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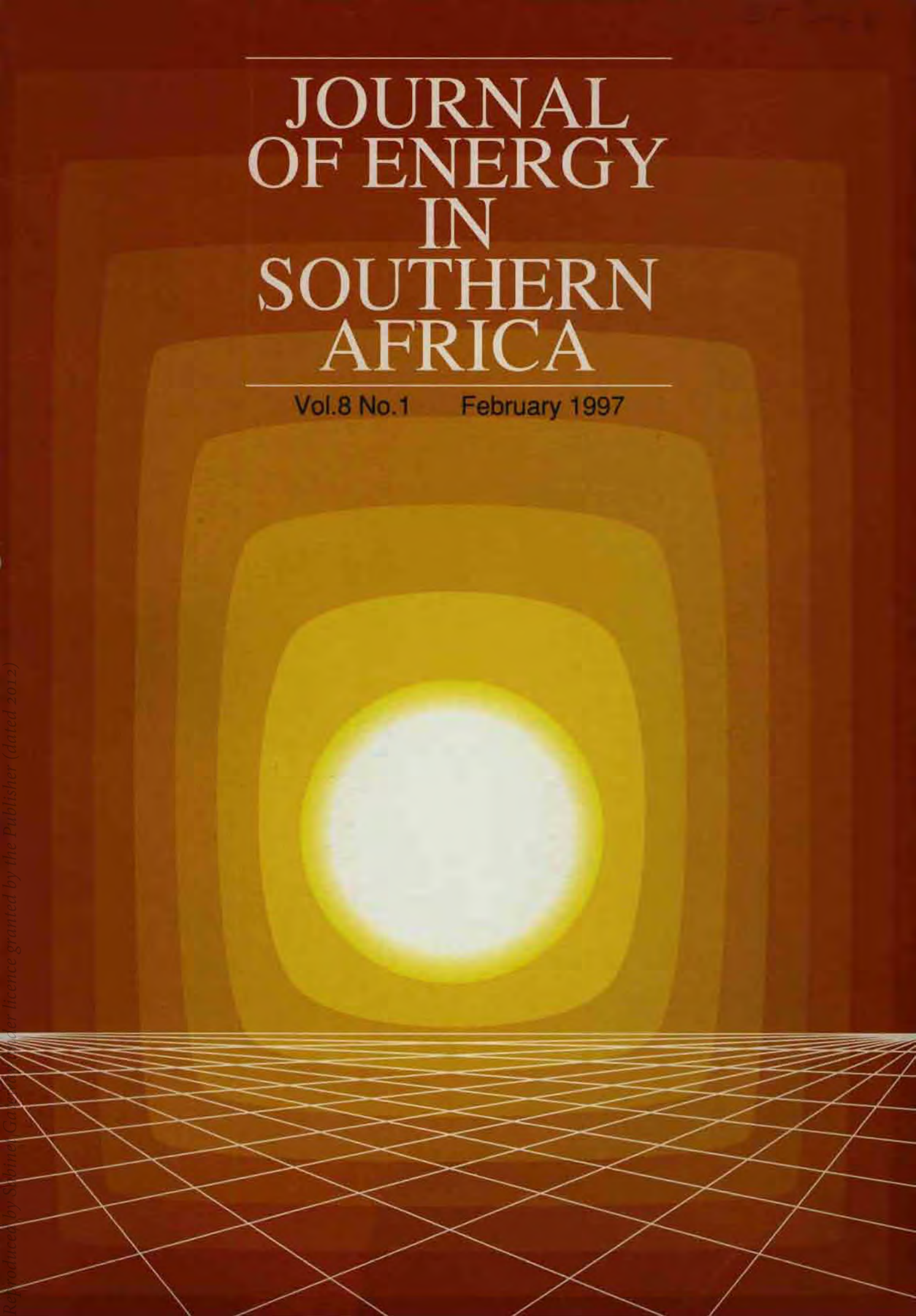

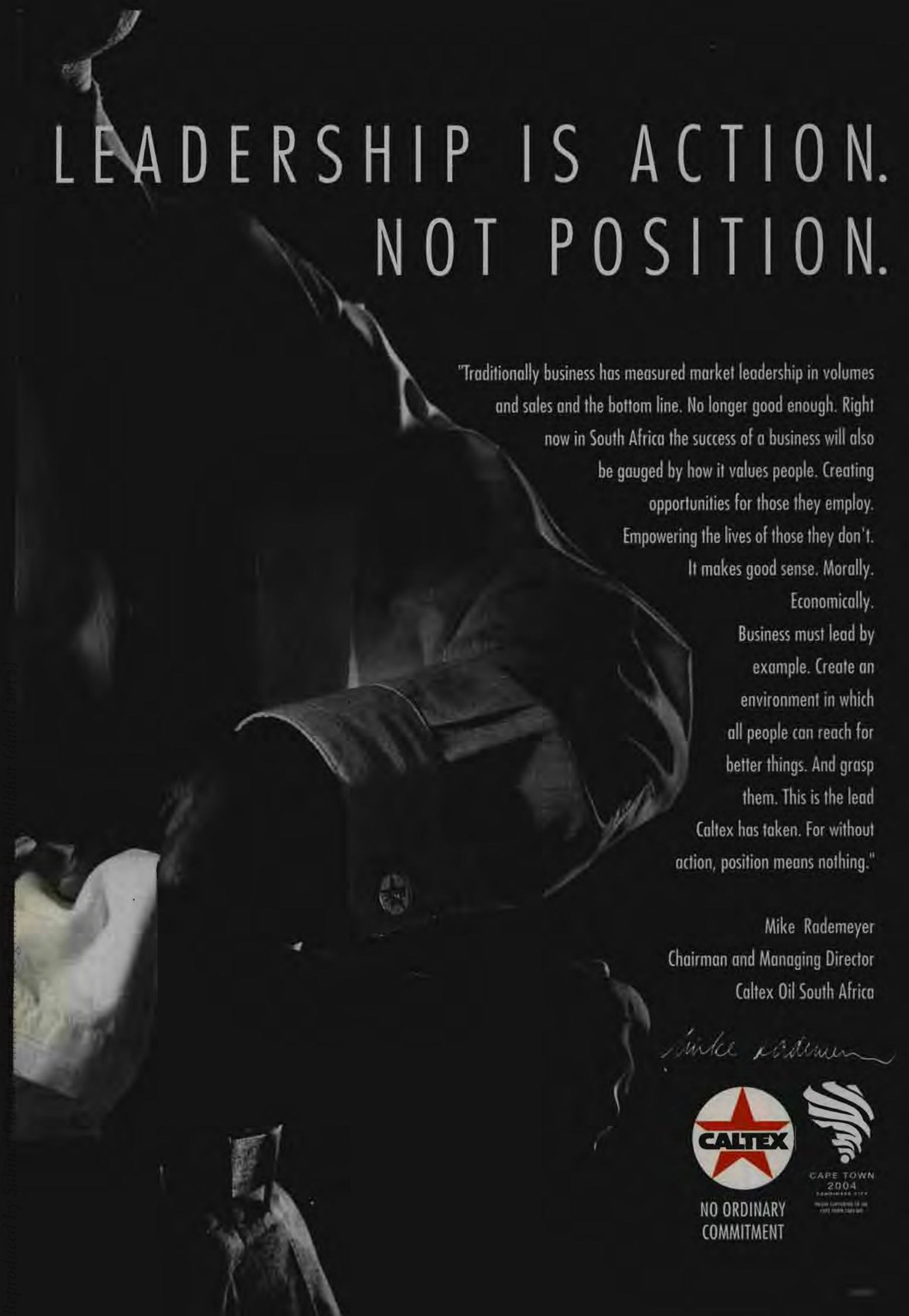

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Mike Rademeyer
Chairman and Managing Director
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It is the policy of the Journal to publish, as far as possible, papers covering the technical, economic, political, environmental and social aspects of energy research and development carried out in or applicable to Southern Africa, and of general interest to Africa. Only previously unpublished work will be accepted. However, conference papers delivered but not published elsewhere are also welcomed. Short discussions, not exceeding 500 words, on articles published in the Journal are also invited. Items of general interest, news, technical notes, reviews and research results will also be included. Announcements of relevant publications, reviews, conferences, seminars and meetings will be included.

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Profile:

Hon. Penuell Mpapa Maduna

Minister of Minerals and Energy, South Africa

In 1996 Mr Penuell Mpapa Maduna was appointed as South Africa's new Minister of Minerals and Energy in the place of Mr Pik Botha after the withdrawal of the National Party from the Government of National Unity.

By profession Mr Maduna is an attorney and is presently studying towards a LL.D degree. His legal qualifications include a B.Juris (Unisa), LL.B (Zimbabwe), LL.M (Witwatersrand) and a Higher Diploma in Tax Law (Witwatersrand). He is also a member of the Faculty of Law of the University of the Witwatersrand.

Born in 1952, Mr Maduna grew up in turbulent times in South Africa. He was very active in student politics, particularly at the University of Zululand, during the "apartheid" years. During the 1970s and 1980s he worked in the underground structures of the African National Congress (ANC) when it was a banned organisation under the previous South African government. This led to his arrest and prosecution.

At the beginning of 1980 he went into political exile. Outside South Africa he worked for the ANC in Tanzania and Zambia. At the end of 1985 Mr Maduna participated in the establishment of the ANC's Department of Legal and Constitutional Affairs, and was a founder member of the ANC's Constitutional Committee, playing an active role in the formulation and adoption of the organisation's Constitutional Guidelines.

Mr Maduna also played an active role in the negotiation process with the National Party, which included the Harare Declaration (1989), the Groote Schuur and Pretoria talks (1990), the establishment of CODESA (1992), the Record of Understanding (1992), culminating in the talks at the World Trade Centre, Kempton Park, and the development of the chapter on fundamental human rights which constituted an important part of what was then the interim constitution.

Mr Maduna was a Visiting Scholar of Constitutional Law at Columbia University Law School, New York , in 1987. He was a founder member of the ANC's Department of Legal and Constitutional Affairs, the legal adviser at ANC headquarters, and a member of the ANC's Negotiations Commission.

He is also the co-author of a book by Azhar Cachalia *et al.* entitled *Fundamental rights in the new constitution,* published by Juta & Co. in 1994.

Mr Maduna is married to Nompumelelo Cheryl and they have three children. His main sporting interests are a keen interest in soccer and boxing. He also enjoys reading and debating.

Profile:

Hon. Susan Shabangu

Deputy Minister of Minerals and Energy, South Africa

Ms Susan Shabangu is the first woman in South Africa to be appointed as Deputy Minister of Minerals and Energy.

In 1977, she matriculated from Madibane High School, Soweto, and since 1980 has been politically active in various labour and women's movements.

As an organiser/administrator for the Amalgamated Black Workers Project, Ms Shabangu was responsible for handling workers' grievances and queries with regard to dismissals and unfair labour practices. Her work with the Transport and General Workers Union (TGWU) included being appointed National Women's Coordinator. She also served as a member of the Cosatu National Women's Sub-committee, dealing specifically with women's issues, and represented the TGWU at these meetings. She was elected vice-chairperson of the National Labour and Development Institute and still serves on their Management Committee.

Ms Shabangu's political activities began in 1981. She was involved in the formation of the Release Mandela Campaign Committee. As a member of the ANC, she was also involved in extensive campaigning for the organisation. As a Member of Parliament, Ms Shabangu actively participated in committees dealing with Labour, Transport, and Trade and Industry.

Ms Shabangu is a widow and has three children.

Policy priorities for developing energy and mineral resources in Africa*

+ Y V PASHKOV and ++ C ZUMKELLER

Received 25 July 1996

Because of the gap between the production and utilisation of mineral resources and energy in Africa, it is essential to develop target scenarios for stepping up development. Africa needs to place higher value on its natural resources for its own development, involve a much wider array of actors in a transparent and accountable manner so that much needed resources, both domestically and internationally, can be tapped. Regional cooperation, for reaping economies-of-scale, both at the investment as well as at the knowledge levels, is paramount.

