditional charcoal production kilns results in large energy conversion losses; secondly, the health risks caused by smoke from charcoal production and burning. Research in Zambia indicates that traditional charcoal kilns are less wasteful than had previously been assumed, but that the efficiency of traditional charcoal making can still be improved (Hibajene & Chidumayo 1993: i). As regards health risks, one should keep in mind the possible risks in using fuels other than charcoal, such as the cow dung commonly used in, for example, Lesotho, and low-grade coal with its high sulphur content.

The situation concerning charcoal varies in the SADC countries. In Zimbabwe, production of charcoal from forests on state lands is forbidden by law. Charcoal production on private farms and estates is mainly consumed by high-income earners and is available at supermarkets in small bags. In Namibia and in Botswana charcoal is also a fuel for high-income earner's. Little charcoal is being produced in Namibia; recently, however, a charcoal factory has been established in the north to utilise brush cut down to prevent bush encroachment resulting from overgrazing. Charcoal is not an important household energy commodity in any of these countries. It is, however, an important energy commodity in Malawi, Tanzania and in parts of Mozambique. In Angola's capital city, Luanda, charcoal is used by about 10% of the population and is available in small units (heaps) at local markets and from ubiquitous pavement vendors. Production requires a licence, and the movement of charcoal to cities is controlled by police checkpoints on the main roads. This leads to market distortions that force the price of charcoal way beyond the combined costs of production and the low licence fees. (Similar movement control arrangements occur in other African countries, as in Ethiopia for coffee, to prevent

trading for profit. This reflects a lack of proper taxation procedures, the existence of government purchasing monopolies, or an inefficient central planning philosophy leading to administered scarcities, internal smuggling and rising black-market prices in urban areas.)

In Zambia, charcoal has been used extensively for cooking and water heating by medium- and low-income households. It is worth noting the Zambian charcoal policy, which now regards it as an important energy source. In cooperation with the Stockholm Environment Institute, Zambia's Department of Energy has carried out a series of investigations of Zambia's charcoal utilisation system, which conclude that the system by and large appears viable, functional and economic; that deforestation due to woodfuel production from miombo woodlands is a temporary problem, and that the regenerative capacity of the natural forest system is sufficient to withstand the degradation of forest land. If charcoal production should increase substantially, sound management practices need be introduced to ensure long-term productivity. It was also found that the environmental impacts of charcoal production and use are relatively limited, and that conversion of woody biomass into charcoal with traditional methods is less wasteful than previously assumed. Finally, although transport and distribution is generally efficient – given the resources available – seasonal variations in charcoal prices are largely due to transport difficulties. The study concludes that, in comparison with charcoal, electricity is expensive (Hibajene & Chidumayo 1993: i-ii).

Through scarcity, woodfuels get a scarcity value and become tradeable. Hindrances to such trade should be removed and the extraction of the resource taxed, through, for example, stumpage fees payable to state forestry departments or local authorities, or through end-use taxation, to provide finance for replanting with species suitable to climatic and edaphic conditions (SADC 1992a: 236-40). Transport systems (roads) must be developed and maintained. Woodfuel prices must reflect woodfuel supply costs and scarcity value; price controls through dictating maximum prices should be done away with. Other aspects of relevant woodfuel policies would be to increase people's participation in tree-growing, stressing both environmental and gender issues (SADC 1992a: 232-5, 263-75).

The following comment seems appropriate: bearing in mind the substantial increase in electricity tariffs taking place (about 1000%) in Zambia, and what has been said above about the increasing government policy support given to charcoal production for supply to peri-urban and urban areas, we must conclude that Zambia has implicitly embarked on an energy path which probably implies backward fuel switching. The recent removal of petroleum price subsidies serves to reinforce such a tendency.

3.2 Electrification without government policies and budgets: Zambia and Zimbabwe

The energy situation in Zambia became very difficult over the years. The electricity utility, the Zambian Electricity Supply Corporation (ZESCO) has been subject to strict price controls and unit costs of production rose. These factors combined to produce operational deficits and increasing problems in serving consumers (such as unplanned outages and customers awaiting connection). Behind these problems was a malfunctioning national economic system, which led to thegrowing use of parallel markets, increasing social inequity and, finally, economic and political collapse.

Some examples of energy pricing are illustrative of some of the above processes. Zambian electricity tariffs have until recently been the lowest in Southern Africa (perhaps even in the world, according to World Bank analysis), with energy charges

as low as 0.07 USc/kWh for large consumers and 0.2 USc/kWh for small consumers (Eskom 1992: 6-10, 33 and 38). In spite of such low tariffs, *access* to electricity has been considered expensive on account of high household connection fees, at present reduced to about US$100 – one-tenth of the actual costs. Nevertheless, ZESCO has a backlog of 15 000 households which have already paid the connection fee (Hibajene & Kaweme 1993: i). This suggests technical and economic inefficiencies at ZESCO: lack of electrical equipment and lack of finance for the unrecovered 90% of installation costs.[1]

Economic developments in Zimbabwe have to some extent paralleled those in Zambia, but not yet to the same disastrous end. After earlier positive, but financially unsustainable developments, the economy has gone into reverse. For the electricity supply industry, these developments have lead to financial weakness (operating deficits) both in Zambia's ZESCO and the Zimbabwe Electricity Supply Authority ZESA. This again has lead to a lack of proper operating procedures and of maintenance, to increased planned and unplanned outages, and to backlogs, in Zambia, of customers wanting to be connected. In addition, both utilities have been plagued with technical problems and disasters (the fire at Kafue Gorge Hydroelectric Power Station in Zambia 1989 was probably due to lack of appropriate maintenance and to technical problems; explosions at Hwange Thermal Power Station in Zimbabwe). Efficiency losses at the Kariba and Kafue Hydroelectric Power Stations due to poor water management should also be mentioned. At Kariba, in particular, there has been a glaring lack of long-term water management policies, while knowledge of the long term hydrological trends are good. In addition, improved generating efficiency at Kariba could be obtained through better water-use measurements and the possibility for transferring unused water (national) allocations from one year to the next, which would improve generating efficiency in the order of 5-10% (Dale 1993: 41-52).

Recent field visits to Zambia or Zimbabwe revealed that neither government had a rural electrification (RE) policy nor much allocated to RE in their budgets. The 1990/91 ZESCO Annual Report shows that only eleven million Kwacha (about US$250 000 at the time) seems to have been received from the government for RE projects during the period (ZESCO 1991: 8-9). It is also reported that support from Denmark has come in at about US$10 million for the construction of a 132kV transmission line (ZESCO 1991: 8). In Zambia, it was reported, there has been no proper definition of what constitutes 'rural', and no criteria for selecting individual RE projects.

Judging from ZESCO's 1990/91 Annual Report, however, some RE projects were nevertheless in the pipeline by early 1991, although no information is given of the number of households connected. It is doubtful whether these projects will add substantially to the low number of rural customers connected by 1990 (see Table 2.2). Zambia's official policy is, for the foreseeable future, to rehabilitate existing RE installations and not to engage in any new ones before those started have been completed. Furthermore, it has been communicated to the authors that RE must be seen in a broader rural development context where loads other than those of households should be identified before electrification. After the severe drought culminating in 1992/93, the Zambian government has shown increased interest in photovoltaic (PV) systems, and it has been proposed that government reduce substantially the high import duties on PV equipment.

