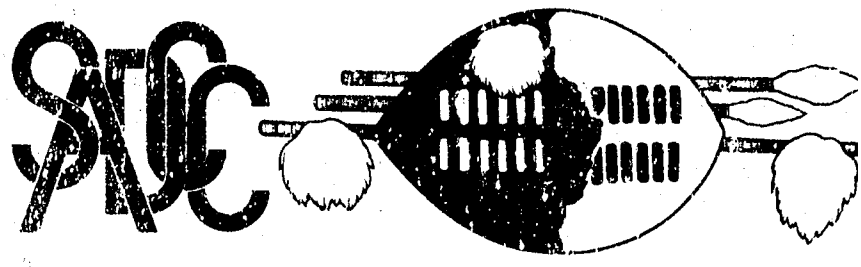
ENERGY

SOUTHERN AFRICAN
DEVELOPMENT COORDINATION
CONFERENCE



Mbabane , Kingdom of Swaziland
31st January — 1st February 1985

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INTRODUCTION

This is the third Energy Sector Report presented to a SADCC Conference. The first and second were presented at the Maseru (1982) and Lusaka (1983) Conferences respectively.

The Report which was approved by the Energy Ministers, SADCC, during their meeting held in Luanda 13 September 1984, is designed to comply with the objectives of the Conference being mainly a review meeting held at the level of senior officials. Accordingly the Conference will consider progress made in the implementation of projects, bottlenecks and, where appropriate, new projects.

Section I of this presentation is a Progress Report which reviews Energy Sector development since initiation in 1980.

Bearing in mind that Energy is one of the sectors given special attention during the Conference a quite comprehensive review has been prepared. Included in Section I are inter alia an outline of the organisational set-up within the Energy Sector, Organisation and Management of the Energy Sector Projects, development of the energy policy and energy planning for the Region, status of ongoing projects and experience with donors.

In Section II a brief outline of the energy situation in the Region is presented. The outline focuses on key energy issues, inter alia the scope for substitution of traditional and imported fuels by indigenous commercial energy. Some comments on the supply, demand and energy imbalance of various types of commercial and traditional fuels are presented. A separate chapter deals with issues relating to energy in the rural sector. The chapter describes interdependence between energy and agriculture - the other sector in focus during the Conference.

The energy overview in Section II outlines the general context from which new projects have emerged.

Section III presents new energy projects.

All the new projects form part of the Energy Sector programme designed to promote the overall socio-economic development of the SADCC Region.

Among the new energy projects are some national projects of specific high priority adopted as regional in accordance with the criteria for the evaluation and selection of regional projects approved by Energy Ministers, SADCC. These projects have the potential to serve more than one of the Member States of SADCC in the medium and long-term perspective.

For the new projects both an executive summary and detailed descriptions have been prepared. Each project description seeks to provide a clear justification for the project.

Background, objectives, work involved and cost estimates including funding requirements are described. It is envisaged, however, that these project descriptions may be refined both as a result of further consultations between SADCC Member States and as a result of negotiations with SADCC international cooperating partners.

1. REVIEW OF ENERGY SECTOR, SADCC DEVELOPMENT

1.1 Establishment of an Organisational Framework

Constitution :

On 1 April 1980 Heads of State and representatives of nine countries of Southern Africa signed a Declaration in Lusaka, entitled "Southern Africa: Towards Economic Liberation". Thus was born the Southern Africa Development Coordination Conference, SADCC. The Declaration recommended that the countries of the Region work harmoniously together in such a way as to integrate their economies and gradually reduce their dependence in particular but not only upon the Republic of South Africa.

Sector cooperation among SADCC Member States was initiated during the Lusaka Summit when Heads of States signed the "Programme of Action". In the programme each country has been assigned the responsibility of coordinating a specific area of cooperation. The People's Republic of Angola was entrusted with the responsibility to coordinate Energy Development, Conservation and Security (Energy Sector).

Organisational Hierarchy :

The Energy Sector, SADCC, is coordinated through Regional meetings and a Technical and Administrative Unit, established by the People's Republic of Angola within the Ministry of Energy and Petroleum.

Two levels of Regional meetings are convened regularly, i.e. Energy Ministers Meetings and Energy Officials Meetings. At these meetings all SADCC Member States should be represented.

Energy Ministers report to the SADCC Council of Ministers while Energy Officials report to the Energy Ministers Meetings.

Altogether five Energy Ministers Meetings and seven Energy Officials Meetings have taken place in various capitals of SADCC countries as follows:

February 1982, Luanda	- Energy Ministers - Energy Officials
June 1982, Luanda	- Energy Officials
September 1982, Luanda	- Energy Ministers - Energy Officials
December 1982, Luanda	- Energy Officials
April 1983, Dar es Salaam	- Energy Officials
July 1983, Maputo	- Energy Ministers

May 1984, Blantyre	- Energy Ministers - Energy Officials
September 1984, Luanda	- Energy Ministers - Energy Officials

The Technical and Administrative Unit :

The mandate for the establishment of a Technical and Administrative Unit, Energy Sector, SADCC, within the Ministry of Energy and Petroleum, People's Republic of Angola, can be found in the Record of the Luanda meeting of the Council of Ministers, SADCC, June 1982:

> "Ministers agreed that the Government of Angola should create a unit, within its Ministry of Energy, with external assistance if necessary, to coordinate work in this field."

The specific functions of the Technical and Administrative Unit include:

(a) Administration

(i) Making all the administrative arrangements for regional meetings of Ministers and Officials;

(ii) Circulation of agendas and papers for all such meetings and the preparation of minutes;

(iii) Other such administrative functions as required.

(b) Energy Bulletin

(i) Editing of the Bulletin;

(ii) Provision of secretarial and translating facilities;

(iii) Production and distribution;

(iv) Advertising.

(c) Technical Assistance and Advice on Request

(i) Preparing reports and documents considered necessary for the work of the Energy Sector;

(ii) Preparing and submitting regional development plans and projects;

(iii) Recommending measures to optimise the utilisation of existing facilities;

(iv) Recommending immediate, medium and long-term measures necessary to meet energy demands;

(v) Assisting Member States with the preparation of documentation in connection with development projects, where necessary.

(d) Relations with Donors

Assisting when requested in bilateral and multilateral negotiations with donors for funding for regional projects and programmes and in lobbying in order to assist the coordinating state and Member States concerned in finding the most suitable potential donor organisation.

The Technical and Administrative Unit is headed by the Regional Coordinator, a senior official of the Government of Angola. Within the context of the guidelines approved by SADCC Ministers, the responsibilities of the Coordinator include:

(a) Convening and chairing regional meetings of energy officials;

(b) Servicing meetings of Energy Ministers and providing follow-up in the implementation of the decisions taken;

(c) Overall editorial and management responsibility for the Regional Energy Bulletin;

(d) Coordination of the Energy Sector in the Region;

(e) When requested, initiating or supporting contacts with SADCC's international cooperating partners;

(f) Overseeing the work and controlling the budget of the Technical and Administrative Unit.

The Coordinator reports to the Committee of Energy Ministers (Energy Ministers Meeting) through the Minister of Energy, Angola.

The Technical and Administrative Unit is in principle organised in three major divisions, i.e. Technical Division, Administrative Division and Energy Bulletin Division. All divisions report directly to the Regional Coordinator and each one is headed by a Coordinator. The Regional Coordinator is supported by a staff of some 15-20 people including an executive director.

The Technical Division is responsible for technical assistance and advice on request (item e, page 3) and takes care of most of the liaison with donors jointly with the Regional Coordinator and the Executive Director (item d, page 4).

The Administrative Division is responsible for internal administrative routines (accounting, secretarial functions, PR, library, etc.), liaison with Member States and administrative arrangements for regional meetings of Energy Ministers and Officials (item a, page 3).

The Energy Bulletin Division is responsible for all matters relating to the preparation, production and distribution of the Energy Bulletin (item b, page 3).

The Technical and Administrative Unit enjoys substantial interest and support from donors. Technical assistance is at present offered by Norway (five experts - one each in energy planning, petroleum, coal, hydropower and administration/economics), Belgium (one expert in administration/staff support) and FFC (one woodfuel specialist) - all stationed or to be stationed in Luanda.

Negotiations are being carried out with Belgium to fund and station in Luanda one energy planner and one specialist in Informatics. Italy has also indicated willingness to second technical assistance personnel to the Unit in Luanda.

Equipment (cars, typewriters, microcomputers, editing equipment for the Bulletin, photocopying machines, etc.) and stationery have been donated by various foreign agencies.

Under a Norwegian grant new temporary offices including office furniture and installations for the Technical and Administrative Unit are being developed. The premises representing a major improvement in working conditions for the Technical and Administrative Unit will be taken into full operation during the last quarter of 1984.

One major objective of the foreign technical assistance is to educate employees of the Technical and Administrative Unit in professions related to energy planning and cooperation. Thus a continuous training takes place in the Unit. So far, Energy Officials have on several occasions received courses in English abroad.

1.2 Organisation and Management of the Energy Sector Project

The Energy Sector, SADCC, is fully aware of the importance in giving donors a clear statement of how the energy projects are to be managed. Consequently, guidelines for the "Organisation and Management of the Energy Sector" have been drawn up in an internal document. Energy Ministers approved the document at their Blantyre meeting, May 1984, as an internal Energy Sector working document for the guidance of Member States. The document reads:

Organization and Management of Energy Sector Projects

The presentation of energy projects to the funding Institutions and Agencies, as well as the subsequent links which will be established at different levels, require a previous definition of the responsibilities concerning the implementation of the projects.

Therefore it is recommended that the following guiding principles are considered:

1. Member States involved in each particular project, undertake to study, with the assistance of the coordinating country the best way to implement it.

2. The Coordinating Country will provide, through the Technical and Administrative Unit of the Energy Sector, the required assistance to Member States in all stages of the project.

3. Financial responsibility for each project will be clearly divided between the Member States involved, and each Member State will be responsible for servicing its financial commitments.

4. Progress report on all energy projects must be presented to Energy Ministers, through the meeting of Energy officials by the Coordinating Country. The Coordinating Country, through the Technical and Administrative Unit, must be kept fully informed of the status of all regional energy projects.

1.3 Coordination With Other Sectors of SADCC

Relationships for cooperation with other sectors have been defined for training and industry in:

"Relationship between the SADCC Regional Training Council and other sectors of the SADCC Programme of Action", Annex F of Report on the Energy Sector, SADCC Council of Ministers, Lusaka, 31 January 1984

and

"Draft Protocol on Cooperation between SADCC Energy and Industry Sector" adopted by Energy Ministers in Blantyre, May 1984, as a guideline to be followed in relations between the two sectors.

These documents define procedures for increased collaboration in fields of common interest and aim at avoiding overlapping or duplication, particularly in the definition, preparation and implementation of projects.

1.4 Energy Policy

The emergence of an energy policy for the SADCC Region was initiated by a position paper prepared and presented by Angola on behalf of SADCC to the UN Conference on New and Renewable Sources of Energy in Nairobi, August 1981. Energy Ministers amended and approved the document during the Nairobi Conference and the Council of Ministers agreed to circulate the paper for information at the SADCC Blantyre Conference, December 1981.

At the first meeting of Energy Ministers in Luanda, February 1982, the Council of Ministers was invited formally to adopt the document. The Council of Ministers adopted the policy paper in their Luanda meeting, June 1982, under the title "Toward an Energy Policy for Southern Africa" on which basis the regional energy programme for Southern Africa is to be developed (Annex I).

1.5 Energy Planning

In Luanda, February 1982, Energy Ministers decided to circulate to Member States a document entitled "An Approach to the Energy Situation in Southern Africa". The document provided a starting point for the construction of an energy master plan for Southern Africa. Questionnaires on national energy balances etc. had been prepared and Member States were requested to fill in these to improve the energy data base.

The February meeting of Energy Ministers requested the meeting of officials to prepare a draft Programme of Action for Energy Planning and Identification of projects in SADCC. The September 1982 meeting of Energy Ministers approved the Programme of Action as a Work Schedule for the near future.

The Work Schedule detailed the time schedule for the collection and analyses of regional energy data leading to the identification of energy projects for presentation to SADCC's international cooperating partners in Lusaka, January 1984. The work was designed to be undertaken in close consultation with Member States and technical missions toured the Region during August/September 1982.

An essential element in the process was the completion by the Member States of the energy questionnaires and their analyses by Angola resulting in the Energy Sector paper presented at the Lusaka Conference 1983 (Project 0.0.1, see Chapter 3).

This work together with the analyses presented in December 1982 at the Harare Seminar, "Energy and Development in Southern Africa, Opportunities and Constraints" (Project 0.0.2, Chapter 3) form the backbone of the available information regarding the overall energy situation in the Region. It is understood that this can only serve as a first approximation to a satisfactory understanding of energy imbalances in SADCC.

There is a clear need to improve the energy data base and also the energy planning system. To facilitate continuous recording of existing conditions, analyses of energy dynamics and predictions of energy developments, the Technical and Administrative Unit has already embarked on the establishment of an Information Coordination System (Project 0.0.5). The system is being developed in the Technical and Administrative Unit with foreign technical assistance and is expected to yield results before the next annual conference.

As an integrated part of energy planning, the Technical and Administrative Unit will have to survey completed studies and reports on energy-related issues conducted by Member States. Of specific interest are Energy Master Plans like those already received from Angola, Lesotho and Swaziland.

Proper energy planning also requires an inventory of regionally based manufacturers of energy equipment, training facilities, research institutions and energy-related journals produced in Member States. Surveying of these topics will be included in the future work programme of TAU.

1.6 SADCC Energy Bulletin

Introduction :

The publication of a Regional Energy Bulletin was agreed in principle by SADCC Energy Ministers at their meeting in February 1982 and formally approved by Ministers at their meeting in September of that year.

The objectives of the SADCC Energy Bulletin are the following:

- To increase the flow of information on the regional energy situation to Member States;
- To provide reliable and up-to-date information relating to energy sector activities at an international level and to help develop and maintain an attitude favourable to regional and international cooperation;
- To promote the policies and programmes of SADCC's Energy Sector in the international media and to prevent disinformation.

At the request of Energy Ministers, a regional survey was carried out covering matters relating to the production, editorial control, organisation and budget of the proposed Bulletin in order to determine where the magazine should be printed and by what methods. The survey examined what type of journalists should be employed by the Bulletin as well as what kind of information ought to be carried by the publication.

Printing :

The first issues of the Bulletin were printed outside the Region. However it is the view of both Energy Ministers and Officials that the Bulletin should be printed in the Region. As from September 1984 the Bulletin will be printed in Angola.

Financing :

The Bulletin shall in principle be self-financed, i.e. the costs incurred in producing it shall be met from sales, advertising and outside contributions.

Editorial Organisation :

The establishment of a qualified Editorial Organisation has proved to be difficult. Being developing countries, the SADCC Member States and in particular Angola as implementing agent have felt the strain caused by lack of adequate infrastructure and qualified manpower to produce the Bulletin.

A gradual and qualitative growth approach has been adopted through initial creation of a small core of professionals in Luanda. The centre in Luanda is supported by regional correspondents and regional experts along with guest contributors taking part in regional activities. A broad exchange of information with regional and international news media is thus being promoted.

Information Material :

As was envisaged from the beginning the main themes of SADCC Energy Bulletin have been: oil, coal, hydropower, gas, new and renewable energy sources, and energy sector activities. In addition it has been possible to extend coverage in the more recent issues to include economics, technology, solar energy and woodfuel. It has also been possible to begin regional reports (so far covering Lesotho, Mozambique, Tanzania, Zambia and Zimbabwe).

1.7 Seminar Activities

Two regional seminars have been completed:

- Energy Development in Southern Africa, Opportunities and Constraints, Harare, December 1982
- Woodfuel Seminar, Luanda, October 1983.

The seminars have proved to be of great importance in making the energy issues of the Region better known. Useful contacts have been established and discussions have been fruitful during both seminars.

The proceedings and recommendations from the seminars have been presented in special reports (see Chapter 3, section on SADCC Energy reports).

A conference on the Operation of SADCC Electricity Utilities is scheduled to take place in early December 1984.

2. CRITERIA FOR SELECTION OF PROJECTS

The criteria for selection of energy projects approved by Energy Ministers in Luanda, People's Republic of Angola, September 1982, and amended in September 1984, are as follows:

2.1 The basic criteria for the selection of regional projects are whether or not they contribute to the achievement of the development objectives of SADCC as defined in the Declaration - Southern Africa: Toward Economic Liberation. SADCC development objectives which will be pursued through coordinated action are:

- the reduction of dependence, particularly, but not only, on the Republic of South Africa;
- the forging of links to create a genuine and equitable regional integration;
- the mobilisation of resources to promote the implementation of national, interstate and regional policies;
- concerted action to secure international cooperation within the framework of our strategy for economic liberation.

2.2 These basic criteria have been further refined in the context of SADCC cooperation in the field of Energy in the policy document - Towards an Energy Policy for Southern Africa. SADCC's energy strategy will aim at achieving, inter alia, the following objectives:

- exploration and exploitation of the Region's massive coal deposits, both to meet regional needs and for export;
- intensification of oil, gas and coal prospecting within the Region, as well as other promising sources of energy;
- increased use of large hydroelectric schemes;
- to promote small-scale hydroelectric schemes as a main contribution to rural development;
- the application of biomass, solar energy, etc., to improve the living standards of the rural population and to meet energy requirements in the urban areas;
- to promote the interconnection of the national electrical networks to guarantee the supply of energy throughout the Region;
- to promote afforestation programmes, to improve forest management practices and to provide basic information to populations in order to achieve rational utilisation and environment improvement.

2.3 In the Energy Sector there are three types of criteria which can be applied in the selection of SADCC projects. These criteria relate to:

(a) The Energy Crisis

SADCC projects should contribute to:

- the reduction of dependence on external supply of energy;
- the lessening of fossil fuel consumption,
- energy conservation;
- meeting the energy needs of the rural population.

(b) Regional Cooperation

SADCC projects should:

- contribute to the energy balance of more than one country;
- be managed, as far as possible, by citizens of the Region;
- represent a certain investment magnitude;
- be owned and controlled from within the Region;
- utilise inputs from within the Region.

(c) Technical Criteria

SADCC projects should meet accepted technical criteria. They should:

- satisfy a clearly defined need;
- be technically feasible;
- be socially and economically justifiable;
- be clearly preferable to any alternative or competing project;
- make a positive contribution to development.

2.4 Given the nature of SADCC and in the light of the above criteria six types of regional projects can be distinguished:

(a) Projects of Regional Dimension and Utility

Such projects result from a coordination of the investment programmes between two or more states, with a view to reducing the competition between countries, avoiding unproductive duplication and promoting production and thus taking advantage of a larger market.

A number of such projects can be developed within the Energy Sector, including among others:

- the refining of oil products;
- the production of electricity, where thanks to the interconnection of grids it is possible to distribute the production of certain power stations between neighbouring countries;
- the production and utilisation of coal.

(b) Projects Located at the Frontier Between Two or Three Countries

Such projects are very specific and generally depend on the presence of natural resources which they exploit. This can be the case with hydroelectric power (like the Kariba power station which belongs both to Zimbabwe and to Zambia), but also coal and gas deposits or other raw materials for energy production.

(c) National Projects With a Regional Impact

- This applies to projects of specific national priority which clearly contribute to the overall development objectives of SADCC and have a potential to serve more than one of the Member States in the medium or long-term future.
- There are also projects which, although they are national, cannot be replaced by projects of regional dimension nor find viable economic alternatives in neighbouring countries and which have a significant impact on the energy balance.

(d) Pilot Projects and Research Centres for New Technologies

Taking into consideration the importance of the investments which such projects require and the economic risks involved, it is preferable to avoid duplication in the Region.

A coordination with regard to the objectives, means and distribution of the results of such projects is consequently desirable for the entire Region.

(e) Utilisation of New and Renewable Sources of Energy

(f) Studies, Training Programmes and Prospecting.

3. STATUS OF PROJECTS, ENERGY SECTOR, SADCC

3.1 Completed Project

OVERALL COORDINATION

0.0.1 Study on Regional Energy Situation and Prospects

The reports of the study was completed during 1983 and distributed to Member States.

0.0.2 Seminar on "Energy Development in Southern Africa: Opportunities and Constraints"

A draft report was made available to Member States in December 1982. As directed by the Maputo Meeting of Energy Ministers July 1983, officials have received the proceedings of the Seminar. In Blantyre, May 1984, Energy Ministers noted the seminar recommendations and agreed that the document be published on behalf of SADCC.

OIL

1.0.1 Phase 1: Study on Regional Self-Sufficiency in the Supply of Oil Products, Phase I - Prefeasibility Study

In Luanda, June 1982, the Council of Ministers approved the Draft Terms of Reference for a study on how SADCC Member States might achieve self-sufficiency in the supply of oil products. The Government of Angola was requested to implement the study as a matter of priority. Technical missions visited Member States to collect information and to consult Member States. Results of the study were presented to Energy Ministers and adopted in Maputo, July 1983. An evaluation of the study has been completed. At the Maputo Meeting a second phase of the study was approved.

3.2 Funded Projects

OVERALL COORDINATION

0.0.3 Support to the Energy Sector, Technical and Administrative Unit

The Technical and Administrative Unit has maintained contacts with those countries and institutions that support it directly and contribute with technical assistance, physical facilities, equipment and training. They are: Belgium, Brazil, EEC, Norway and Sweden.

In the near future, a staff of foreign technicians will join the unit in Luanda. The objective is to develop an increasing amount of work in the Region and through training eventually achieve complete self-reliance in coordination of the Energy Sector, SADCC.

0.0.4 Energy Bulletin

See paragraph 1.6.

0.0.5 Information Coordination System

In early August 1984 discussions between the Regional Coordinator, Norwegian Technical Assistance to TAU and possible Belgian Technical Assistance took place in Luanda. The objective was to establish criteria for cooperation in development of an Energy Data Base and Planning System for the Region. Agreement was reached on a paper defining the cooperation.

OIL

1.0.1 Phase 2: Study on Regional Self-Sufficiency in the Supply of Oil Products, Phase 2 - Feasibility Study

Funding for the study has been secured by EEC.

Following the internal procedures of the EEC the call for tender will be submitted to a short list of eight European Consultants. The Coordinating State is still waiting to receive the short list.

Opening of tender is scheduled for the beginning of November 1984.

The Technical and Administrative Unit will evaluate bids immediately on receipt and appoint the consultant for the study.

1.0.2 Regional Petroleum Development Centre

This project is jointly financed by the Norwegian Agency NORAD, the UNDP and the Angolan Government.

ELECTRICITY

3.0.2 Specialised Training in the Field of Electric Power

This project has received financial commitment from the EEC. The consultant in charge of the implementation of the project will probably be E.D.F. INTERNATIONAL. E.D.F. INTERNATIONAL has now developed the terms of reference and presented them for approval, with a

detailed budget and schedule of work to the European Commission. The Coordinating State is still waiting to receive a response from EEC.

3.5.1 Mozambique/Zimbabwe Electricity Supply Cooperation in the Central/Southern Border Region

Financial commitment for this project was assured by Norway at the Maseru Conference. Bilateral discussions concerning practical matters between the countries involved have started.

3.2.1 Interconnection of Botswana/Zimbabwe Grids

3.2.2 Botswana/Zambia or Zimbabwe Cooperation

3.5.2 Mozambique/Swaziland Electricity Supply Cooperation

In their Blantyre Meeting, May 1984, Energy Ministers decided that Canada should be requested to fund projects 3.2.1, 3.2.2 and 3.5.2. Canada has accepted to finance the studies of all the projects and the implementation of two (3.2.1 and 3.2.2). Member States involved are preparing agreements to be negotiated and signed with CIDA.

3.8.1 Reinforcement of Zambia's North Eastern Grid in Coordination with Malawi and Tanzania.

Norway has been requested and agreed to fund this project.

3.3 Projects with Potential Funding

NEW AND RENEWABLE SOURCES OF ENERGY PROJECTS

4.0.2 Energy Saving in Industry

In January 1984, during the Lusaka Conference, Canada and United Kingdom expressed special interest for this project. Further contacts were made with the United Kingdom.

The Coordinating State with the help of other member countries conducted the first phase of the project in 1983. The first phase dealt with the preliminary selection of candidate enterprises for this project in each member country.

However, without first informing TAU the International Development Research Centre (IDRC) also present in Lusaka started preliminary investigations of industrial companies in Angola and Lesotho. IDRC is prepared to finance and implement the project (4.0.2).

Further negotiations between TAU, CIDA and IDRC will take place in October 1984 or at the beginning of 1985 to define forms of cooperation between interested parties. Cofinancing between CIDA and IDRC is expected to permit a more comprehensive coverage of companies to be investigated.