Keywords: development; regional cooperation; Africa; energy resources; mineral resources; energy policy; minerals policy

Introduction

> *Does extracting minerals from the ground, for example, hurt or help future generations? The answer depends upon what is done with the revenues. If they are consumed carelessly, less 'wealth' is available to future generations (and to the poor of today). If they are invested wisely, a nation's wealth can rise. Today's income can be translated into tomorrow's productive capacity through saving and wise investment.*
>
> A Steer. *Where, really, is the wealth of nations?*[1]

Africa's paradox of pervasive poverty in the face of abundant natural resources which have remained, however, un- or underutilised and undervalued, is not intractable. Yet, the dearth of means for efficiently exploiting the continent's natural wealth – ranging from the sun and other renewable sources to fossil fuels and thus depletable ones - must indeed be urgently tackled if lasting benefits to its people are, at last, to accrue.

The forces of change are well-known. They are: (1) political vision which will translate into institutional strength and collaboration among all actors from the local to the international level; (2) the determined building up of human capacities for optimising the harnessing and processing of natural resources; and, (3) the prioritised allocation of financial resources, again, from the local to the international level, to areas yielding the highest sustainable developmental benefits. But these forces of change need to be systematically mobilised if Africa's specific legacy as a supplier rather than a user, in particular, of its mineral wealth, is to be cast off.

The vision can be translated into concrete targets. In the case of energy, there is wide agreement that Africa needs to put an emergency energy transition on the top of its agenda to undo the spiral of underdevelopment, environmental degradation and social destitution to which most of its people are subjected. Breaking with its history of underconsumption of energy would be measurable by two indicators and should be aimed for within one generation:

- at the individual level, per capita energy consumption would need to move from the woefully low and dismally utilised 14 MJ towards 62-83 MJ, efficiently used, and,
- at the collective regional level, Africa should consume much more of its own commercial energy production – and thus become comparable with other developing regions, i.e. the ratio should be raised from less than 50% to some 70%-80%.

With regard to the development of minerals, the targets should translate, source by source, into policies which were aptly formulated by the African Ministers responsible for the development and utilisation of mineral resources and energy at their first regional conference in November 1995 in Accra, Ghana:

> *"to derive greater benefits out of value-added with other associated benefits such as employment creation and more intensive use of minerals;"*[2]

At issue in Africa is therefore by no means a lack of any natural resource, but the under- or malutilisation of a tremendous amount of natural and human capital, i.e. of national wealth. Structurally, Africa thus remains locked into a de facto colonial resource economy with all its manifestations of dependency and vulnerability to external shocks. Consequently, the discourse and policies on natural resources have been focusing unduly on just one variable in the equation of sustainable wealth creation, namely, the immense physical resource endowment of the continent. They have thus insufficiently appreciated the modalities of its exploitation, i.e. the other factors which constitute a nation's wealth: human capital, social (in the sense of institutional and cultural) capital and produced assets. Yet, in the debate on the rational use of national wealth with a long-term perspective, also called sustainable development, the interaction among all factors is increasingly understood as the core issue of development - with political will and commitment as the ultimate energisers underlying all endeavors.

Africa is the one region feared to being closer to sustained poverty than to sustainable wealth. Being economically marginalised and politically fragmented, countries cannot but pursue a coordinated strategy - involving all economic, social and political actors. The African Economic Community sets a framework for action at all levels. Plans to set up an African Energy Commission, addressing the lack of a strategic and policymaking body in the field of energy, an action which other developing and developed regions and groupings in the world have long taken, are a sectoral expression of the ambition to regionally cooperate, where most countries would fail on their own.

Only on the basis of the continent's enlightened self-interest and demonstrated determination to make optimal use

* Slightly revised version of a paper presented at the conference, *Sub-Saharan Oil and Minerals: A major investment*, held in Johannesburg, South Africa, 10-12 June 1996.

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of its resources can the enormous financial resources be mustered and the respective cooperation agenda with partners joining in Africa's development be specified.

The production/ utilisation gap

Energy

No other region in the world makes so little use of its natural mineral wealth for the benefit of its peoples as Africa. Figure 1 illustrates the gap between production and domestic (i.e. continental) utilisation of commercial energy (see also Table 1 at the end of this paper, which gives the aggregated energy balances for Africa). This translates, of course, into very low and stagnant levels of per capita consumption which are well below the threshold from which development is known to happen[3]. At the same time, the modes and levels of biomass consumption for meeting energy needs erode, even the narrow basis on which mostly rain-fed and extensive agricultural systems are based.

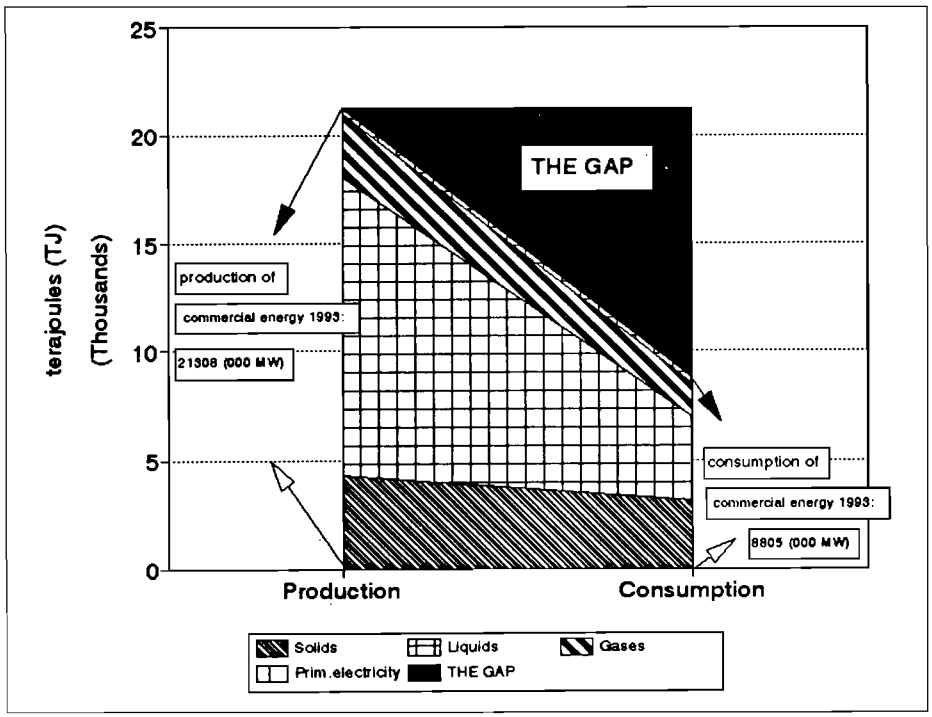

Figure 1[4] Commercial energy in Africa, 1993

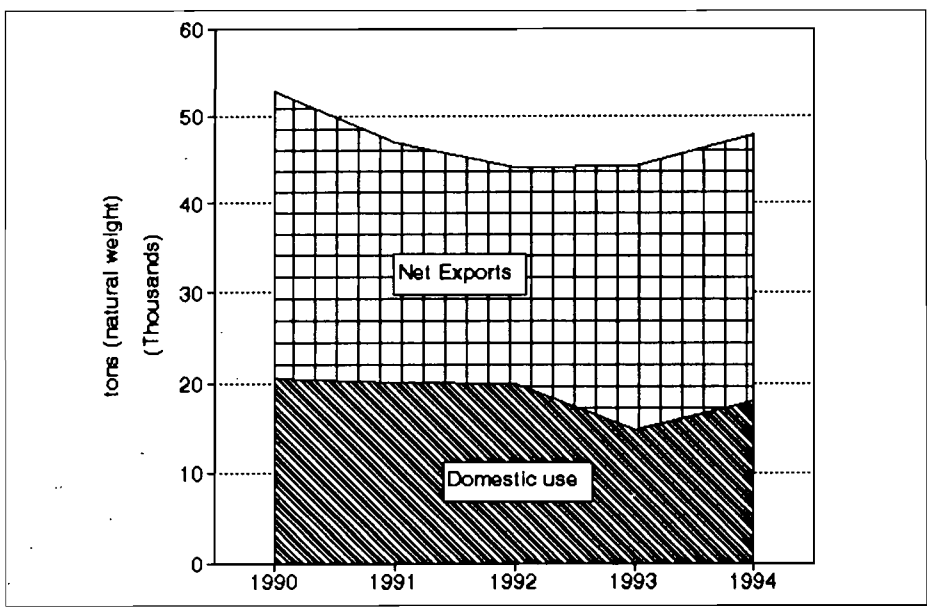

Figure 2[5]: Iron ore in Africa, 1990-1994

Minerals

Except for South Africa, countries in Sub-Saharan Africa remain locked into the historical pattern of being suppliers of raw materials to the rest of the world. In addition, there is – as is the case with commercial energy – a marked domestic underconsumption of products derived from these raw materials, due to a lack of production facilities and insufficient resources for imports. Meagre beginnings to develop downstream activities within Africa were often nipped in the bud when revenue gained from extracted minerals were directed to other, often unproductive, uses. Just how little has changed, in spite of decades of calls for diversification and the development of processing industries, is depicted in Figures 2,3 and 4 respectively for which three strategic products – essential "material development carriers" – were chosen: iron ore, bauxite and copper.

This underutilisation of resources is all the more remarkable when seen in the context of sustainable development. Especially in low price periods, as experienced throughout most of the 1980s, when developing countries were forced to compensate decreasing value with increasing quantity – to meet debt-servicing obligations and gain a minimum of essential revenue - one can hardly see how prices were internalising externalities and guaranteeing productive resource conversion. Instead, the undervaluation of natural capital exploitation, combined with low levels of productive assets acquisition, led to the underutilisation of human capital, to even more widespread poverty and the erosion of social, institutional and political structures. The various and spiralling degrees of instability experienced in many countries dependent on territorial-based resource extraction, often manifested as "ethnic conflicts", are therefore hardly surprising. As national wealth, in the most narrow or in any more comprehensive sense, is not increasing but dwindling, competition cannot but harden.

In the following discussion, some policy priorities are highlighted which can be considered as applicable to most Sub-Saharan African countries. These principles and forces will need to be mobilised, strengthened and synthesised if Africa is to close the gaps in resource utilisation and wealth creation and, thus, to narrow the development gap vis-à-vis other developing regions.

Valuing resources

It appears that much rethinking is underway which will deeply affect the economic decision-making processes on natural resource exploitation and utilisation in the future. Concepts of utmost relevance to the minerals and energy industries, such as the polluter-pays-principle and the internalisation of all costs in the context of protecting the global common, are making inroads throughout the world in the wake of the process associated with the Rio Earth Summit in 1992.

Globally, the need for "Taking Nature into Account" which was the theme not only of the latest Club of Rome report[8], but also of a conference initiated by the Club, the World Wide Fund for Nature (WWF) and the European Parliament in 1995, is becoming increasingly acknowledged. Andrew Steer's[1] introductory quote bears testimony to important rethinking within the World Bank.

Also, even mainstream economists now concede that traditional accounting concepts do not cater adequately for the special features of renewables, i.e. high initial capital outlays and long-term, quasi infinite durability. Assessing indirect costs poses an additional challenge, with renewables being characterised by modularity, flexibility, very low operating costs and thus relative cost certainty and strategic options for the future[9].

In this context, renewed attention should also be paid to efficiency, material inputs and cleanliness of processes – not only concerning energy (e.g. in modes of transport) - but also related to all modalities of production and consumption involving inputs from nature. Calls for dematerialisation are bound to have profound implications for Africa's minerals and energy industries in the medium- to longer term[10]. Similar effects may emanate from the insurance industry which is becoming weary of bearing costs associated with the exploitation, transportation and use associated with minerals and energy.