In Zimbabwe, there was a rural electrification policy some years back, concentrating on district centres (with typical population of about 8000), of which 68 have been electrified since 1983 (ZERO 1988: Ch. 2.1). (The village of Gokwe in north-western Zimbabwe is such a centre: electrification in 1986 sparked off latent development potential, leading to a demand (also potentially industrial) which could not be satisfied by the existing powerline capacity; finance was not, however, available to strengthen the grid.) This electrification programme was part of a

1. As regards paraffin, the new Zambian government has instituted a no-subsidy policy and is now taxing paraffin neutrally. Prices have been rising, but so, probably, has availability.

national growth centre policy for rural development, financed through ZESA's operational surpluses and external donations from, for example, Sweden. In later years there have been little or no local funds to pursue RE in Zimbabwe.[1]

Whatever policies the two governments might have had, the conventional wisdom seems to be that RE should be financed from the surpluses of the respective utilities – ZESCO and ZESA – and by foreign donors. Both utilities are to this day strictly controlled by government, who must approve tariff changes. The two economies exhibit a strong inflationary pressure. The cumbersome political processes for government approval of increases result in electricity tariffs lagging more and more behind the general movement of prices. With rapidly rising costs, also due to organisational problems, both utilities have more recently incurred substantial operational losses. Hence no financial strength exists for system expansion in either urban or rural areas. Where there is little 'ability and willingness to pay' from domestic sources, there could perhaps also be less willingness to contribute from foreign sources. ZESCO is now proposing to increase tariffs by about 1000% in quarterly steps to bring about a financially sustainable utility, with a realistic real tariff at about 3 USc/kWh. ZESA, for its part, increased tariffs by 30% from 1 September 1993. According to the Zimbabwe Electricity Act, ZESA must operate on a commercial basis, and RE would not satisfy such a criterion. ZESA has, therefore, for a number of years asked for government policy to be established in this field and has requested the Ministry of Transport and Energy to establish and seek approval for a new RE policy – an Electricity Master Plan. Such a plan would also be expected to lay down a policy concerning economically non-viable RE projects.

Even if ZESA and ZESCO were to be run efficiently, however, they could not be expected to contribute sufficiently from their own surpluses to a large RE programme, particularly taking into account the large investments needed in the years to come for overall system rehabilitation and expansion to meet increasing loads. On the other hand, utilities could participate in RE within their financial means (if surpluses could be generated) with supplementary government support, provided that a RE policy would clearly specify the respective responsibilities – financial and otherwise – priorities and project selection criteria. If governments give RE high priority, it might be expected that they would contribute financially within a long-term (rural) development budget framework. Some SADC countries – Botswana and Namibia – have come to such a conclusion and are using it also as a vehicle for attracting donors' to RE programmes on the basis of their perceived beneficial social implications. It can be noted that, in Namibia, SWAWEK's operating surpluses are not being allocated to RE at this stage and that, perhaps for this reason, the government is considering taxing SWAWEK's operating surpluses.

3.3 Rural electrification as a sustainable budgetary process: Botswana and Namibia

In Botswana, the Botswana Power Corporation (BPC) and the Ministry of Mineral Resources and Water Affairs (MMRWA) cooperate in the electrification of rural villages. In addition to BPC's own investable surpluses there is government funding under the current National Development Plan (NDP VII).

During 1993/94 the government has budgeted about ten million Pula (about US$ 4.5 million) for RE projects. In addition foreign grants, from Canada and Denmark, have been secured, with a government/foreign funding mix of about 80/20. Although regular consultations take place between MMRWA and BPC on RE, BPC nevertheless would like to see a clearly documented government RE strategy. Two ministries now share responsibility for RE: MMRWA and also the Ministry of Works and Communications, through its Department of Electromechanical Engi-

neering. The latter is responsible for village supplies through gensets, and charges a tariff much higher than BPC's uniform national tariffs. BPC would also like to take over the genset operations in order to apply uniform principles in public electricity supply.

Under Botswana's RE programme five major villages have been electrified, some of them previously having used gensets. A phased plan for rural electrification of 50 villages is being prepared, based on financial calculations requiring a 6% rate of return at current prices, using a ten-year amortisation period, based on a conservative estimation of present village energy consumption, a 5% annual kWh increase and a 5% annual tariff increase. The costs are calculated under two very cautious alternatives:

- long-range marginal costs to BPC (0.257 Pula/kWh, about 13 USc/kWh); and
- marginal costs of supplying (imported) power (0.18 Pula/kWh, about 9 USc/kWh).

The net present value is calculated under both alternatives assuming a load factor of 0.25. For a village to be selected for electrification it would ideally have to satisfy the rate of return specified under both cost alternatives.

The plans are to extend the grid to ten selected villages per annum. Villages which have been considered are those up to 50km distant from the grid and with at least 2 000 inhabitants. Each village would receive five substations and an initial grid of five kilometres of low-voltage lines, on average representing an additional free investment at 200 000 Pula (US$100 000) per village to encourage connections and earlier uptake of load.[1]

Connection fees (at cost) would be charged at an average of 2 000 Pula/household (US$1 000) in a typical village to which the grid has been extended, and 1 000 Pula in a town. There is, however, an alternative to cash payment up front: the household can pay 40% up front and BPC will finance 60% of the connection fee, to be recovered over ten years through the tariff at favourable interest rates (below 10%). A service charge will, however, be levied at 1% per month of capital costs of estimated capacity not taken up. Financing of appliances remains a great barrier to the use of electricity in households.[2]

It should be noted that BPC, by and large, does not have a problem of collection and debt: during the last accounting year bad debts amounted to only about 100 000 Pula. Bills are paid monthly, within about 40 days after the period concerned. Billing thus is efficient. Losses due to illegal connections are small.

Prepayment meters are to be used where there is a collection problem in the wider sense – where, for example, reading of meters might be costly because of distance. About 1 000 prepayment meters have been installed at the new Sua Town (BPC 1992: 9, 13). It has, however, been discovered that prepayment metres can be 'tinkered with'. Prepayment-card vending-points will be set up. Villages considered for prepayment meters at this stage are Bobonong, Maun, Lethlakane, Kasane and Sehitwa. In future all rural installations might be based on prepayment metres, as soon as this policy has been approved by the BPC board. Individual prepayment meter cards would also help BPC better forecast load.

In Namibia the main players of the rural electrification programme are the Ministry of Mines and Energy (MME), the South West African Water and Electricity Corporation (SWAWEK) and the Ministry of Local Government and Housing (MLGH). It should be noted that SWAWEK is a bulk supplier, and that reticulation and revenue collection are the responsibilities of local councils and similar organisations to be established in rural areas.[3]

When it comes to the supply of electricity, the major policy principle which has been accepted is that electricity can only be available on commercial terms (pres-

1. The scheme is about to be changed to involve settlements 100km distant from the present grid and of no particular size. This rather bold change in selection criteria might signify a rather more vigorous RE policy in future years, given availability of funds.