WOODFUEL PROJECTS

During the Lusaka Conference, the EEC expressed its interest in funding some woodfuel projects. After the Conference, further contact was made with Holland and some discussions with EEC were carried out. These donors are now willing to handle projects 5.0.1, 5.0.2, 5.0.3, 5.0.4 and 5.0.5 regrouped in one global project. This new approach would be less expensive. The Coordinating State is still waiting to receive a draft programme of work for the global project.

3.4 Projects Not Funded

Coal Projects 2.0.1 and 2.0.2

Neither project received financial commitment during the Lusaka Conference. Bilateral-funded studies at a national scale are being carried out in Zimbabwe and Botswana with the cooperation of the German Federal Republic.

The subject was raised once again during consultations between the Regional Coordinator and the EEC. The latter would be prepared upon request of SADCC Member States to convene a special pledging meeting on "How to optimise the coal resources of SADCC Region". A technical document containing all data on coal resources as well as the results of national studies would have to be prepared by TAU and presented to the donors.

Projects 1.7.1, 3.0.1, 3.1.1, 4.0.3, 4.0.4 and 4.0.5 were also not funded.

STATUS OF PROJECTS, ENERGY SECTOR, SADCC (August 1984)

Project No.*)	Project title	Presented	Funding	Status	Reports
	OVERALL COORDINATION				
0.0.1	Study on Regional Energy Situation and Prospects	Maseru (1983)	Belgium	Completed	Belgium Mining Engineering, Vols. 1, 2, 3 and 5
0.0.2	Seminar on 'Energy Development in Southern Africa: Opportunities and Constraints'	Nairobi (1981)	Sweden (SIDA)	Completed	Beijer Institute, 2 volumes
0.0.3	Support to the Energy Sector Technical and Administrative Unit: - Technical Assistance - Physical Facilities & Equipment - Training	Luanda (1982)	Belgium Brazil EEC Norway Sweden	Under implementation	Internal reports on organisation, computer information systems, etc.
0.0.4	Energy Bulletin	Luanda (1982)	Angola	Under implementation	SADCC Energy, 6 issues
0.0.5	Information Coordination System	Lusaka (1984)	Belgium Norway	Start-up 4th quarter 1984	

Project No.*)	Project title	Presented	Funding	Status	Reports
	OIL				
1.0.1	Study on Regional Self-Sufficiency in the Supply of Oil Products				
	Phase 1 - Prefeasibility Study	Maseru (1983)	Belgium	Completed	Belgium Mining Engineering, Vol. 4
	- Evaluation of report		Norway (NORAD)	Completed	Norconsult, 1 volume
	Phase 2 - Feasibility Study	Lusaka (1984)	EEC	International tender beginning Nov. 84	None
1.0.2	Regional Petroleum Development Centre	Maseru (1983)	Angola Norway (NORAD)/ UNDP	Under implementation	
1.7.1	Rehabilitation of Tazama Pipeline	Lusaka (1984)	No finance		
	COAL				
2.0.1	Coal Export Potential Study	Lusaka (1984)	No finance	Potential donor identified	
2.0.2	Coal Conversion Study	Lusaka (1984)	No finance		

Project No.*)	Project title	Presented	Funding	Status	Reports
	ELECTRICITY				
3.0.1	Rural Electrification Pilot Projects	Lusaka (1984)	No finance		
3.0.2	Specialised Training in the Fields of Electric Power - Study	Lusaka (1984)	EEC	Awaiting final decision from EEC	
3.1.1	Flow Measurements on the High Zambezi in Angola	Lusaka (1984)	No finance		
3.2.1	Interconnection of the Botswana/Zimbabwe Grids	Lusaka (1984)	Canada (CIDA)	Negotiations agreement between parts involved	
3.2.2	Botswana/Zambia or Zimbabwe Corporation	Lusaka (1984)	Canada (CIDA)	Negotiations agreement between parts involved	
3.5.1	Mozambique/Zimbabwe Electricity Supply Cooperation in the Central/Southern Border Region	Maseru (1983)	Norway (NORAD)	Agreement reached at the technical level between the two electricity corporations, pending final decision from Ministries in charge	

Project No.*)	Project title	Presented	Funding	Status	Reports
3.5.2	Mozambique/Swaziland Cooperation	Lusaka (1984)	Canada (CIDA)	Negotiations agreement between parts involved	
3.8.1	Zambia/Malawi/Tanzania Interconnection	Lusaka (1984)	Norway (NORAD)	Negotiations agreement between parts involved	
	NEW AND RENEWABLE SOURCES OF ENERGY				
4.0.1	Seminar on 'Woodfuel'	Dar es Salaam (1983)	Angola EEC	Took place in Luanda, Oct. 1983	3 volumes
4.0.2	Energy Saving in Industry	Lusaka (1984)	Canada (CIDA)	Negotiations with IDRC and CIDA	
4.0.3	Solar Energy Pilot Projects	Lusaka (1984)	No finance		
4.0.4	Wind Power Pilot Projects	Lusaka (1984)	No finance		
4.0.5	Integrated Energy Systems for Villages, based on Local Energy Sources	Lusaka (1984)	No finance		

Project No.*)	Project title	Presented	Funding	Status	Reports
	WOODFUEL				
5.0.1	Designing a Methodology for Conducting an Inventory and a Survey of Woodfuel Energy in any SADCC Country	Lusaka (1984)	Holland EEC		
5.0.2	Evaluation of the Experience and Progress made in Agro-Forestry and Community Forestry in SADCC Countries	Lusaka (1984)	Holland EEC		
5.0.3	Evaluation of the Problems, Prospects, and Potential of Urban Wood Plantations as Suppliers of Woodfuel to the Urban Areas	Lusaka (1984)	Holland EEC	Awaiting draft work programme for the projects	
5.0.4	Selection of Suitable and Efficient Woodburning and Charcoal-burning Stoves	Lusaka (1984)	Holland EEC		
5.0.5	Selection of Suitable and Efficient Briquetting and Producer Gas Technologies	Lusaka (1984)	Holland EEC		

*) First digit defines sector: 0 - Overall, 1 - Oil, 2 - Coal, 3 - Electricity, 4 - New & Renewable Energy, 5 - Woodfuel.
Second digit defines country: 0 - Regional, 1 to 9 - SADCC Member States in alphabetical order.
Third digit is a serial number.

SADCC ENERGY SECTOR REPORTS

I. BME - STUDIES ON ENERGY SITUATION

Vol. 1: Reports of the Technical Missions, Botswana, Lesotho, Malawi, Swaziland, Tanzania. November 1982.

Vol. 2: Reports of the Technical Missions, Angola, Mozambique, Zambia, Zimbabwe. November 1982.

Vol. 3: Regional Analyses and Prospects. January 1983.

Vol. 4: The Regional Supply of Oil Products. March 1983.

Vol. 5: Identification of Projects of Regional Interest.

II. BEIJER INSTITUTE REPORT

SADCC: ENERGY AND DEVELOPMENT TO THE YEAR 2000
May 1983 (Parts I and II)

III. EEC - WOODFUEL SEMINAR REPORTS

1. SADCC ENERGY SECTOR
Proceedings of the Woodfuel Seminar. Luanda, October 1983.

2. SADCC ENERGY SECTOR
Final Report, Woodfuel Seminar. Luanda, October 1983.

3. SADCC ENERGY SECTOR
Seminar Document, Woodfuel Seminar. Luanda, October 1983.

IV. NORCONSULT

Evaluation of the Belgian Mining Engineers (BME)
Study on how SADCC countries might achieve self-sufficiency in the supply of oil products (Phase 1).

4. RESPONSE AND LIAISON WITH DONORS

SADCC Energy Sector has been enjoying a great interest and encouraging commitments from the donors' community.

In fact, the majority of the regional energy projects presented both at the Lusaka Conference (January 1984) and the Maseru Conference (January 1983) have secured funds in grant terms or have been targets of a deep interest towards their implementation. The Technical and Administrative Unit (TAU) is no exception to donors' interest in the SADCC Energy Sector. Considerable funds for offices, equipment, cars, etc., have been received as well as technical assistance.

Belgium, Brazil, Canada, EEC, Norway, Sweden and UNDP are, so far, the SADCC Energy Sector international cooperating partners.

There is a strong interest to include others such as Austria, Denmark, Federal Republic of Germany, Finland, France, Greece, India, Italy, Japan, Mexico, Portugal, Switzerland and UK, among others.

The SADCC Energy Sector Technical and Administrative Unit Officials and the Regional Coordinator in particular, have been travelling to undertake consultations and negotiations in order to bring about financing packages that could enable the Sector to successfully carry out its programme of action. Angola-sponsored travelling has taken place since August 1982 to all the SADCC Energy Sector cooperating partners. The results of this activity is the agreements already signed or about to be signed with donors on financial, technical assistance to the TAU or to each individual project.

More detailed information on the relationships with SADCC Energy Sector and each international cooperating partner is summarised below.

Status of the Relationship Between SADCC Energy Sector and the International Donor Country (countries and organisations listed alphabetically)

AUSTRIA
- Consultations in preparation phase.

BELGIUM
- Agreement signed in 1982 on technical and material assistance to TAU
- Further assistance under negotiation.

BRAZIL
- Assistance to TAU on professional training
- Material assistance to TAU agreed and about to be started.

CANADA	- Committed to finance studies and implementation of electricity interconnection projects 3.2.1, 3.2.2 and 3.5.2 (only prefeasibility study)
	- Support to the SADCC Energy Bulletin
	- Further support subject to discussion.
DENMARK	- Consultations in preparation phase.
EEC	- Assistance granted to TAU (technical, material and on professional training) since 1982
	- Funds granted to 2nd phase of the study on "How SADCC countries might achieve self-sufficiency in the supply of oil products"
	- Funds about to be granted on project of electricity training (3.0.2)
	- Funds granted for woodfuel projects.
FINLAND	- Consultations in preparation phase.
FRANCE	- Agreement about to be signed on financial assistance to TAU (technical, financial and on professional training)
	- Interest to finance project 3.0.2 together with EEC.
FEDERAL REP. OF GERMANY	- Consultations in preparation phase.
GREECE	- Consultations in preparation phase.
HOLLAND	- Funds granted for woodfuel projects.
INDIA	- Consultations underway.
ITALY	- Agreement about to be signed on financial assistance to TAU and to the Regional Energy Bulletin (technical, financial and on professional training)
	- Interest to finance other projects.
JAPAN	- Consultations in preparation phase.
MEXICO	- Consultations in preparation phase.
NORWAY	- Assistance granted to TAU (financial, technical, material and on professional training) since January 1985
	- Major donor "Regional Petroleum Training Centre" (with UNDP), project 1.0.2
	- Funding projects 3.5.1 and 3.8.1
	- Interest to fund other projects.

PORTUGAL	- Agreement about to be signed on financial assistance to TAU
	- Consultations underway for further assistance on other energy projects.
SWEDEN	- Assistance provided for the preparation and implementation of the Harare Seminar (December 1982)
	- Consultations for further assistance still underway
	- Funds granted for material assistance to TAU.
SWITZERLAND	- Consultations in preparation phase.
UK	- Material assistance provided to TAU
	- Consultations underway for further assistance.
UNDP	- Assistance granted to the project "Regional Petroleum Training Centre" (together with Norway)
	- Consultations for further assistance in preparation phase.

INTRODUCTION

The dualistic socio-economic structure of the economies in the SADCC Region with the formal or modern sector on the one hand and the traditional or informal sector existing independently on the other hand is clearly reflected in the energy situation. This is characterised by two rather distinct and almost unrelated phenomena:

- Depletion of woodfuel resources in rural areas and the vicinity of urban settlements restricting or even reducing agricultural output and energy supply to low and medium-income households and

- rapid increases in the price and instability in supply of petroleum and petroleum products since 1973 causing severe depletion of foreign exchange reserves and deterioration to the activity of the modern sector of the SADCC societies.

For the large majority of the population in the SADCC countries problems related to energy are associated with the woodfuel crises. Varying with country 60% to 90% of total population in the Member States live in the rural areas and depend on woodfuel with very limited alternative energy supply options available.

Of major importance to the rural population is the interrelationship between energy, agriculture and forestry.

In urban and semi-urban areas a major problem related to traditional fuel is deforestation in the vicinity of settlements and deteriorating supply of woodfuel. This again introduces commercial wood-cutting in remote rural areas with excess harvesting of wood stocks where local subsistence demand has been balanced by the yields.

Due to the structural dichotomy between formal and informal sectors of the Member States' economies the impact of increasing commercial energy prices has mainly been limited to the modern sector. Terms of trade have deteriorated for most of the Member States. This has been caused both directly by the price increases of petroleum and petroleum products and indirectly by price increases on manufactured imports and in some cases reduced prices on exports. Balance of payments problems with increases in debts and debt servicing burdens and drainage of foreign reserves have been predominant.

The SADCC Region experiences shortages in woodfuel but is richly endowed with commercial energy sources. The indigenous potential in hydropower, coal, oil and gas can be developed to substitute imports (petroleum and petroleum products) and woodfuel. Technically this is possible and from an economic point of view the countries may benefit grossly from such an approach. Furthermore it might lay the foundation for increased agricultural production and spur on manufacturing activities.

The new projects presented in Section III clearly demonstrate the efforts of SADCC to exploit the indigenous energy potential to substitute traditional and imported fuels by domestic commercial energy.

Within the Member States it is extremely important that the energy, agriculture and forestry sectors outline joint strategies due to the strong mutual interrelationships identified in the rural sector. In general the Ministries of Planning and Energy should secure coordination between the overall macro-economic plans and the various utilities, corporations and institutions in the Energy Sector.

An assessment of present imbalances and future trends toward year 1990 in regional supply and demand of various sources of energy were presented in detail to the Lusaka Conference in 1984. Consequently in this report only a summary of the present energy situation and future trends are presented (Chapter 2). Little new information in way of improved statistics on energy in the SADCC Region has been made available since the Lusaka Conference.

Energy and Agriculture are sectors given special attention during the Conference in Mbabane. These sectors are also heavily interrelated and of major importance to the overall socio-economic development of the SADCC Region. It has therefore been natural to give a specific outline of issues related to energy and the rural sector in this presentation of the Energy Sector (Chapter 3).

ENERGY SUPPLY AND DEMAND PATTERN IN SADCC

General

Traditional fuels (i.e. firewood, charcoal, animal dung and crop residue) are the major sources of energy for the majority of people in the SADCC Region. Measured in energy equivalents approximately 2/3 to 3/4 of total energy consumption in the Region are traditional fuels.

The dominant sources of commercial fuels constituting 1/4 to 1/3 of total energy requirements in the Region are petroleum, petroleum products and hydropower. In some of the Member States (Zimbabwe, Zambia and Botswana) steam coal plays a significant role in energy supply.

The relative importance of the various types of energy is not easily measured in a reliable and meaningful way. Many types of energy sources cannot be used as substitutes for other sources for technical and/or economic reasons. Furthermore, data on consumption of traditional fuels are strongly dependent on estimation since statistics are scarce. The conversion of various fuels into one common denominator also poses significant problems. Comparable statistics on energy consumption by source may vary significantly dependent on whether a straightforward conversion by energy equivalent factors or factors reflecting requirements

to generate one type of energy by another - generation factors - are applied.

Table 1 presents data on energy demand in the SADCC Region from two different studies.

TABLE 1

Energy Demand by Type of Fuel in the SADCC Region (1980)

	Consumption			
	BME estimate[2]		Beijer estimate[3]	
	PJ[1]	%	PJ	%
Traditional fuels (Woodfuel, charcoal, animal dung and crop residue)	803	66	1130	78
Commercial fuels				
Electricity	189	16	57	4
Petroleum products	145	12	155	11
Steam coal	80	6	93	6
Total	1217	100	1456	100

1) 1 million t.o.e. = 45.37 Peta Joule (10^{15} Joule : PJ)

2) Belgian Mining Engineers: "Regional Analyses and Prospects January 1983"

3) Beijer Institute, Sweden: "SADCC, Energy and Development to the Year 2000".

The figures illustrate a wide variation in the two studies both in the estimated importance of traditional fuels compared to commercial fuels and in the distribution of commercial fuels.

The traditional fuels dominate the energy demand picture as presented in Table 1. In any further analysis it is however important to recognise that measured in terms of end use the commercial fuels increase their share from approximately one fourth of the demand to two-thirds of the energy actually utilised by the consumers due to higher conversion efficiencies.

The presentation above should clearly illustrate the difficult statistical situation facing analysts of the energy situation in the SADCC Region. It is thus relevant to caution that data presented in this report should be interpreted as orders of magnitude rather than exact statements.

The data base to be implemented (Project 0.0.5) is expected to improve the data situation, i.a. as analysis and consistence control by comparing different information sources will improve data assessment and quality. The data base will probably demonstrate weaknesses in the existing statistics and hence identify requirements for more primary statistics.

Demand by Source of Energy, Area and Sector

Traditional fuels are mainly consumed in the rural areas and by urban low and medium-income households (Chapter 3).

Consumption of commercial fuels is linked to the modern sector and consequently mainly to the urban areas of the SADCC Member States.

Available statistics indicate that of petroleum products used in the Region more than half is consumed by the transportation sector and one quarter by industry. Only 10-15% is consumed by agriculture and households and 10% by institutions etc. Consequently mainly gas-oil, gasoline and jet fuel are consumed. Total consumption in the SADCC Region of petroleum and petroleum products was 3.5 million tonnes in 1981.

The bulk of hydropower consumption is concentrated along the central, interconnected 330 kV/220 kV grid between Northern Zambia (the Copperbelt) and Southern Zimbabwe (Harare/Bulawayo), reflecting the demand by the mining and urban sectors in Zambia and the industrial and urban sectors in Zimbabwe.

Coal is consumed in all the SADCC Member States with the exception of Angola. But only Zimbabwe, Zambia and Botswana are major consumers. The main users of steam coal are the thermal power stations, a certain number of mining installations and to a lesser degree the railways (Zimbabwe, Mozambique).

Supply and Energy Imbalances

Petroleum :

Angola is the only producer of crude in the Region and refines the products required for its market (Luanda Refinery).

Tanzania, Zambia and Mozambique import crude and refine it at refineries in Dar es Salaam, N'Dola and Maputo.

Other countries cover all their requirements by importing petroleum products. Zimbabwe, which is in this category, has a refinery at Feruka, but it has been closed since 1966.

Installed annual refinery capacity in the Region is more than 5 million tonnes. Available refinery capacity is approximately 3.5 million tonnes.

Even though the refinery capacity is more or less equal to total demand of petroleum products demand in the Region, imbalances by product exist. At present there is a shortage in internal refinery output of light products, notably gas-oil and gasoline and surplus production in heavy products (fuel oil).

Electricity :

The total installed capacity for electricity generation in the Region is about 6300 MW (1982). The available installed capacity for internal use in the Region is 4400 MW as only 150 MW out of the 2075 MW from the Cahora Bassa hydroelectric plant in Mozambique are reserved for this country.

Out of the 4400 MW of installed capacity available for the Region 3/4 are from hydroelectric plants, 43% of which from the Zambezi River, 1/8 from coal power stations and approximately 1/8 from fuel and gas-oil power stations or gas turbines.

The regional demand for electricy amounted to some 18,000 GWh in 1982 implying an average load factor on available generation capacity for internal use of 46%. Assuming that fuel- and gas-oil installations are used as emergency or back-up power only the load factor on hydropower and coal-fired generation was on average 53%.

Coal :

The coal sector is little developed in the Region, and for the time being represents only some 20% of commercial energy consumption.

The proven reserves of coal in the Region are however considerable. More than 4 billion MT of coal have been identified. The major proven deposits are located in Botswana and Zimbabwe. The potential coal reserves of the Region have been estimated at 55-75 billion MT. However, except for Zimbabwe, coal sector development in the Region is still in its infancy.

Future Trends

The future development in supply and demand of energy in the SADCC Region will be dependent, inter alia, on the overall socio-economic development, substitution from one source of energy to another, technological change and policy decisions.

In the preparation of this report, no attempt was made to quantify how all these interrelated factors may develop and in the end determine the future energy supply and demand situation in the Region. Only some general comments are offered to indicate the determinants of future commercial energy trends and options available.

The present structure of demand for commercial energy indicates that future consumption may be critically exposed to fluctuating demand due to the structure of few and large units in mining and manufacturing. Domestic use of commercial energy mainly in urban and semi-urban areas and energy demand by the transportation sectors will probably develop more steadily.

Forecasts by type of energy will depend on policy decisions and the possibility of raising finance for development of internal gas, hydropower and/or coal resources.

In some cases, the direct and immediate substitution of petroleum by a given replacement fuel is possible (e.g. natural gas for fuel oil in boiler or furnace applications). However, in most cases significant process modifications and/or substantial investments in new or add-on facilities are needed (e.g. coal handling facilities and new boilers to replace fuel oil in industrial applications or thermal power plants, or the added equipment for compressed natural gas utilisation in transport, etc.). Also, in many cases such substitutions are uneconomic unless a sufficiently large number of new uses can be developed jointly and simultaneously in order to justify required infrastructure investments such as pipelines, railways, bulk handling facilities, storage yards, etc.

As many of the countries in SADCC often consume too little energy to justify the large initial investments alone, coordinated effort is required in the SADCC Region to launch such multi-energy development projects.

3. THE ROLE AND STRUCTURE OF THE RURAL SECTOR

In 1980 almost 50 million out of a total 58 million population of the SADCC Region lived in rural areas. In addition a significant portion of the urban population still practise rural habits and technologies in their household activities such as cooking, heating, washing and other energy-consuming tasks.

Not surprisingly therefore the share of traditional fuels is the dominant source of energy in the Region varying from less than 60% in Botswana, Zambia and Zimbabwe to around 90% in Malawi, Mozambique and Tanzania. These latter three countries constitute 60% of total population in the SADCC Region with more than 31 million rural dwellers.

Traditional energy sources are expected to continue to be dominant in the SADCC member countries. There are several reasons why this is a realistic assumption.

- The urban share of total population is on average less than 15% varying from less than 8% in Tanzania, Mozambique and Malawi to more than 20% in Angola and Zimbabwe and an exceptionally high 42% in Zambia.

- In spite of rapid urbanisation rural populations are projected to grow significantly for several decades.

- Large portions of urban dwellers continue to use traditional energy and rural technologies for cooking, heating and washing.

- Although there is some scope for fuel substitution and fuel efficiency improvement in urban areas, very little scope for substitution is projected for rural areas.

- The relative inaccessibility and the male head of household orientation of extension services to rural areas make the introduction of fuel-saving techniques very costly and too slow to have major impact.

- Due to the dualism between formal (modern) and informal (traditional) sectors, the scope for transfer of technology is limited in the short and intermediate run.

There is thus little scope for rural fuel use substitution and savings in the short run.

Increasing difficulties in obtaining sufficient and readily available supplies of woodfuel are experienced to varying degrees throughout the Region. The rate of harvesting from the biomass stock exceeds the yields in many cases and the pace of stock depletion then becomes an exponentially accelerating process.

At present the situation ranges from cases of woodfuel shortages over substantial portions of the populated rural areas, deforestation around urban areas for charcoal supply, to acute but limited local shortages of woodfuel.

Surveys have found that in parts of Central Tanzania women and children spend 250-300 workdays per year on average to collect the fuelwood needs of a household. Several places in sub-Sahara Africa with low-income households have been found to spend more than 20% of their income on fuelwood/charcoal; it is not unusual to find that the cooking fuel costs more than the content of the pot.

Rural dwellers collect half of their fuelwood from their own trees and the rest from communal land. The consumption is rather cost-inelastic. In other words if the effort required to collect the necessary fuelwood increases, the amount of fuelwood is hardly reduced. It is the amount of household resources in terms of cash income and labour for activities other than fuelwood collection that are cut back.

The per capita fuelwood consumption in the SADCC Region varies from 0.5 to 2 m^3 per year depending on location (urban/rural, temperature, humidity, etc.). These unit figures are not expected to change much with increasing fuelwood scarcity so that total rural consumption increase would be proportional to rural population growth.

Depletion of the forest cover leads to deforestation, soil fertility reduction and eventually desertification. Only to a limited extent this negative development can be attributed to the fuelwood gathering for local needs by rural dwellers.

If anything, it is the opening up of communal forest land to non-local demands for forest products that poses the dominating threat to the forest cover in the Region. Commercial logging operations require access roads that are later used by small-scale farmers for establishing new settlements on this newly accessible land. They tend to apply non-sustainable slash-and-burn farming techniques and too short fallow.