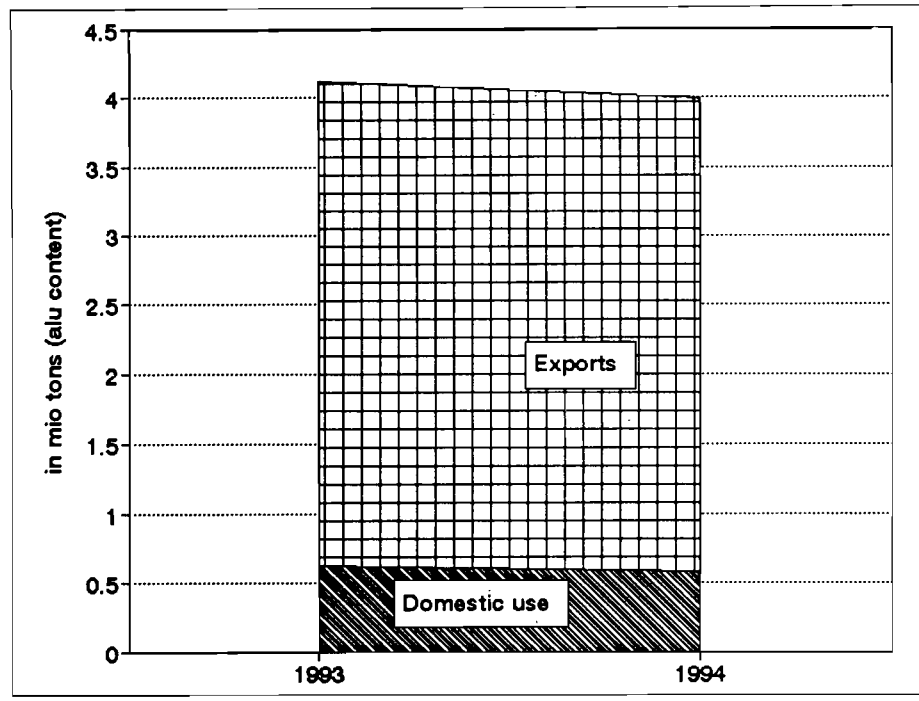

Figure 3[6]: Bauxite and primary aluminium production in Africa, 1993-1994

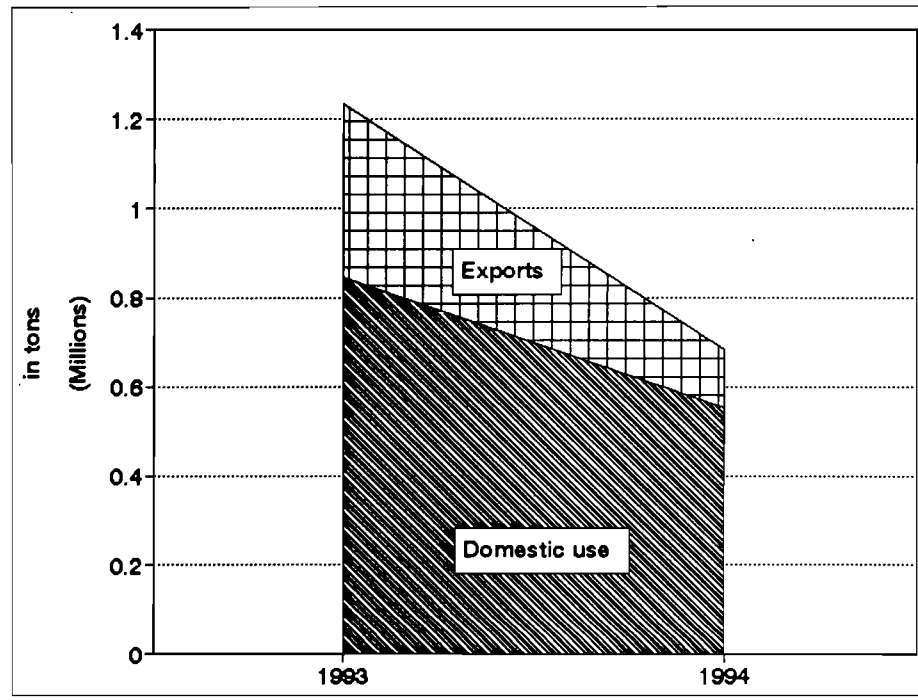

Figure 4[7]: Copper industry in Africa, 1993-1994

Diversifying actors

For all too long, geopolitics have locked Africa into narrow bandwidths of concepts and realisations of development. Internal marginalisation of the majority of people, manifested in economic vulnerability and social exclusion, has been interacting with the marginalisation of the continent, relegating it largely to a mere supplier of raw materials to the global economy at mostly externally determined conditions.

Yet, while monoculturalism has long been identified and deplored as a core cause of dependency, the domestic correlate, the exclusion of the majority of the population from partaking of the benefits of natural resource exploitation, has only gradually been evolving into a major theme. The virtual marginalisation of women, as well as of indigenous peoples whose territories host the resources at issue, are cases in point. Yet, in small-scale mining, as well as in the management of traditional energy systems, such groups are the major, albeit officially almost invisible, actors. It is hard to imagine how accountability and the sustainable development of the nations' wealth are to evolve if the 'ownership' by the people, their direct participation in decision-making and their upgraded roles

in natural resource management are not guaranteed.

It is a core right of citizens to control their country's national natural resources. They can only exercise this right if transparent and accountable management is in place – albeit at various governmental levels, within parastatals or in private industry. Their representatives and duly mandated policymaking and regulatory bodies, guiding and overlooking the actors managing the sectors in a rational manner, are an important element not only in the economic and sustainable utilisation of natural resources but also constituent elements of building democratically controlled institutions.

A participatory and transparent process of resource utilisation is, moreover, essential in conflict prevention within countries. This means that the benefits derived from the extraction of natural resources in the host area – in terms of education, health, jobs, etc. – must be tangible. They must also be larger than the associated losses – environmental, cultural, etc. – inflicted upon the affected area. Natural resources would thus not be considered as 'lost forever' by the people concerned, but as transferred into equitably accessible and productive opportunities. Participation, public control and consensus-building over the utilisation of natural resources could thus defuse many a cause of conflict in Africa.

The increasing recognition of the special role of women in natural resource management needs to be translated into policies and programmes which allow women to graduate from the lowest level of the natural resource hierarchy towards policymaking, technological development, engineering, scientific and extension work. As the Ministers stated at the Accra Conference: "Their marginalisation in the search for solutions in these sectors was perhaps part of the problem."[11]

Tapping resources

In recent years a wealth of arguments and, by now, also of experiences, have emerged about the advantages and pitfalls of the privatisation and deregulation of the minerals and energy industries, globally as well as in Africa. It is possibly more difficult to sketch the right path on the continent than in other parts of the world and, accordingly, caution has reigned at the level of strategic pronunciations.

One important reason is the frequently seen conflict between developmental needs and the survival and success criteria of private enterprises – or, in other words, when the need to invest in ventures with deferred paybacks clashes with pressures to satisfy investors in the very short term. Measures towards sustainable development, such as the electrification of rural areas, are therefore often not deemed economically viable by commercial operators as potential consumption and cash incomes by consumers are feared to remain too low. At least the intermediary role of the State is thus considered desirable. In addition, the recent debate over environmental practices of multinational companies involved in exploiting oil and gas resources in some parts of Africa has brought renewed attention to the need for an "effective regulatory system".[11]

There can, however, be no doubt that a broad array of financial resources – and thus of actors – needs to be tapped for developing the mining and energy sectors in developing regions in general and in Africa in particular[12]. While, until recently, the perception of institutional carriers of natural resource development, at least the legal and large-scale operations, were narrowly understood as meaning the State, often in its centralised form, there is a gradually widening notion as to who should carry future development. Local communities and their organisations as well as private initiatives, both local and foreign, in the past often frustrated and marginalised, if not suppressed, are now being recognised as sources of financing, increasing productivity and for setting in motion multiplier effects for development.

In this context it is essential for Africa to tap the resources of knowledge and information, i.e. to reckon with emerging trends and avoid the costly mistakes of other regions. Concerning specifically the development of investment in the minerals sector, Sub-Saharan Africa is perceived to have the potential to emerge as a major competitor as the predominance of Latin America as a location for investment might become somewhat qualified, as questions are being raised as to "whether the Latin American mining boom was broadly enough based and financially sustainable."[13] Of the 1995 total investment in exploration spending of US$2,69 billion, some 12% (1994:10%) went to Africa. This meant that Africa's share overtook the one for the Pacific Region and the United States. It was only slightly behind Canada. The key players in this development are globally likely to be a "relatively small number of large companies that will be truly global in scope and internationally staffed".[13]

Regional cooperation

The debate on the valuation of natural resources and related issues of sustainable development economics should be of crucial importance for shaping African policies on natural resource management. It can help in defining a generational vision and strategies apt to address the question on how Africa's natural wealth can be utilised to allow the majority of its people to emerge from poverty.

In its work on minerals and energy, set in the context of the Abuja Treaty on the African Economic Community and carried out in collaboration with the OAU, the African Development Bank (ADB) and other partners within and outside the continent, the United Nations Economic Commission for Africa (ECA) seeks to identify answers and practical approaches to the following challenges:

- how can societies and governments mobilise the huge domestic human resources, and, to this end, strengthen those institutional and cultural assets which are conducive to, or suppress those which are counterproductive to development?
- how can countries, individually and collectively, develop their natural capital, in particular mineral and energy resources, so that national wealth is not diminished but accrued in the process? And, related to this point, which criteria must be adhered to by African countries and the international community to ensure sustainable conversion and consumption modalities?

At the highest intergovernmental levels, there is distinct awareness and consensus as to the core issues and priorities facing the minerals and energy sectors. Decisions and resolutions adopted by the First Regional Conference of African Ministers Responsible for the Development and Utilisation of Mineral Resources and Energy, held in Accra (Ghana) in November 1995[11], as well as by the Commission at its recently concluded 35th Session, bear testimony to this. Once more, African countries as well as their regional organisations, are called upon to contribute in various ways towards the development of the minerals and energy sectors.

The ECA, based on its mandate and jointly with pertinent partners, intends to promote a specifically regional perspective. This entails, inter alia:

(1) Advocacy role for African interests

Energy: As the regional intergovernmental institution with a mandate to promote energy development in the context of sustainable development, the ECA should work, in collaboration, first and foremost with the OAU and the ADB, on an *African Energy Agenda or Charter*. This blueprint should be the framework for mutually beneficial collaborative strategies and intra-continental policies at sub-regional and regional levels, as well as the basis for Africa's position in international negotiations (in the context of Agenda 21, the Climate Convention, the Desertification Convention, ACP, global trade, South-South, etc.). The ECA should play the role of catalyst in merging evolving sub-regional strategies and policies into such a regional framework.

Minerals: There have been a host of recommendations and resolutions by intergovernmental regional bodies governing the development of the minerals sector. Implementation has, in most cases, been lagging far behind initial intentions. There is therefore a continuous need to improve systems on the **protection of the environment** against the adverse effects of mining, on **human resources development** and on the **intra-African sub-regional cooperation and integration.** In this vein and in order to underscore the importance of mineral resources development and utilisation, the ECA has been called upon to establish, in cooperation with all other relevant actors, a **programme for a decade for the development of minerals industries in Africa** and to convene, jointly with the OAU, a meeting of sub-regional economic groupings in order to arrive at mechanisms for cooperation in the minerals sector.

(2) Advocacy role for Africa's marginalised majority (the poor, women, rural people) and future generations

Energy: The ECA has a particular role in promoting the em*power*ment of those most excluded from effective energy services (and disproportionately reliant on their own muscle power). This involves, among other activities,

- the elaboration of policy frameworks for increasing the utilisation of energy in rural areas (especially through electrification and gasification; pragmatic switching to higher quality energy carriers, e.g. from human to animal to mechanical power) which should cover, in particular, the mobilisation of domestic and international resources; and
- programmes for systematically *upgrading the role of the traditional energy managers and providers, i.e. of women, in the African energy economy at all levels* (education, training, accumulation of experience, decision-making) in the context of strengthening the technical and managerial capacity of African energy institutions, academia and of the private sector.

Minerals: Given the role played by small-scale mining and the involvement of women in such activities in many African countries, there is a distinct need for upgrading their skills, technology and credit levels to achieve increased productivity, health and environmental protection as well as income-enhancement. The ECA has been called upon *to develop models and instruments for promoting small-scale mining* and *to devote special attention to women in all areas of mining*.

In support of national mineral development policies, the ECA is to carry out *studies* on selected minerals. It has been requested to undertake research on privatisation as it impinges on the development of minerals industries in Africa and on macroeconomic frameworks as they affect the performance of Africa's minerals industries.

(3) Capacity-building

With human and institutional resources for minerals and energy development in Africa requiring determined expansion in terms of quantity and quality, capacity-strengthening will be an ongoing assignment for years to come.