2. This is so even in urban areas, where it has been estimated that only about one-third of households have been connected to BPC reticulation. In rural areas only about 1% of households have so far been connected. A total of only about 11% of households have been electrified.

3. This is similar to the situation South Africa, where it is considered a problem. It should be noted that Namibia has promulgated new legislation for local authrities (Act 23 of 1992). Part X of the Act regulates the regional authorities' rights to supply electricity in their own areas (Para 52d) but also 'on such terms and conditions as may be determined by mutual agreement, [to] supply electricity or gas to any person other than a resident in its area...' (Para 53).

ently the tariff for rural consumers is R0.20/kWh, or R0.16/kWh without prepayment metering and R0.12 – R0.13/kWh in Windhoek) and that electricity could presently only reach few households in rural areas. The policy of the government is, however, on the one hand *not* to promise electricity to all households and, on the other hand, to extend the grid in a phased manner to all major rural centres in the entire country over a period of seven years until 1997. At present, no further plans exist to subsequently extend the grid into deep rural areas with a scattered population.

The Namibian RE programme started in the north, in Owambo, during 1991 and will provide electrification of major rural centres by about 1997.[1] The entire programme has been costed at about R100 million, with at least a 50% Namibian contribution. The RE policy has been to connect, without connection charges, schools, clinics, government institutions and households in preselected rural centres paid for under the programme. Previously such centres used gensets, gas etc – and thus had identifiable loads. New centres will be connected when identified. Originally (in Owambo) 29 rural centres had been identified, with 13 added later.[2] Total costs of the Owambo RE programme has been R21 million. Some savings against budget have been realised as a result of SWAWEK's efficient work performance (operating as a contractor to government) and falling prices of conductors. The distribution of construction responsibilities has been as follows: high tension lines – SWAWEK; low tension lines – MME; and connections – MLGH.[3] Financing of the Owambo RE programme has been shared between the government of Namibia and grants from Norway. MME is of the opinion that the Owambo RE programme is feasible, in the sense that it will cover its recurrent costs, and may also contribute towards some of the programme investment costs. Costs per kilometre of line are estimated at R20 000. It is the intention to introduce high-voltage single-phase transformers to reduce costs of new (more distant) connections. Connections presently include three-phase prepaid metering systems. While connection is 'free' if done in a rural centre, the tariff has been calculated to recover costs over 20 years. House wiring is carried out by licensed firms. Installations must be tested by the relevant council before power hook-up. MME has now found it necessary to draft an Electricity Bill to replace the old South African bill from 1922 (as amended). In the new act the powers of municipal and local authorities are to be regulated. In addition there exists an act regulating SWAWEK's operations. The establishment of new regional distribution utilities has been proposed. They would be responsible for collection, maintenance, tariffs and expansion. It was felt that both rural and urban areas should be combined into one utility, probably on an administrative regional basis. Obviously this would allow for an optimal range of consumer categories where the load is concerned, and also for the possibility of some cross-subsidisation.

It is clear from the above that Namibia has a RE policy and that the government supports the RE programme through budget appropriations inside a longer-term planning framework. SWAWEK is only responsible for bulk supply to rural areas and is operating as a contractor to government in the construction of the high-voltage lines. It should further be noted that Namibia has been able to secure external grants for its RE programme – perhaps because the government has placed due emphasis on a RE strategy and through budget allocations; and perhaps also because the administration has approached the programme in a businesslike manner. At this point one might cite the mission statement of SWAWEK (100% government owned): 'to give reliable and adequate supplies of electricity at affordable prices wherever it is economically possible to do so' (SWAWEK 1992: 2).

The World Bank has commented, referring to the Namibian RE programme, that:

> it is unlikely that the programme, and others like it, can be justified on strict economic grounds. The primary justification for such projects will therefore tend to be social and political.... This is entirely legitimate, particularly in

1. For example, during 1991/92 SWAWEK carried out work on rural schemes at Kalkplateau, Hochfeld, Owambo, Kavango, Opuwo, Khan/Henties Bay, Elizabeth Bay Diamond Mine, and on the upgrading of the Otjikoto-Rundu line (SWAWEK 1992: 12).

2. Urban centres in Owambo, like Oshakati and Ondangwa, had been electrified prior to 1990.

3. This particular division of work might lead to problems in overall programme implementation because MLGH's connections work has been lagging behind SWAWEK's high-tension line implemention.

> view of the fact that the capital costs are clearly identified and separately funded (largely by foreign grants), but it leaves questions about whether the expected social benefits are being realized.' (World Bank 1993: 15)

The reference to 'largely by foreign grants' refers to electrification in Owambo only.

3.4 Civil strife and energy supply to households: Angola

Two SADC member states have been plagued by civil strife since independence in 1975: Angola and Mozambique. Obviously, under such circumstances, long-term development policies, including household energy supply policies, do not have priority. Angola's situation therefore does not allow for any RE activities, although a national water utilisation and electricity access programme is under preparation. According to the Direccao Nacional, Energia, the main responsibility is 'to keep main systems functioning and guarantee a stable power supply to main towns'. In Luanda, the supply of power from the Kambambe hydropower station has been cut repeatedly over the years, and the city has to rely on planned and unplanned outages and supply from utility-operated gas turbine generators in Luanda, and on thousands of privately owned gensets. Fuel is obtained from the domestic refinery at subsidised prices. It is not known with certainty how many of Luanda's inhabitantshave access to electricity. The number of formal connections known to the utility (80 000!) probably means very little, as the 'informal' connections are as numerous as the 'stars in the night sky' – which is indeed the impression one gets at night, even in the informal outskirts of the city. Added to this, are enormous 'technical losses' and the revenue collection problems among those who are formally connected but unwillingto pay. The Angolan electricity utilities – Empresa Nacional da Electricidade, responsible for generation, transmission and distribution outside Luanda, and Electricidade de Luanda, responsible for distribution in Luanda – face technical, organisational and financial problems of the first order.

Before any Angolan rural development programmes, including those to widen access to electricity, may be contemplated, national reconstruction of basic infrastructure must take place. The costs of rehabilitation of power lines and installations including dams (for example, the Gove Dam which is intended to regulate the flow of the Rio Cunene and the inflow to the Ruacana hydroelectric station from which Namibia draws the bulk of its power) had been estimated at US$400 million *prior* to the recommencement of hostilities in November 1992. Since then the large Capanda hydropower station, under construction, has been damaged – perhaps severely.

Because the original value of money has been almost eliminated, and because of rigid decision making procedures, tariffs once set tend to be 'sticky'. Some examples will suffice: Using the parallel market exchange rate, the household tariff (covering 2-3% of real costs) is about 0.015 USc/kWh, while petrol costs 0.01 USc/litre. (Using the official forex rate, the prices may be multiplied by factor of twelve only; energy prices remain low whatever rate of conversion is used.)

Until the recent destruction of the road and transport infrastructure, there was widespread distribution of petroleum products for household use. The present energy supply situation for Angolan rural households must be left to speculation. Woodfuels, normally accounting for more than 50% of energy consumption in Angola (2.5 million tons/year of woodfuel and 0.5 million tons/year of charcoal), will probably have increased in importance during the last year. 'Programmes of wood-fuel replacement by LPG, kerosene or electricity in coastal areas, or the supply of improved cookers into urban areas and surroundings have successively been postponed due to lack of a global understanding on the matter' (Tito 1992: np).