Charcoal tradesmen serving the urban centres constitute another outside commercial demand factor whose activities lead to significantly increased wood harvesting even at minor price increases. In other words, whereas the purely local subsistence fuelwood demand is limited and price-insensitive, the commercial impact of logging and urban woodfuel demand is increasingly price-elastic and leads to accelerated depletion of forest stock. The scarcer the woodfuel near urban centres the higher the price and the farther away it becomes profitable to deplete the woodstock for commercial trade. This development is widely observed in the Region and elsewhere in sub-Sahara Africa.

This process is, unfortunately accelerated further by the environmental impact of soil deterioration thus reducing agricultural potentials. As the tree cover is removed the soil is eroded and fertility declines. The rapidly increasing population pressure on gradually less fertile land accelerates the process of cultivating new and increasingly marginal land with increasingly intensive subsistence techniques in terms of shortened fallow periods. This reduces the cultivable soil life further and new land must be cleared reducing the tree cover and thus fuelwood supply further. With increasing fuelwood scarcity animal dung and crop residues are increasingly adopted as woodfuel substitutes, and through reduced application of dung as fertiliser this habit further deteriorates the soil quality and thus agricultural yields.

This strong and increasing interdependence between energy, agriculture and forestry requires strategies, actions and programmes across the domains of individual ministries. Whatever is decided for one sector strongly affects the outcome of the others. The fragile ecological balances and the high risk of overall severe losses if one sector chooses a development path out of balance with the other two, suggest strong coordination between the three sectors - if necessary through a national planning commission - or ministry. Where transnational issues are in focus the SADCC Secretariat may serve as the coordinating body.

Clearly, data available to the analysts and planners of these tasks are poor, unreliable and not covering all those variables and characteristics required by detailed policy-oriented planning models. Designing a uniform and appropriate energy data format and establishing methods and routines for collection and processing these data is an urgent task.

But the accelerating imbalances in the traditional Energy Sector are so acute that comprehensive documentation for policy formulations, strategies and actions is urgently required. Work can start immediately to develop feasible and operational demand management systems and coordinated supply increased by joint efforts of energy, forestry and agriculture officials. To the extent agro-forestry is found to provide a set of promising actions the extension services required should be jointly designed and provided by the agriculture and forestry sector experts, possibly supported/checked by environmental experts and the planners of the Energy Sector.

The SADCC countries can ill afford to delay actions along these lines in the traditional sector.

SECTION III

NEW PROJECTS

INTRODUCTION

This section consists of descriptions of projects for which funding is sought by SADCC Member States.

It should be noted that there is considerable variation in the degree of detail in which the various projects have been described. This is because these projects have reached differing stages of evaluation and consideration. Some of the projects described in this section will require a more detailed Terms of Reference to be formulated prior to initiating project activities. However, the descriptions presented here should be sufficient to indicate to SADCC international partners the nature and magnitude of the activities proposed for each project.

The projects have been numbered according to a system based on three digits. The first digit indicates the sector as follows:

0 - Overall coordination/Multimodal
1 - Oil
2 - Coal
3 - Electricity
4 - New and Renewable Sources
5 - Woodfuel

The second digit indicates the country as follows:

0 - Regional	5 - Mozambique
1 - Angola	6 - Swaziland
2 - Botswana	7 - Tanzania
3 - Lesotho	8 - Zambia
4 - Malawi	9 - Zimbabwe

The third digit is a serial number, to differentiate among several projects having the same sector and country. The serial numbering is a continuation from the projects presented at the SADCC Lusaka Conference of 2/3 February 1984.

A summary of the project descriptions is presented immediately following this page. The intention of this summary is to provide an overview of the SADCC projects, which are described in greater detail after the summary.

SUMMARY OF PROJECT DESCRIPTIONS

Project No. : 1.4.1

Country : Malawi

Title : Hydrocarbon Exploration in the Malawi Rift Valley

Summary : This project will be the sequel to a ship-borne seismic survey on Lake Malawi which investigated the possible presence of hydrocarbons. The project consists primarily of onshore geophysical surveys and deep exploratory drilling with associated evaluation of data.

Cost Estimate : USD 1,514,000

Detailed Description : Page 48.

Project No. : 2.2.1

Country : Botswana

Title : Investigation into Possible Low-Temperature Carbonisation (LTC) of Coal

Summary : Phase I of the project is a feasibility study which will assess the size of a coal conversion plant and Phase II includes the sampling, transport and laboratory tests of approximately 20 tonnes of coal from the Morupule and Kgaswe coalfields.

Cost Estimate : BWP 540,000

Detailed Description : Page 50.

Project No. : 2.4.1

Country : Malawi

Title : Coal Exploration and Evaluation

Summary : This project consists primarily of geological investigations of coal-bearing sedimentary basins. Trenching, drilling and mapping will be done, together with the collection and testing of samples.

Cost Estimate : USD 1,952,825

Detailed Description : Page 54.

Project No.	:	2.4.2
Country	:	Malawi
Title	:	Development of Coal Analysis Laboratory
Summary	:	This project involves the acquisition and development of a laboratory to analyse coal samples, and training activities sufficient to allow the operation of the laboratory.
Cost Estimate	:	USD 288,000
Detailed Description	:	Page 59.

Project No.	:	2.4.3
Country	:	Malawi
Title	:	Coal Mining Development Trial at Livingstonia
Summary	:	This project involves the design of a coal-mining procedure for a site at Livingstonia, and the trial mining of 500 tonnes.
Cost Estimate	:	USD 385,000
Detailed Description	:	Page 63.

Project No.	:	2.8.1
Country	:	Zambia
Title	:	Investigation of Coal Briquetting
Summary	:	The project comprises appraisal of previous studies, sampling, transport, laboratory and coal briquetting tests. Benefit-cost analyses and a market study are also included in the project.
Cost Estimate	:	USD 240,000
Detailed Description	:	Page 65.

Project No. : 2.9.1

Country : Zimbabwe

Title : Coal Stoves for Use in Rural Areas

Summary : The project aims at installing 400 coal-burning stoves in rural areas of the country as well as training of local artisans and users. A study of user acceptability and impact on the deforestation problem is also included in the project.

Cost Estimate : ZWD 260,000

Detailed Description : Page 69.

Project No. : 3.0.3

Country : All SADCC countries

Title : Prefeasibility Study for Maintenance of Mechanical Equipment in Power Stations

Summary : The study aims at assessing the present maintenance costs of power station mechanical equipment in all SADCC member countries and will propose measures to reduce the related foreign exchange expenditures.

Cost Estimate : USD 150,000

Detailed Description : Page 73.

Project No. : 3.1.2

Country : Angola

Title : Interconnection of the Northern, Central and Southern Electricity Supply Systems

Summary : The study will, in three phases, evaluate and design, survey, and produce tender documents for an interconnection of the presently unconnected electricity supply systems of Angola. In addition, the possibility of interconnection with the Namibian system will be considered.

Cost Estimate : Phase I - USD 50,000
Phase II - USD 150,000
Phase III - USD 250,000

Detailed Description : Page 76.

Project No. : 3.1.3

Country : Angola

Title : Consultancy Services for the Completion of the Gove Hydroelectric Development

Summary : Phase I of the project is a study concerning the generation and transmission facilities in the central power system, with special emphasis on using the existing Gove Dam for hydroelectric production purposes.

Phase II comprises detailed engineering, tendering and works supervision.

Cost Estimate :

Phase I	USD 200,000
Phase II	USD 1,800,000
Total	USD 2,000,000

Detailed Description : Page 78.

Project No. : 3.2.2

Country : Botswana

Title : Connection of Serowe, Palapye and Mahalapye to the National Grid

Summary : The project comprises the construction of about 140 km route length of 33 kV overhead transmission lines and three 33/11 kV substations. Consultancy services are also included.

Cost Estimate : BWP 2,150,000

Detailed Description : Page 83.

Project No. : 3.3.1

Country : Lesotho

Title : Development of Small Hydropower Facilities at Mantsonyane and Semonkong

Summary : This project involves the design and construction of two small hydropower projects. Feasibility studies have been performed at both sites.

Cost Estimate : USD 7.4 million

Detailed Description : Page 88.

Project No.	:	3.3.2
Country	:	Lesotho
Title	:	33 kV Subtransmission Network Development
Summary	:	The project involves the construction of subtransmission network extensions which have already been planned and designed.
Cost Estimate	:	USD 4 million
Detailed Description	:	Page 90.

Project No.	:	3.4.1
Country	:	Malawi
Title	:	Malawi-Mozambique Electricity Supply in the Eastern and Western Border Regions
Summary	:	The project involves the construction of 33 kV transmission lines from the Malawi grid to serve three towns in Mozambique near the border with Malawi.
Cost Estimate	:	USD 1,726,000
Detailed Description	:	Page 92.

Project No.	:	3.4.2
Country	:	Malawi
Title	:	Karonga Small Hydropower Plant
Summary	:	This project will be carried out in two stages: the first consists of a feasibility study of the hydropower site near Karonga Town, and the second stage consists of project construction.
Cost Estimate	:	USD 2.5 million
Detailed Description	:	Page 97.

Project No.	:	3.5.3
Country	:	Mozambique
Title	:	Corumana Hydropower Project
Summary	:	This project involves the construction of a hydropower generation facility as an addition to a dam and reservoir currently under construction for irrigation purposes. A feasibility study has indicated that this 14 MW installed capacity project is economic. Tender documents are under preparation.
Cost Estimate	:	USD 10.95 million
Detailed Description	:	Page 99.

Project No.	:	3.5.4
Country	:	Mozambique
Title	:	Mavuzi Hydropower Project Expansion
Summary	:	This project involves a two-stage study of alternative sources of electric energy in Mozambique which could be used to supply the Mutare Region in Zimbabwe.
Cost Estimate	:	USD 720,000
Detailed Description	:	Page 102.

Project No.	:	3.5.5
Country	:	Mozambique
Title	:	Mozambique-Malawi Interconnection of Electricity Supplies
Summary	:	This project consists of a study of the feasibility of a transmission line which would carry power generated at Cahora Bassa to Malawi, and thereafter to the northeastern part of Mozambique. A number of towns along the line could be connected to the national grid of Mozambique, and power exchanges with Malawi could take place with the construction of this line.
Cost Estimate	:	USD 100,000
Detailed Description	:	Page 106.

Project No.	:	3.5.6
Country	:	Mozambique
Title	:	Pequenos Libombos Hydropower Project
Summary	:	This project involves the construction of a hydropower generation facility as part of a reservoir currently under construction for Maputo water supply. It will serve to provide a secure source of generation for pumping of water to Maputo.
Cost Estimate	:	USD 7.58 million
Detailed Description	:	Page 108.

Project No.	:	3.7.1
Country	:	Tanzania
Title	:	Malagarasi Hydropower Project
Summary	:	The project comprises the complete construction of a 7.6 MW hydroelectric scheme in the Kigoma Region of the country. Transmission lines, substations and consultancy services for engineering and supervision are also included in the project.
Cost Estimate	:	USD 30 million
Detailed Description	:	Page 111.

Project No.	:	3.7.2
Country	:	Tanzania
Title	:	Sunda Falls Power Plant
Summary	:	The project comprises the complete construction of a 3 MW hydroelectric scheme in the Tunduru Region near the border with Mozambique. Transmission lines, substations and consultancy services for engineering and supervision are also included in the project.
Cost Estimate	:	TZS 90 million
Detailed Description	:	Page 114.

Project No.	:	3.7.3
Country	:	Tanzania
Title	:	Kidatu-Morogoro 220 kV Transmission Line
Summary	:	The project comprises the construction of approximately 160 km route length of 200 kV overhead transmission line from existing Kidatu Power Station to Morogoro Substation. Consultancy services are also included.
Cost Estimate	:	USD 20 million
Detailed Description	:	Page 117.

Project No.	:	4.8.1.
Country	:	Zambia
Title	:	Energy Conservation Projects, Indeni Petroleum Refinery
Summary	:	The project, which aims at saving energy in the existing Indeni Petroleum Refinery, comprises the installation of the following: - Waste-heat recovery from the hydrodesulphuriser and reformer furnaces - Economisers in the boilers - Pre-flash tower in the crude distilling unit.
Cost Estimate	:	USD 1.4 million
Detailed Description	:	Page 120.

Project No.	:	4.8.2
Country	:	Zambia
Title	:	Energy Conservation in Mining and Industry
Summary	:	The project is a study which will assess energy use in mining and other industries and recommend adequate measures to reduce their energy consumption.
Cost Estimate	:	ZMK 215,000
Detailed Description	:	Page 123.

Project No.	:	5.1.1
Country	:	Angola
Title	:	Evaluation of the Use of Woodfuel in Angola
Summary	:	The study comprises development and proposal to the national authorities of the basic guidelines to be adopted to alleviate the woodfuel crisis - mainly in the urban areas. New woodfuel projects including terms of references are to be identified and presented.
Cost Estimate	:	USD 286,500
Detailed Description	:	Page 129.

Project No.	:	5.4.1
Country	:	Malawi
Title	:	Blantyre City Fuelwood Project
Summary	:	This project involves the establishment and operation of 64,660 ha of fuelwood plantations, together with the associated training and civil works.
Cost Estimate	:	USD 6,540,000
Detailed Description	:	Page 133.

Project No.	:	5.7.1
Country	:	Tanzania
Title	:	Establishing a Fuelwood Plantation at Ruvu
Summary	:	The project comprises the establishment of a 45,000 ha fuelwood plantation. A feasibility and market study to determine the need and profitability of an associated charcoal production is also included.
Cost Estimate	:	TZS 11,700,000
Detailed Description	:	Page 137.

PROJECT DESCRIPTIONS

Project No. 1.4.1

Project title: HYDROCARBON EXPLORATION IN THE MALAWI RIFT VALLEY - (MALAWI)

Background

During 1981 a ship-borne seismic survey was carried out on Lake Malawi by a team from Duke University of the USA, with assistance from the Geological Survey of Malawi. Preliminary interpretation of the results indicated that considerable thicknesses of lake-bed sediments were present in two fault-bound basins. Two sedimentary units could be distinguished from the seismic profiles: an upper unconsolidated unit of muds and sands about 100 m thick covering a much thicker consolidated formation with faults. It is the very thick sedimentary formations which have a potential for gas and oil content in significant quantities.

Following this project, an agreement was negotiated with Shell B.V. to carry out airborne geophysical surveys over Lake Malawi and the Lower Shire Valley. The results indicated that sediments up to 4 km thick exist in primarily the northern areas of the lake.

The next step in investigations should be an exploratory drilling programme. As it is very expensive to conduct offshore drilling activities, it is proposed to do the drilling on land at appropriate locations, followed by offshore studies at a later stage.

Objectives

This project has the following objectives:

- to gain information of regional natural resources
- to assist in the long-range goal of diminishing importation of fossil fuels.

Work Description

The project basically involves the following main features:

1. Establishment of the lithostratigraphic sedimentary units, their thickness, and depth to basement complex. Retrieval of complete sediment core sections by deep drilling.

2. Determination of the onshore hydrocarbon potential of the Malawi Rift Valley using geophysical and deep drilling method.

3. Evaluation of geophysical and deep drilling data to improve the presently available geological knowledge of the Malawi Rift Valley.

4. Provision of basic information to commercial concerns wishing to carry out additional detailed hydrocarbon exploration.

The geophysical surveys (including seismic and gravity surveys) will be carried out in Chilumba, Nkhata Bay, Dwangwa and the Lower Shire areas.

Implementation

The Donor will solicit international tenders for suitable contractors and geophysical consultants. The executing agency will be the Geophysical Survey of the Malawi Government. The work will be done in the following phases over a period of 2 years:

Phase 1: A consultant geophysicist will be hired to carry out detailed project analysis including estimated costs, geophysical instrumentation, capacity of drilling equipment, contract specifications, review quotations, and advise on the hiring of a contractor.

Phase 2: Once a contractor is hired, the consultant geophysicist and the Department of Geological Survey (Malawi Government) will monitor progress of the work.

Phase 3: Evaluation of the work done by the contractor. The consultant geophysicist will advise on the result of the work of the contractor.

Cost Estimate

The project costs are estimated as follows. Costs are indicative and subject to change.

(Estimated costs US dollars)

	Category	Year		Total
		1985	1986	2 years
(i)	Equipment	86,800	31,500	118,300
(ii)	Personal emoluments	168,000	177,800	345,800
(iii)	Running expenses	154,000	185,500	339,500
(iv)	Special expenditure	514,500	196,000	710,500
	GRAND TOTAL	923,300	590,800	1,514,100

Notes:
(i) Purchase of other equipment and spare parts.
(ii) Salaries for project consultants.
(iii) External travel, internal travel and office sundries, etc.
(iv) Ground geophysical surveys, deep drilling, data analysis and interpretation, purchase special equipment as per (i) above (mobile drilling rig and accessories).

Funding Requirements

All project costs are requested to be met by donor funding.

Project No. 2.2.1

Project title: INVESTIGATION INTO POSSIBLE LOW-TEMPERATURE CARBONISATION (LTC) OF COAL - (BOTSWANA)

Synopsis

This project proposes a detailed investigation into the various Botswana coals in order to determine whether Low-Temperature Carbonisation (LTC) is a feasible technology for coal processing in Botswana.

Coal conversion by LTC is a proven method of producing combustible gas, tar and coke (char). The gas can be burned for domestic or industrial use, the tar can be refined to produce benzol for chemicals or motor fuels and asphalt for roads. Ammonia for fertilisers can be extracted, and coke can be used as solid, smokeless fuel.

An LTC plant in Botswana may satisfy a significant part of the total demand for motor fuels (presently imported), and additionally would make available a solid, smokeless fuel which could substitute for imported graded coal. Export of coke may be viable. (It should be noted that the coke so produced has a higher calorific value than raw coal and firewood and thus transport costs per calorific unit are lower.)

Before a full-scale feasibility study can be mounted it is necessary to undertake specific tests on coal quality, as recommended in the study "Botswana Coal Utilization Study: Preliminary Screening of Options" undertaken by Coal Processing Consultants Ltd. with assistance from the European Communities.

Background

Botswana currently has one coal mine in production (Morupule) which produces approximately 400,000 tonnes of coal a year. The government of Botswana and Shell Coal Botswana Pty. Ltd. are conducting a feasibility study for a large export coal mine in the Serowe/Palapye area which would produce 5 million tonnes of coal a year. A number of other international companies are evaluating export possibilities, including Total Coal Botswana, CDF Botswana Pty. Ltd., Amax Exploration (Botswana) Inc. and BP Coal Ltd.

The Government of Botswana, with assistance from the European Communities undertook a study to determine whether exports were necessarily the only, or indeed the best, means of exploitation or whether the coal could be used in Botswana. This study was deemed to be particularly important given that the viability of exporting coal had not been established, and indeed appeared seriously questionable at the prevailing world prices. The study was undertaken by Coal Processing Consultants Ltd. (CPC).

The CPC study was concerned with potential large-scale projects which could substitute for export of coal. But it also considered the possibility of introducing pyrolysis processes. It was concluded (Chapter 7) that the opportunity to create a chemical industry based on such a process appeared in principle attractive.

A computer simulation was undertaken for high-temperature carbonisation of Morupule coal, and it was concluded that it was doubtful if processes could be economically attractive utilising that coal. But the return on the investment required for the pyrolysis plant depends largely on the proceeds from the scale of products produced. It is the quality and type of coal used and the nature of the processing that determine the output of products. It was therefore recommended that data on the main seams and locations of interest for large-scale coal production should be collected and specialised laboratory tests carried out to determine the suitability of the coals for conversion processes (Chapter 9). It must be noted that the various coal seams in Botswana vary considerably in their qualities, and further, that low-temperature carbonisation would have a higher yield than the high-temperature process.

Whilst low-temperature carbonisation would not confer the same magnitude of benefits to the national economy as a large export coal mine, it is a particularly interesting option because it would, if feasible, permit the substitution of locally produced products for imports, particularly motor fuels and graded coal.

It is not known at this stage whether the establishment of a pyrolysis plant would be dependent upon the the opening of a coal mine for export, or whenever it would be feasible to open a colliery specifically for the plant. Once the testing is complete the economics of the project can be considered in closer detail and a judgement made.

The LTC process was used extensively in Europe and the USA during the 1940s until the end of World War II. There was a revival of interest in the 1950s and 1960s in the UK as a consequence of the clean-air acts. In the German Democratic Republic there is a 3.5 million tonne/year LTC plant operating, and in Australia a 60,000 tonne/year plant, both using brown coal. The LTC process is used in several countries to manufacture coke briquets. As a result of the oil crisis in the 1970s considerable research was undertaken in this field but the availability later of cheap oil and gas on the world market meant that most of this work was suspended, for example a 2 million tonnes/year plant was planned in Gwai-Lubimbi, Zimbabwe, but then shelved. This plant is now under consideration again.

It is believed that LTC represents a feasible technology where coal of the right quality can be procured inexpensively and where oil product prices are high, or supply of products unreliable. In Botswana it would have the additional advantage of substitution for imported graded coal. Further coke produced would be a smokeless fuel, thus reducing the pollution impact of any increase in coal utilisation.

With assistance from the German Agency for Technical Assistance (GTZ) the Government of Botswana will shortly undertake comprehensive market research which will establish the existing and potential markets for graded, washed coal (in both the domestic and industrial sectors). The coke produced by LTC would be a substitute for such coal and the viability of an LTC plant.

It would be inappropriate to undertake market research into the demand for the liquid fuels which would be produced since until the testing is undertaken it is impossible to hypothesise on the quantities of fuels

which may be available. It is expected that the output will be not greater than a significant proportion of the quantities presently imported.

Technical Description

It is proposed that the investigation into the coal should take part in two phases:

Phase 1 will be the setting up of a computerised model and program with parameter variation on the feasibility of low-temperature carbonisation in principle and should determine the minimum capacity of a coal conversion plant taking into account market requirements (existing and future demand for synthetic products in comparison to imported oil products) and available coal reserves (quality and quantity).

Phase 2 will include laboratory and carbonisation tests with crushed raw coal, graded washed coal and discard.

1. The sampling of a minimum of 60 tonnes of coal from the Morupule and Kgaswe coalfield.

   To include the shipping of 20 tonnes in sealed drums to an LTC pilot plant in Germany.

2. Laboratory tests and analysis of 20 tonnes.

3. A carbonisation test at a plant in Germany and laboratory tests and analyses.

Capital Costs

Total cost is estimated at BWP 280,000.

Breakdown

Phase 1	BWP 20,000
Phase 2	BWP 260,000
Phase 2 part 1	BWP 50,000
part 2	BWP 40,000
part 3	BWP 145,000
Contingency and inflation (10%)	BWP 25,000

Economic and Social Analysis

As noted above, this is not a feasibility study. The project as described simply seeks to establish sufficient data to allow an informal decision to be taken as to whether a full-scale feasibility study is justified.

The cost, BWP 280,000, is believed reasonable in comparison with the potential benefits which are described below.

Firstly the output of this process is a coke which can easily be burnt in households using a simple stove. It has the advantage of being easy to ignite and of a constant quality. Stoves in households and furnaces in industry can be run at their optimum efficiency during their lifetime. These advantages of coke should mean that it represents a viable alternative to the use of firewood. The rate of firewood depletion is increasing (it should be possible to obtain a specific figure for this rate of depletion after the UK Rural Energy Study is completed. It seems likely that as wood becomes scarce and the cost increases, either in money terms or in terms of hours and energy spent in gathering it, that coke will be an economic alternative to wood, at least in urban areas. Coke is a reactive fuel which can be burnt in power plants.

The second advantage to low-temperature carbonisation is that it presents a way for increasing the value of Botswana coal prior to exporting it. By processing the coal within Botswana more jobs can be created and if the higher value manufactured products are exported then more foreign exchange per tonne of exported material can be earned than from a tonne of unprocessed coal.

It is also worth noting here that the process also produces gas and tar which can easily be converted to diesel and petrol fuel. An LTC plant based on coal utilisation in Botswana of 650,000 tonnes/year could produce enough hydrocarbon fuels to replace 20% of the present consumption of such fuels, thus reducing dependence on imported oil supplies.

Project No. 2.4.1

Project title: COAL EXPLORATION AND EVALUATION - (MALAWI)

Background

Coal is a small but important source of energy for Malawi. Currently total demand requirements are met by import from Mozambique, Zimbabwe, South Africa and Zambia. Indigenous sources of supply exist but have not been exploited. The Geological Survey estimates some 800.9 million tonnes of coal as being the probable potential of indigenous reserves, of which 540 million tonnes are speculative, 175 million tones are hypothetical, 26.3 million tonnes are inferred, 50 million tonnes are indicated, and 15.6 million tonnes have been measured.