Energy: Among the host of necessary activities, the ECA's focus should be on building a continental agency for African energy development, notably, the *African Energy Commission*. This is all the more critical as a global agency dedicated to energy issues is emerging as a distinct possibility. Africa needs to be well-prepared for such a setting.

Specifically, the ECA is to service, jointly with the OAU and ADB, and within existing institutional capacities, the loose body which should initially and provisionally perform the functions of an African Energy Commission until the time is opportune for its actual creation. During this preparatory phase, a state-of-the-art and easily accessible information base, as well as multidisciplinary analytical capacities, needs to be built up. An African Energy Information System should therefore be set up which comprises a data and bibliographical component, modelling software as well as a roster of energy specialists. Such an information base, wherever possible with online access, must naturally encompass environmental aspects of the energy economy, and notably cater for sustainable development indicators and integrated economic and environmental accounting, as well as feature spatial analysis tools (e.g. GIS). Multidisciplinary aspects will be brought in through in-house collaboration among various substantive divisions.

In order to gain the requisite inputs into the databases and to maintain dialogue with countries on methodological, conceptual and organisational aspects of the African Energy Information System, technical advisory service missions, training workshops and seminars will need to be stepped up in frequency.

In order to accomplish this, the ECA has been specifically mandated to establish, jointly with other African organisations, *energy networks for the exchange of information* on the development and utilisation of energy resources in general and new and renewable energy resources in particular.

Minerals: The ECA is to compile, in continued cooperation with the ADB, the *Directory of African experts in minerals and energy sectors*, and provide for the standardisation of formats of electronic databases for networking.

Conclusions

"Our Common Future" was the title of the original report of the Brundtland Commission which opened the way for the process, culminating in the Earth Summit, the United Nations Conference on Environment and Development in Rio de Janeiro exactly four years ago. With the adoption of Agenda 21, the UN system as well as governments and non-governmental organisations recognised the urgent need to rethink development from local to global levels in a sustainable direction. It was thus acknowledged that the spiral of poverty and ecological degradation in the developing world, and unsustainable patterns of production and consumption in the developed world, needed to be arrested and reversed. At the recent UN Commission on Sustainable Development which reviewed the progress since Rio, there was widespread disappointment over the slow progress in implementing Agenda 21 and a renewed call was made to heed the commitments of 1992. Especially highlighted was the need to address energy, transport, trade and technology issues as a matter of urgency and, of particular interest to Africa, to harness natural resources for poverty alleviation.

For the ECA this means that strategies and policies for the sustainable development of the energy and minerals sectors in Africa – and for the benefit of Africans – are of utmost importance in its work. It thus emphasises – in its cooperation with governments and a multitude of partners, both within the continent and outside - the need for an interdisciplinary approach to planning, policymaking and the implementation of programmes. The environmental impact of exploration, exploitation and utilisation in mining and energy is therefore as much an issue as are social and economic implications – be it the promotion of upgraded roles for women in the management of both sectors, the creation of jobs or the improvement of institutions and resource flows, both public and private. The ECA's technical support services, as well as its policy and technical studies, are informed by an integrated, cross-sectoral approach which seeks moreover, and in particular, to identify the potential for reaping the benefits from sub-regional and regional cooperation among its member states.

Among the recent and upcoming activities of the Commission aimed at contributing to the regionwide sustainable development of the mining and energy sectors are the following:

- In the course of its current programme of work in the minerals and energy sectors, the ECA is focusing on (i) the contribution of the private sector and on deregulation (a workshop which was to have been held from 14-16 October 1996); (ii) the identification and mobilisation of domestic resources; (iii) the role of renewable energy technologies in energy efficiency and conservation; and, (iv) exploring the potential for emulating strategies and policies for sustainable energy development in Southern Africa in other sub-regions (all scheduled for completion in 1996).

- In the context of identifying sources of financing, especially for the development of mining, the ECA was a contributor to the MIGA Symposium on African Mining Investment and Business Opportunities which took place in Montreal in May 1996. It co-organised with MIGA the Seminar on Investments in Africa, held at the end of June 1996 in Accra (Ghana)[14].

- The Second Conference of African Ministers Responsible for the Development and Utilisation of Mineral Resources and Energy, hosted by the Government of the Republic of South Africa, is scheduled for 17-22 November 1997 in Durban, South Africa. It is to focus on the interaction among private and public actors in the development of the two sectors.

It is furthermore hoped that, in line with the Special Initiative on Africa recently launched by the UN Secretary-General, multilateral and bilateral donors will create goal-oriented regional fora to raise resources for key sectors, such as energy and minerals. Also, African governments are expected to prepare goal-oriented country investment programmes to maximise the impact of internal and external resource flows. The involvement of non-traditional partners, such as leaders of business and civil society, in consultative group and round-table meetings is being encouraged.

Africa needs the mobilisation of all actors and resources if it is to achieve, within one generation, the transition from a state of underutilised natural resources to one of rational and efficient management for its own benefit. There can be no doubt about the urgency of this objective: it is essential for markedly reducing the number of poor and the levels of poverty from which the continent's people suffer and for allowing, indeed, "our common future".

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This paper is based on a wide range of sources from within and outside Africa. They include Ministries, agencies and parastatals responsible for the development and utilisation of mineral resources and energy in member states, as well as a host of other actors, such as private enterprises and colleagues in the research community and non-governmental and international organisations. The wealth of information made available by the World Energy Council is gratefully acknowledged. In addition, the authors wish to express their appreciation for the opportunity of accumulating knowledge and experience in the course of their many years of happy association with the United Nations Economic Commission for Africa. All omissions and errors are, however, their sole responsibility.

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1980	Solids	Liquids	Gases	Electricity	Biomass	TOTAL
Primary production	2 874	12 785	1 013	218	3 981	20 871
Imports	60	1 908	0	48	0	2 016
Exports	704	10 939	329	49	0	12 021
Stocks	-107	582		0	0	475
Bunker	0	368		0	0	368
Unallocated	0	349		0	0	349
Total energy requirements	**2 337**	**2 455**	**684**	**217**	**3 981**	**9 674**

1990	Solids	Liquids	Gases	Electricity	Biomass	TOTAL
Primary production	4 088	13 527	2 702	299	4 641	25 257
Imports	134	1 910	67	10	0	2 121
Exports	1 258	10 759	1 475	15	0	13 506
Stocks	0	91	-1	0	0	91
Bunker	0	263		0	0	263
Unallocated	0	791	-175	0	0	616
Total energy requirements	**2 964**	**3 533**	**1 470**	**294**	**4 641**	**12 902**

1993	Solids	Liquids	Gases	Electricity	Biomass	TOTAL
Primary production	4 259	13 835	2 941	273	4 976	26 284
Imports	130	2 077	72	17	0	2 296
Exports	1 255	11 215	1 617	23	0	14 109
Stocks	4	-111	0	0	0	-107
Bunker	0	250		0	0	250
Unallocated	0	699	-152	0	0	547
Total energy requirements	**3 130**	**3 859**	**1 548**	**268**	**4 976**	**13 781**
(SACU in %)	**90**	**18**	**-**	**27**	**3**	**27**

Source: United Nations Energy Statistical Yearbook, 1983 and 1993
Note: Production of primary electricity refers to hydro, geothermal, wind and nuclear.

Table 1: Energy balances for Africa, 1980, 1990, 1993 (in thousand terajoules - TJ)

South African coal prospects

* X A PREVOST

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Although the South African coal industry did not perform as well in 1996 as in the previous year, the prospects for domestic and international coal trade in the foreseeable future are good, and production, sales and export increases are almost certain. After more than a century of intensive exploitation, the South African coal resources situation is not very promising. But with improved mining techniques and the possibility of opening small-scale low-reserve blocks, previously not considered to be mineable, the life of the country's coal industry might be somewhat extended into the next century.

Keywords: South Africa; coal; coal trade; coal reserves

Although the promising predictions made during of the last quarter of 1995 did not materialise in 1996, South African coal is and will remain the main source of energy for the country and an export commodity second only to gold for a long time to come. In spite of coal's excellent performance during 1995, when both production and export records were broken, a number of factors made things difficult for the coal mining industry in 1996. Firstly, the unusually heavy rainy season affected opencast operations in Mpumalanga (which contributes 82% of South African coal production) resulting in production losses of several days. Secondly, the price negotiations for exports did not yield the expected increases. As a consequence, some producers, like the Transvaal Coal Owners Association (TCOA), are planning to export their product as steam coal instead of beneficiating it to low ash, as this may increase their profits. Thirdly, labour unrest at the Richards Bay Coal Terminal (RBCT) at the end of July 1996, reduced loading operations by about 30%. Lastly, the environmental regulations in the European Community (EC), which are aimed at reducing the use of fossil fuels, and the slow but steady introduction of natural gas as an energy alternative to coal, are gradually decreasing the volume of South African coal exports to Europe. The combined effect of these factors will probably prevent the South African coal industry achieving another record year in 1996. Also, the Richards Bay Coal Terminal target of 60 million tons (Mt)/annum exports might not be reached. Nevertheless, coal mining in South Africa continues to be a fast growing and promising industry.

On the international market, coal demand has been on the increase since the beginning of the century, although steam coal growth has been somewhat affected by competition from gas and by improvements in mining and power generation technology. About 40% of power stations worldwide are coal-fired and their emissions, especially sulphur dioxide (SO_2), are creating a threat to the environment. However, with efficient scrubbing, most of these emissions can be controlled. Coal will continue as the dominant supplier of electric energy, with gas, at some 16% usage, remaining in second place. While economic growth continues, more power will be required which will fuel coal demand. In the long term, according to reports from the World Energy Council (WEC), coal will overtake oil and become again the world's primary energy source by the year 2020. The International Energy Agency[5] forecasts a steady increase in international coal trade, from 8% (1973) to 16% (2010). Coal's main competitor, nuclear energy, is on the retreat, mainly due to the high cost of implementing new safety laws and problems with the safe storage of nuclear waste.

The high GDP growth occurring at present in the Far and Middle East is expected to continue rise for the next twenty years. A growth of up to 8% has been forecasted. Power generation is anticipated to grow at the same pace and by the year 2000 and some 182 Mt of steam coal per year will need to be imported into these regions. As a result of the gradual removal of coal subsidies by the EC, European demand will also increase and imports in this region could rise to 140 Mt.

New expansions are planned for the RBCT towards the end of this year, and more enlargements are likely to follow in the ensuing years until the 72 Mt/annum target is reached by the year 2000. A decision to mine the Waterberg coalfield could boost the prospects for upgrading and developing facilities at the Maputo harbour. A new railway line, about 300 km long and costing about R1 500 million has to be built, while the port requires an investment of at least R445 million to increase its capacity to 7 Mt/annum by the year 2000.

Local demand is also expected to increase steadily as a result of increased consumption by Eskom, Sasol and domestic household trade which combined represent 91% of local coal sales. This situation will make it imperative to increase South African coal production using all available and economically exploitable coal resources.

It is foreseen that future growth in South African coal production will come mainly from coal mines being restructured and enhanced to increase output and quality for the coal export market, as well as from the opening of new mines using small blocks owned by the major mining companies. This policy was recommended to the South African Government by the International Energy Agency (IEA) in a report released in March as a response to ways of easing the very tight coal supply situation. This view is supported by most mining houses.

The latest coal reserve/resource estimate for South Africa was published in 1983[1]. At that time the recoverable reserve figure was 55,3 billion tons, of which 22,7 billion tons were located in the Waterberg, Springbok Flats, Limpopo, Soutpansberg and Free State coalfields. These reserves, although added to the reserves from the traditional coalfields, were only considered by the author as a "back stop" because of the nature of the deposits and their distance from the main markets. The Waterberg coalfield, which lately features so prominently in many articles, represents approximately 28% (15,5 billion tons) of the total abovementioned reserves.