3.5 Petroleum products and PV systems

Petroleum products of relevance here are paraffin (kerosene) and LPG for household use. Until recently, paraffin was generally subsidised, but this is being changed in many countries: the new approach seems to be to eliminate subsidies and to tax paraffin neutrally.

Only Angola has indigenous petroleum resources. Distribution of petroleum products has been the responsibility of Sonangol, the state oil company, but legal provision has recently (1992) been made for other companies (foreign and local) to participate. Distribution of kerosene and LPG from the refinery in Luanda (jointly owned by the government and Petrofina of Belgium) is mainly along the coast and prices are extremely moderate, apparently for social reasons. LPG, on an energy unit basis, costs about on-quarter as much as charcoal, according to official maximum prices. If, however, the comparison is made at LPG black-market prices (which a substantial share of households have to pay), the comparison is very different, with LPG 2.5 times more expensive than charcoal. Distribution is also hampered by lack of high-pressure bottles.

LPG and paraffin are also used widely in Botswana. The products are imported from South Africa and reflect the pricing arrangements there. In Zambia paraffin is an important energy product for households. While prices were previously subsidised by government and regulated through ZIMCO's subsidiary ZIMOIL, the policy of the new government is to tax neutrally and not to subsidise. Hence paraffin prices have risen during the last year. In Zimbabwe paraffin is cross-subsidised through petrol prices, which are low; the elimination of cross-subsidies is being discussed. LPG is used in higher-income households.

In Namibia paraffin is sold extensively and plays an important role in household energy use in rural areas, as do candles. The policy of the government is not to subsidise paraffin, and prices have been deregulated. LPG is not competitive with fuelwood, because of transport costs, in particular in the north. LPG is predominantly used by medium- and high-income households for cooking and refrigeration, and is less widely used than 20 years ago, because electricity has become relatively more cheap.

In summary, household petroleum products are generally sold at cost reflective prices in most SADC countries (apart from Angola), due to the need for imports of petroleum (either as crude oil or as finished products) in most SADC countries, except for Tanzania and Zambia which have their own refineries, and on account of considerable transport and distribution costs.

Most SADC countries are experimenting with the introduction of PV systems. These are expensive imports and are also taxed heavily on the assumption of their being 'luxury goods'. In Botswana the government tries to promote such systems in rural off-grid areas. Manyana village (not far from Gaborone) has been selected as a pilot area, and some systems have been put up there, at government institutions as well as for selected households; some street lighting has also been installed. The charge to households is about 10 Pula/month (US$5), to cover maintenance. Plans for similar installations far from the grid – in the Kalagadi, for example – are under way. Zambia is considering reducing import duties on PV equipment.

In Zimbabwe some installations have already been made in rural areas for water-pumping for irrigation, for household water supplies and for clinics and schools. Proper pricing arrangements need to be instituted in order to avoid the present general overloading of the PV systems. At present, finance is available to Zimbabwe for a more substantial RE-PV pilot programme under the UNDP/World Bank Global Environment Facility (GEF). PV systems for about US$4.5-5 million will be imported, and about 10 000 households will receive PV systems. This programme will involve ZESA for selection of sites and maintenance. The PV systems will be

supplied on a cost recovery basis (revolving fund). One Zimbabwean PV systems producer and several distributors will assist, as will NGOs for installation and support services.

In Namibia a remote areas power supply policy has as yet to be established, but is expected to be based on PV systems. German technical assistance (GTZ) will be involved initially. Household self-finance is expected to be assisted by a revolving fund.

Both petroleum products and PV systems are available on the market in most SADC countries, mostly without subsidies, but taxed – at best neutrally. Market penetration of PV systems is only about to start, while paraffin has already a substantial penetration. PV systems are expensive and would only attract off-grid consumers who can afford it. For the foreseeable future, widespread PV utilisation would require substantial government finance and/or grants from foreign sources. LPG mainly attracts medium- to high-income earners. Paraffin is the alternative to woodfuel of the 'small consumer'.

3.6 Fuelswitching: Quo vadis?

We have noted that real prices of certain high-level energy commodities (electricity, and petroleum products like paraffin and LPG) are rising – particularly in the case of electricity. It has also been pointed out that household access to, for example, electricity is widening only slowly, and that the economies of the countries discussed have stagnated or are declining. This is the context for the following discussion of fuelswitching.

Generally speaking, an *upwards fuelswitching* would require three tendencies – working together or independently: first, broadened user access to superior energy goods (electricity, petroleum products); secondly, user costs (prices) of electricity, petroleum products and PV systems need to decline in price *relative* to prices of other energy products; and, thirdly, real monetary incomes of households need to *increase*.

These factors would drive the overall trend, which could mask individual household strategies for coping with changes in macro variables like incomes and prices. Some households might receive compensatory remittances from family-members living in towns or abroad, some might draw on savings, some might devise other crisis-coping strategies allowing them to move against the trend. However, if incomes continue to fall or stagnate, if real-prices for energy commodities rise, and if access is not broadened to energy commodities which are per se are relatively attractive (such as electricity), then demand for these energy commodities will fall.

Increased user access means increased access to electricity in dwellings, and the ability to purchase required appliances like stoves. Increased access to electricity in dwellings would also be helped by better financing arrangements and improved economic conditions in general. Rural and peri-urban access to electricity is being broadened (slowly) in both Botswana and Namibia – countries with relatively small populations and, also, relatively efficient financial institutions. In other countries (Angola, Zambia and Zimbabwe) not much happens in the sphere of broadening access to electricity, except for Zimbabwe's plans for introducing household PV systems. Their financial systems are rudimentary and lending is distorted through inflation and 'crowding-out' effects due to heavy government domestic borrowing.[1]

As for declining prices of superior energy goods (paraffin, LPG and electricity) relative to other energy goods, this seems to take place only in Angola – where access is limited through war. In other countries (Zambia and Zimbabwe) the price

1. The main point is that when government acts as a large borrower on domestic markets, the rate of interest on the lending of remaining funds will increase to such a level that other borrowers (enterprises and households) cannot compete. This would reduce investments and job-creation in industry, construction, housing, etc. In the case where interest is controlled at below-market levels, the amount of available credit would be allocated at 'low' interest rates rationed at non-market criteria, possibly leading to misallocation of scarce investment funding.

of electricity is rising sharply, subsidies on paraffin are being removed, and increased use of charcoal is supported by the government, as in Zambia. Declining relative prices for electricity and petroleum products in Angola must, however, be expected to be reversed soon after a politically stable situation has been established and as a result of outside pressure – including intervention from institutions like the Inernational Monetary Fund and the World Bank. A parallel situation might be said to exist in Mozambique, where the electricity tariffs have risen most sharply over the last 12-14 months. Hence, even Angola's energy pricing situation is only temporary.

As for the possibility for increasing real household incomes, all five countries discussed here (Angola, Botswana, Namibia, Zambia and Zimbabwe) face low or even negative economic growth in the short-to-medium term, with the possible exception of Zambia.