The coalfields presently known in Malawi include Ngana, Lufira, Kibwe, Karonga Plain, Mwakenya, Mwesia, North Rukuru, Nthalire, Hara, Livingstonia (i.e. Kaziwiziwi and North Rumphi), all in the Northern Region, and Lengwe and Chiromo in the Southern Region. some of these, notably the Livingstonia, Ngana, North Rukuru. Nthalire, Lengwe and Chiromo coalfields were located by the early European settlers geologists between the late last century and early this century. Some drilling was undertaken at Livingstonia, Lengwe and Chiromo; while coal from Livingstonia was successfully tested on a lake steamer. No detailed exploration work was undertaken on any of the coalfields until the mid-1970s when the Chamber of Mines of South Africa carried out systematic drilling on the Ngana coalfield.

Approximately 3 years ago, after several years of fieldwork in the Northern Region, the Geological Survey committed itself to a programme of exploration and evaluation of all the known coalfields of the country.

At present only two coalfields, Ngana and Lufira, both in Karonga District have been explored in detail by this department to enable their evaluation. A Government geologist has just completed reconnaissance geological mapping of the North Rukuru and Nthalire coalfields; while drilling is in progress at Kaziwiziwi near Livingstonia. The project will therefore make available detailed information on all the known coalfields except for Ngana and Lufira which have already been investigated. This information is necessary before exploitation of the coal resources can be considered.

Objectives

This project will investigate and assess the economic potential of known coal occurrences in Malawi. This will assist in the objectives of increasing knowledge of local resources, and eventually, in increasing self-sufficiency for Malawi.

Work Description

1. Details of Outputs and Services

Trained and equipped geologists will produce detailed geological maps of each of the coal-bearing sedimentary basins with a view of selecting sites for trenching and drilling. Outcrop and core coal samples collected after the mapping/trenching and drilling will be sent for analysis to the Geological Survey or abroad. From these investigations maps and reports will be produced indicating the quantity and quality of coal at various localities within or among the coalfields.

2. Phasing of Project Outputs

The investigations will start by using available Geological Survey staff when the project is funded and the requested vehicles, plant, machinery and other items start flowing in. Early to midway through the project some staff will be trained in various fields related to this project, and a consultant will be retained to advise on project implementation. The present plan is to complete investigating all the known 13 coalfields by the end of 5 years.

Implementation

The project will be undertaken and managed by the Geological Survey of Malawi. The Chief Geologist will be the overall supervisor.

Cost

The total cost of the project is expected to be about USD 1,952,825, and has been developed as described in the following table and notes.

(Estimated cost in US dollars)

	Category	Note	1985/86	1986/87	1987/88	1988/89	1989/90	1990/91	1991/92	Total 7 yrs.
(a)	Malawi Government contribution:									
	Personal emoluments	1	26,845	29,680	33,355	37,310	41,265	42,000	42,070	252,525
	Running expenses	2	10,500	10,500	10,500	10,500	10,500	10,500	10,500	73,500
	Special expenditure	3	700	1,050	1,050	1,400	1,400	1,400	1,750	8,750
	Subtotal		38,045	41,230	44,905	49,210	53,165	53,900	54,320	334,775
(b)	Donor contribution:									
	Buildings	4	-	17,500	-	-	21,000	-	-	38,500
	Other construction	5	700	2,800	4,200	3,500	3,500	2,100	700	17,500
	Plant and vehicles	6	21,000	94,850	39,200	88,900	21,000	26,600	-	291,550
	Other equipment	7	35,000	70,000	140,000	105,000	70,000	70,000	35,000	525,000
	Personal emolument	8	-	196,000	70,000	77,000	7,000	3,500	3,500	357,000
	Running expenses	9	14,000	28,000	28,000	35,000	38,500	28,000	14,000	185,500
	Special expenditure	10	14,000	35,000	35,000	35,000	42,000	28,000	14,000	203,000
	Subtotal		84,700	444,150	316,400	344,400	203,000	158,200	67,200	1,618,050
	GRAND TOTAL		122,745	485.380	361,305	393,610	256,165	212,100	121,520	1,952,825

Notes:

1. Salaries and wages of project personnel:

   (a) Full time: 2 x PO, 2 x Driller, 4 x Trainee Driller, 10 x Drilling Overseer, 6 x Driver.

   (b) Part time: Chief Geologist, Assistant Chief Geologist, Principal Geologist, 2 x Senior Geologist, each about 1 month every year.

2. Subsistence allowance and drilling bonus for the drilling teams (all on full time except drivers who receive only subsistence allowance).

3. Miscellaneous office services, e.g. sample preparation, drawing of maps, typing services, etc.

4. Construction of two storage facilities for machinery and other equipment at selected sites, one in the Northern Region and another in the Lower Shire Valley.

5. Construction of access roads for fieldwork.

6. The following are requested to be purchased:

   4 x Land-Rover Pick-up long wheel base - one each in the 1st, 2nd, 5th and 6th year
   1 x 7-ton lorry, 2nd year
   1 x 4-ton lorry, 3rd year
   1 x 5-ton lorry, 4th year
   2 x drilling machine in 2nd and 4th year
   4 x water pump, one each in 1st, 2nd, 4th and 6th year
   2 x water bowser, one each in 2nd and 3rd year.

7. Trenching equipment (picks, shovels, hoes, crowbars, etc.)

   Drill accessories (e.g. rods, bits), casing, reaming shells, wenches, spanners, water swivel, etc.) and spares

   Water-pump accessories including water pipes

   Protective clothing

   Camping gear and surveying equipment, laboratory chemicals and apparatus.

8. 2 x undergraduate studies in geology starting 2nd year
   2 x postgraduate studies in coal geology, each for 1 year in 3rd and 5th year
   4 x technician training in drilling, one in 2nd year and the other in 5th year
   2 x technician training in laboratory techniques, one in 2nd year and the other in 3rd year
   1 x consultancy in coal exploration procedures for 1 month in 3rd year
   Seminars, workshops and meetings.

9. Fuel and oils for drills, vehicles, water pumps and maintenance of vehicles and plant.

10. Supplementary coal analyses abroad, drawing office consumables, printing of reports, etc.

Funding Requirements

The requested Donor contribution is USD 1,618,050 of the total project cost of USD 1,952,825.

Project No. 2.4.2

Project title: DEVELOPMENT OF COAL ANALYSIS LABORATORY - (MALAWI)

Background

At present Malawi does not have a coal analysis laboratory and therefore is forced to export all her samples to South Africa for analysis. With the present coal exploration and evaluation programme many samples will need to be analysed and therefore necessitates the establishment of a coal analysis laboratory in Malawi for quick evaluation.

The Geological Survey is currently conducting a long-term programme (over 10 years) of detailed evaluation of all the eight main coalfields in the Northern and Southern Regions. The work involves detailed mapping of each coalfield, extensive trenching and sampling of coal outcrops and drilling. Hundreds of samples will be collected. In fact, evaluation of the northern coalfields is already underway and will be extended to the south in due course. A coal laboratory will be an essential and integral part of the coal assessment programme which will enable the analysis of samples collected during the field investigations in a timely manner.

The alternative means of achieving some of the outputs and services would be to use overseas specialised laboratories to carry out the tests on coal. The cost of sending adequate samples abroad for analysis would, however, be comparable to the cost of purchasing the project equipment over the same project life. Meanwhile, there would be no development in the acquisition of appropriate technology.

Objectives

With the acquisition of this laboratory, regional capability in resource evaluation will be enhanced.

1. Details of output and services:

   (a) Data compiled from tests will complement field exploration information for the systematic assessment of Malawi's coal resources.

   (b) Services would be offered which only overseas laboratories could previously provide at high cost. A well-equipped laboratory would also facilitate analysis of large numbers of samples rapidly with minimal financial constraints.

   (c) The acquisition of new equipment will add to or replace obsolete equipment which has become expensive to maintain high levels of sensitivity.

   (d) Laboratory capacities would be increased by the multidisciplinary approach to analysing using wet chemical, electronic and physical methods.

(e) Trained technical personnel with modern apparatus and methods of analysis will provide efficient service to Government, investors and the general public.

2. Expected contribution of project to present knowledge of mineral resources evaluation.

(a) Bulk beneficiation studies of coals will be carried out to assess the levels to which they may be upgraded in actual production. Shallow shaft-sinking to obtain fresh, bulk samples from some of the coalfields would become relevant to the exploration stage.

(b) Development and test briquetting methods of coal will become available.

(c) Government would be able to monitor the results of most private mineral exploration projects by carrying out independent tests rapidly for a variety of mineral resources.

Work Description

The project basically involves the following main features:

1. To acquire modern laboratory apparatus suitable for use in Malawi for the analysis of coal.

2. To develop capabilities in the analysis of coal samples for calorific value, relative density, moisture contents.

3. To develop capabilities for the beneficiation and elemental analysis of coal samples from the sample preparation to classification stages.

Implementation

The construction of the laboratory will be carried out by a suitable contractor under Ministry of Works and Supplies supervision. Donor will supply all laboratory fixtures and equipment. There will be close collaboration between the Donor and the Chief Geologist in the overall phasing and execution of the project.

Project Cost

The total project cost is approximately USD 288,401, and is based on the following items:

(Estimated cost in US dollars)

	Category	Note	1985/86	1986/87	1987/88	1988/89	1989/90	Total 5 yrs.
(a)	Malawi Government contribution:							
	Equipment	1	1,400	3,220	4,900	4,900	5,600	19,670
	Personal emoluments	2	6,207	6,504	6,831	7,158	7,531	34,231
	Running expenses	3	1,050	4,550	4,900	5,250	5,250	21,000
	Special expenditure	4	700	700	700	700	700	3,500
	Subtotal		9,357	14,974	16,981	18,008	19,081	78,401
(b)	Funds request Donor component:							
	Fixed equipment (existing lab.)	5	37,800	-	-	-	-	37,800
	Fixed equipment (new coal lab.)	6	54,012	-	-	-	-	54,012
	Scientific equipment	7	50,736	-	-	-	-	50,736
	Building construction	8	46,200	-	-	-	-	46,200
	Training overseas	9	11,560	-	-	-	-	11,560
	Training in Malawi	10	-	9,692	-	-	-	9,692
	Subtotals		200,308	9,692				210,000
	GRAND TOTAL		209,665	24,666	16,981	18,008	19,081	288,401

Notes:

1. Acquisition of additional laboratory glassware and replacement of breakables and worn-out items.

2. Five additional posts to be created from first year of the project.

   1 Chemist (PO), starting salary USD 2505
   1 Senior Laboratory Technician (STO), starting salary USD 3379
   3 Laboratory Assistants (TA), starting salary USD 471

3. Electricity and water charges, waste disposal, purchase of cleaning detergents, maintenance charges, etc.

4. Consumables - heavy media liquids and other chemicals.

5. Improvements to existing chemical laboratory:

Flame hoods (4)	USD 18,200
Modular laboratory benches	USD 17,500
Water still	USD 2,100
Total	USD 37,800

6. New coal laboratory:

Fume hoods (4)	USD 27,300
Laboratory benches (incl. fixtures)	USD 15,400
Water still	USD 7,000
Storage cabinets	USD 4,312
Total	USD 54,012

7. Scientific equipment for:

Sample preparation	USD 1,400
Air-dried loss	USD 3,500
CV + proximate + FSI + sulphur (total)	USD 16,900
Spectrophotometer	USD 18,536
Balances (2)	USD 3,500
Miscellaneous	USD 4,900
Total	USD 50,736

8. Building construction of new building (including utilities)

9. Training overseas (all coal analysis techniques)

10. Training in Malawi (on-the-job training for technicians).

Funding Request

The funding request is USD 210,000 over 2 years.

Project No. 2.4.3

Project title: COAL MINING DEVELOPMENT TRIAL AT LIVINGSTONIA - (MALAWI)

Background

Coal is a small but vital source of energy for Malawi. Currently total demand requirements are met by imports. The Geological Survey estimates some 800.9 million tonnes of coal as being the probable potential of indigenous reserves and 15.6 million tonnes have been indicated which could be exploited to supply the current and future demand.

The occurrence of coal in the Livingstonia area has been known for many years, and some detailed exploration and quantification is being carried out here by the Geological Survey in the 1984 dry season. This is in addition to a bulk sample (± 1000 tonnes) to be mined for trial by the Coal Users Committee.

Presently, Malawi imports about 75,000 tonnes of coal per year at a high foreign exchange cost. In the late 1970s before the recession, imports were about 100,000 tonnes per year, which is considered to be minimum potential of the current market for coal in Malawi.

It is recognised that to meet the planned production levels, it will be essential to design a mining method which will optimise exploitation, along with limiting mining costs and overheads.

The Government is in the process of forming a Mining Development Investment Agency which will be entrusted with the responsibility for promoting mineral development in joint ventures with interested private investors.

Objectives

This project will lead to commercial mining of coal in Malawi, thus furthering the objective of national self-sufficiency. The following comments define the short-term project objectives:

1. Details of outputs and services. An opportunity will be provided for investors to acquire coal mining know-how.

2. Phasing of project outputs: Mining of a bulk sample (± 1000 tonnes) for test by consumers is to be carried out by the Coal Users Committee in the 1984 dry season. This is likely to be done by the Portland Cement Company on behalf of the association, and in liaison with both the Geological Survey and Department of Mines.

   The Department of Mines' trial mining is essentially aimed at designing the optimum mining method for short and long-term mining of coal resources in Malawi.

3. Expected contribution of project to present knowledge: Local investors have generally been reluctant to invests in the mining of our mineral resources. This project will be a further attempt to encourage them to look at mining as another area into which they can invest.

Work Description

The project basically involves the following main features:

1. To design a coal-mining method which will optimise exploitation along with limiting mining costs and overheads.

2. To mine 5000 tonnes of coal on trial basis.

3. To separate the valuable coal from diluent waste materials as/if required.

After the trial mining, plans will be formulated for long-term exploitation of the coal resources to meet the current and future demand.

Implementation

The mining and processing (washing and/or screening, if necessary) will initially be executed by the Department of Mines, under the supervision of the Chief Mining Engineer.

Cost

The estimated total project cost is approximately USD 385,000, and has been developed as shown below:

Category	Total USD
Buildings	70,000
Other construction	10,500
Plant and vehicles	112,000
Other equipment	21,000
Personal emoluments	24,500
Running expenses	140,000
Special expenditure	7,000
Total	385,000

Funding Requirements

Funding for the entire project cost, USD 385,000, is desired.

Project No. 2.8.1

Project title: INVESTIGATION OF COAL BRIQUETTING - (ZAMBIA)

Background

Maamba Collieries Limited (MCL) is a wholly-owned subsidiary of ZIMCO Ltd., the largest Zambian state-owned holding company, involved mainly in mining and industrial activities.

Coal production started at Siankondobo, Southern Zambia, in late 1970. Run of mine coal (ROM) is washed in the processing plant at Siankondobo, transported by trucks and ropeway to the railway line, and then sized and railed to customers. The main customers belong to the industrial and mining sectors: copper smelters, cement plant, fertiliser plant, etc.

Maamba Collieries Ltd. has experienced technical problems, particularly a severe lack of spare parts which has resulted in decreased production (550,000 tons p.a. washed coal produced although the design capacity is 1,200,000 tons p.a.) and correspondingly heavy losses.

In order to revamp operations, the World Bank has provided an IDA credit which is being used for financing imports of critical spare parts and a comprehensive technico-economic study which will determine the geological, technical, financial and managerial requirements to enable MCL to play its required role in the effective substitution of imported fuels. This study is presently underway and is being carried out by British Mining Consultants whose report is expected to be completed by the latter half of 1983.

The present treatment process for Maamba coals result in a loss of about 25% of coarse rejects (+6 mm) consisting mainly of mudstone material and of 8-10% of slurries. In order to improve coal recovery and consequently the economic results, a programme of studies is underway with the assistance from the Federal Republic of Germany, Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ). The investigations include:

- Sampling of different coal products, ROM, washed, rejects
- Laboratory tests for fine coal processing, with special emphasis on flotation
- Laboratory tests for preparing smokeless briquets
- Preparation of a prefeasibility study of a briquetting plant using reprocessed slurries and rejects.

Justification

A high amount of energy consumed for domestic purposes in Zambia is provided by woodfuel and charcoal. The projected demand, according to the report of the Joint UNDP/World Bank Energy Sector, January 1983, was estimated as follows:

Projected Demand for Woodfuel (million m^3)

Sector	1980	1985	1990	1995	2000	Average growth rate (%) (1980-2000)
Urban	3.8	5.3	6.2	7.2	8.4	5.5
Rural/other	3.2	3.4	3.9	4.6	5.3	3.4
Total	7.0	8.7	10.1	11.8	13.7	4.6

The excessive use of charcoal will increase the deforestation of woodland surrounding the urban centres (Lusaka and the Copperbelt towns); obviously the ecological effects of charcoal and firewood consumption will lead to adverse environmental problems if the increasing demand is not checked by the introduction of a substitute material into the market. Such a substitute product can only be introduced successfully if it can be used on the same appliance as those being used for charcoal and if the market price for the substitute is lower than that of charcoal.

The laboratory tests already carried out by the GTZ have shown that it is possible to obtain coal briquets that can burn well, without smoke, in the same braziers commonly used with charcoal. These briquets can be prepared with washed Maamba coals and molasses which is available in Zambia.

It is proposed to take advantage of the encouraging results of the German-funded project which was, as already pointed out, targeted towards a better recovery of coal in the processing plant.

The target of the proposed study would be to investigate the technical and economic feasibility of a briquetting plant to be fed with washed fine coal (acceptable level of sulphur content) in order to provide a substitute for charcoal, competitive in terms of quality and price. It should be indicated that a charcoal bag (25/30 kg) is presently sold in Lusaka for ZMK 5.00/6.00; the cost of 1 ton of washed coal, at Batoka, about 200 km south of Lusaka was ZMK 49.00.

In order to compare coal briquetting with charcoal the following tentative calculations are of interest.

Retail price x calorific value = retail price per MJ

Charcoal

5/25 x 33 = 0.00606 ZMK/MJ

Briquets

49/1000 x 27 = 0.001815 ZMK/MJ

This implies that if the production costs and distribution costs of briquets are lower than 0.004245 ZMK/MJ or 114.6 ZMK/ton the project will be feasible. In addition the reduced deforestation will have to be added as positive benefits in an overall benefit-cost analysis.

Project Objectives

1. The project will assess and indicate the technical possibility of producing a smokeless fuel for the substitution of charcoal by a special treatment of coal produced at Maamba Collieries Ltd. The possible reduction of deforestation is a main objective.

2. Based on the results of the study, the technical and economic viability of installing a briquetting plant will be investigated. This technique may also be utilised in other SADCC countries.

3. A market study will be carried out in order to determine the demand in Zambia and the neighbouring countries where coal briquets could compete favourably with charcoal.

Description of Work

The following works shall be carried out:

(a) Appraisal of the previous investigations, particularly the GTZ study. Determination of laboratory tests programme and size of sample;

(b) Perform the actual sampling;

(c) Transport coal samples to laboratory as well as binder agents;

(d) Laboratory tests:

- Analyses
- Briquetting tests using various binder agents available in Zambia (molasses, clay, etc.)
- Degassification tests under different drying and coking temperatures. Determination of briquet characteristics.
- Burning tests in braziers and stoves which are or could be produced in the SADCC Region.

(e) Prefeasibility studies and benefit-cost analyses;

(f) Market study:

Evaluation of potential market for coal briquets in the area, within Zambia as well as in the neighbouring countries, where briquets could successfully compete with charcoal in terms of quality and price. An evaluation of selling price including production cost, transportation cost and retail cost shall be done.

Implementation

The project will be carried out by a consulting firm under the supervision of the Ministry of Mining. The project is expected to last about 15 months.

Cost Estimate		Local ZMK	Foreign USD
(a)	Appraisal of previous studies		25,000
(b)	Sampling and sample conditioning (coal, binder agents)		15,000
(c)	Sample transport		10,000
(d)	Analyses and briquetting tests		60,000
(e)	Prefeasibility study		100,000
(f)	Market study (in conjunction with the SADCC Energy Sector)		25,000
	Local coordination	3,600	
	TOTAL	3,600	235,000

Financial Requirement

Zambia may cover the local expenses. Most of the work has however to be undertaken by an international consultant and thus will have to be financed in foreign currency.

Project No. 2.9.1.

Project title: COAL STOVES FOR USE IN RURAL AREAS - (ZIMBABWE)

Background

Zimbabwe has an estimated 29 billion tons of coal in more than 26 coalfields. Presently only 3.2 million tons per year are exploited at Hwagwe Colliery, the only operating coal mine in Zimbabwe.

The Rural Afforestation Division has identified 27 deforested communal areas in seven provinces. It has therefore become critical for other sources of fuel to be introduced to halt the deforestation trends. Also other SADCC Member States face deforestation problems and have the same possibility of applying coal as a substitute for fuelwood. On this basis the findings of this project will be of regional significance.

Experiments have been carried out by the Energy Department on coal-burning stoves. Satisfactory results on combustion efficiency, flue gas dispersion and chimney design and installation have been obtained.

Objectives

The objectives of the project are to assess the acceptability of the stoves by users and to gain experience concerning installation and use by low-income households. The project also aims at reducing deforestation in the selected areas as well as gaining experience on this which may have future impact for the Region.

Description

The project comprises the following activities:

- Installation of 400 coal-burning stoves in rural areas. As explained in the previous section the design of the stoves has been finalised. As can be seen from the attached drawing the construction is based on low-cost technology (ZWD 40 per unit), and on this basis the cost advantage over the commercial cast-iron stoves is very high. The selection of areas for deployment of the stoves will be based on safe supply of coal and deforestation problems.

- Training of local artisan in the installation and repair of the stoves.

- Training of users in operating the stoves to ensure that efficiency and safety are maintained.

- Distribute the coal to the users at various collection points in close collaboration with Hwagwe Colliery. (The first few loads of coal will be provided by Hwagwe Colliery free of charge.)

- Assess the acceptability of the stove by users and encourage diffusion of the stove to the bulk of the rural population.

- Assessment of the impact of increased coal use on the deforestation problem.

- Assessment of the possible changes in social life, especially among the female population, due to reduced requirements of fuelwood transport.

- Reporting and preparation of all relevant findings on items as described above and distribution to SADCC Member States.

Implementation

The Energy Department will act as executing agency on behalf of the Government and in close collaboration with Hwagwe Colliery.

Phase 1 of the project, comprising location and installation of the stoves, will be finalised after 6 months.

Thereafter the supervision of the users and all data collection relevant for assessment of deforestation impact, social impact, user acceptability, etc., will continue for 18 months and the report will be presented.

Cost Estimate

The project cost estimate is as indicated here below.