Thus far, however, only one colliery has been opened in the Waterberg, at very high cost and on a relatively shallow

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block. The main reason for establishing the mine was for the extraction of a coking coal fraction which was desperately required in South Africa at the time. The remainder of the Waterberg coal deposits lie much deeper and have not yet been proved recoverable. Since the release of the report, the reserves of these coalfields, including the Waterberg, have been quoted as being part of South Africa's total recoverable reserves. However, in retrospect, this is incorrect as they can only be considered a resource. Therefore, strictly speaking, the recoverable reserves of this country amount to 32,6 billion tons of coal. Since the completion of the report [1] at the end of 1982, some 2,3 billion tons have been extracted from the traditional coalfields, leaving an in-situ recoverable reserve of 30,3 billion tons, some of which have already been sterilised by surface development and mining. The smaller blocks, which were mentioned earlier in this paper, are remnants of larger mining blocks that were considered uneconomical as viable entities due to their size but which could now be released by their owners for possible exploitation by small-scale operators who would perhaps be able to mine the coal with leaner profit margins. Another advantage of these smaller operations is that, under the umbrella of the big mining groups, the smaller companies could benefit from their technological know-how, and may even be able to use some of their existing facilities, such as washing plants. They could possibly even sell coal through the existing contracts of large companies. This could extend the lives of some of the older mines and increase the mineable coal reserves to a degree. It is expected that in the near future, a number of these smaller operations will be feasible and contribute a sizeable amount of coal to what is considered to be insufficient South African coal production. Table 1 shows comparative world coal production and exports (in Mt) for 1985-1995 in selected countries.

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Year	China		USA		India		SA		Australia		CIS.	
	Prod.	Exp.	Prod.	Exp.	Prod.	Exp.	Prod.	Exp.	Prod.	Exp.	Prod.	Exp.
1985	872,3	7,7	738,8	84,0	154,3	-	173,5	44,9	117,5	87,9	569,0	22,4
1986	894,0	9,6	738,4	76,0	165,7	-	181,0	45,5	133,4	92,0	588,0	25,4
1987	928,0	13,1	762,3	72,2	179,9	-	177,0	42,2	147,7	101,9	595,0	27,1
1988	979,9	15,7	784,9	86,1	194,2	-	181,0	43,0	134,8	99,6	599,0	39,4
1989	1 054,1	13,0	811,3	91,0	200,9	-	176,3	47,0	147,8	98,7	577,0	37,5
1990	1 079,9	17,7	853,6	96,0	211,7	-	174,8	49,6	158,8	108,1	543,0	32,3
1991	1 087,4	20,1	825,1	98,9	229,3	-	180,4	49,4	164,6	119,2	498,0	25,0
1992	1 116,4	19,7	823,3	92,9	238,3	-	174,4	50,1	175,1	126,5	466,5	20,0
1993	1 154,0	19,8	776,4	67,6	246,0	-	182,2	51,7	176,5	131,7	422,0	23,5
1994	1 210,0	24,3	845,4	64,7	257,5	-	195,8	54,6	176,9	131,2	377,3	19,3
1995	1 253,4	27,5	577,1	80,3	263,5	-	206,2	59,7	194,7	136,1	332,0	19,0

Year	Poland		Germany		UK		Canada		Indonesia		Colombia	
	Prod.	Exp.	Prod.	Exp.	Prod.	Exp.	Prod.	Exp.	Prod.	Exp.	Prod.	Exp.
1985	191,6	36,2	88,8	9,0	94,0	2,6	34,3	27,6	2,5	-	9,0	3,7
1986	192,1	34,0	87,1	7,2	108,1	2,7	30,5	27,0	2,5	1,0	10,7	5,8
1987	193,0	31,0	82,4	5,6	104,4	2,4	32,7	27,1	3,0	0,9	13,5	9,6
1988	193,0	32,2	79,3	5,8	104,1	1,8	38,6	31,0	4,5	1,3	15,3	10,7
1989	177,6	28,0	77,5	5,0	101,1	1,0	38,8	31,0	8,7	2,2	18,9	13,0
1990	147,7	28,0	76,6	5,1	94,4	2,3	37,7	31,0	10,5	4,2	20,5	15,2
1991	140,4	19,4	72,7	3,5	94,9	1,8	39,9	34,1	14,1	6,7	23,5	15,4
1992	131,6	19,3	72,2	0,6	84,5	1,0	32,3	27,4	23,1	16,3	23.6	15,2
1993	130,5	22,1	64,2	0,6	68,1	1,0	35,3	27,6	27,6	18,2	21,1	15,7
1994	133,2	27,1	57,6	1,6	48,0	1,2	36,6	31,1	31,7	24,1	20,1	15,7
1995	135,3	31,9	53,6	1,8	52,6	0,7	38,6	34,0	39,1	31,6	26,1	19,5

Table 1: World coal production and exports 1985-1995 (in Mt)

Sources: BP Statistical Review of World Energy 1996
IEA Coal Information 1995
CAR Coal 1995
South African Mineral Industry 1995/1996
ECE Annual Bulletin of Coal Statistics 1995

* Prospects for coal in Africa

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The paper provides an overview of coal prospects in Africa at present and in the future. Although there are vast coal reserves on the continent, there are also problems in many of the countries with respect to the development of these resources. These problems include poor infrastructure, poverty, low economic growth and, in many cases, political instability in several of the countries. The paper contrasts the energy resources available in the Northern and Southern regions.

Keywords: energy resources; energy reserves; Africa; Southern Africa; North Africa; coal

Introduction

The forty-seven countries of Africa present a mixture of extremes: equatorial forests and deserts, a mixture of First and Third World economies, heavy reliance on fuelwood as an energy source for cooking and heating, but with a heavy oil import component. The continent also has large energy resources, with North Africa having extensive oil- and gas fields, Southern Africa having large coalfields, and Central Africa with a large hydro potential. However, Africa has suffered a series of setbacks, resulting in an economy which makes it one of the poorest regions in the world.

In the post-colonial period Africa was faced with an exodus of skilled personnel and an inadequately prepared administration which caused a deterioration in the economy, hastened by the adoption of inappropriate economical structures. These ills, compounded by a high birth rate, a high level of illiteracy and a series of civil conflicts, have made Africa the second poorest region of the world, with only South Asia having a lower Gross National Product (GNP). For example, at US$60 per capita GNP, Mozambique is the poorest country in the world.

Over the last two decades the rate of growth of the economy in many countries has been declining and in most countries the Gross Domestic Product (GDP) per capita has been decreasing. In parts of the continent the problems have been compounded by a series of droughts which have seriously affected food production and economic development.

Against this background the energy industry has largely been technically neglected and administratively over-regulated, making change necessary if an economic reconstruction of the region is to be possible. A lack of planning has resulted in an over-dependence on imported oil as an energy source causing serious foreign exchange problems.

These institutional and technical problems have resulted in an energy industry which cannot adequately service the present demand and is badly equipped to support any economic upturn that may result from the improving world economic situation.

In contrast to the economic situation, the continent has large resources of minerals, energy and people. Given economic growth the continent has the resources to support such improvements as long as there is the political will and a political understanding of the methods by which the resources have to be developed.

Energy resources are particularly plentiful, with large resources of coal, oil, gas, hydro, fuelwood and uranium. Unfortunately these resources are not always well distributed and the largest concentrations are often in areas where there is no or little demand. For instance, fuelwood is plentiful in the equatorial regions but there are great shortages of fuelwood in other areas, such as Mozambique, Angola, Tanzania etc. – areas where the reliance on fuelwood amounts to over 90% of total energy requirements. There is also a large potential for hydropower production on the Zaire River, with over 80 000 MW capacity (which is sufficient to supply the present needs of the whole of the continent). However, the demand for electricity is mainly in South Africa and in the North African countries, like Egypt.

Energy resources

As previously mentioned, the continent is well endowed with energy resources, ranging from fuelwood to uranium. However, these resources are not always in regions where they can be adequately exploited. Thus the main source of hydroelectricity is on the Zaire River but Zaire does not have the electricity demand required for the economic development of this source. Similarly there are large fuelwood resources in the central tropical forest regions but serious shortages in the drier parts of the continent.

Energy resources include oil, natural gas, hydro, coal, peat, geothermal and wood. In general, Southern African countries have large coal resources, while the countries nearer the equator have relatively large hydro resources. Oil and gas reserves have been identified mainly in North Africa and along the eastern and western coastlines. The largest uranium reserves have been identified in Nigeria, Namibia and South Africa, while the largest wood resources are found near the equator. Zaire has the largest hydro potential, with South Africa having the largest proven coal deposits.

	Forests (Mill. ha.)	Hydro (TWh p.a.)	Oil (Mt)	Gas (Tera m^3)	Coal (Mt)	Uranium (kt)
North Africa	4	20	6 020	4 956	141	0
Central Africa	597	1 415	2 718	3 094	5	326
South Africa	1	6	0	28	55 333	426
Africa	602	1 441	8 739	8 078	60 929	752

Table 1: Proven recoverable energy resources of Africa

* This paper was presented originally at GEO '95 but was never published.

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The main commercial energy reserves on the continent in terms of the countries with the largest reserves are given in Table 2.

A large portion of the known energy resources have not yet been exploited. This is due mainly to the lack of suitably large indigenous markets, distances, location, finance and, in some cases, quality. However, there is much scope for the exploitation of these resources within the framework of regional interchange of energy. This would increase the viability of exploiting these resources, as well as making them available for indigenous consumption. The possibilities for the regional interchange of energy have been hampered by the lack of a transport infrastructure, rugged or inaccessible terrain, instability/civil war, lack of finance, distance to suitable markets and – most significantly – the importance of the role of governments, institutions and utilities on the security of energy supply. As long as Africa is plagued by instability, governments will prefer to either produce within their own countries or buy offshore, rather than import from within the continent.

Coal		Crude oil	
South Africa	89	Libya	35
Botswana	6	Nigeria	27
Zimbabwe	1	Algeria	20
Zaire	1	Egypt	9
		Angola	3
		Tunisia	3
Natural gas		Hydroelectricity	
Algeria	40	Zaire	40
Nigeria	30	Ethiopia	11
Libya	15	Cameroon	9
Egypt	4	Angola	8
		Mozambique	5
		Congo	4
		Nigeria	3
Uranium			
South Africa	50		
Niger	25		
Namibia	15		
Algeria	4		

Table 2: Main proven recoverable energy reserves as a percentage of the total in Africa

Coal reserves

Coal remains the world's most abundant fossil fuel, in spite of the large improvements in reserves of oil and gas. With current annual production of 3,6 Giga tons (Gt) of bituminous coal and 1,1 Gt of lignite, the world's coal reserves should last 200 years, even with an anticipated increase in demand. Six percent of the world's reserves are in Africa, and South Africa is one of the main exporters of coal.

Sixteen countries in Africa have significant recoverable reserves of coal, while in a number of other countries that have coal reserves, conditions exist that preclude recovery at prices anticipated for the foreseeable future. Out of a total resource base of 62 078 million tons (Mt) of recoverable coal, 89% is in South Africa, with 98% in the southern countries of South Africa, Botswana, Mozambique, Zambia and Zimbabwe. The reserves of recoverable coal in the various countries of the continent are shown in Table 3.

Country	Bituminous	Sub-bituminous	Lignite	Total
Algeria	43			43
Botswana	3 500			3 500
Central African Republic	–	–	4	4
Egypt	13	40	–	53
Ethiopia	–	11	–	11
Malawi	2	–	–	2
Morocco	45	–	–	45
Mozambique	240	–	–	240
Niger	70	–	–	70
Nigeria	21	169	–	190
South Africa	55 333	–	–	55 333
Swaziland	208	–	–	208
Tanzania	200	–	–	200
Zaire	54	–	–	54
Zambia	–	69	–	69
Zimbabwe	734	–	–	734
Total	**60 463**	**289**	**4**	**60 756**

Table 3: Proven recoverable reserves of coal in Africa (end 1990 estimates) (Mt)

While there appears to be a large imbalance in the coal reserves throughout the continent, the smaller amounts of coal are still significant in terms of the energy demand of the individual countries. The significance of coal for each of the countries presently producing coal is shown in Table 4 as a ratio of proven recoverable coal reserves to present coal production. Most of the countries have sufficient coal for some hundreds of years of production at present rates. It is apparent therefore that there is a significant amount of coal to allow each of the countries to expand their production.

The quantities quoted refer to proven recoverable reserves and do not include estimates of further reserves in known fields nor discoveries in new fields. In the case of South Africa, where exploration has been intensive, the estimates of further reserves are small. However, for the other countries, and especially the Southern African countries, the potential for further resources is good. Estimates of such additional coal reserves in Southern and Eastern Africa are that there is an extra 50% more coal than the figures given in Table 3.