From the above it must be concluded that fuel-switching seems to be set on a *backward* trend. Detailed micro studies of actual household expenditure on energy commodities would of course be required to substantiate this conclusion, which is based on a macro-perspective.

If backward fuel-switching is, in fact, taking place, what consequences would this have for energy demand, relative prices and energy conservation? Again, conclusions can only be tentative. Reasoning within a framework of general equilibrium, however, leads to one strong conclusion: household sector demand for electricity in Zambia and in Zimbabwe will decline. This would, incidentally, assist in the conservation of scarce water stored in Lake Kariba. The amount of fall in demand would depend on how price-elastic the short-term demand for electricity would be. Alternative fuels would have to come into play. Assuming that demand for electricity falls more than the price increases, savings would then be expended on other superior fuels. In a free-market economy this would tend to drive up prices of such commodities as paraffin and LPG. It has been noted that the price of paraffin has recently been deregulated in several SADC countries. Hence one may initially expect rising prices, and closure of some petrol stations in more remote areas.[1] Energy demand might then be shifted downwards towards charcoal and wood where these are the alternatives. If there are no energy alternatives, overall household energy demand would fall in the short-to-medium term or, if demand is relatively inelastic, energy's share of household expenditure would increase. Government policies would then have to encourage more efficient production, marketing and consumption of energy commodities, while prices should be left to adjust in a competitive environment. A pricing system that gives the appropriate signals as to relative scarcities would also assist conservation, but would seem to be contrary to what are considered good social policies in the short term. Broadening access and encouraging efficient production and distribution would in time increase supplies and lower prices. Good overall economic policies that stimulate production and employment would give increased purchasing power to households and enable them to make their choices in a changing energy market. In the longer term both households and increased energy efficiency (reduced use of energy per unit of output) would be well served by cost-reflective pricing of energy goods.

1. This assumes that the regulated prices have served as effective maximum prices. If, however, increased competition were to come in, making distribution more efficient, prices might decline. Prices would tend to be reflective of costs, including transport, and be more expensive in remote locations. In cases where this would not be acceptable, a transport subsidy on paraffin might be the solution. It is feared that deregulation might lead to closure of retail outlets, especially in remote areas. Closure might also, however, occur under a regulated regime, as the following instance from Namibia indicates:
'Since the major products are controlled ... competition must be based on service in lieu of price.... As a result the country is well served, but "over-pumped" – i.e., there has been over-investment in an excessive number of excessively elaborate stations. Recognizing this, the MME (Ministry of Mines and Energy) has agreed with the companies on a five year rationalization plan aimed at preventing proliferation of retail outlets by *requiring that more old service stations be closed than new ones are opened.*' (World Bank 1993: 32; emphasis added)

CHAPTER FOUR

Regional energy sector networks and training

4.1 Energy sector networks

Both NGOs and interregional organisations like SADC, or the preferential trade area (PTA), perform both informal and formal energy sector networking in the Southern Africa region.

Energy sector NGOs in the SADC region are involved with energy supply (solar, wind, biogas, biomass) and energy conservation (Moyo, S 1989: 4). ZERO, which is a Zimbabwe-based NGO promoting and co-ordinating indigenous environmental research, participates in the SADC Regional Energy NGO Network. This is a loosely organised network, with little activity in recent years due to financial constraints (ZERO 1992: 14), and which at times has liaised closely with the SADC Energy Sector/TAU in Luanda, Angola.

Afrepren (African Energy Policy and Research Network) is a programme on energy, environment and sustainable development coordinated by the University of Botswana (NIR) with support from the Swedish Agency for Research Cooperation with Developing Countries, and involving researchers from Eastern and Southern Africa. According to an undated Afrepren circular: 'The key objective ... is to strengthen local research capacity and to harness it in the service of energy policy making and planning'.

TAU in Luanda is the core of a formal network of official SADC contacts in the energy sector, using facilities of national governments, with an officially appointed energy contact in each SADC member state. TAU's basic organisation is given in Figure 4.1. Funding for its operations and projects comes mainly from Angola, Canada, Holland and Norway. It reports both to the Angolan State Secretariat

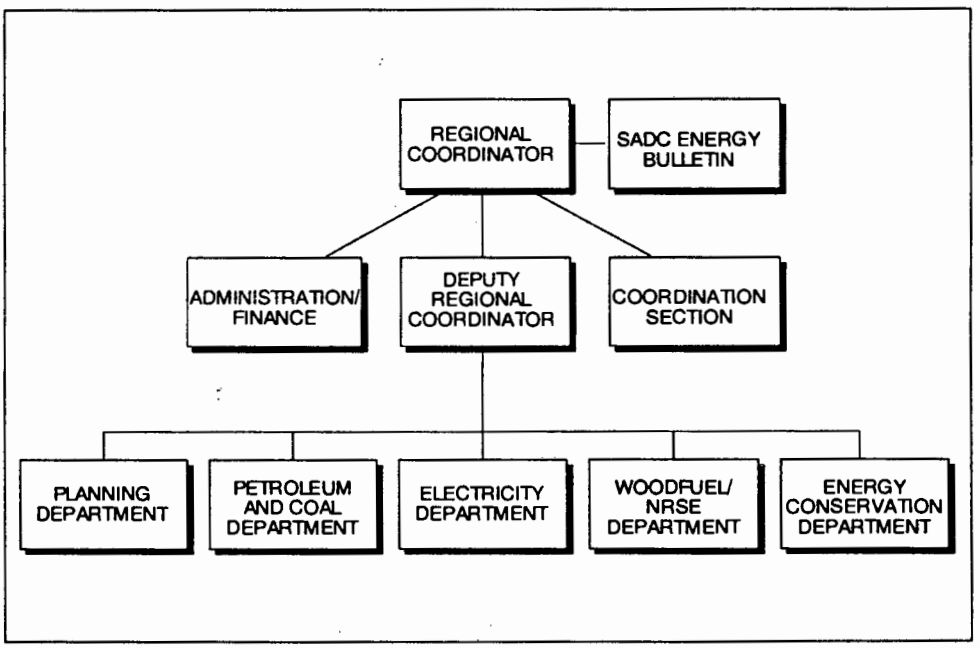

FIGURE 4.1 SADC Energy Sector/TAU: basic structure

for Energy and Water and the Ministry of Petroleum, as well as to the SADC Executive Secretariat in Gaborone, Botswana; reports are given at the twice-yearly meetings of Sector Coordinators. This procedure is about to change in accordance with the new SADC Treaty, although the new modus operandus of the sector coordinating units has not yet been worked out. TAU arranges regular agenda meetings with energy officials and ministers, and with energy sector donors. Through the work in the various energy sector technical subcommittees (electricity, energy conservation, petroleum, NRSE/woodfuel, and energy planning), energy utility and government officials meet with researchers and TAU local and international staff discussing practical technical issues of common interest, also in preparation for meetings of SADC national energy sector officials and energy ministers. While energy officials' and ministers' meetings are closed, seminars and workshops allow participation by observers and special invitees. The SADC Electricity Subcommittee is of particular importance as it is a formal forum for the SADC electricity utilities; the electricity utilities of both South Africa (Eskom) and Zaire (Societé National d'Electricité) have participated as special invitees when discussing regional electricity interconnectors. In August 1993 the SADC Council of Ministers decided to allow cooperation on technical matters between SADC and South African institutions. The annual cycle of energy sector meetings is given in Figure 4.2.