		ZWD x 10^3
(i)	Materials	
	Stoves and accessories	16.0
	Cement	2.0
	Bricks	4.0
	6 trucks	80.0
	Labour (casual)	10.0
	Field demonstration	10.0
	Subtotal Materials	122.0
(ii)	Personnel	
	2 project coordinators (2 years)	20.0
	2 research officers (2 years)	20.0
	6 builders (1 year)	18.0
	3 field demonstrators (2 years)	18.0
	Subtotal Personnel	76.0
	Total (i) + (ii)	198.0
	Price escalation (10%)	20.0
		218.0
	Physical contingencies (20%)	42.0
	TOTAL	260.0
	Equivalent in USD	196,000

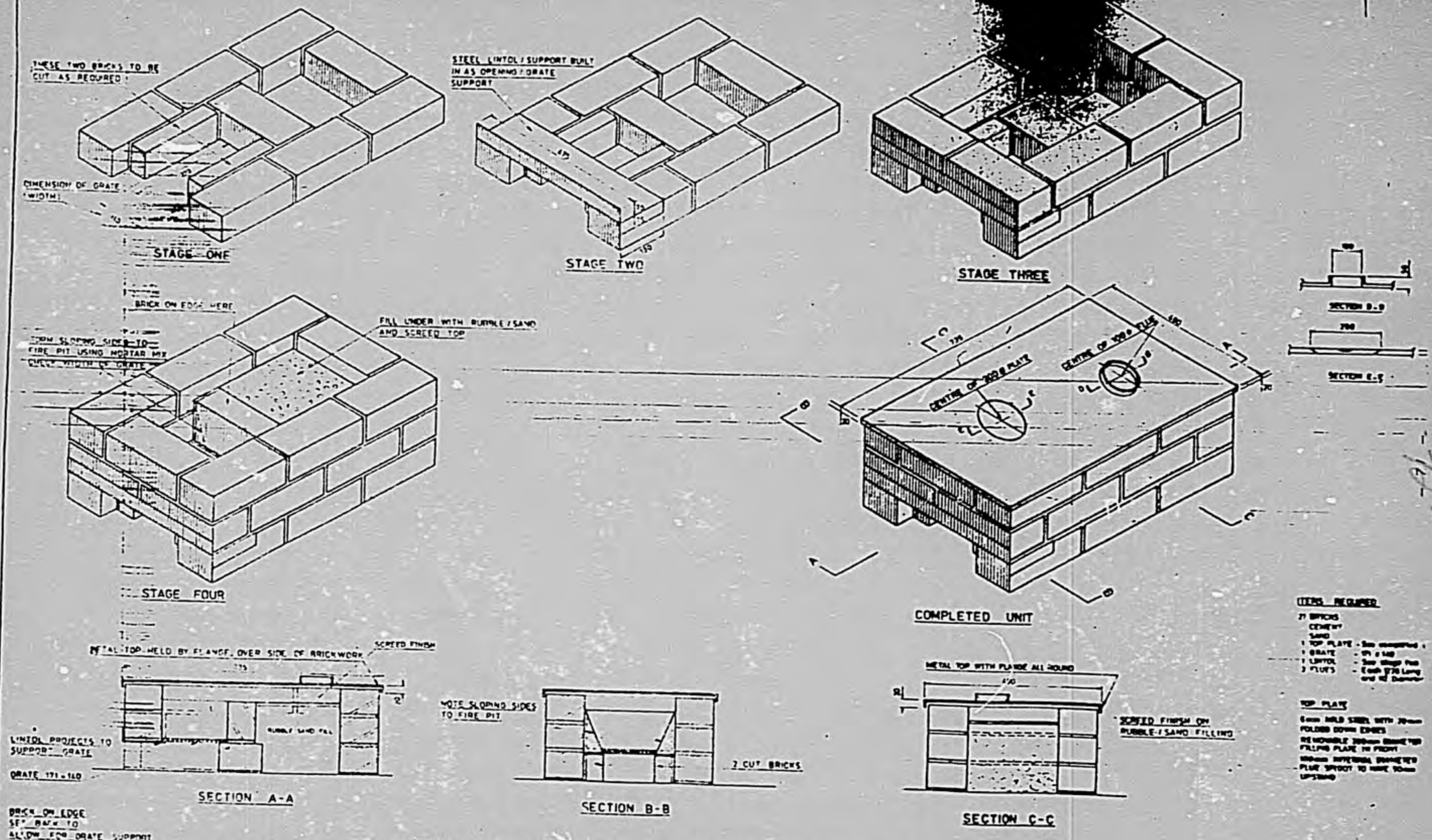
All costs apart from the trucks (ZWD 80,000) are local currency costs.

The expenditure will be distributed over 2 years with approximately 85% in the first year after financing has been secured.

Financial Requirements

The project officers and research officers will be recruited from the Energy Department and the costs financed by the Government. The financial requirements from the Donor will therefore be as follows:

In foreign exchange	ZWD 80,000	(USD 60,000)
In local currency	ZWD 140,000	(USD 105,000)



WANKIE COLLIERY CO LTD. — CONSTRUCTION DETAILS OF COAL STOVE

ANGLO-AMERICAN CORPORATION

Project No. 3.0.3

Project title: PREFEASIBILITY STUDY FOR MAINTENANCE OF MECHANICAL EQUIPMENT IN POWER STATIONS

Background

As a group the nine SADCC Member States have an aggregate installed generating capacity of approximately 4400 MW. The installations comprise hydroelectric power plants (3300 MW), coal-fired power plants and (600 MW) and others, mainly diesel generators (600 MW).

These installations represent investments of several billions of USD. As the major portion of the spare parts for the mechanical equipment of these power plants presently is purchased abroad, the corresponding foreign exchange expenses cause heavy burdens on the national budgets. In some cases lack of spare parts leads to production losses and inadequate reliability of supply of electric power.

In spite of problems concerning the relatively advanced technology in question, different manufacturers of the installations in various power plants and countries, etc., the problems of maintenance and availability of spare parts ought to be examined. This is because even minor improvements may result in considerable foreign exchange savings and improved reliability of power supply in the Region.

Objectives

In view of these factors a study with the following objectives is anticipated:

- to assess in each SADCC Member State the annual foreign exchange expenses caused by purchase of spare parts and foreign expertise for maintenance of mechanical equipment in hydroelectric and thermal power plants;
- to propose adequate measures which will ameliorate the situation;
- to evaluate the technical feasibility and financial viability of above-proposed measures.

Work Description

The project should be worked out in detail so as to meet the above-mentioned objectives, according to the following Terms of Reference.

1. Survey of Present Situation

   The study should be limited to power plants (hydroelectric, coal-fired or diesel/gasoil-based) operated by public utility companies. Private generating units and power stations with installed capacities below 1 MW shall be excluded. Bearing these limitations in mind the following shall be performed for each SADCC Member State

and broken down in accordance with type of generating facility (hydro, coal-fired, oil-based):

- To describe and assess the cost of desired maintenance, both spare parts and manpower input, which at present involves foreign exchange requirements.

- Same as above for presently executed maintenance, if any differences.

- Describe the existing facilities within the utilities, both equipment and expertise.

- Describe and evaluate the possibilities of undertaking some of the above-mentioned works in existing domestic workshop, factories not belonging to the utility companies.

2. Proposed Measures

Based on information on above-mentioned items the following shall be done:

- Propose measures which will ameliorate the situation. These could be, but are not limited to, the following:

  . Improved coordination of works between existing facilities at power plants in a separate country and between countries;

  . Increased utilisation of existing domestic industries;

  . Investments and improvements of facilities at power plants or domestic industries;

  . Manpower developments;

  . Establish new industry(ies)/workshop(s) and propose their desired location;

  . The do-nothing option shall also be considered.

- Determine both the investment and operating costs of proposed measures.

- Determine the benefits of proposed measures.

- Economic evaluation of proposed measures.

Implementation

The SADCC Energy Secretariat in Angola will be the executing agency for the project.

A team of consultants comprising two mechanical engineers (one turbine expert and one industrial engineer) shall visit all SADCC Member States. A period of approximately 3 months is envisaged for this field work. Thereafter another period of 3 months is foreseen for the preparation of the report which gives a total project implementation period of 6 months.

Cost Estimate

The total estimated project costs are estimated at USD 150,000, all of which would be in foreign currency.

Financial Requirements

Financing of the total amount, USD 150,000.

Project No. 3.1.2

Project title: INTERCONNECTION OF THE NORTHERN, CENTRAL AND SOUTHERN ELECTRICITY SUPPLY SYSTEMS - (ANGOLA)

Background

There are currently three separate power systems in Angola - known as the Northern, Central and Southern systems. They are not connected with each other. In addition, an Eastern net is anticipated.

Total energy produced from all sources of electrical generation is estimated at 714.3 GWh for 1981.

There is presently no connection with the Namibian power system. However, due to the possibility of joint hydropower project development on the Cunene River, the possibility of a connection between the Angolan and Namibian power systems may also be of interest.

Objective

The objective of the project is to determine the economic, financial and technical feasibility of an interconnection between the three existing electrical systems in Angola, named Northern or Kwanza, Central or Catumbela and Southern or Kunene. The studies shall be carried out in such a manner that, if the project is feasible, they may be used as a base to guarantee the financing of the works and equipment by international financing agencies.

In addition, the possibility of a future connection to the Namibian system should be reviewed.

Work Description

The work is to be carried out in several phases, which are:

Phase I - Prefeasibility Studies
Phase II - Feasibility Studies
Phase III - Design and Production of Tender Documents

In Phase I, the following aspects will be evaluated:

- existing load flows
- existing electrical production
- existing transmission facilities
- consumption and production forecast
- projected increases in generation and transmission capacity
- review previous studies by consultants from EDP (Portugal), BME (Belgium) and Energoproject (Yugoslavia).

Phase II will be a feasibility level study, which will evaluate the following:

- operational problems and system stability
- energy flows
- optimisation of interconnection capacity
- cost estimate
- economic analysis
- financial analysis.

If the conclusion of Phase II is positive, the project will proceed to Phase III, which consists essentially of final design and the production of tender documents. This phase would also include the final route determination and survey.

Implementation

The project will be carried out by consultants, under the direction of Empresa Nacional de Electricidade, U.E.E. A decision to proceed will be made at the conclusion of each stage, based on the findings up to that point.

The anticipated schedule is as follows:

Phase I	3 months
Phase II	8 months
Phase III	8 months

Cost Estimate

The cost estimate is as follows:

Phase I	USD 50,000
Phase II	USD 150,000
Phase III	USD 250,000

Funding

Funding is requested for the entire project cost.

Project No. 2 1.3

Project title: CONSULTANCY SERVICES FOR THE COMPLETION OF THE GOVE HYDROELECTRIC DEVELOPMENT

Background

The generation and transmission of power in Angola basically comprises three separate systems, the Northern, the Central and the Southern system. The cited project belongs to the Central system, the map of which is given on the subsequent page. The Bie sub-system is located east of the Central system and is not yet interconnected. The existing and planned power stations of the Central system and the Bie sub-system are given in the table below:

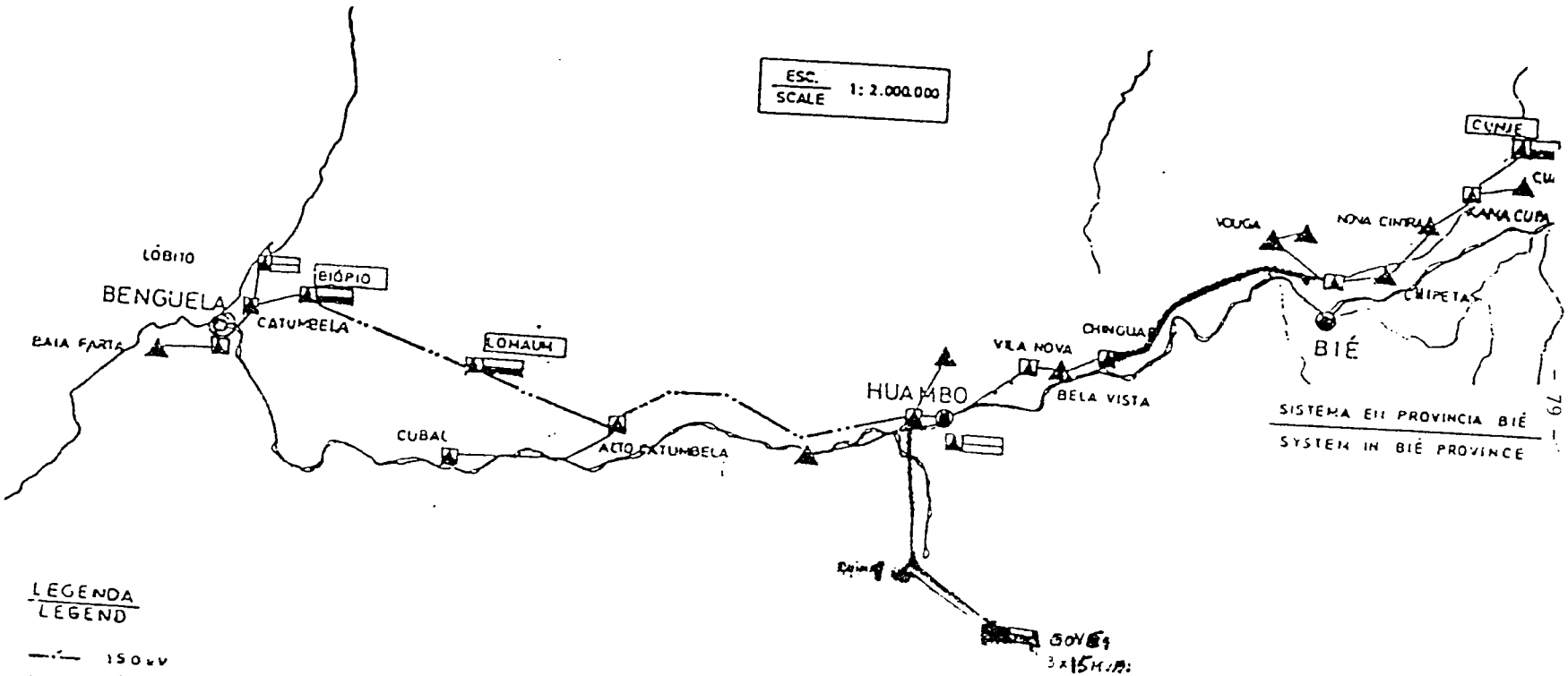
Power stations	Installed Capacity (MW) Hydro	Thermal
Lomaum	2 x 10 1 x 15 (2 x 15)*	-
Biopio	4 x 3.6 (2 x 1.5)*	1 x 23 2 x 1.5
Huambo	(3 x 15)*	1 x 10
Kunje**	3 x 0.67	-

* Planned power stations
** Bie sub-system.

The configuration of the power transmission network for the Central system and the Bie sub-system is given on the map. It can be seen that their major transmission voltages are 150 kV and 30 kV, respectively.

Civil and military disturbances have seriously affected the Angolan energy infrastructure. Mention should be made of the attacks to halt the Luanda Refinery operations and against the Lomaum Power Plant which succeeded in stopping the latter's operation in 1982. Resumption of Lomaum operation requires an estimated USD 20 million over a 3-year period, and as the power plant is located far from the main administrative and military centre some delay is expected before reconstruction begins.

The single gas turbine at Huambo Thermal Power Plant has also not been running regularly due to logistical difficulties in the fuel carried by air or rail. Airborne transport of diesel fuel has therefore been intensively used due to interruptions in surface transport. Under such conditions running expenses are very high in spite of the fact that Angola is an oil-producing country.



ANO / YEAR 1981.

SISTEMA PRODUTOR DO CENTRO

CENTRAL POWER SYSTEM

The main consumption centres in the area covered by the Central system and the Bie sub-system are Benguela, Huambo and Bie. The service area is approximately 150,000 km^2 with the population of about 2.8 million in 1984. The energy consumption of the Central system was 193.5 GWh in 1974 with a peak load of about 26 MW. The consumption declined considerably in 1975 and 1976, but has since then increased and reached 140 GWh in 1981.

There is a pressing need to ensure a stable and reliable power supply to the city of Huambo. This city has scientific institutions essential to the southern region. The Angola Veterinary Research Institute (IIVA) at Huambo, in addition to domestic scientific responsibilities undertaken by its laboratories, also produces animal vaccines exported to other SADCC member countries. The IIVA is also expected to handle the "African Swine Fever Regional Study".

The Angolan Agronomy Research Institute, also located in Huambo, has been successfully engaged in scientific work on industrial development of forestry products and in seed improvement.

Huambo has also the largest and best equipped SADCC workshops for railway equipment. Transport sector projects such as Lobito Port and Benguela Railway have already been approved as SADCC projects and it is obvious that a more reliable supply of electric power will facilitate their implementation.

The Gove Dam is located where the Cunhangama, Cuene and Ftembo Rivers meet, about 85 km south of Huambo. It was built for flow-regulating purposes, to meet downstream requirements. The dam is easily accessible with a paved road, a paved landing strip and railway branch line reaching 30 km north of the dam at the town of Kuima.

The main characteristics of the dam are:

Maximum height	58 m
Length	1111 m
Reservoir capacity	2574 x 10^6 m^3

The downstream water requirements are:

- To supply 6 m^3/s of water to Namibia via the Calueque pumping station on the Cuene River
- To provide, together with the Calueque Dam a regular flow to the 4 x 80 MW Ruacana Hydropower Plant in Namibia.

The consulting firm Hidroelectrica Portuguesa carried in 1969 out a preliminary study regarding the possibilities of hydroelectricity production from the dam in which an annual energy production of 115 GWh with installed capacity of 3 x 15 MW was indicated.

Currently the dam faces operational problems and some repair works are envisaged. These works have been awarded to the Angolan company Geotecnica. They are supposed to start before the end of 1984 and will not have influence on the possible construction works of a hydroelectric power plant.

Objectives

The objectives of the project are to ensure a stable and reliable power supply and help meet future load growth of the Benguela, Huambo and Bie Provinces.

Work Description

To meet above-mentioned objectives a study comprising two phases as follows shall be carried out:

Phase I

- Review existing relevant studies (Gove hydroelectric installations, power transmission studies for Gove-Huambo, Huambo-Kuito, etc.).
- Make an inventory of all generation and transmission facilities in the area (Benguela, Huambo and Bie Provinces).
- Develop demand forecasts for the area.
- Assess the hydroelectric potential for the Gove Dam.
- Develop preliminary engineering for the required Gove Dam construction and installations as well as required transmission facilities.
- Develop preliminary engineering for upgrading of existing facilities.
- Work out cost estimates (foreign exchange and local currency costs), implementation schedules and financing requirements for the different technical solutions.
- Assess the technical feasibility and financial viability of the different options.
- Make recommendations.

Phase II

Assuming that Phase I of the study recommends installations for hydroelectric production at Gove Dam and required power transmission facilities Gove-Huambo/Cuima and Huambo-Kuito, an outline work description of Phase II will be as follows:

- Detailed engineering for above-mentioned components
- Tender documents
- Tender evaluation
- Contract negotiations
- Works supervision.

Implementation

The consultancy services will be carried out under the direction of Empresa Nacional de Electricidade. Phase I is expected to take approximately 6 months and Phase II approximately 2 years.

Cost Estimate

The cost estimate, at 1984 levels, is as follows:

Phase I	USD 200,000
Phase II	USD 1,800,000
Total	USD 2,000,000

Funding Requirements

Funding is desired for the entire project cost.

Project No. 3.2.3

Project title: CONNECTION OF SEROWE, PALAPYE AND MAHALAPYE TO THE NATIONAL GRID - (BOTSWANA)

Background

A Rural Power Supplies Project, comprising 16 rural centres, was initiated in 1973 as part of the Government's rural development strategy. Four of these centres were supplied by establishing isolated diesel-generating stations and the remaining ones by expansions of the power transmission network Gaborone and Francistown areas, respectively (see network configuration on next page).

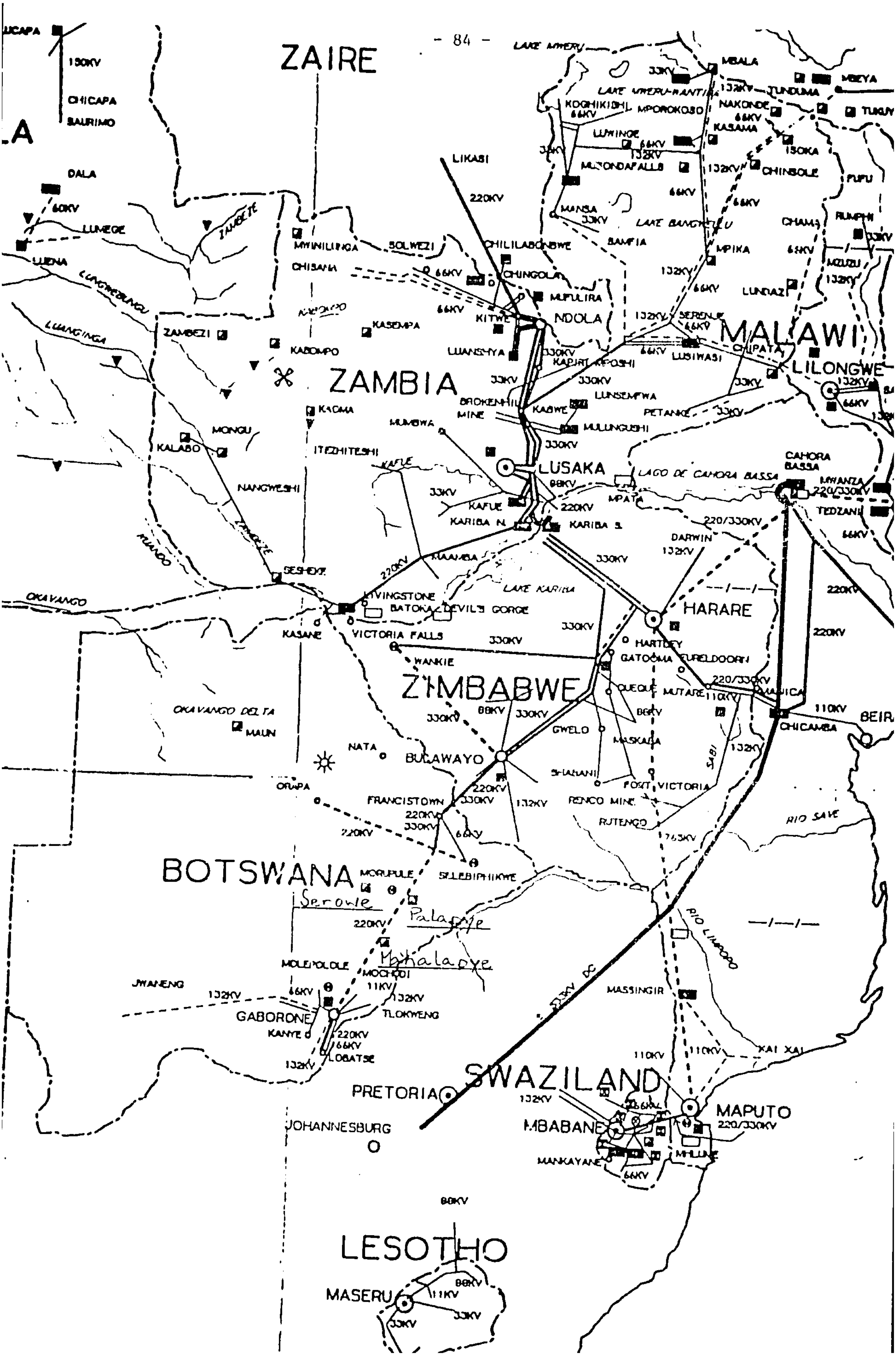
The project was successfully implemented by BPC, acting as executing agency for the Government. It is obvious that the costs of supplying these rural centres are considerably higher than the costs of supply in urban centres. From the point of view of the need to discourage urban drift the Government subsidises BPC with approximately BWP 700,000 per annum to enable a proper operation of the scheme without increasing tariffs in rural areas above those of urban levels. At present the major part of the above-mentioned subsidy is allocated to the four isolated power stations.

A huge project, The Morupule Power Project, is currently being implemented by Botswana Power Corporation (BPC). This project, which is financed by the World Bank, the African Development Bank and other international lending institutions, comprises the construction of a new coal-fired power plant of approximately 90 MW, located on the Morupule coalfield, and the construction of a 220 kV transmission line which will connect the BPC's Southern and Northern Divisions and thereby establish an overall national interconnected grid. The project is progressing satisfactorily and is scheduled for completion in May 1986. The transmission line component will, however, be substantially completed in 1984 and power from Selebi-Phikwe will then be available at Morupule.

Objectives

The short-term objectives of the project are to interconnect three rural centres, Serowe, Palapye and Mahalapye, to the national grid and thereby reduce the production costs of electricity and oil imports (presently from the Republic of South Africa) and to ensure the stability and quality of power supply.

The long-term objectives are to expand the possible future regional grid Botswana-Zimbabwe, the interconnection of which is subject to an ongoing SADCC study.


ZAIRE
ZAMBIA
MALAWI
ZIMBABWE
BOTSWANA
SWAZILAND
LESOTHO
LUCAPA
150KV
CHICAPA
SAURIMO
DALA
60KV
LUMEGE
LUENA
LIKASI
220KV
MWINILUNGA
SOLWEZI
CHISANA
CHILILABOMBWE
CHINGOLA
MUFULIRA
KITWE
NDOLA
LUANSHYA
KAPIRI MPOSHI
330KV
KABWE
LUNSEMFWA
MULUNGUSHI
BROKEN HILL MINE
MUMBWA
LUSAKA
KAFUE
KARIBA N.
KARIBA S.
ZAMBEZI
KABOMPO
KASEMPA
KAOMA
MONGU
KALABO
ITEZHITEZHI
NANGWESHI
SESHEKE
MAAMBA
LIVINGSTONE
BATOKA
DEVIL'S GORGE
LAKE KARIBA
KASANE
VICTORIA FALLS
WANKIE
OKAVANGO
OKAVANGO DELTA
MAUN
NATA
BULAWAYO
ORAPA
FRANCISTOWN
SELEBIPHIKWE
MORUPULE
Serowe
Palapye
Mahalapye
MOCHUDI
MOLEPOLOLE
JWANENG
GABORONE
KANYE
TLOKWENG
LOBATSE
PRETORIA
JOHANNESBURG
HARARE
HARTLEY
GATOOMA
QUEQUE
GWELO
SHABANI
FORT VICTORIA
RENCO MINE
RUTENGO
MUTARE
CHICAMBA
BEIRA
CAHORA BASSA
LAGO DE CAHORA BASSA
MPATA
DARWIN
MAPUTO
MBABANE
MANKAYANE
MHLUME
MASSINGIR
XAI XAI
RIO SAVE
RIO LIMPOPO
SABI
MASERU
LAKE MWERU
LAKE MWERU-WANTIPA
MBALA
MBEYA
TUNDUMA
NAKONDE
KASAMA
MPOROKOSO
LUWINGU
MANSA
LAKE BANGWEULU
SAMFYA
MPIKA
CHINSALI
ISOKA
SERENJE
LUSIWASI
LUNDAZI
CHIPATA
PETAUKE
LILONGWE
MZUZU
RUMPHI
CHAMA
TEDZANI
MWANZA
220/330KV
LUSAKA
ELDOORN

Description

This description is based on preliminary engineering performed by BPC and may be subject to changes depending on the findings of the consultancy services which are included in the project. The project comprises three components, transmission lines, substations and consultancy services as indicated here below.