Coal quality

Compared with the world's main coalfields, which were laid down during the period between the Devonian and Creta-

	Ratio reserves/ production years
Morocco	90
Niger	350
South Africa	316
Swaziland	1 040
Zaire	543
Zambia	172
Zimbabwe	147

Table 4: Coal reserves (proven recoverable) as a function of coal demand for selected countries

ceous periods, the coals of Southern Africa were laid down over a much shorter period between the Permian and Triassic periods, and under very different conditions. The coals were formed in shallow ice-scoured basins and in associated rivers, swamps and deltaic systems, and in cool to temperate environments. Compared with these conditions, the northern hemisphere coals were laid down from dense tropical forests and the two types of coal have therefore very different properties.

The northern hemisphere coals are richer in vitrinite and exinite, and are more reactive and softer than the Southern African coals. The northern hemisphere coals are also more friable, more susceptible to spontaneous combustion, higher in sulphur and lower in ash. Because of their relatively high ash and low calorific values, Southern African coals require beneficiation before they can be traded on the international market.

Coal quality varies significantly from region to region, and even between adjoining countries. For instance, Botswana's coal is of a low quality, with some coal having to be imported from South Africa to satisfy certain demands, even though Botswana mines its own coal.

Coal demand

Coal utilisation on the continent is low, with only a 16% share of total final commercial energy. Oil is the dominant energy source, at 59%, with gas at 7% and electricity at 19%. Taken regionally, coal's share varies as shown in Table 5.

The high coal figure for South Africa, which is one of highest in the world, reflects the large reserves and low cost of coal. Demand for coal in Africa as a whole has risen by 0,6% per annum over the last 20 years, compared with an oil consumption rise of 5% per annum and electricity at 7,3% per annum.

Table 5 does not reflect the large component of fuelwood in the African energy market with some countries, such as Ethiopia and Tanzania, using fuelwood for over 90% of their total final energy demand. Fuelwood is becoming scarce over most of Africa and in the future more use will have to be made of commercial energy. There is a predominant use of oil, especially in the oil-rich North Africa as well as in the Central African countries which do not have any indigenous oil. The substantial use of oil is also due to the large component of energy used for transport purposes. As the economies of the countries improve there will be a growing need for energy for the industrial and manufacturing sectors of the economy.

There are therefore good prospects for the expansion of demand for coal in the medium to long term as economic growth takes place and as the countries increase their industrial sectors.

There is also scope for increased exports into the world market. Attempts by various countries to enter the export market have been in the past largely unsuccessful (except for South Africa), because they were uneconomical at the prevailing international coal prices over the last two decades. The increases in international prices are unlikely to make entry into the export market likely before about 2010.

There is, however, scope for increased consumption within Africa as already mentioned. Regional economic integration in various regions could open up significant increased demand, making new mines economic. This would require improvements in the infrastructure in these regions, especially improvements to the rail systems. Many of the rail links in the southern region have been closed or are operating very inefficiently due to sabotage and guerrilla activities. With improvements in the political situation in the region these activities have largely ceased. However, even when these links are fully opened, there will be a chronic shortage of rolling stock, a shortage of skilled technical staff, as well as a shortage of managerial skills to operate the links at an efficiency figure acceptable to the coal trade.

Thus in the short to medium term the prospects for a significantly improved regional usage of coal is poor. However, with political stability and economic growth, the future growth in coal demand should be good.

The role of coal in the South African economy, however, is much brighter. Local demand for coal rose by 1,4% per annum from 1973 to 1985 but fell thereafter due to the worsening economic situation. Over the last twenty years the average growth has been only 0,1% per annum. This low growth should be compared with the growth in oil demand of 2% per annum over the same period and 4,4% per annum in electricity. Since most of the increase in electricity consumption has been from coal-fired power stations, the overall increase in coal consumption has been significant. Excluding exports, total (primary and secondary) coal consumption in South Africa rose by 5,3% per annum over the 20-year period.

While prospects for coal consumption in power generation in South Africa are good in the medium term, there will be a move towards alternative electricity production methods, with gas and nuclear taking some of the market and imports of hydropower from Central Africa playing an increasingly important role in the longer term.

Country	Coal	Oil	Gas	Electricity
Africa	16	59	7	19
North Africa	4	67	15	15
Central Africa	9	74	3	15
South Africa	36	36	1	27

Table 5: Total final consumption as a percentage of total commercial energy for regions in Africa (for 1992)

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SHORT COMMUNICATION

Recent developments in the energy sector of the Southern African Development Community (SADC)

* N J GROBLER

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Introduction

Since the accession of South Africa to SADC in 1994, the Department of Minerals and Energy (DME) has been actively involved in the SADC Energy and Mining Sectors. Eskom had already laid a basis for regional cooperation with utilities in the region. Several important milestones have been reached in the Energy Sector, namely the signing of the Memorandum of Understanding on the Southern African Power Pool (SAPP), inter-utility agreements, and recently, the signing of a SADC Energy Protocol. However, there has been some general dissatisfaction with the SADC institutional structure and the efficiency of its Energy Sector administration.

At its meeting in Gaborone in January 1994 the Council of Ministers of SADC directed the Secretariat to carry out a study on the establishment of SADC institutions. This included the development of a SADC Energy Protocol and an appropriate institutional structure for the future.

The Protocol is a legal document setting out the areas of regional cooperation in the energy field. Its institutional structure is that of a Commission, consisting of a Committee of Energy Ministers of the SADC region, a Committee of Senior Officials (one from each Member State) and a Secretariat. Work on programmes and projects will be undertaken by demand-driven Subcommittees which would consist of government, private enterprise, parastatals, NGOs, stakeholders and academics. Their work would be facilitated by a Technical Unit headed by a Director with a core staff of nine. The cost of the Technical Unit will be borne in equal parts by the Member States.

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After wide consultation, the team of consultants recommended that the present Technical and Administration Unit (TAU) of the SADC Energy Sector be transformed to that of a Technical Unit in a strictly facilitating role, relying on stakeholder-based subcommittees for each subdivision of the energy field to carry out programmes and projects. Various sources of funding will be sought to execute the programmes. A tentative operating budget of US$470 000 p.a. is visualised for the Technical Unit which would be shared in equal parts among SADC Member States. It was recommended that the members of a subcommittee be responsible for their own expenses, as well as for the joint expenses of the subcommittee. However, subcommittees may lobby for donor funding. Projects, programmes, special studies, etc. shall have individual funding from various sources, such as stakeholder-, donor- and special contributions by Member States.

The final version of the Protocol was signed by the Heads of State of the SADC countries on 24 August 1996 at a meeting in Maseru. The Protocol is now in the process of ratification by those Member States, including South Africa, whose constitutions require that international agreements be ratified by parliament.

Summary of the SADC Energy Protocol

The SADC Energy Protocol is a legal document which spells out the obligations and objectives of Member States and details the institutional mechanism for cooperation in the field of energy. There is nothing in the Protocol which is contrary to the SADC Treaty of 1992.

The institutional mechanism adopted by the Protocol is that of a Commission comprising the following organs:

- the Committee of (Energy) Ministers
- the Committee of Senior Officials
- the Technical Unit
- Subcommittees established by the Committee of Ministers for electricity, petroleum, coal, woodfuel, new and renewable sources of energy, energy efficiency and conservation, energy planning and other areas or tasks when and where appropriate.

The main tasks of the Commission can be summarised as coordination of regional energy activities; formulation of a coordinated approach to regional energy policy, strategy and plans; establishment and maintenance of a regional energy database; formulation and implementation of human resource development; promotion of energy research and development; creation of such other organs as may be necessary for the implementation of the Protocol; and mobilisation of finance for the implementation of SADC energy programmes and projects.

The Committee of Ministers consists of the Ministers of Energy of the 12 SADC Member States. The chairperson shall be appointed from the Member State coordinating the Energy Sector (Angola at present). Its functions comprise mainly the establishment of the policy and strategy of the Commission; considerations and recommendations for approval by the Council of Ministers (composed mainly of ministers of finance, trade and industry and foreign affairs) of the business plan, budget, annual reports and financial statements of the Commission, consideration and approval of recommendations on projects and programmes and, in general, the overseeing of the implementation of the Energy Protocol. They will normally meet once a year.

The Committee of Senior Officials shall comprise of one representative appointed by each Member State, with the chairperson appointed from the Member State coordinating the Energy Sector, its functions will be mainly to advise the

Committee of Ministers and the Technical Unit on the activities of the Commission; and to recommend the agenda, provisional programmes, studies and projects proposed by the Technical Unit for the consideration of the Committee of Ministers.

The Technical Unit and subcommittees are constituted and have functions in accordance with the recommendations of the consultants as set out above.

The Technical Unit as defined above, is the executive administrative and coordinating organ responsible for the implementation of the Protocol. Its director organises meetings of the Committee of Ministers and the Committee of Senior Officials and acts as secretary for these meetings. The director will also prepare annual reports, draft budgets and other financial statements and business plans for consideration by the Committee of Ministers, as well as facilitate the establishment and operation of the subcommittees. The director performs a central coordinating function. An operating budget (tentatively US$470 000) will be financed by the Member States on an equitable basis.

The subcommittees are the organs which will be responsible for the working of the Energy Sector at ground level. They shall address regional energy needs and shall normally be established for the duration of their specific task. They can initiate programmes and projects for approval by the Committee of Ministers via the Technical Unit. They shall report regularly to the Technical Unit about their work, which would also attend their meetings.

Cooperation with non-SADC states and organisations

In recognition of the fact that energy development transcends national and regional boundaries, cooperation between SADC Member States and non-SADC states and organisations in energy development and use shall be encouraged. The Commission may therefore enter into agreements with such non-SADC states and organisations.

SHORT COMMUNICATION

Indaba 1996: 2nd Indaba of the Fossil Fuel Foundation of Africa, in the series Coal Science and Technology, held 5 November 1996, Johannesburg, South Africa

The Fossil Fuel Foundation of Africa "went public" for the first time on 5 November 1996, at the launch the 2nd Indaba held under the series, Coal Science and Technology in Africa.

The main purpose of the Fossil Fuel Foundation is to further education, science and technology in the carbon and energy industries, and in so doing, enhancing the quality of life and environment for the peoples of Africa whilst optimising the available resources. The achievement of these goals can be met through the stimulation of a sound education base, a stronger research and technology network , enhanced distribution of information and the promotion of collaboration through communication.

Indaba 1996 focused on coal research in South Africa, giving those currently involved in coal research and development the opportunity to publicise their work to those in similar or related fields, and to industry in general.

Twenty-eight papers were presented, with Professor Fred Lockwood, Professor of Combustion at the Imperial College of Science and Technology in London delivering the keynote address. His paper discussed the results of the latest research on the origin and formation of environmentally unfriendly gases during coal combustion and how these can be controlled by improved engineering design.

The main sessions covered the following broad topics:

- Geology, palaeontology and exploration
- Physico-mechanical properties of coal
- Beneficiation
- Storage, safety and the impact on the environment of coal and by-products
- Organic and inorganic aspects of combustion
- Gasification
- Metallurgical aspects
- Environmental aspects
- Research and development strategies

A list of the individual papers presented are as follows:

- Coal reserves and resources: The route forward
- A review of the coalbed methane potential in South Africa
- No.4 seam reviewed: Quality distribution as reflected by geological, geochemical, palaeontological, chemical, petrographic and mineralogical characterisation
- Palynology of the No.5 seam in the Witbank/Highveld coalfields
- Evaluating coal milling characteristics: Current perceptions and trends
- The use of an online analyser measuring techniques in determining the mineral matter content, abrasiveness and ash deposition potential of coal
- Milling and flotation: Recent developments from Wits University
- Coal flotation: Modelling the downcomer from free jet flotation
- Fine coal beneficiation: Optimisation of the Twisdraai fine coal circuit
- Sulphur removal: Is prevention better than cure?
- The effect of stockpiling on coal degradation over time
- The role of oxidised sulphide minerals in the acidification and salinisation of water in the mining industry
- The storage of power station ash: Geotechnical properties, safety and the environment
- The spontaneous combustion of coal: Principles and practice
- Carbon reactivity in coal utilisation: Myths, legends and practicalities in the transformation of coal to carbon materials at high temperatures
- Applications of fluidisation (FBC and FBG) in coal technology
- Coal combustion of six international coals
- Coal combustion technology for power generation: The Eskom perspective to 2001 and beyond
- Ash fusion temperatures: Mineralogical, petrographic and geological controls on coals from Witbank No.2 seam
- Mineral matter transformations: Impact on ash formation, characterisation and deposition
- Koppers Totzek gasification *a la* Kynoch (AECI): Status quo of coal research – quality versus performance
- Reactivity of chars during the solid state reduction of oxides
- The behaviour of chars in submerged arc smelting of ferrochromium
- Review of Eskom's current research in environmental topics: Waste management, ground, water and emissions
- The planning, management and execution of coal research and development: Whose responsibility in the new South Africa?