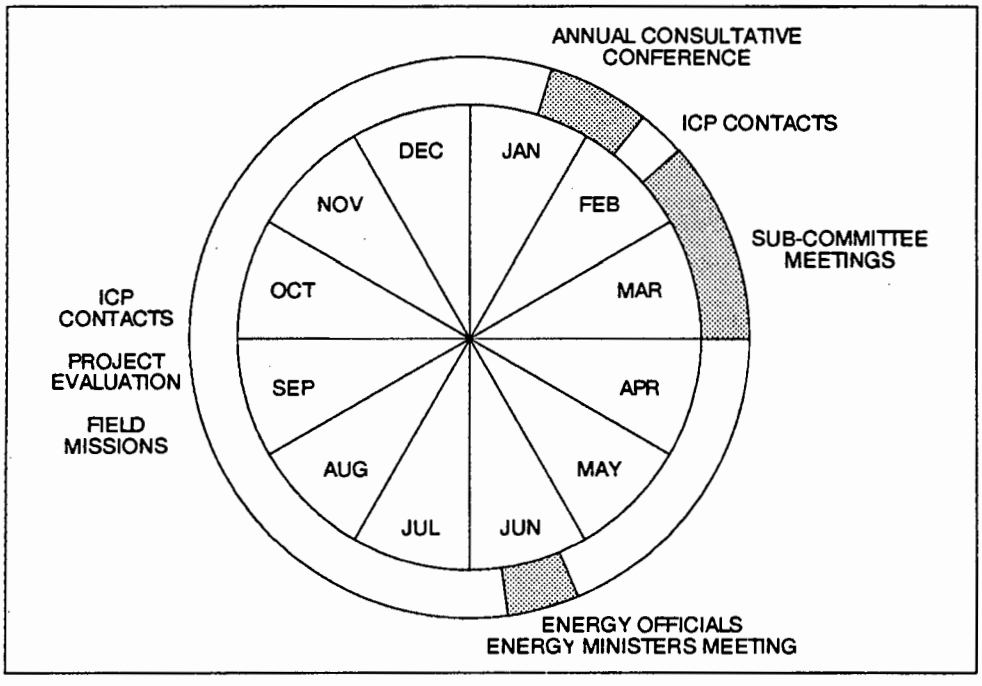

FIGURE 4.2 SADC Energy Sector – annual cycle of meetings

The PTA (with headquarters in Lusaka and members from southern, central, eastern and north eastern Africa) was originally established to facilitate intra-regional trade. The PTA secretariat has managed to set up a regionally accepted unit of account (UAPTA) for the area, facilitating settlement of trade among PTA member states and the issuing of UAPTA-denominated travellers' cheques. Recently PTA has taken an interest in cooperation with the productive sectors like energy. At present discussions are taking place between SADC and PTA with view to closer cooperation; the SADC Council of Ministers has in principle supported such discussions.

Environmental Development Action in the Third World (ENDA) in Dakar, Senegal, is an NGO oriented to energy policy research and training in an African context. ENDA has run energy planning courses since 1985 directed at Francophone African countries, with approximately 250 energy managers having completed the course.

The Stockholm Environmental Institute (the former Beijer Institute), financially supported by the Swedish International Development Agency, has been active in the energy sector with LEAP/REAP modelling in several SADC member states, particularly Tanzania and Zimbabwe. TAU has also been at some stage involved with testing of LEAP; the approach failed on account of limited access to data from member states, and inability to establish shared interests.

4.2 Energy sector training

There is reason to believe that very little systematic training of relevance to energy policies takes place in the region at the national level. Scholarships have, quite correctly, been granted to a number of individuals for post-graduate studies at universities in Europe and North America, but without any programmes or plans for how this could benefit future regional energy policy-making.

There are many indicators of the importance of training for energy sector policy- and decision-makers. As regards woodfuel problems, a substantial medium-level awareness pressure has built up over the last decade, yet successful national and regional woodfuel policies still have to appear. In the field of energy-pricing – of electricity, for example – it is our experience that neither top civil servants nor policy-makers have yet grasped fully the paramount importance of proper pricing principles and rules. There is room in the region for an institution to take care of this. Decision-makers need to make decisions on the bases of up-to-date information and correct principles.

The SADC Energy Sector itself is grappling with these problems. Until quite recently, the whole issue of energy pricing was often 'hidden', for reasons of 'national security'. The issue of self-sufficiency, particularly the resistance to allowing 'outsiders' access to principles and processes for determination of national energy prices, has for a long time been a major obstacle to real regional cooperation in the field of energy supply – with, for example, the establishment of regional electricity interconnectors. During the 1992 SADC Energy Ministers' Seminar in Windhoek, pricing of energy was the topic for discussion; a recent SADC seminar in Malawi discussed pricing of electricity for interstate exchange, with a surprising new, open attitude from some of the participating electricity utilities. The importance of energy pricing is being realised; but there are still no systematic methodologies or long-term policies developing.

Externally financed longer term technical assistance projects in the energy sector, through GTZ (the German organisation for international development cooperation), have taken place in Malawi (some years back), Botswana, Lesotho, Swaziland and Zimbabwe, and are due to be initiated in Namibia. Policy-makers involved in these programmes meet annually to exchange information and experiences.

In the proposed SADC project AAA.0.8 (SADC energy planning network), originally to have been financed by Belgium, an embryonic idea has been formulated for a regional energy-planning network with a large training component, based on a shared philosophy of energy planning, methodology, data etc. One of the first challenges for this project will be to determine a common basis on which regional efforts in the energy-planning field can take place. At present the project may take one of many directions. Cooperation with other energy institutions, like ENDA and a proposed energy networking institution for Anglophone Africa (possibly based at the Energy for Development Research Centre (EDRC) at the University of Cape Town) might prove fruitful at this stage of project formulation. EDRC is planning a regional postgraduate course in energy policy-planning and might through this assist in the establishment of a common professional platform for Southern African energy planners.

Over the last four years (1990-93), a postgraduate course in 'Planning and Analysis of Development Projects' has been held in Botswana, in cooperation with the International Summer School of the University of Oslo. Each year some 25 participants from ministries and public sector utilities and organisations in the SADC region have attended. The course curriculum has had a solid bias towards economic and financial analysis of energy projects, dealing with the basic characteristics of energy supply and demand, pricing issues as well as principles for planning, formulating and analysing projects in various energy subsectors. International staff from TAU have been involved as lecturers.

The Angolan Instituto Nacional de Petroleos Angola runs a series of courses for petroleum personnel at its school at Sumbe, south of Luanda. The school is supported by oil companies active in Angolan waters, in particular Cabinda Gulf. Some of these courses were previously run as SADC courses, open to all SADC member states – personnel from Lesotho, Mozambique, Swaziland and Tanzania have thus far participated. The Sumbe School is now re-evaluating its courses directed at SADC, aiming at a middle-management level.