1. Transmission Lines

Approximately 10 km route length of 33 kV overhead transmission line from Morupule power station to Palapye.

Approximately 50 km route length of 33 kV overhead transmission line from Morupule power station to Serowe.

Approximately 80 km route length of 33 kV overhead transmission line from Morupule power station to Mahalapye.

The lines will be constructed on wooden poles and the scope of work includes furnishing, delivering, erection and testing of all poles, conductors, insulators and accessories.

2. Substations

One 33/11 kV substation at Palapye.

One 33/11 kV substation at Serowe.

One 33/11 kV substation at Mahalapye.

The scope of work for the substations will include civil works, installation of circuit-breakers, switchgears, transformers, ancillary equipment and cabling.

The substations will feed existing 11 kV reticulations in each rural centre. No substation of 220/33 kV is required as 33 kV will be available at Morupule power plant.

3. Consultancy Services

Outline Terms of References for the consultancy services are as follows:

- Review of preliminary engineering performed by BPC to finalise the transmission system configuration and ensure the technical feasibility of the scheme.
- Ground survey and profiling of the transmission lines.
- Engineering and design of the substations.
- Work out tender documents for components and assist with tender evaluation and contracting.
- Supervision of transmission line and substation construction works.

- Assess the possibilities of applying labour-intensive technology and thereby enable high local participation and transfer of technology, this in close collaboration with BPC.

Implementation

A tentative implementation period of 18 months is envisaged from the time that financing has been secured. BPC will act as executing agency on behalf of the Government. The project should be undertaken on a turnkey basis by using consultants/contractors as indicated in the previous section.

Cost Estimate

A tentative cost estimate is indicated here below. As mentioned in previous sections some further engineering is needed to determine the transmission system configuration, conductor cross-section, etc. For these cost estimates a unit price of BWP 13,000 per km has been anticipated.

		BWP x 10^3
I.	Transmission Lines	
	Morupule-Palapye (10 km)	130
	Morupule-Serowe (50 km)	650
	Morupule-Mahalapye (80 km)	1,040
	Subtotal Transmission lines	1,820
II.	Substations	
	Substation Palapye (33/11 kV)	90
	Substation Serowe (33/11 kV)	90
	Substation Mahalapye (33/11 kV)	90
	Subtotal Substations	270
III.	Consultancy Services	
	Engineering and supervision	200
	Subtotal Consultancy services	200
	Total I + II + III	2,290
	Price escalation (10%)	230
		2,520
	Physical contingencies (15%)	380
	TOTAL	2,900
	Equivalent in USD	2,150,000

Approximately 20-30% of these costs will be in local currency depending on the application of labour-extensive technology as mentioned in previous sections. This should be finalised on the basis of negotiations between the Government and the Donor.

Financial Requirements

Funding is desired for the entire project.

The costs will be equally distributed over the two first years after financing has been secured.

Project No. 3.3.1

Project title: DEVELOPMENT OF SMALL HYDROPOWER FACILITIES AT MANTSONYANE AND SEMONKONG - (LESOTHO)

Background

Lesotho is completely dependent on the RSA for its electricity supply, and the country is therefore evaluating possibilities to increase self-sufficiency in this aspect.

A reconnaissance and feasibility study has identified two small hydropower project sites for potential development. One of these, called Mantsonyane, will be connected to the existing 33 kV transmission line. The other, called Semonkong, will be used to complement diesel generation in a town not currently served by the main grid.

The country is making the first attempt to break the 100% dependence on imported power.

The Semonkong Hydropower Project will consist of a single 180 kW turbine and generator, with a potential future installation of an identical second turbine and generator in the powerhouse. The civil works consist of a concrete dam approximately 60 m long and 2.5 m high, a buried penstock 420 m long, an above-ground powerhouse, and a short tailrace channel.

The Mantsonyane Hydropower Project will consist of a single 2 MW turbine and generator. The rockfill dam will be 16 m high with either a concrete upstream lining or an asphaltic core. The power waterway will consist of 690 m of unlined tunnel, with a cross-section of 9 m^2, leading to a powerhouse located at the lower entrance of the tunnel.

Objectives

The construction of these projects will assist in lessening the dependence of Lesotho on RSA for both electric energy and diesel fuel.

Work Description

The work to be carried out in this project consists of final design, tender document preparation and construction of the projects, as well as the associated community services, commissioning and training aspects.

The entire process is expected to take approximately 2 to 3 years.

Implementation

This project will be supervised by the Ministry for Water, Energy and Mining in cooperation with the Lesotho Electricity Board. Consultants will carry out design and construction supervision and the construction will be performed by contractor.

Cost

The capital costs of the projects are estimated as follows; at 1983 cost levels:

Mantsonyane	USD 5.6 million
Semonkong	USD 1.8 million

Additional aspects of the project, pertaining to distribution and community electrical services, will also entail additional costs, and this must be discussed with the funding agencies.

Funding

Funding is desired for the entire project cost. Donor has been identified.

Project No. 3.3.2

Project title: 33 kV SUBTRANSMISSION NETWORK DEVELOPMENT - (LESOTHO)

Background

Electricity supplies to Lesotho were restricted to 27 MW prior to February 1984, as this was the limiting capacity of two inadequate and insecure 11 kV circuits which connected Lesotho to the ESCOM network. A first phase transformer programme operating at 88 kV has since made it possible to supply a firm 40 MVA demand. A new subtransmission network comprising four 33 kV radial circuits has also reinforced, improved and secured the electricity supplies. Continued expansion of the transmission network is scheduled for 1987.

It is common practice to consider electricity as one of the infrastructural requirements in rural areas. The development of basic rural networks requires high-tension extensions at 33 kV to be planned, designed and constructed in an orderly fashion to the locations designated as priority areas.

A 2nd phase 33 kV extension programme is essential to uprate the main high-tension rural networks during the next 2 years and would be a significant move towards the development of 11 kV basic rural networks in a 3rd phase rural electrification programme for commencement in 1986.

With this approach it will be possible to extend the 11 kV distribution networks into the villages and thus reduce the average connection contribution per consumer to low-voltage extension and service connection costs.

Objectives

The objective of this project is to extend the service and decrease the cost of electricity to the consumer. This will have the consequence of diminishing the amount of diesel fuel, kerosene, and wood used for heating, cooking and lighting purposes. As wood is currently in very short supply in Lesotho, this will be a very important benefit.

Work Description

The following lines and transformer stations will be constructed:

- Construction of 30 km of 33 kV line, Sebaboleng to Teyateyaneng/St. Agnes
- Construction of 2 MVA 33/11 kV station at Teyateyaneng/St. Agnes
- Construction of 20 km of 33 kV line, Pioneer Road to Mazenod
- Construction of 5 MVA 33/11 kV station at Mazenod
- Construction of 10 MVA 33/11 kV station at Bots'abalo
- Construction of 2 MVA 33/11 kV station at Roma (University of Lesotho)
- Construction of 25 km of 33 kV line, Roma to Molimo Nthuse
- Construction of 30 km of 33 kV line, Mazenod to Morija

- Construction of 30 km of 33 kV line, Morija to Mafeteng
- Construction of 50 km of 33 kV line, Mafeteng to Mohale's Hoek
- Construction of 10 MVA 33/11 kV station at Sebaboleng
- Construction of 2 x 2 MVA 33/11 kV station at Mohale's Hoek
- Additional 10 MVA 33/11 kV transformer and completion of station at Pioneer Road
- Establishment of a Regional Control Centre at the LEC Headquarters.

The projects will commence as soon as possible, and are expected to take place over a period of 2 years.

Tender documents have been written.

Implementation

The planning and construction of these lines will be carried out under the direction of Lesotho Electricity Corporation; by international tendering and contracting procedures.

Cost

The cost of this project is estimated to be between USD 2,600,000 and USD 4,000,000 at 1984 cost levels.

Funding

Funding is desired for as much of the project cost as possible.

Project No. 3.4.1

Project title: MALAWI-MOZAMBIQUE ELECTRICITY SUPPLY IN THE EASTERN AND WESTERN BORDER REGIONS - (MALAWI)

Background

Malawi is currently involved, with financial assistance from the African Development Bank, on a rural electrification project. Among the 12 centres to be electrified is Namwera Township in the Southern Region where supply was made available in April 1984. Namwera is on the eastern border with Mozambique and is about 12 km from the border. Mandimba, a town in Mozambique, is only 6 km from the border and has an estimated load potential of 400 kW.

On the western border power supplies are available at Nkula Hydropower Station, 55 km east of Mwanza. Mwanza is a Malawi border town which is only 6 km from the Mozambique border. A proposal to supply Mwanza at 33 kV has top priority when funds are available. Zobue, a Mozambican border town with an estimated load of 300 kW is only 1 km from the border and 7 km from Mwanza. Further north on the same western border, power supplies exist at Dedza, a Malawi border centre 5 km from the border and about 40 km north of Vila Ulongwe (Vila Coutinho) in Mozambique. Vila Ulongwe has an estimated load of 1500 kW and can be supplied at 33 kV.

Each of the towns in Mozambique to be supplied from the Malawi grid under this project has significant potential for electricity demand growth due either to projects within the local service area or to administrative functions.

Mandimba is the location of a major cotton-producing area with plans for 400,000 ha of cotton ultimately to be cultivated in the Region. Cotton processing and ginning will therefore create a demand in addition to secondary sources of electricity demand growth.

Zobue is an important border crossing point between Mozambique and Malawi. As traffic increases across the border, both administrative and service functions will require increasing amounts of electric energy.

Vila Ulongwe is the location of a seed-potato production facility, and has a power demand associated with refrigeration and other processes of the facility.

All of these towns are presently supplied with diesel generation, as they are not connected to any grid. Both generation and distribution in the towns are in poor condition and require improvements.

This scheme would be similar to one in which the Mozambique border town of Milange is presently supplied from the Malawi Grid.

Objectives

The objectives of the project are:

- Savings on foreign exchange for Mozambique with the replacement of diesel generation by relatively less expensive hydropower generation in Malawi.

- The development of energy cooperation between two SADCC Member States on a modest and realisable scale with a relatively small investment.

Work Description

It is proposed to extend 33 kV lines (i) from Namwera in Malawi to Mandimba in Mozambique; (ii) from Nkula Falls through Mwanza in Malawi to Zobue in Mozambique; (iii) from Dedza in Malawi to Vila Ulongwe in Mozambique.

The supplies will be bulk metered for easy administration. Design, implementation and supervision will be done by personnel of both countries, with Malawi expected to carry out the major portion of the work.

The network in Mozambique Territory for all three schemes in this proposal is for 33 kV overhead lines to the villages. In addition, the project budget includes funds for the inspection and renovation of the low-tension distribution systems of Mandimba, Zobue and Vila Ulongwe.

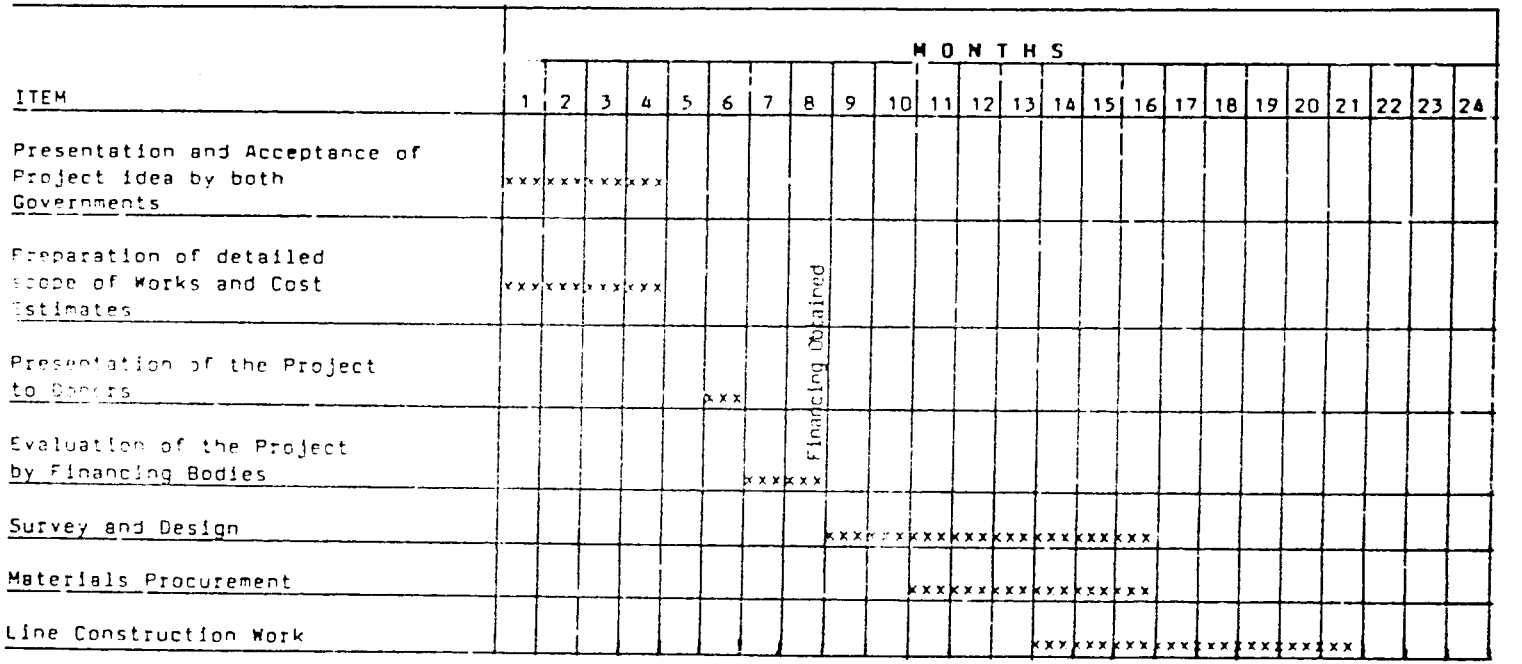
Implementation

A general agreement has already been developed between Malawi and Mozambique regarding this project, and as soon as funds are made available, a specific and detailed agreement will be made.

Generally, the construction, maintenance and power supply of the system will be undertaken by Malawi for payment in hard currency by Mozambique. This arrangement will be somewhat similar to an existing arrangement regarding power supply for the town of Milange.

The planning, design and construction can be done by the respective national utilities, according to the work programme shown in the accompanying figure in a period of less than 2 years.

WORK PROGRAMME



Cost Estimate

The project cost estimate is as follows:

Component	USD Total
1. Mandimba (East Mozambique) duration 12 weeks	
Within Malawi Territory (Namwera to Chiponde)	
7.35 km 33 kV overhead line	88,200
Switchgear	3,000
Total	91,200
Within Mozambique Territory (Chiponde to Mandimba)	
6.0 km distribution line	65,000
5.9 km 33 kV overhead line	70,800
Pole-mounted metering unit	9,500
Total	145,300
Works total	236,500
Physical contingencies (5%)	11,825
PROJECT TOTAL	248,325
2. Zobue (West Mozambique) duration 30 weeks	
Within Malawi Territory (Nkula to Mwanza)	
54.6 km 33 kV overhead line	655,200
Switchgear	9,000
Total	664,200
Within Mozambique Territory (Mwanza to Zobue)	
3 km distribution line	32,000
6.7 km 33 kV overhead line	80,400
Metering unit	9,500
Total	121,900
Works total	786,100
Physical contingencies (5%)	39,305
PROJECT TOTAL	825,405

Component	USD Total
3. Vila Ulongwe (Vila Coutinho) duration 30 weeks	
Within Malawi Territory (Dedza switchyard to border)	
5 km 33 kV overhead line	60,000
Switchgear	9,000
Metering unit	9,500
Total	78,500
Within Mozambique Territory (border to Ulongwe)	
7 km distribution line	75,000
39 km 33 kV overhead line	468,000
Total	543,000
Works total	621,500
Physical contingencies (5%)	31,075
PROJECT TOTAL	652,575

Summary of Costs

Supplies to Mandimba	248,325
Supplies to Zobue	825,405
Supplies to Ulongwe	652,575
TOTAL	1,726,305

Funding Requirement

The funding requirement for this project is equal to the capital cost, USD 1,726,305. In addition, approximately USD 500,000 is requested to finance the purchase of energy by Mozambique from Malawi for 3 years following project completion. Thus, the total funding request is USD 2,226,305.

Project No. 3.4.2

Project title: KARONGA SMALL HYDROPOWER PLANT - (MALAWI)

Background

Karonga Town lies in the north of Malawi and has an urban population of approximately 8000. At present, the town is served by a system consisting of two 120 kW diesel generators, 18 km of distribution lines and 19 km of medium voltage transmission line. Power is delivered to 241 customers.

The existing system produces energy at very high costs, as all diesel fuel must be imported to Malawi from external sources, and thereafter transported to Karonga over long distances. Karonga is so isolated that it is not anticipated to be connected to the national grid in the near future.

In 1981 a UNDP report "Evaluation of Small Hydropower Sites in Malawi - TCD/INT-80-R47/5" indicated that a promising site for small hydropower development lies near Karonga. The reconnaissance level report revealed that, by using the net head of 75 m and a design discharge of 0.8 m^3/s, of the location on the North Rukuru River and the Sere River, it should be possible to obtain an annual energy production of approximately 2.6 GWh with the installation of a 500 kW generating facility and an average load factor of 60%.

Objectives

The objectives of this project are:

- to reduce the quantity of diesel fuel imported to Malawi
- to increase the supply of electric energy, available to Karonga Town
- to reduce the internal Malawi transport of fuel over long distances
- to increase local self-sufficiency.

Work Description

The project will be carried out in two stages.

The first stage will consist of a team of consultants who will travel to the site to undertake the final feasibility evaluation and at the same time, perform the necessary field work for design. Implementation will take place as the second phase.

The project thus consists of the study, design and construction of small hydropower facility and the associated 37 km of transmission and distribution line.

Implementation

It is envisaged that the study and design of the Karonga Small Hydropower Project will be carried out by a consultant. The civil works would be carried out by a contractor and the mechanical/electrical equipment would be installed by Electricity Supply Commission of Malawi (ESCOM) staff under the supervision of the supplier. The substation, transmission and distribution lines would be designed and constructed by ESCOM staff.

Cost Estimate

The first stage studies will cost approximately USD 200,000, and the second stage is anticipated to cost about USD 2,300,000, with a total cost of USD 2.5 million.

Funding requirements

Funding is sought for the entire cost of USD 2.5 million.

Project No. 3.5.3

Project title: CORUMANA HYDROPOWER PROJECT - (MOZAMBIQUE)

Background

It is the aim of the Government of the People's Republic of Mozambique to minimise the dependency on electric energy supplied from the Republic of South Africa.

The southern part of Mozambique, including its capital Maputo, is at present highly dependent on imports from ESCOM in South Africa for its power supply. In accordance with an agreement to supply power from Cahora Bassa I to South Africa, Mozambique will receive 78 MW at a very low price. Until recently, however, little or no power from Cahora Bassa has been available to Mozambique, as the supply to the Apollo substation in South Africa has been unreliable. This means that approximately 90% of the energy consumed in the Maputo area has been supplied by ESCOM at a price higher than that which would have been paid for Cahora Bassa power.

Maputo's thermal power station is kept in reserve in the event of power outage which occurs with relatively high frequency. The installed capacity is 57 MW coal-fired and 46 MW gas-fired.

The annual system consumption is 360 GWh and the load is 66 MW. According to moderate forecasts made by EDM the consumption in southern Mozambique is estimated at 450 GWh in 1985 and 600 GWh in 1990. This corresponds to an annual growth rate of approximately 6%.

The Corumana Power Plant on the Sabie River has been proposed as a source of electric power and energy to the South Energy System of Mozambique. Its distance from Maputo is some 140 km by road. An earthfill dam is presently under construction at the Corumana site. The main use of the dam will be for irrigation purposes of the arable land around the lower reaches of the Sabie and Incomati Rivers.

The Sabie River is a tributary of the Incomati River. Both rise and flow for most of their length in South African territory. At the project site, some 10 km from the border, the average runoff based on 31 years of records at the border has been estimated at 634 Mm^3, the individual years ranging between a minimum of 80 Mm^3 in 1983 and maximum of 1700 Mm^3 in 1976. The catchment area at the site is 6310 km^2.

The June 1984 Feasibility Study concludes that a power plant with a rated capacity of 14.5 MW is a feasible addition to the dam project. The powerhouse will be located above ground at the toe of the dam, between the bottom outlet structure and the spillway. The generating units comprise two Kaplan turbines of 7.25 MW each at 36 m rated head (8.1 MW at HWL). The generators are each rated at 9 MVA.

The selection of the recommended hydropower plant is based on a comparison of alternative sizes of installations ranging from 3.6 MW to 17 MW. The least unit energy cost alternative is achieved with an installed capacity of 4.5 MW requiring an investment of USD 5.9 million. The power

station capacity was increased until the incremental cost of generating one more kWh equalled the cost of generation with gas, giving an installed capacity of 14.5 MW and requiring an investment of USD 10.8 million. An additional advantage of choosing a higher installation than 4.5 MW is the increased security of supply should the transmission line from South Africa fall out. The size of the reservoir allows the generation at full capacity for a longer period of time without significant influence on reservoir water level.

The unit energy cost of the Corumana project at 12% discount rate is US¢ 4.15/kWh and is significantly lower than either of above thermal alternatives. If the Corumana project's output was reduced to firm energy alone, the cost per kWh would be higher than US¢ 5.6/kWh.

The Corumana project may be said to be justified from an economic aspect. Furthermore, assuming the electricity generated at the Corumana plant is sold at a tariff higher than the current high-tension tariff of US¢ 2.94/kWh (MZM 1.67/kWh) as average tariff, the return on capital is adequate (12%) and significantly higher than the prevailing rates of interest in Mozambique. The payback period has been estimated at 6 to 7 years. It is very important to note that funds are already available for electrical interconnection between Corumana and the 110 kV southern networks.

Objectives

With this project, Mozambique will materially reduce its dependence on RSA for electricity supply in the southern part of the country. In addition, the domestic reserve generation capacity will improve the system security.

Work Description

This project consists of the construction of an above-ground powerhouse at the toe of Corumana Dam, and the production and installation of the associated electromechanical generation equipment, consisting of two similar units of 7.25 MW Kaplan turbine linked to a generator of 9 MVA capacity. The facility will be integrated with a dam currently under construction as part of an irrigation project.

Feasibility study and design of the power station have already taken place, and final design and production of tender documents are currently underway.

Cost Estimate

The total cost of the hydropower project is estimated at USD 10.95 million and is categorised as follows:

Costs (end 1983 price level)

Civil works	USD 3.44 million
Electromechanical works	USD 7.51 million
Total	USD 10.95 million
Foreign currency component	USD 9.39 million

Funding Requirements

Funding is desired for the complete project costs of USD 10.95 million.

Project No. 3.5.4

Project title: MAVUZI HYDROPOWER PROJECT EXPANSION - (MOZAMBIQUE)

Background

At present, the Mutare Region and the area south of Mutare in Zimbabwe are being supplied with electricity from the hydropower plant at Kariba on the Zambian border. Two lines run from Harare to Mutare carrying the existing supply. In the near future, increasing electricity demand in the east of Zimbabwe may create a shortfall in the supply from the existing two lines. This raises the prospect of a considerable expenditure if the country has to resolve the problem solely by increasing the capacity of existing transmission lines from Kariba.

The advantages of having interconnected electric power systems are readily apparent. Compared with smaller isolated systems they are more reliable and economical, preventing the wasteful spare capacity frequently associated with single national systems. The spinning reserve in the two linked countries can also be substantially reduced. In addition, the distribution of generation can be improved.