In between the presentation of the papers, Sasol presented the latest economic and financial implications regarding the debate on the cost-effectiveness of sulphur-reduction during coal utilisation, i.e. whether prevention (beneficiation) is better or cheaper than the cure (gas scrubbing technologies).

In summary, it was agreed that the amount of work being conducted in South Africa and the levels at which this was being done were surprisingly high (little of which, to date, has seen the light of day locally). In addition, it became apparent that there was a lack of communication between researchers in both different and common fields as regards work being undertaken.

An inventory of people, services and activities in the fossil fuel world has also been requested and is currently being initiated, to identify those active in the variety of fields now opening up to the community at large. In addition, an inventory of educational and training courses, and their locations, is under review.

(Source: Press Release: Fossil Fuel Foundation, 2nd Indaba, Coal Science and Technology Series and 2nd Indaba Programme)

COMPARATIVE ENERGY COSTS IN SOUTH AFRICAN CITIES RELATED TO HEATING VALUE

MARCH 1997											
Energy source	Consumer prices			Cost of energy (c/MJ)			*Relative heating costs			Heating value	
	Coast	Inland	Units	C.T.	Jhb	Dbn	C.T.	Jhb	Dbn		
Coal A (Peas)	297,83	87,78	R/Ton	1,06	0,31	0,69	3,39	1,00	2,20	28,0	MJ/Kg
Elect.	22,54	24,43	c/kWh	6,26	6,79	6,25	19,97	21,65	19,94	3,6	MJ/kWh
Heavy Furnace Oil	95,83	115,78	c/litre	2,34	2,82	2,34	7,46	9,01	7,46	41,0	MJ/litre
Illum. Paraffin	142,08	155,64	c/litre	3,84	4,21	3,84	12,25	13,42	12,25	37,0	MJ/litre
Petrol (Premium)	213,00	219,00	c/litre	6,14	6,31	6,14	19,58	20,13	19,58	34,7	MJ/litre
Diesel (Heating)	207,37	218,77	c/litre	5,34	5,64	5,34	17,05	17,99	17,05	38,8	MJ/litre
Power Paraffin	180,12	194,14	c/litre	4,80	5,18	4,80	15,32	16,51	15,32	37,5	MJ/litre
LPG	138,17	156,18	c/litre	5,04	5,70	5,04	16,08	18,18	16,08	27,4	MJ/litre
Gas Sasol Gas	–	19,95	R/GJ	–	1,99	–	–	6,36	–	–	–

This table shows comparative energy costs (in SA cents/MJ) in selected South African cities (coastal and inland) based on a range of energy sources. The following criteria were taken into consideration in the calculation of the cost of energy:

(1) Transport costs for coal were obtained from Spoornet. Railage of coal was calculated from Saaiwater to Cape Town and from Saaiwater to Durban respectively.

(2) The energy cost has been calculated on the bulk delivered price for consumers, i.e. includes 14% VAT and other charges.

(3) All figures for electricity have been based on energy requirements for large commercial users.

(4) Electricity prices have been based on typical monthly accounts for large users (see Table 5 in the Energy Price List in *Selected Energy Statistics: South Africa).*

(5) A 75% load factor has been used in the calculation of the Sasol Gas prices.

(6) *The relative heating costs are shown in relation to the cheapest source, i.e. coal in Johannesburg.

(Source: *Selected Energy Statistics: South Africa,* No. 40, February 1997)

Energy news in Africa

Electricity

Algeria

The European Investment Bank has granted about $45 million to Algeria for transmission lines planned by Sonelgaz. Four hundred and eighty-five kilometres of lines will link the gas-fired power station at Adrar to that city as well as to Aloulef, Reggane, Tiberghamine and Timimoun, which are currently supported by diesel generators. When the new power station is operating, the diesel generators will be decommissioned.

The region is close to where BP and Sonatrach have a major gas project.

(Source: Africa Energy & Mining, No.194, 4 December 1996)

Botswana

The Botswana Power Corporation (BPC) is to be fully privatised after 1997, with a minimum stake (about 20%) set aside for local investors. The same will apply to all big state-owned companies. However, actual method will depend on the findings of a government commission which will be handed down towards the end of 1997.

Air Botswana and BTC (telecoms) are likely to be the companies to be privatised, followed by BPC and the Water Utilities Corp.

(Source: Africa Energy & Mining, No.195, 18 December 1996)

Tanzania

Independent Power Tanzania (IPTL), a private company made up of local and Malaysian interests plans to build a power station in Zanzibar running on gas or fuel-fed turbines. Because of the project, the islands of Unguja and Pemba will no longer be dependent on the state-owned utility, Tanesco.

The power station, to be located at Tegeta, will be built by Electrogen, a South African company. It will be built in three stages: the first two of 35 MW each and the last with a capacity of 40 MW.

(Source: Africa Energy & Mining, No.194, 4 December 1996)

Tunisia

A forthcoming meeting of North African electricity ministers in Tunisia in March will provide an occasion for the countries to voice satisfaction over fresh progress in interconnection projects between the region and Europe.

In late December, Egyptian electricity minister announced that Egypt had received assurances from the African Development Bank that it would back the next five-year part of Egypt's electricity schemes between Egypt and its North African neighbours.

In Tunisia in December 1996, an interconnection with Libya was approved by parliament. Estimated at $68M, the scheme is to be financed by a loan from the Arab Fund for Economic and Social Development, which Tunisia and Libya will repay in equal parts. A consultancy will now carry out the detailed engineering work on the project and invitations to tender will follow quickly for 300 km of line (mostly in Tunisia), a substation at Medenine and improvements to other stations on each side of the border.

(Source: Africa Energy & Mining, No.197, 22 January 1997)

Zimbabwe

The Zimbabwe Electricity Supply Authority (ZESA) recently unveiled a 20-year, $2,8 billion plan to build up its electricity network. The new programme, endorsed by the government, will consist initially of pressing ahead with ongoing renovation to restore the nominal 920 MW capacity of Hwange's first and second sections (4 x 120 MW and 2 x 220 MW respectively). The capacity of the third section will be 660 MW (2 x 330 MW). There is also to be an effective 120 MW increase from the newly completed upgrading of the Harare and Munyati power stations.

Renovation work is also to be undertaken on the power station on the southern bank of Kariba dam, representing 84 MW when completed in about 1998. Each of the six turbines will have been boosted from 111 MW to 125 MW. Kariba is expected to provide an additional 300 MW by 2008.

Zimbabwe's 800 MW from the power station planned downstream on the Zambezi at Batoka Gorge will enter service in 2004 and the coal-fired power station at Sengwa (2 x 330 MW) in 2011.

The interconnection, with a capacity of 500 MW, that is being built between Cahora Bassa in Mozambique and the power station at Bindura will most likely be available from the end of 1997.

If ZESA's new programme is accepted, it has been designed to lift generation capacity to the level of expected domestic demand in 2003. It will also not mean the end of exchanges within the Southern African Power Pool via the connections with Zambia, Mozambique and South Africa.

(Source: Africa Energy & Mining, No.194, 4 December 1996)

Oil and gas

Algeria

The Spanish part of the North Africa-Europe gas pipeline was inaugurated by King Juan Carlos on 9 December 1996. Some 200 million m^3 of gas has already has already crossed the Straits of Gibraltar since the commercial serve was commissioned in November 1996.

Enagas' contract is for 6 billion m^3/year and deliveries to Spain will gradually increase from 3,6 billion m^3 to 4,2 billion m^3 in 1997.

(Source: Africa Energy & Mining, No.195, 18 December 1996)

Chad

In November 1996, Exxon announced an agreement to develop fields in Chad's Doba basin. The agreement was signed by the Chad government and a consortium made up of Esso Exploration & Production Chad (40%), Shell Tchadienne de Recherche et d'Exploitation (40%) and Elf Hydrocarbures Tchad (20%).

Unlike offshore operations, this oil has heavy political risks attached to it. However, if the Doba project goes through without a hitch, it has been described as the "next promised land". At this stage, Exxon is only talking of a "protocol" laying down of "key financial, juridical and operational terms" The "necessary agreements" for the pipeline remain to be ratified by Chad and the Cameroon, and the financial arrangement finalised. Proven reserves of 900 million barrels for Moundou, Doba and Kome have been confirmed.

(Source: Africa Energy & Mining, No.194, 4 December 1996)

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Professor Dutkiewicz was born in Poland and obtained his schooling in the United Kingdom and South Africa. He obtained his B.Sc. and M.Sc. degrees from the University of the Witwatersrand in South Africa, and his Ph.D. degree, which was on heat transfer in nuclear engineering, from Cambridge University in the U.K. He joined the General Electric Company in the U.K. as a nuclear engineer and worked on the design of the Hunterston Nuclear Power Station in Scotland and the Tokai Mura Nuclear Power Station in Japan.

He returned to South Africa to work for what was then the Electricity Supply Commission (now Eskom), and was appointed head of the newly formed Research Laboratory. Promotion saw him in the position of deputy chief mechanical engineer (construction), and later as manager of system planning.

He joined the University of Cape Town in 1975 as Professor of Mechanical Engineering. Whilst in the Department of Mechanical Engineering he started the Energy Research Institute, which is now a separate entity within the Faculty of Engineering. He is currently Professor of Applied Energy and director of the Energy Research Institute.

Professor Dutkiewicz served as president of the South African Institution of Mechanical Engineers in 1978/79. He presently serves on a number of international committees dealing with alcohol fuels, energy demand-side management, and environmental matters.

GROBLER N J

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Dr Grobler spent his first working years as exploration geophysicist/geologist with the Tsumeb Corporation, Tsumeb in what was then South West Africa. He also worked for the Anglo American Corporation in the Northern Transvaal and Botswana. In 1970 he joined the Department of Geology at the University of the Orange Free State where until 1972, he occupied the Chair of Economic Geology. Research was conducted in various fields but focused mainly on stratigraphy, geochemistry and volcanology in the volcanic-sedimentary Proterozoic Ventersdorp Supergroup immediately overlying the gold-bearing Witwatersrand Supergroup.

From 1989 to 1993 Dr Grobler was seconded to the post of Counsellor for Minerals and Energy at the South African Embassy in London, with diplomatic accreditation to the U.K., Portugal, Spain, Greece, Israel, Turkey and Bulgaria. His main focus was on the promotion of South African mineral sales, investment in the South African mining industry and the transfer of minerals and mining technology.

When the last remaining posts were abolished in 1993, Dr Grobler was appointed Director of the Geological Survey of Bophuthatswana, now the North West Province. Since April 1995 he occupied the position of Director for SADC Coordination in the Department of Minerals and Energy, which has since been expanded to include all international coordination.

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Yuri V Pashkov graduated as a geologist/mining engineer from the Moscow Geological Institute in 1958 and joined the All-Union Research Institute of Petroleum Exploration in the Ministry of Geology of the Soviet Union in the same year. For about three years he worked as a field geologist and research fellow in the central Asian republics.

In 1961 he entered the foreign contracting field. Between 1961 and 1964 Dr Pashkov worked in Afghanistan, exploring for oil and natural gas, and in 1966 he began working for the United Nations, starting with the UNDP project in India.

On the completion of a three-year contract period, Dr Pashkov returned to Moscow where he served in various capacities at the Research Institute of Petroleum Exploration. He obtained his Ph.D. degree from this research institution and executed a number of projects on petroleum exploration in the former Soviet Union and abroad. For four years (1977-1980) he was in charge of the research project on the petroleum prospects of Bulgaria. In 1981 he returned to the United Nations and served as a consultant to the government of Cyprus for the UNDP project on energy conservation.