The Eastern and Southern African Management Institute has started 12-week courses for rural energy development, financed by the Netherlands.

In light of what has been discussed in this chapter, there seems to be scope for a systematic networking of all institutions presently active in the region in the fields of energy policy and training.

CHAPTER FIVE

Some policy implications for household energy supply programmes

5.1 General energy pricing recommendations

It must be recognised that the 'playing field is not level' as regards social and economic conditions in SADC countries, as well as in South Africa. There are enormous differences in living standards – between urban and rural households in each country, and between countries. Rectifying these differences is a difficult and cumbersome process which can only be accomplished through sustainable economic growth and redistribution over a long period of time. This would require astute economic management, and good fortune with regard to the external economic factors not under control of any government. The authors of this paper are, however, concerned that the possibility for such sustainable growth will be hampered through the promotion of non-sustainable economic policies. Such policies have normally begun by expanding government expenditure without a matching expansion in the tax-base, which leads to increasing government borrowing at home and abroad. Some of the domestic borrowing would be in the central bank, leading to a net expansion of the money in circulation. This leads to a gradually increasing price level, which might be further sustained through new central bank lending. On account of the inequitable effects which the resulting inflationary pressure would have, price and exchange controls and regulations would be put in place and gradually tightened. Over time this process would lead to distortions in investments and economic policies, resulting in faltering exports and an increasing import demand on account of an overvalued currency which, in combination with possible external adverse economic events, would lead to the kind of economic situation which have developed in many countries in Southern Africa – the notable exceptions, so far, being Botswana and Namibia.

The effect on demand, also on the demand for energy commodities, of a skew income distribution is recognised by the authors, who are of the opinion that the inequalities should preferably be addressed by other means than, for example, subsidising energy prices. Such subsidies would to some extent be wasted because they would also benefit those who do not need subsidies from a social point of view; subsidising electricity and LPG, for example, for medium- to high-income consumers, is hardly recommendable – it would have the effect of stimulating demand but not production. This is clearly about to be recognised in countries like Angola, Mozambique, Zambia and Zimbabwe. The appropriate arena for ameliorating income distribution problems would be through macro-economic policies based on sound government finances: a fair system of income- and wealth-taxation, a system of broadly-based and neutral commodity taxes, equitable access to education and a realistic exchange rate. These measures would contribute to the creation of new employment in industries with comparative advantages and to the creation of new wealth which, through the taxation system, would help to gradually level the economic and social playing field.

One of the most striking observations made from the review of SADC experiences and analysis of recent developments in the field of household energy supply programmes is that successes and failures to a large extent appear linked to the financial viability of energy sector institutions. Policies and programmes for rural electrification in Botswana and Namibia are based on the active support and involvement of financially sound electricity utilities. Electricity tariffs are set at levels that provide cost recovery, and ambitions and targets for the programmes are closely linked to the current and projected availability of financial resources in

the sector. Lack of clear government policies, combined with non-economic energy prices, do, on the other hand, lead to financially troubled energy utilities and poor results in household energy programmes – as in the cases of Zambia and Zimbabwe. Biased energy taxation policies, that switch energy consumption towards commodities with prices that do not reflect the true costs of supply, further contribute to the problems. These processes are most noticeable in the electricity sector, but also apply to the other energy sectors like petroleum and woodfuel.

A policy recommendation that would apply to all energy commodities is, therefore, that *energy supply prices must be cost-reflective, and that energy commodity taxes must have a neutral effect*. This implies uniform ad valorem taxation as a guideline. *Relative* prices would then reflect relative energy costs, and provide consumers with a strong signal to choose an efficiently composed bundle of energy commodities. This would promote fuelswitching processes towards those energy commodities which are relatively least expensive and relatively least scarce.

When considering negative externalities like environmental degradation from deforestation the picture is somewhat confusing. It is noted that, in the SADC region, appropriate levels of woodfuel taxes are *not* applied to reduce or counteract deforestation: stumpage fees for felling trees on communal lands are low or non-existent, licence fees for charcoal are low. This means that consumers do not pay for the costs of reforestation; on the contrary, there are subsidies – for instance, for urban woodfuel plantations. Such subsidies would, if successful, contribute towards keeping woodfuel prices lower than they would have been and prevent fuel-switching away from woodfuel, which is becoming scarce around dense human settlements. Alternatively such plantations would not have much effect on reducing prices but would be a squandering of scarce financial resources, often supplied by external donors. The inclusion of externality costs is desirable where at all possible, to allow the market price to reflect important environmental costs.

5.2 Biomass

National woodfuel strategies and plans are lacking in most of the SADC countries. Where government programmes exist, they are rarely based on an integrated energy planning approach and are often defined to meet a specific need of a particular region or area, or to match a specific financial contribution from some outside donor agency.

Woodfuel and charcoal prices should, as with the other energy commodities in question, be cost reflective and their markets deregulated. This means that production costs (including imputed or actual costs for replanting) must be included when determining pricing policies for these energy products. On communal lands, this means establishing an appropriate level for stumpage fees – as well as a system for collecting the fees. Regarding charcoal, marketing and transport must be made more efficient. In some SADC member states, charcoal can be seen as the closest substitute for fuelwood and economically much more efficient than urban fuelwood plantations.

An important policy question remains: how to stimulate localised cost-effective production of wood? Social forestry seems to be one recommendable solution, whereby trees would be just another crop in mixed farming smallholdings. Another solution would be the replanting of communal forest lands through revenues from the sale of trees.

Reviewing experiences and ongoing programmes revealed the apparent lack of coherent government policies and programmes aimed at actually improving the energy efficiency of existing biomass fuel use, both for fuelwood and charcoal. Considerable effort has been put into research into methods and techniques for

improved stove efficiency, while few resources have gone into the dissemination of research results and the definition of programmes based on improved stove designs. This applies to most of the SADC countries, with Malawi and Tanzania as possible exceptions. Research efforts are, on the other hand, to a considerable extent duplicated in several of the SADC countries.

5.3 Electricity

Two important and interconnected issues are clearly observed in most SADC countries: first, the financial viability of electricity supply utilities, and, secondly, the financing of access to electricity in rural and peri-urban areas.

In order for a supply utility to be financially viable its tariffs need to be cost-reflective overall, including also the cost of a fair return to capital, in order to meet future needs for system expansion and improved quality of supply. This means that *the use of electricity should not be subsidised through tariffs which are, on average, below cost.* Average tariffs below cost would require the supply utility to cover its costs through a subsidy transfer, probably from the fiscus. On the other hand, if cost-reflective tariffs are charged, the electricity industry would be able to finance at least part of a system expansion – including rural electrification – from current surpluses. This could mean that the industry would finance new consumers on a recovery of capital basis, particularly if increased access to electricity is seen as a long-term political goal and not as a basis for short-term political gain.[1] The long-term approach to development of electricity supply obtains in countries like Botswana and Namibia. Such an approach is not contradicted by a policy of *subsidisation of new consumers' access to electricity* on social grounds. Even if 'connection' was paid for by the utility, it would, by and large, mean efficiency in consumption of electricity if households would pay a tariff which would be cost-reflective – covering all variable generation, transmission and distribution costs. Connection subsidies would be equitable from the point of view of more equitable *access* to electricity. This would be entirely different from subsidising consumption, which would lead to misallocation of scarce financial resources.