In the Manica Province of Mozambique there is a hydroelectric scheme with base-load and peak-load stations at Chicamba and Mavuzi. There has long been in existence a 110 kV line connecting Chicamba to Mutare in Zimbabwe with a capacity of 40 MW and for a period in 1980 power was received from the Zimbabwe network without any technical problems arising. The precedent for cooperation between the two countries' networks therefore exists.

By taking the necessary steps to interconnect the Mozambique and Zimbabwe networks considerable advantages can accrue to the two countries. In addition to those previously mentioned it is apparent that by using Mozambique's spare capacity to supply the area south of Mutare three advantages are to be gained:

(a) The security of supply for the two countries will be increased. Any disruption on one side can be covered in part by power from the other system.

(b) The huge distances involved carrying power from Kariba to the extreme southeast of Zimbabwe not only increases the vulnerability of the national system but also leads to large losses in the transmission process.

(c) The expansion of supply alternatives will allow less costly sources of generation to be considered.

The objective of this project is to investigate the export potential of power to Zimbabwe from new facilities in Mozambique.

New hydropower projects possibilities are:

- Expansion of the existing power plant constructed in 1953, Mavuzi I, which has an installed capacity of 46 MW (incl. 10 MW in reserve).

- Development of Mavuzi II with a head in the order of 40 m and installed capacity of 8 MW. The intake to this power station has been located at the tailwater of Mavuzi I, hence the power stations will work in series.

- Development of Mavuzi III with a head in the order of 240 m and installed capacity of 56 MW. The intake has been located in the Mavuzi I reservoir, hence both power stations will have to share the available water resources.

Objectives

To compare the electricity unit cost that can be produced by developing new hydropower facilities in Manica Province (Mozambique) to supply Mutare and the southeast of Zimbabwe, with Zimbabwean cost to supply the same area.

Work Description

The study should be carried out in two stages.

The first stage will consist of a system analysis of the existing system comprising the AC transmission line from Cahora Bassa and the Mavuzi and Chicamba hydropower stations and their transmission facilities. The system study should be based on a load and energy forecast for export to Zimbabwe.

It will commence with a field visit of a small team of experts to the project area. The team will consist of:

- A power systems expert who will assess the possibilities for export from the existing facilities and eventual future projects in the Mavuzi area.

- A hydropower planner and designer who will assess in situ possible development alternatives.

- An engineering hydrologist who will assess the existing water resources and energy potential of the hydropower projects.

The team will collect data from the relevant authorities in Mozambique and Zimbabwe.

Following a study period of approximately 3 months the team will issue a report presenting their findings, which will include:

- Demand forecast for the next 10 years for export possibilities to Zimbabwe

- Hydropower potential of various alternative developments in the Mavuzi area

- Ranking of alternative according to unit cost of energy available for export to Zimbabwe, and comparison with Zimbabwe alternative cost

- Recommendations of which project to take to feasibility level study

- Recommendations for further field investigations.

In the second stage a feasibility study will be carried out for the recommended project. The feasibility study will be in accordance with the requirements of international financing institutions, based on accepted criteria for data and design. For this stage of the project a complete planning team will be required covering all the usual professional fields such as

- Geological and geotechnical engineering
- Topography (surveying and mapping)
- Hydrology
- Water resources analysis and optimisation of energy generation
- Planning and design of optimal hydropower and transmission facilities
- Cost estimates and project schedule
- Economic and financial analysis.

Further field investigations may be necessary following the recommendations given in stage one. Possible investigations may be:

- Establishment of further hydrometric and meteorological stations
- Surveying and mapping of chosen project
- Geological and geotechnical investigations.

Key personnel will visit the relevant authorities in Mozambique and Zimbabwe for discussions and to obtain available data and information.

Implementation

The study will be carried out by consultants under the direction of Electricidade de Moçambique. Stage I is expected to take approximately 3 months and Stage II is anticipated to take 6 to 9 months.

Cost Estimate

The cost estimate, at 1984 levels, is as follows:

Stage I	USD 120,000
Stage II	USD 400,000 to 600,000
Total	USD 520,000 to 720,000

Funding Request

Funding is desired for the entire project cost of USD 520,000 to 720,000.

Project No. 3.5.5

Project title: MOZAMBIQUE-MALAWI INTERCONNECTION OF ELECTRICITY SUPPLIES - (MOZAMBIQUE)

Background

This project consists of a study to investigate the feasibility of a transmission line which would carry power generated at Cahora Bassa to Malawi, and thereafter to the northeastern part of Mozambique. A number of towns along the line could be connected to the national grid of Mozambique, and power exchanges with Malawi could take place.

The proposed route is via Zobue along the border to near Ulengwe, interconnect to the Malawian 132 kV system running north-south at Sharpevale south of Lake Malawi (Niassa), where a substation is planned. From there the transmission line may be extended eastwards to the southern parts of northeast Mozambique at Mecanhelas and then eastwards following the road and railway through Cuamba, Malema, Ribue and finally joining the existing 220 kV line from south at Nampula.

This route involves the construction of approximately 230 km of 220 kV line in Mozambique to reach the Malawi border at Zobue, and approximately 140 km of 220 kV line in Malawi. To reach Nampula, another 400 km will be required, at a later stage thus closing the 220 kV transmission ring from Tete-Mocuba-Nampula and Tete-Malawi-Nampula, thus securing a two-way feed for the consumer points.

An important part of this study would be an evaluation of the power market for such a transmission line both in Malawi and Mozambique. This would include an assessment of such issues as, for example, electrification of the railway running from Nacala to Cuamba and Blantyre and the possibility of altering the hydropower construction programme in Malawi. In addition, the implications and consequences of such an interconnection would be considered.

Among the consequences would be:

1. Electrification of the Northern and Central Regions of Mozambique.

2. The possibility of reducing spinning reserve generation capacity in both systems, and increasing system stability by exchange of power.

3. The possibility of delaying future generation capacity expansion.

Objectives

This project would assist with regard to several SADCC objectives. It will be a major step towards regional cooperation, and it has the potential of reducing significantly possible major costs by delaying construction of large generation facilities. It will also displace local diesel generation facilities, causing savings on diesel fuel expenses, as well as electrifying new areas.

Work Description

The study should be carried out in two stages:

The first stage will consist of a field visit to the two countries involved to collect data for an upgrading of existing load and energy forecasts for the relevant regions and to discuss with the Electricity Supply Authorities.

The field visit will involve a Power System Engineer and a Power Economist for about 4 weeks.

The second stage done at the Consultant's home office will consist of a report presenting a feasibility study based on the collected data and interviews and will contain:

- Power demand forecasts for the next 20 years.
- Proposed line routing and transformer stations.
- Load flow, load losses and voltage distribution, stability conditions and compensation requirements.
- Basic design with number of circuits and transformer sizes, suitable compensation if found necessary.
- Time schedule for the implementation of the various stages of construction based on power demand.
- Cost estimates and economic analysis.

The second stage will involve senior and junior staff, clerical staff and computer assistance.

Implementation

This project will be carried out by consultants under the direction of Electricidade de Moçambique and the Electricity Supply Commission of Malawi.

Cost Estimate

The cost of this study is estimated at approximately USD 100,000.

Funding

Funding is sought for the complete project cost.

Project No. 3.5.6

Project title: PEQUENOS LIBOMBOS HYDROPOWER PROJECT - (MOZAMBIQUE)

Background

The Pequenos Libombos Dam, located southwest of Maputo, is the main component of a multipurpose project situated in the south of Mozambique, with water supply to the city of Maputo as its primary function and irrigation in the Umbeluzi Valley as secondary. The earthfill dam, 38 m high and 1600 m long, with a central concrete spillway, is under construction. Completion of construction is scheduled for December 1985.

Design of new water supply facilities to increase the present supply capacity from 4000 m^3/hr to 7000 m^3/hr is currently in progress. Raw water will continue to be abstracted from the Umbulezi River about 12 km downstream from the dam.

The Umbeluzi Valley irrigation project involves the development of 3240 ha gross area for fruit and arable crops downstream of the dam.

A further area for irrigation development has been identified in the neighbouring Tembe Valley, with irrigation water to be drawn from the Pequenos Libombos reservoir. It has been suggested that 12,500 ha of Tembe Valley land are suitable for development, but actual plans will depend on the amount of water available.

Hydropower was not originally included in the Pequenos Libombos Dam Project, but is now contemplated as a means to improve the security of power supplies to the water supply and treatment facilities for Maputo. The Consultant, however, was engaged at a very late stage to investigate the implementation of a hydropower plant in conjunction with the Pequenos Libombos Dam Project. The unusual layout of the project with two separate power plants was dictated by the dimensions of the waterways which had already been designed and ordered. The adopted solution is expected to cause minimum interference with the ongoing work on the dam. Hydropower may be incorporated into the existing dam design by using planned low-level outlets, suitably reinforced, as pressure waterways for power stations located along the sides of the spillway.

The hydropower project under consideration is proposed as an integrated addition to the Pequenos Libombos Dam, currently under construction, with two reinforced concrete power stations being constructed as part of the dam spillway sidewalls. Pipes of 1500 mm diameter, originally designed as bottom outlets, would be used as pressure conduits for proposed 2.0 MW Kaplan power turbines.

The implementation of a hydropower station at the Pequenos Libombos Dam Project is technically viable and presents certain advantages over a diesel-generating solution. Ease of operating and taking advantage of an available resource for the generation of energy are but two of several advantages. Diesel fuel is today a scarce commodity in Mozambique, as is the availability of qualified personnel to maintain the more maintenance-prone diesel-generating sets. The hydropower units will operate most of the time, and hence faults easily discovered. The diesel units

are standby and will seldom be used, but maintenance will be required to keep them operative at all times. As Pequenos Limombos is half-way between Maputo and Namacha (an important farming area and tourist town with a power demand of about 500 kW on the border with Swaziland), its construction will reinforce the present 60 km of 33 kV transmission line Maputo/Namacha (which presently faces tension fluctuation problems) avoiding the erection of a new line and making possible the power supply to a small village across the border in Swaziland.

The possibility also exists of decreasing project cost with the installation of smaller turbines. This would result in an insignificant diminution of energy production, but the power would then be inadequate for water-supply pumping to Maputo.

Objectives

This project is intended primarily to ensure the security of water supply to Maputo, and will also provide a small hydropower generation facility to the grid. As such, it will displace some fuel importation into Mozambique and will therefore decrease the national fuel importation requirement.

Work Description

The work to be carried out in this project consists of the construction of 2 x 110 m pressure conduits leading to above-ground powerhouses each containing a single 2.0 MW Kaplan turbine linked to a 2.5 MVA generator, with associated transformer and switchyard.

The electromechanical equipment must also be contained as a part of this project.

The feasibility studies and design have already been carried out, and the construction is to take place in coordination with the construction of the Pequenos Limombos Dam currently underway. The activities are planned to begin in 1984 and be completed by 1987.

Implementation

This work will be carried out under the direction of Electricidade de Moçambique by contractors. The electromechanical equipment will be obtained by international tender.

Cost Estimate

The estimated total capital cost of the project in current prices is USD 8.661 million. At 1984 cost levels, this is equal to USD 7.58 million. The following table shows the cost breakdown:

Proposed Pequenos Libombos Hydropower Project costs, first half 1984 and escalated price levels (in million US dollars)

Year	1984 costs				
	Civil works	Electro-mechanical equipment	Trans-mission lines	Total	Total (in current prices)
1984	0.775	-	-	0.775	0.789
1985	0.775	-	-	0.775	0.843
1986	0.900	2.000	-	2.900	3.281
1987	0.900	2.000	0.230	3.130	3.748
Total	3.350	4.000	0.230	7.580	8.661
Foreign	2.020	4.000	0.170	6.190	
Local	1.330	-	0.060	1.390	

Funding

Funding assistance is desired for the entire project cost.

Project No. 3.7.1

Project title: MALAGARASI HYDROPOWER PROJECT - (TANZANIA)

Background

A feasibility study, performed by Norconsult, Norway and financed by NORAD, with the objective of presenting conclusions and results concerning potential hydropower development for supply of the Kigoma Region was presented to TANESCO in August 1983. Several alternatives were studied and a site at Malagarasi River, approximately 60 km southeast of Kigoma and 35 km west of Uvinza, was found to be the most viable economically, taking power market, power transmission, hydrology, geology, and geotechnical aspects into consideration.

The population of Kigoma Region is approximately 750,000. The major urban centre is Kigoma/Ujiji with an approximate population of 80,000. Other main towns are Uvinza, Kasulu and Kibondo. As the main consumers to be served from the project are in the towns of Kigoma, Ujiji, Kasulu and Uvinza, the project will influence locations with an aggregate population of approximately 100,000.

The existing facilities in the region consist of isolated diesel generators located in Kigoma Town and Uvinza. They operate under severe constraints, with respect to both diesel fuel and spare parts for maintenance. As diesel fuel is expensive, electric energy is produced at a relatively high cost under the existing conditions and the lack of a reliable power supply is considered to be an important constraint on the development of the region.

Objectives

The project will ensure a reliable supply of electric power to the towns of Kigoma, Ujiji, Kasulu and Uvinza in the Kigoma Region by developing indigenous hydroelectric potential on the Malagarasi River. The proposed scheme will meet projected load growth up to year 2002 and thereby contribute to the general development of the region.

Description

The project comprises a run-of-the-river development of the rapids along some 4 km of the river. The head being developed is approximately 62 m. A brief description of the project components is given here below.

- The headrace channel intake is located on the south side of the river about 200 m downstream of the gorge, approximately 3.5 km upstream of the powerhouse.

- A low intake weir will be constructed across the river about 200 m downstream of the channel intake. The weir will have a length of about 130 m and a maximum height of 2.5 m.

- The headrace will comprise a headrace channel 7 m wide and 590 m long to be excavated along the southern riverbank, a headrace tunnel intake and a headrace tunnel 3115 m long with a cross-section area of 20 m^2.

- A surge chamber will be provided to ensure hydraulic stability. It will be excavated as a vertical surge shaft, 72 m long with a cross-section area of 15 m^2.

- The penstock connecting the headrace tunnel and surge chamber to the power units in the powerhouse will have a total length of 205 m and a diameter of 3 m. The penstock material will be fine-graded structural steel.

- The powerhouse, a reinforced concrete structure, will be located above ground. The main dimensions will be 27.5 m by 10.5 m/12.5 m in plan and 19 m in maximum height.

- The tailrace channel will be excavated along the course of the small creek which runs near the power station. It will be 6 m wide and 350 m long.

- Two vertical shaft Francis turbines with an output of 3.8 MW each and a rotating speed of 375 rpm.

- Two vertical shaft synchronous generators with a nominal rating of 4.5 MVA.

- 185 km of 33 kV overhead transmission lines with ACSR conductors on wooden poles.

- Three 33/11 kV substations in Kigoma, Kasulu and Uvinza, respectively.

Cost Estimate

A cost estimate, based on 1982 price levels, is given here below, broken down according to major components.

	Foreign exchange USD x 10^3	Local currency USD x 10^3	Total
Civil works, including access roads	14,120	2,460	16,580
Electromechanical works	3,730	440	4,170
Transmission lines and substation	4,176	1,691	5,867
Engineering and supervision	2,580	640	3,200
Total	24,606	5,231	29,837

These cost figures include physical contingencies but not price escalation and interest during construction.

Implementation

TANESCO will act as executing agency on behalf of the Government. Malagarasi Hydropower Project is a medium-size project. As such, various concepts for implementation have been considered during the course of the study. The conventional concept consists of a final design phase, a tendering and contract negotiation phase and finally the construction phase. The time schedule for this implementation procedure shows that final design, tendering and mobilisation will take 1½ years, road construction approximately 1 year and power plant construction 2 years; thus totalling 4½ years. This also includes construction of the transmission system.

Financial Requirements

Based on the 4½ year implementation schedule and including price escalation, the project cash requirements have been estimated as follows:

Project cash requirements

USD x 10^6

Year	Foreign	Local	Total
1	0.1	-	0.1
2	3.2	0.6	3.8
3	7.1	1.8	8.9
4	10.6	2.8	13.4
5	11.2	3.2	14.4
	32.2	8.4	40.6

Funding of the entire project is desired. However, local contribution to cover some of the local currency expenses may be subject to negotiations between the Donor and the Government.

Project no. 3.7.2

Project title: SUNDA FALLS POWER PLANT - (TANZANIA)

Background

A feasibility study, with the objective of studying hydropower development possibilities in the Ruvuma River, was carried out by the Swedish consultancy firm, SWECO, in 1982. Two different power plant possibilities were studied, the Lupilo Power Plant and the Sunda Falls Power Plant, respectively.

The Sunda Falls Project has been given priority by the Tanzanian Government. The project is situated about 65 km southeast of Tunduru on the border between Tanzania and Mozambique. It will supply the town of Tunduru and its surroundings, which are in great need of electricity supply. The only existing facilities are some minor isolated diesel generators for the supply of hospital, state buildings, etc.

The population of Tunduru District is about 130,000 of which nearly 20,000 live in Tunduru Town. The potential consumers comprise 2500 domestic and some small-scale industries.

The chosen alternative comprises the installation of two generating units, each with a capacity of 1500 kW. This will cover the demand for electricity in the Tunduru area for the next 15-20 years, based on an assumed annual load growth of 7-8%.

Objectives

The objectives of the project are to develop the hydroelectric resources of Sunda Falls at the Ruvuma River on the border between Tanzania and Mozambique.

This will ensure a reliable supply of electric energy for the population of Tunduru and its surroundings for the next 15-20 years and thereby contribute to the general development of the area.

Description

The selected development scheme is a run-of-the-river type with a firm capacity of 2.5 MW and an estimated annual energy production of 10 GWh.

The natural head at Sunda Falls is 13.5 m on a river length of about 100-150 m. Another 0.5 m will be created by the construction of small overflow dams in the river branches.

An outline description of the major components is given here below.

- An access road of approximately 0.9 km will be required to connect the dam and powerhouse with the existing road from Tunduru.

- The headrace channel will have a length of about 280 m and a width of 9 m. It will mainly be excavated in rock.

- The dam connects the access road and the powerhouse. It will be constructed as an earth and rockfill dam.

- The powerhouse will be located close to the left bank of the river and connected to the dam as described above. The main part of the structure will be constructed of concrete and founded on rock.

- Two turbines of the propeller type with fixed guide vanes and adjustable blades will be installed. They will have a capacity of 1500 kW each and a rotating speed of approximately 350 rpm. They will be connected with long shafts via gear transmissions to the generators.

- The generators will be of the 3-phase synchronous type and will each have a rotation speed of 750 rpm, a frequency of 50 Hz and a nominal rating of 1900 kVA.

- The tailrace channel will have a length of about 300 m. It will mainly be excavated in rock with a bottom width of about 9 m.

- A transmission line with a route length of 65 km will be constructed between the power station and Tunduru Town. The suggested transmission voltage is 33 kV. A substation will be built in Tunduru.

Implementation

TANESCO will act as executing agency on behalf of the Government. A construction period of 2½ years will be required. The civil works constructions will mainly have to be executed in the dry period from May to November. Due to the relative complexity of the civil works, it is recommended to award the overall responsibility to a foreign contractor, tentatively on joint venture basis with local contractors.

Cost Estimate

These cost estimates are based on local and international prices valid in January 1982. Interest during construction is not included. Physical contingency allowances have been included with 15% for civil works and 10% for other items, respectively.

The estimated project costs are given below:

	Local currency TZS x 10^6	Foreign exchange TZS x 10^6	Total TZS x 10^6
Civil works	14.5	33.9	48.4
Mechanical works	1.3	7.4	8.7
Electrical works (incl. transmission)	1.3	14.3	15.6
Engineering	1.1	6.2	7.3
Physical contingencies	2.5	7.5	10.0
Total	20.7	69.3	90.0
Equiv. USD x 10^6	1.20	4.03	5.23

Financial Requirements

As mentioned in the previous section the basis for the cost estimates is January 1982. Allowances for price escalation will therefore have to be added to the given figures.

As the project implementation period is 2½ years, all expenditures will take place within the first 3 years after financing has been arranged.

Funding of the entire project is desired. However, local contribution to cover some of the local currency expenses may be subject to negotiations between the Donor and the Government.

Project No. 3.7.3

Project title: KIDATU-MOROGORO 220 kV TRANSMISSION LINE - (TANZANIA)

Background

The existing transmission network and proposed future extensions are shown on the attached map. The major part of the generating capacity is located at Kidatu (200 MW) and is transmitted via Morogoro and Chalinze to the capital, Dar es Salaam. The transmission facilities between Morogoro and Dar es Salaam comprise one 220 kV line and one 132 kV line which are connected at Morogoro via 220/132/33 kV autotransformers.

Between Kidatu and Morogoro, however, there is only one 220 kV transmission line which passes through very difficult terrain, almost totally inaccessible during rainy seasons. The major part of the line passes through the eastern part of the Mikumi National Park where apart from the accessibility problems there is an additional danger of wild animals being a threat to the maintenance crew. Maintenance of this line is therefore extremely difficult.

A system study, also covering transmission system extensions, was carried out by the Swedish consultancy firm SWECO in 1981. Among the recommendations in this study was the doubling-up of the Kidatu-Morogoro tran-mission capacity, which according to load-flow studies would be insufficient by 1990 and that a new transmission line should be commissioned before that year.

With the formation of SADCC there have been new developments concerning regional cooperation. A feasibility study for the reinforcement of Zambia's northeast grid and possible interconnection with Tanzania is underway. Future power exports to neighbouring Kenya are also likely. With these additional developments implemented the need for the additional transmission line will also be justified from the regional point of view and TANESCO wishes to see this line built as soon as possible.

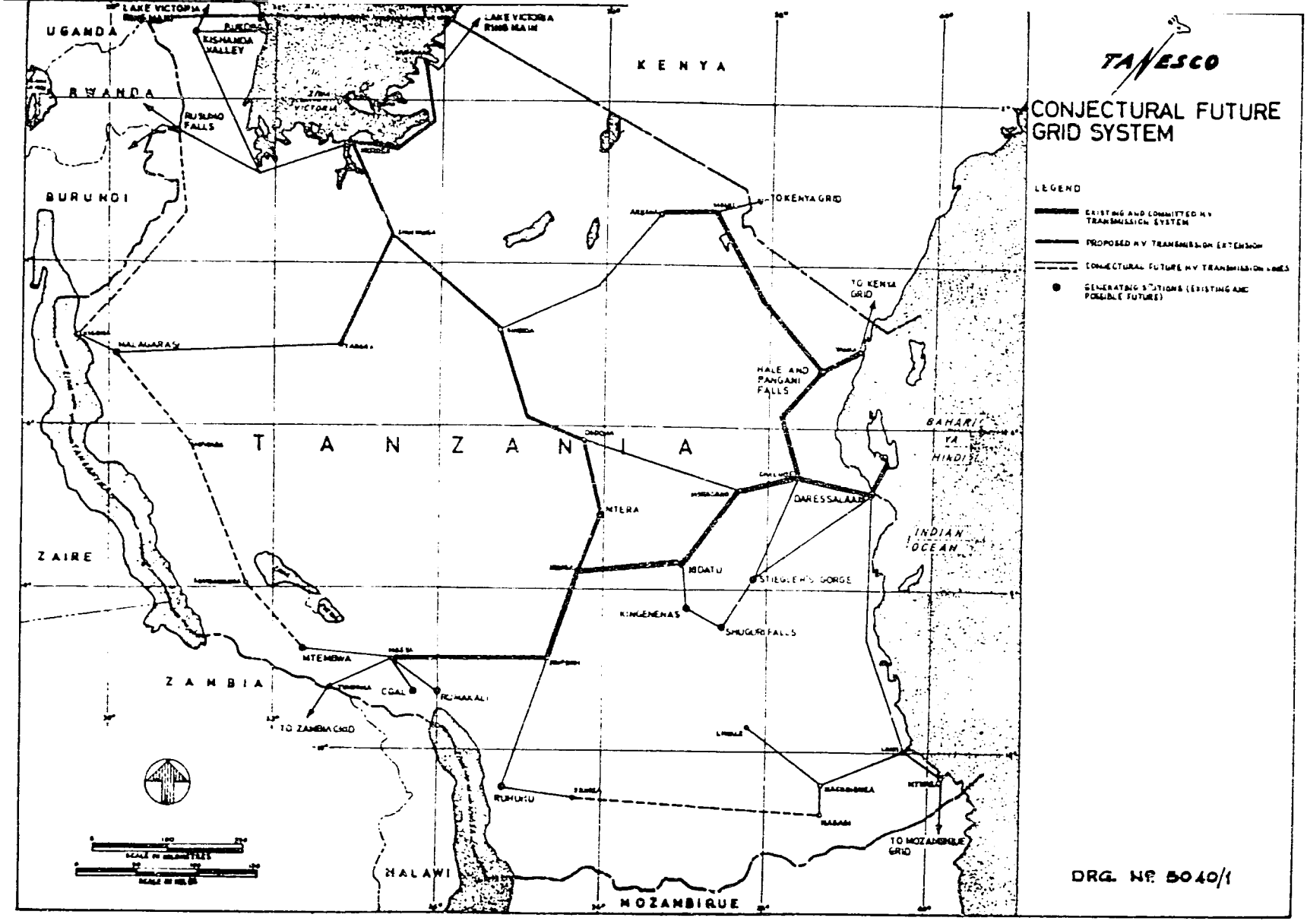
Objectives

The short-term objectives of the project are to improve the reliability and expand the transmission capacity for the supply of Dar es Salaam and the northeast part of the country. On long-term basis this proposed reinforcement of the Tanzanian grid may facilitate future interconnection with Zambia and power exports to Kenya.