For the past thirteen years (1983-1996), Dr Pashkov has worked for the United Nations Economic Commission for Africa (UNECA). He was in charge of the Energy Resources Unit of the Natural Resources Division for a number of years and upon retirement from the United Nations was Officer-in-Charge of that Division. His responsibilities included research and supervision, coordination and representation.

In 1996 Dr Pashkov was appointed as head of the World Energy Council's Africa Energy Programme.

Dr Pashkov has also travelled extensively in Africa, Europe and the United States.

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Xavier Prevost began his career as a geologist with the mining sector in Bolivia and worked there for seven years before going to Austria's Montanistiche Hochschule to obtain a postgraduate diploma in mining and exploration.

He was offered a job with the then Geological Survey in Pretoria in 1974, where he was instrumental in the establishment of the National Coal Data Base, the system used for coal research and government policymaking. He managed the NCDB until his resignation in 1989.

With his background and previous experience in systems and data processing, he was then offered the post of Information Systems Manager by Genmin's Gold Exploration Department, where he

established first a gold, and later a multi-commodity database.

As a consequence of the slump in prospecting activities, he left the mining industry and began a job as a consultant for information systems.

In 1995 he joined the Minerals Bureau and was given coal and hydrocarbons as his commodities. He is actively involved in establishing links between users, technologists and producers in the coal industry and providing them with a reliable and efficient information pool.

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Christine Zumkeller received her M.Sc. in Economics from the University of Heidelberg, Germany, in 1975. She specialised in internationally comparative statistics with a particular focus on national and resource accounting. Since 1981, she has worked for the United Nations, first in the UN's Statistical Office, assisting with the compilation of energy statistics, particularly renewable energy statistics and energy balances for developing countries.

Since 1988, Ms Zumkeller has worked for the UN Economic Commission for Africa on the compilation of environment statistics, general statistical development and energy policies for Africa. Her particular research interests lie in strategic issues and capacity-building related to Africa's sustainable development.

Between 1992 and 1995, Ms Zumkeller was the Research Coordinator in the UNDP-assisted African Centre for Development and Strategic Studies in Nigeria. She is presently back with the Economic Commission for Africa and is involved in a number of activities to promote, through the establishment of an appropriate African regional energy institution, the accelerated development of energy options compatible with sustainable development criteria.

Forthcoming energy and energy-related conferences: 1997/1998

1997

APRIL 1997

14-17

2ND AFRICAN OIL TRADE CONFERENCE Harare, Zimbabwe

Enquiries: 2nd African Oil Trade Conference, Eastern and Southern African Trade and Development Bank, P O Box 48596, Nairobi, Kenya

Fax.: +254 (2) 711 510
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JUNE 1997

4-6

SUSTAINABLE ENERGY DEVELOPMENT FOR SOUTHERN AFRICA Midrand, South Africa

Enquiries: Mrs I von Bentheim, Energy Research Institute, P O Box 207, Plumstead 7801, South Africa

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17-19

SUB-SAHARAN OIL & MINERALS Grand Baie, Mauritius

Enquiries: Europe Energy Environment, Johannesburg, South Africa

Tel.: +27 (11) 442 3230
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1998

MAY 1998

24-26

EFFICIENT ENERGY UTILISATION AND MANAGEMENT : A SEMINAR Johannesburg, South Africa

Enquiries: Rhona Campbell/Pam Rooney, J H Isaacs Group, P O Box 5575, Johannesburg 2000, South Africa

Tel.: +27 (11) 28 1066

16-19

SOUTH AFRICAN TRANSPORT CONFERENCE Johannesburg, South Africa

Theme: Transport policy: Vision to reality

Enquiries: Conference Planners, P O Box 82, Irene 1675, South Africa

Tel.: +27 (12) 63 1681 (Cilla Taylor)
Fax.: +27 (12) 63 1680

Email: confplan@iafrica.com

SEPTEMBER 1998

13-18

11TH WORLD CLEAN AIR CONGRESS AND ENVIRONMENTAL EXPOSITION Durban, South Africa

Theme: Interface between developing and developed countries

Enquiries: Congress Secretariat, Mrs Ammie Wissing, P O Box 36782, Menlo Park, Pretoria 0102, South Africa

Tel./Fax.: +27 (12) 46 0170

Recent energy publications

CAWOOD W N

Maphephe the rural electrification programme. Nov-1996. 45p.
Report No. EO9512

The project's main objective was to set up a pilot programme to investigate the cultural, environmental, educational, technical and financial procedures that need to be followed in providing solar electricity to rural communities in South Africa. The following issues were addressed: how to locate and set up communication with rural communities unlikely to receive grid electricity within the next 5 years; how to establish whether the community is genuinely interested in obtaining photovoltaic (PV) electricity in preference to grid electricity; demonstration and promotional material requirements; methods of procuring funding for the supply and installation of PV equipment and management of the programme; sourcing the most suitable equipment at the best price; selection and subsequent technical, financial and management training of a local entrepreneur responsible for installing and maintaining these systems; practical installation of PV systems; ongoing monitoring and evaluation of the programme.

CAWOOD W N

Life expectancy of solar water heaters. Oct-1996. 26p. + appendix.
Report No. EO9409

The objectives of the investigation were as follows: to create a database of names and addresses of owners of domestic solar water heaters; to establish the approximate life expectancy of solar water heaters installed in South Africa; to establish the cumulative area of solar water heaters installed over the last 20 years and which are still operating; to establish the annual saving of electricity and water resulting from the installation of solar water heaters; to establish whether there are significant differences in the life expectancy of solar water heaters installed in different climatic zones or regions; whether different types of solar water heaters have significantly different life expectancies; to establish whether records of savings are being kept by owners of solar water heaters; to solicit comments from owners of solar water heating systems.

EVERT C R

The detection of sugar cane or other fires under high voltage transmission lines. Oct-1996. 210p.
Report No. EL9015

The major objectives of this project were: to investigate the nature and properties of electromagnetic noise on power lines arising from the presence of fires under those lines; to establish the feasibility of discriminating between this noise and the intermittent presence of comparable levels of noise from other sources, such as conductor corona and polluted insulators. This research is expected to lead to the development of a practical detection device for recognising the presence of fire induced noise and the proposal for such a detector.

KACHELHOFFER P M

Energy and energy efficient courses aimed at primary, secondary and tertiary levels. Dec-1995. 64p.
Report No. ED9503

The aim of the research was to assist the Department of Minerals and Energy (DME) in the introduction of energy and energy efficiency into the education system of South Africa. The following recommendations made to the DME from the research are as follows: the DME should monitor the development of the South African curriculum development system so that the DME can make an input where necessary; the DME should develop prototypes of unit standards and teaching and learning programmes for energy and energy efficiency to be introduced into the curriculum as the opportunity arises.

LANE I E

Load audits and simulations to develop DSM potential in the mining sector. Aug-1996. 255p.
Report No. ED9206

Deals with a methodology which can be utilised to prove load management potential on existing mines and which can be adapted for least cost energy system planning in new mines. A holistic approach in the main report is focused primarily on deep-level gold mines to demonstrate the effects of certain existing electricity tariff structures. Tariff structures create a need to make load management decisions on a mine-wide basis. Some end-use categories found in open-cast mines have been included in the appendix to demonstrate that the techniques can be extended to a wider variety of mining environments.

REYNDERS J P

Enhanced diagnostic procedures for partial discharge measurement in rotating machines. Aug-1996. 168p.
Report No. EL8901

Proposes that measurement of partial discharges at the terminals of amachine is dominated by surface discharge activity produced in the overhang of the winding. Although large in magnitude these overhang discharges are not very damaging, except that they mask the effects of small discharges within the cell insulation in the slot area of the winding, which are very damaging. Describes an instrument which can distinguish between partial discharge activity in the slot and partial discharge activity in the overhang.

TRIEBEL R

Feasibility study on energy efficiency communication programmes aimed at the industrial and commercial sectors. Nov-1996. 53p.
Report No. ED9502

The primary aim of the study was the development of a package of communication programmes for the DME that needed to be initiated to set the scene for an increase in energy efficiency in industry and commerce in South Africa. The research recommends that the DME play a facilitating and initiating role in the energy sector in creating awareness of energy efficiency. Some of the initiatives recommended are the use of high-profile people/events, widespread dissemination of information, bottom-up approaches through the education system and assistance from a macro-economic perspective.

All these reports are Final Reports (unless indicated) and are the result of research funded by the Chief Directorate: Energy, Department of Minerals and Energy.

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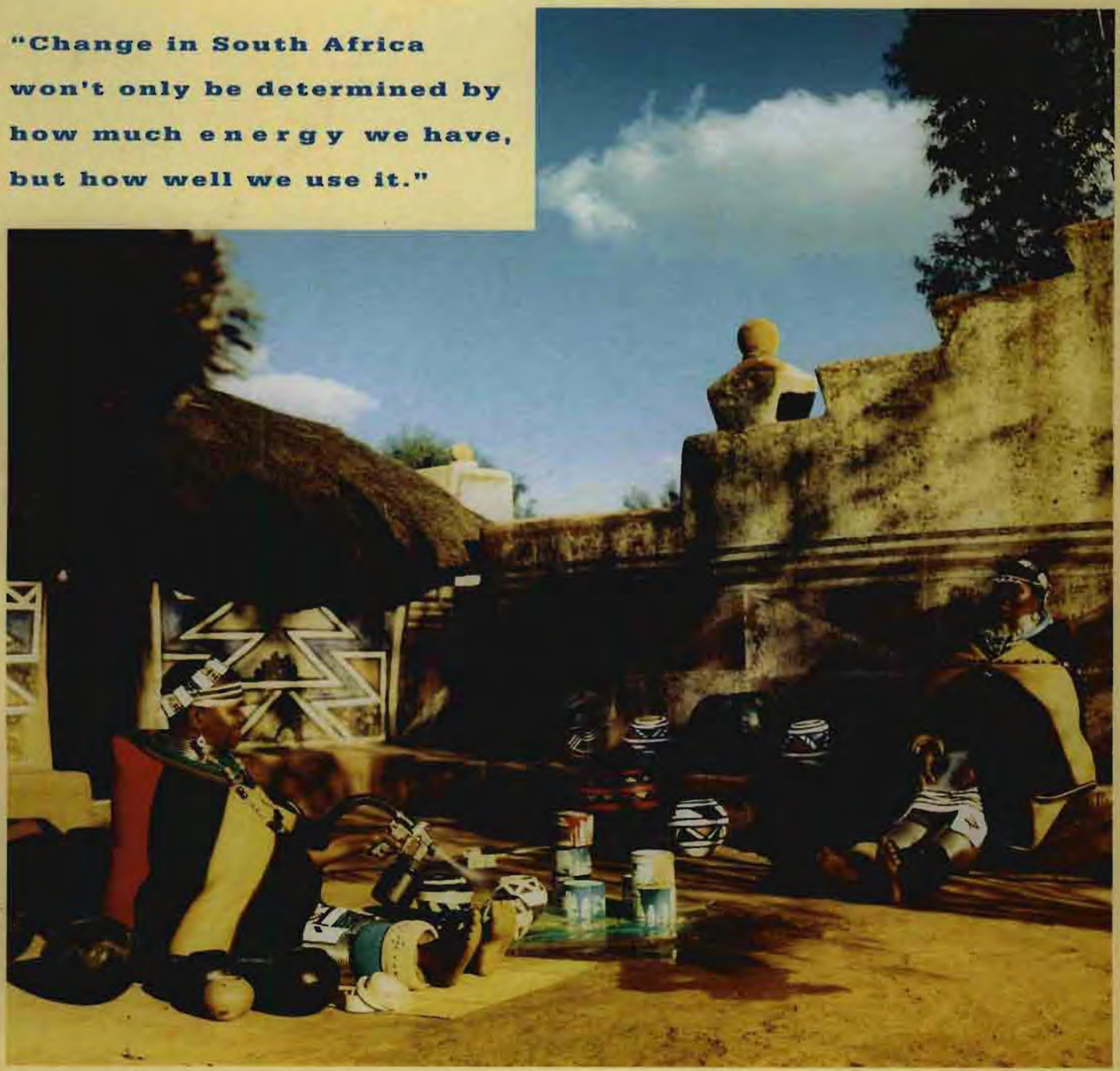

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