If electrification should take place at a tempo exceeding the supply utility's financial capability, government must allocate financial resources commensurate with the political emphasis it places on (rural) electrification through provision of a specific budget-line item. A budget-line item will also make the subsidies transparent to all decision-makers and stakeholders involved. Allocations of finance for a monitorable rural electrification programme might be integrated with budget allocations for a rural development programme. In Namibia, for example, rural electrification planning is done through close cooperation between the ministries responsible for energy, on the one side, and local government and housing, on the other. Such a joint approach to rural development makes sense from the utilities' point of view, as load would increase much faster. With limited government financial resources, support to rural electrification should aim at being a catalyst in rural areas where other developments are already taking place, or where a clear development potential has been established.

5.4 Petroleum products

Only Angola produces and refines its own crude. In addition to the Luanda refinery, only two other refineries are in operation in the SADC region: in Tanzania (Dar es Salaam) and in Zambia (Ndola). All other SADC countries import petroleum products. After the oil-price shocks in 1973 and 1978 lead to steeply rising supply costs, SADC governments inaugurated, for social reasons, a policy of subsidising products like paraffin and diesel – and, in some countries, also LPG.

1. A financially viable utility might also be able to raise loans in its own name on the capital market, even if it were government-owned, as, for example, Eskom does at such favourable interest rates.

Over time this policy became entrenched, leading to further increases in subsidies and, in the end, to an unsustainable drain on the fiscus. The policy also encouraged the continued, and unaffordable, high dependence on petroleum products.

Overall prices for all petroleum products, however, on average equal costs in most countries, with the exception of Angola, and possibly some other countries with small, inefficient hydro-skimming refineries. Paraffin has been subsidised because it is regarded as a product for the poorer part of the population and in order to reduce the use of woodfuels. Diesel has been subsidised primarily to stimulate production in the agricultural and transport sectors of the economy. Over time, these cross-subsidies have resulted in consumption levels and inefficiencies with considerable negative effects on resource allocation, sector performance and government budgets.

The general trend now in the SADC region is to deregulate prices of petroleum products which are important to household energy supply (such as paraffin and LPG); subsidies are being removed and energy taxation is neutral. Consumers in many SADC countries are, however, paying higher petroleum products prices than otherwise necessary, because of certain price-raising practices in the South African petroleum industry, which is the source of petroleum products for many of the SADC countries. Further inefficiencies exist in the form of supply monopolies (in procurement, in refining and in distribution) without any competitive pressure to improve the efficiency of their operations. Such market inefficiencies should be modified through increased competition in the petroleum supply industry, both in the SACU area and in other SADC countries. Increased competition could be stimulated by gradually deregulating the petroleum industry in South Africa as well as in neighbouring countries, with greater emphasis being put on a transparent legal and regulatory framework and less on direct price-fixing. If industry margins remain higher than normal economic returns on investments should indicate, this would trigger increased competition in the industry and hence efficiency gains to both the economy at large and the individual consumers. In a recent study of Namibia, the World Bank (1993: 46) concludes that deregulation would initially lead to reduced prices through competitive forces.

5.5 Photovoltaics

Beyond the reach of the grid alternative electricity supply solutions need to be found. PV systems are competitive for certain limited loads, compared with diesel gensets or long-distance grid extensions. A PV system would, however, be expensive – in terms of both initial capital outlay and of life-cycle costs per kWh. PV installations would be out of reach for most rural households, even if an appropriate financial solution could be found for spreading the capital costs over a number of years. If, however, we are comparing PV technology with a situation where a utility considers a rural electrification programme through *grid extensions* and intends to subsidise the cost of electricity access, wholly or partly, the utility could consider PV systems as an unorthodox least-cost solution, and only charge the households a flat rate for their use, covering maintenance and perhaps also replacement costs. Some SADC electricity supply utilities and energy ministries (as in Botswana and Zimbabwe) are considering such an option, at this stage mainly as part of externally financed pilot projects. More creative thinking would be required. An increased use of PV systems for rural households does, therefore, appear realistic if proper institutional and pricing mechanisms can be developed. SADC has in this respect embarked on a strategy to stimulate the use of PV systems by the electricity utilities, on a sound cost-recovery basis. The government should also consider supporting access to PV-based electricity on equal terms with other supply solutions, particularly if the funds would be channelled through the same institution – for example a national power utility.

Stimulation of community PV systems (for schools, clinics etc) should be considered initially, rather than individual household usage. This appears to be the trend in Zimbabwe. Individual consumers in remote areas who can afford to pay for the real costs of a PV system should, of course, be given an opportunity to do so. Governments should consider following Tanzania's example in removing high import duties and other commodity taxes levied on PV components. Such taxes are presently acting as barriers to more extended use of PV systems. A larger market for such systems would, combined with further expected technological development (particularly with regard to battery technology), contribute to bringing down the unit costs per kWh.

5.6 Coal

Coal is not much used in SADC as a household fuel. Botswana tried to encourage increased use of coal some years back through the introduction of more efficient stoves. In Zimbabwe, households around the coalfields at Hwange use (some) coal. Perhaps a market for coal would develop over time provided smokeless coal were to be introduced at a competitive price.

5.7 Policy implications – a summary

Biomass supply programmes to households should, on the production side, concentrate on social forestry techniques – encourage the growing of trees by households. When it comes to consumption, the supply of own-grown woodfuel would assist in rural areas. In urban and peri-urban areas, marketing of woodfuels may be assisted through lifting artificial trading barriers and regulations. Programmes for dissemination of more efficient stoves would take a long time to have a noticeable effect on household fuel-demand patterns, because the purchase of a new stove might be outside the financial reach of many households and because a stove might conflict with cultural traditions connected to woodfuel use. Perhaps simpler means might increase woodfuel efficiency without large financial outlays and without having to come into conflict with cultural traditions – for example, improving the way an open fire could be sheltered against wind.

With regard to a sustainable supply of electricity, in particular to peri-urban and rural households' access to electricity, the financial viability of a power utility is of paramount importance. This would require overall cost-reflective electricity tariffs in order to provide the utility with an operating surplus. In addition, the government would have to assist the utility in financing the required grid expansion into rural areas in particular.

For petroleum products, in particular paraffin and LPG, the trend in the SADC region is for a deregulation of prices. This will probably increase supply (in particular where the prices have been unrealistic) and thereby motivate an increase in supplies of petroleum products to more remote areas, thus improving access. Prices would probably increase, assuming that the regulated prices previously functioned as effective maximum prices. Deregulation would, however, also mean increased competition, which could lead to reduced prices through cost-cutting on the supply side.

Photovoltaic products are in many SADC countries subject to high duties and levies. Because PV products are expensive, reducing and abolishing such taxes would help market penetration of PV products.

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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.

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PAPER Nº 17

A selective review of household energy studies in Southern African countries

Hans-Erik Dahl and Tore Horvei

SOUTH AFRICAN ENERGY POLICY RESEARCH AND TRAINING PROJECT

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

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