Description

The project description is as given here below.

- Approximately 160 km route length of single-circuit, 220 kV overhead transmission line from existing Kidatu Power Station to existing Morogoro Substation. From Kidatu to Mikumi Village it will be routed closely to the existing road and from Mikumi to Morogoro it will be located closely to the existing Tan-Zam Highway. (This


UGANDA
RWANDA
BURUNDI
KENYA
TANZANIA
ZAIRE
ZAMBIA
MALAWI
MOZAMBIQUE
INDIAN OCEAN
BAHARI YA HINDI
LAKE VICTORIA
KIHANSA VALLEY
RUSUMO FALLS
TO KENYA GRID
TO KENYA GRID
MALAGARASI
HALE AND PANGANI FALLS
DARESSALAAM
MTERA
KIDATU
STIEGLER'S GORGE
KINGENENAS
SHUGURI FALLS
MTEMBWA
CGAL
TO ZAMBIA GRID
RUHUHU
TO MOZAMBIQUE GRID
TANESCO
CONJECTURAL FUTURE GRID SYSTEM
LEGEND
EXISTING AND COMMITTED H.V. TRANSMISSION SYSTEM
PROPOSED H.V. TRANSMISSION EXTENSION
CONJECTURAL FUTURE H.V. TRANSMISSION LINES
GENERATING STATIONS (EXISTING AND POSSIBLE FUTURE)
DRG. NO. 5040/1

location along existing roads will facilitate the construction works and enable proper future operation and maintenance.)

- The scope of work includes surveying, designing, furnishing, delivering, erection, testing and commissioning of the complete line, including foundations, steel towers, conductors, shield wires, insulators and accessories and grounding system.

- The towers will be galvanised steel, self-supported lattice towers and the line conductors will be of the Aluminium Core Steel Reinforced (ACSR) type.

Implementation

TANESCO will act as executing agency on behalf of the Government. The final contract awards will be subject to discussions between TANESCO and the Donor. However, it is tentatively assumed that two contracts will be awarded, one with a consultancy firm responsible for surveying, design, tender documents and works supervision, this in close collaboration with TANESCO. The other contract will be awarded to a foreign contractor responsible for the remaining items as indicated in the project description.

The engineering and tendering phase is expected to take ½-1 year and the manufacturing and construction 1½-2 years, thus giving a complete project implementation period of 2½-3 years after finalising the financing.

Cost Estimates

The estimated project costs are as indicated below:

	Foreign exchange USD x 10^6	Local currency USD x 10^6	Total USD x 10^6
Transmission line	13.5	2.9	16.4
Engineering, supervision	1.4	0.3	1.7
Subtotal	14.9	3.2	18.1
Physical contingencies	1.5	0.4	1.9
Total	16.4	3.6	20.0

Price escalation and interest during construction and not included.

Financial Requirements

Funding is desired for the entire project cost. However, Government participation in covering some local currency expenditures is subject to discussions with the Donor. Expenditures will be phased over 3 years.

Project No. 4.8.1

Project title: ENERGY CONSERVATION PROJECTS
INDENI PETROLEUM REFINERY - (ZAMBIA)

Background

The Indeni Refinery was built in 1972/73 by SNAMPROGETTI. It now operates at a 60% capacity, and covers the national market. If more profitably operated the Refinery could be the supplier of parts of Zimbabwe and Malawi as well.

The Indeni Petroleum Refinery was brought on stream in June 1973 prior to the drastic increase in oil prices. The Refinery was designed to minimise capital investment and take advantage of low energy costs. However, with the increase in oil prices, it became necessary to reduce energy consumption as far as possible. Improved housekeeping measures such as elimination of steam leakages and better firing control on furnaces have enabled reduction in fuel consumption.

Objectives

To achieve greater energy savings, three project needs to be implemented:

1. Waste-heat recovery from the hydrodesulphuriser and reformer furnaces.

2. Installation of economisers in the boilers.

3. Installation of a pre-flash tower in the crude distilling unit.

Description of Work

1. Waste-Heat Recovery from Furnaces

   Flue gas from the hydrodesulphuriser heater is directed to the convective zone of the reformer heater. A study carried out by AGIP PETROLI shows that it would be possible to obtain 4100 kg/hr steam production at 18.5 atm and 330°C by installing a waste-heat boiler in the convective zone of the reformer heater. Steam production is calculated at 25% excess air. The fuel saving is evaluated assuming the same steam production in a fuel oil-fired boiler with 90% efficiency.

2. Installation of Economisers in the Boilers

   The three package boilers installed at the Refinery have provision for economisers. The installation of economisers is estimated to increase the boiler efficiency from the present 82% to 90%.

3. Installation of a Pre-Flash Tower in the Crude Distilling Unit

A pre-flash tower upstream of the heater of the crude distilling unit can reduce the fuel consumption of the heater. Part of the feed (8.45 MT/hr) will vaporise at a lower temperature (170°C) and at 1.5 kg/Cm^2 g pressure. In this way, heating of the vaporised part up to 335°C is avoided and the heat exchange of the liquid feed is improved.

These practical measures are advised in a study by AGIP in 1982, INDENI ENCO STUDY.

Implementation

This project covers practical implementation which can be carried out within 1-2 years.

Cost Estimate

1. Waste-Heat Recovery from Furnaces

The design and supply of equipment is estimated to cost USD 800,000 in foreign exchange including contractor's expenses in supervision of erection. Civil works, project management and erection will be carried out locally at an estimated total cost of USD 200,000. The payout time is estimated at 1.5 years.

2. Installation of Economisers in the Boilers

The foreign exchange cost is estimated at USD 300,000 for the three boilers with USD 30,000 in local cost for civil works, installation and interconnection. The payout time is estimated at 3.3 years.

3. Installation of a Pre-Flash Tower in the Crude Distilling Unit

The design and supply of equipment is estimated to cost USD 300,000 in foreign exchange. The local cost of civil works, project management and erection is estimated at USD 50,000. The payout time is estimated at 1.5 years.

Hence the total costs will be:

		Local USD	Foreign USD
1.	Waste-heat recovery from furnaces	200,000	800,000
2.	Installation of economisers in the boilers	30,000	300,000
3.	Installation of a pre-flash tower in the crude distilling unit	50,000	300,000
	Total	280,000	1,400,000

Financial Requirement

Part of the local costs may be covered by the Refinery or by the Zambian Government.

Project No. 4.8.2

Project title: ENERGY CONSERVATION IN MINING AND INDUSTRY - (ZAMBIA)

Background

The University of Zambia, School of Engineering, has proposed a national project on energy usage and rationalisation in Zambia. The first part of this project has already been partially funded by the National Energy Council of Zambia. The following two parts seem however to be of more general interest as the practical results to be obtained no doubt will be of great benefit and value to the SADCC countries where similar industries exist. This project is closely linked to the existing project (4.0.?) and may be looked upon as an extension and/or a specification of the existing project.

Objectives

(a) To examine the energy use patterns in each of the sectors and to use the data to explain the interrelationships between sectors from an energy and development point of view.

(b) To identify problems associated with the efficient use of this energy.

(c) To determine the economic and technical feasibility of the efficient use of other forms of energy.

(d) To identify and recommend how best each of the consumers can save energy through conservation techniques.

(e) To look at the energy policy implications in the light of the above findings and thus enable the rationalisation of future energy plans.

(f) To recommend a suitable energy management practice, and specific energy conservation measures requiring only minor capital investment and appropriate local technology depending on the benefit-cost calculations.

(g) To recommend specific penetrating changes in processes, equipment and energy supply in view of conserving energy on a long payback basis.

(h) To assess the technical and economic requirements for the implementation of the above energy conservation schemes.

Description of Work

The study can be separated into two parts although much of the equipment will be utilised in both parts.

Mining

The Zambian Copperbelt is the area consisting of the copper mining towns, namely Chililabombwe, Chingola, Kalulushi, Kitwe, Luanshya, Mufulira and Ndola, with a population of 1.25 million. It is a very highly urbanised area and because of this, there is a need that it be taken separately for this study. This study should also include Kabwe, a mining town outside the Copperbelt. Because of the similarity of mining operations, the researchers intend to choose the following mines:

- Nchanga Mine — Because it is unique in that it has a leach plant and open pits which are not very common to other mines.
- Rokana Mine — It has a smelter and is one of the largest mines in the country and produces cobalt.
- Kabwe — It is a smaller mine, outside the general copperbelt and is engaged in mining zinc and lead.
- Mufulira — It is a very big mine with large underground operations which deserves to be considered separately.

An audit of the mines will have to be undertaken. This will enable the researchers to have first-hand information on how the energy is consumed in the sector. Because of the size of the mines, there will be subdivisions as follows:

1. Copper ore production (underground or open pit)
2. Concentrator
3. Leach plant
4. Refinery
5. Smelter
6. Other plants, e.g. acid plants, transport sector, maintenance.

It is proposed that each mine be audited for 6 weeks, with each subdivision taking one week.

Industry

Although the mining industry constitutes a major part of Zambia's industrial muscle, the role of the other industries cannot be underestimated particularly with the fall in prices of copper on the market today. The Department of Energy in 1983 did carry out a survey of these 'Other' industries and identified the following for an initial energy audit: Nakambala Sugar Estate, Chilanga Cement Limited, Kaplri Glass Products and Nitrogen Chemicals of Zambia. The audit exercise which was to have started in May 1984 by the proposers of the research has been delayed due to unforeseen problems.

This project proposal intends to pursue this exercise on a much wider scale and also to carry out an analysis of the results so that data obtained can be applied to other industries that will not be examined. For purposes of this study the industries have been grouped according to location.

Zambian Copperbelt:	Metal Fabricators of Zambia Limited Monarch Zambia Limited National Breweries Limited National Milling Company Limited Norgroup Plastics Limited Superbaking Company Limited Zambia Clay Industries Limited Dunlop Zambia Limited Scaw Limited Kafironda Limited Zambia Sugar Company Limited
Midlands:	Kapiri Glass Products Limited Kabwe Industrial Fabrics General Pharmaceuticals Limited
Lusaka:	Zambia Breweries Limited Zambia Oxygen Limited Crushed Stone Sales Chilanga Cement Limited Kafue Textiles Lusaka Engineering Company Limited Nitrogen Chemicals of Zambia Limited Chilanga Cement Refined Oil Products Limited
Livingstone and South:	Livingstone Motor Assemblers Limited Nakambala Sugar Estate Choma Milling Company Limited
Chipata and East:	Luangwa Industries
Luapula and North:	Masa Batteries Limited Tazara

It is estimated that on an average, a week at each of these industries will be sufficient.

From the studies dones in other countries, the Industrial Sector can realise energy savings of up to 40% with simple conservation techniques. It is proposed that a detailed energy audit of these industries be carried out. This will involve the analysis of flue gases for CO, O_2 and CO_2 to assess combustion efficiencies where furnaces are used. Studies will be conducted on the Use of Available Insulation to save costs, qualities of steam, electric power factor correction, etc.

Where heavy fuel oils are used, the use of local coal will have to be carefully studied and pollution problems will have to be taken into consideration.

Implementation

The work schedule for these two parts will be as follows:

Mining	1985-86	Collecting of data and analysis
	1987	General report

Industry	1985-87	Collecting of data and analysis
	1987	General report

Cost Estimate

Also the cost estimate is divided into two parts, one for energy conservation in the mining industry and one for manufacturing industries.

Mining industry	Local ZMK	Foreign USD
1. 6 weeks visit per mine, i.e. 24 weeks, subsistence for Principal Researchers	40,320	
2. Fuel		
6 trips to Copperbelt at 3600 km 1 trip to Kabwe and back 400 km	500	
3. Equipment*		
2 digital thermometers with general purpose insertion probes and surface probes		2,000
2 chart recorders		3,000
2 infrared remote-sensing pyrometers		3,000
4 pitot probes		800
4 static head probes		800
6 manometers		500
2 Fyrite kits		3,500
2 Clipon amp voltmeter elaviscrip recorders		1,500
2 power factor meters		2,000
2 portable combustion optimisers		3,000
2 fuel efficiency monitors		2,000
2 portable relative humidity flow analysers		2,000
4. Computation 100 hours at 42 USD/hr		4,000
5. Report writing and stationery		600
6. Consultancy for researchers	35,000	
7. Research Assistant salaries	20,000	
TOTAL	95,820	28,700

* Estimates only.

Manufacturing	Local ZMK	Foreign USD
1. Fuel		
(a) 2 visits to Copperbelt 1 week long at 600/visit + 30 km/day internal travel 2850 km at 8 km/litre	400	
(b) Lusaka Industries, daily basis 9 industries at industry 1 week 9 weeks at 60 km/day 2700 km/8 km/litre	400	
(c) Mazabuka and South 2 industries (Livingstone & Nakambala) 2000 km	300	
(d) Kabwe and Kapirimposhi 2 weeks at 400 km	100	
(e) Mansa 2000 km	300	
(f) Chipata and East 1 week at 1500 km 8 km/litre/fuel	200	
2. Subsistence for Principal Researchers		
(a) Copperbelt 11 industries 1 week each industry, 11 weeks/4 researchers	20,000	
(b) Mazabuka and South 2 weeks a night	4,000	
(c) Kabwe and Kapirimposhi 3 weeks MZK 100 a night	6,000	
(d) Mansa, 1 week	2,000	
(e) Chipata, 1 week	2,000	
3. Consultancy fees for researchers	30,000	
4. Computation at 100 hrs	5,000	
TOTAL	70,700	

Total Costs

Hence the total costs will be:

Local	ZMK 166,520	(ZMK 1 = USD 0.6)
Foreign	USD 28,700	

Most probably the distribution of costs will be:

1985 :	50%
1986 :	35%
1987 :	15%

The equipment will have to be purchased in 1985.

Financial Requirements

Most of the project will have to be financed by SADCC. A minor part of the consultancy expenses for Researchers and Research Assistant salaries may however be financed by Zambia or the University of Zambia.

Project No. 5.1.1

Project title: EVALUATION OF THE USE OF WOODFUEL IN ANGOLA

Background

The project presented here reflects the action programme outlined in the regional seminar on woodfuel held by the Technical and Administrative Unit, Energy Sector, in Luanda between 12 and 17 October 1983. In the "Conclusions and Recommendations" of the seminar it is considered as urgent, among other actions, to organise technical assistance to help SADCC Member States to define a policy to alleviate the woodfuel crisis.

The general situation in Angola is described as follows:

1. General :

The importance of the use of traditional fuels, mainly wood and charcoal, in the peri-urban and rural areas of Angola cannot be minimised. It represents close to 80% of the total energy consumption of the country.

The exodus of the rural populations to the big cities such as Luanda, Huambo, Lobito, Lubango, Benguela, etc., due to the military situation prevailing in Angola, is bringing an astonishing concentration in the wood consumption. At present the devastation of the forests, mainly around the big cities, is an incontrollable process. For example, in 1982, in Huambo, a storm had disastrous consequences for the town infrastructure. This was the result of the destruction, for domestic consumption of the forestal barriers, which for years were planted for protection. The future consequences of wood harvesting beyond the reproductive capacity of the forests must be regarded as very serious.

This situation requires the definition of the basic guidelines and practical measures to avoid the destruction of the forests.

The possible solutions would probably include the combined use of the following steps:

- Preservation and maintenance of the existing forests
- Reforestation programme to satisfy growing energy consumption
- Use of furnaces for the production of charcoal with improved efficiency
- Introduction of adequate improved stoves by the population for efficient energy use and energy conservation.

The detailed process to overcome these problems is very complex if we consider the ecological, economical and social effects arising for the involved populations and territory.

In Angola the Government is responsible for the planning of Energy and Agriculture through its competent organs. Based on the general political guidelines - already defined - they design the national basic guidelines to be adopted. In this process correct evaluation of the real meaning of the crises is of the utmost importance.

The plans and programmes have to be coherently implemented in the several geographic and economic areas of the country and between the several Ministries involved.

2. Consumption of the Biomass :

In Angola, no statistics on consumption of the biomass are available. The cut of trees based on the number of licences issued for that purpose are recorded. The data referring to some industrial consumers, however for example, bakeries, ceramics, foundries, etc., are available.

3. Forest Resources :

The situation in Angola is not very favourable, considering that the reserves in natural forests are very low, both in quality and quantity. The biggest forests are those in the provinces of Cabinda, Zaire, Uíge, Bengo, Kwanza North, Malange and Lunda North.

The national inventory of the forest resources has yet to be done; therefore, the real situation of the forest coverage is unknown.

Objectives

To study and evaluate the woodfuel importance in the rural and urban areas in Angola. The studies shall be carried out to:

- Propose to the national authorities the basic guidelines to be adopted to face the woodfuel crises, mainly in the urban areas.
- Subsequently develop the terms of reference for real projects in order to:
  (a) provide the involved populations the energy they need
  (b) maintain the ecological balance in the areas affected by the irrational use of the forests.

Work Description

1. Analysis of the Current Situation :

The consultant shall carry out the following tasks, updating the existing data whenever possible:

- To assemble and analyse all available pertinent data and draft a resume thereof - agronomic, climatic, ecological, economic and social parameters.

- To evaluate the demand for woodfuel at three levels - micro, medium and macro.

  At a micro level, the evaluation shall be done by type of consumer, i.e. families (urban and rural), industries (bakeries, railways, ceramics, etc.), communal facilities (hospitals, schools, etc.) and others considered relevant. If there are no possibilities of obtaining the information, then the consultant shall use the more adequate methods available in the world and make the necessary adaptations for use in the regal Angolan conditions, since the techniques of investigation are not universal.

  At the macro and medium level, the values obtained for the micro level cannot be simply extrapolated because the consumption models differ from one group to another and from one area to another.

- To evaluate the quantity of woodfuel which is actually supplied to the consumer and the available potential production at micro, medium and macro levels.

  At a micro level, the consultant shall according to each situation develop the most suitable method to determine the total value of woodfuel used per tree and its annual growth.

The consultant shall also determine the calorific value of woodfuel. Also, he will identify and make an inventory of the indigenous plant species that may be used as energy sources. He shall also determine annual growth rates and woodfuel production potential of the various plant species. When carrying out these tasks the consultant shall always have in mind that it is absolutely necessary to know the exact situation of the demands and of the supplies, in view of getting a clear idea of the problem, without which it will not be possible to outline the appropriate action programmes. Besides this, he also shall bear in mind the experiences of other African countries - mainly in Southern Africa - on this subject.

2. Proposals for Guidelines :

At this stage, the consultant based on the knowledge obtained from the analysis of the current situation in Angola will be able to draft the first guideline proposals in order to minimise the crisis. In principle, the proposal shall cover the following aspects:

- Preservation of forest resources
- Rational utilisation of woodfuel
- Training of local people for handling of forests
- Industrial use of the forests
- Expansion of the forests.

3. Definition of the Projects :

Based on the analyses of the current woodfuel situation and with the objective to minimise the woodfuel crisis the consultant shall identify a coherent group of projects to be implemented in Angola.

The projects shall be compatible with the proposed guidelines drafted by the consultant. Then he shall indicate the projects which should be given priority and need to be immediately implemented.

The consultant shall draft detailed terms of reference for all projects, which will be available for presentation to the international financing agencies.

Implementation

	Months
Evaluation of the demand and supply	6
Discussions with the authorities	1
Draft of the guidelines	2
Approval by the authorities	1
Draft of the TOR for the projects	2
Final report	1
TOTAL	13

Cost Estimate

	USD
Studies in the field of demand supply	189,000
International travel	22,500
Local expenses	10,000
Draft of the guidelines	30,000
Draft of the TOR for the projects	30,000
Draft and reproduction of the report	5,000
TOTAL	286,500

Funding Requirement

All project costs are requested to be met by donor funding.

Project No. 5.4.1

Project title: BLANTYRE CITY FUELWOOD PROJECT - (MALAWI)

Background

Fuelwood is the main source of energy for the majority of the Malawi population, i.e. 98% of the rural households and 89% of the urban households. It is also used in the agro-based and rural industries for tobacco curing, tea processing, brick-making, fish smoking, pottery, beer brewing, etc. In all, woodfuel accounts for 85% of total energy consumed in Malawi, whereas other biomass (crop residues etc.) constitutes 6%, petroleum products 5%, hydropower 3% and coal 1%.

The main sources of wood are the natural woodlands on customary land, which is by far the largest; the gazetted forest reserves and protected hill slopes; and the plantations. The annual consumption of wood is about 11 million m^3 (solid) (fuelwood 9 million, building poles 1.9 million and timber 0.1 million), and the supply is 9 million m^3 (solid), which means the aggregate consumption creates a deficit on a national basis of 2 million m^3 (solid). This deficit is however being met from the continued depletion of the forest cover, at the rate of depletion of 3.5% per annum.

These national statistics, however, subsume the regional and localised variations in the pattern of fuelwood supply and demand. In the sparsely populated Northern Region of Malawi, the sustainable supply of fuelwood is well in excess of current demand, and adequate woodfuel supplies are available in most localities. On the other hand, the pattern is very different in the more heavily populated Central and Southern Regions, where the sustainable supply falls short of the consumption level, the localised woodfuel shortages have become apparent, and the fuelwood crisis has begun to emerge.

The Government of the Republic of Malawi recognises the potential seriousness of the woodfuel crisis, and has therefore embarked on remedial measures aimed at increasing the supply, reversing the deficit trend, and alleviating the future fuelwood shortages. These measures include the intensive protection, conservation and management of the residual natural forests and woodlands, the increased afforestation programmes with fast-growing tree species in areas of very localised wood shortages and high population densities, the establishment of national network of tree nurseries for raising seedlings for sale to the public, the provision of forestry extension and publicity, the development and promotion of wood-use efficiency and wood-conserving technologies.

In 1983, the Department of Forestry carried out a survey on energy use in the four major urban areas: Blantyre, Lilongwe, Mzuzu and Zomba. The survey indicated that woodfuel is the most dominant source of energy for household use. For example, about 90% of all urban households use woodfuel for cooking meals, heating water and keeping warm while other fuels, primarily paraffin, are used for lighting. In 1983, about 939,180 m^3 (solid) of wood were consumed as fuel in the urban areas, and this was estimated to increase to 1,541,707 m^3 (solid) by 1990. Blantyre City, with an urban population of 310,000 persons (1983), consumed

525,321 m^3 (solid) as woodfuel in the form of firewood (100,000 m^3 (solid)) and charcoal 425,321 m^3 (solid) (47,655 tonnes). By 1990, Blantyre City residents will consume 872,033 m^3 (solid) of trees for fuel. On average, the Blantyre City households spent monthly MWK 12.41 (compared to an average of MWK 12.19 for all Malawi's urban households: MWK 3.45 for firewood, MWK 3.98 for charcoal, MWK 3.46 for electricity and MWK 1.52 for paraffin.

The UN Food and Agriculture Organization (FAO) Mission on the Environmental Effects of Development revealed in 1983 that there is a high demand for wood energy in Blantyre City, which would require about 60,000 ha of plantations to meet present and future demand. There is no way of meeting this energy demand or halting the deforestation in the Shire Highlands, unless development strategies are undertaken to increase the woodfuel supplies: improving management of indigenous forests for fuelwood production, establishing wood-energy plantations, encouraging smallholder farmers to grow their own trees for domestic purposes and for sale as fuel, introducing wood-saving technologies, etc. The city of Blantyre obtains much of its woodfuel from customary land (outside the city boundaries), notably from areas along the Chikwawa, Mwanza and Matope roads. Firewood also comes from the gazetted forest reserves and the plantations. However, it is the customary land forests which are a diminishing asset due to fuelwood collection, agricultural expansion, shifting cultivation, grazing, bush fires, and commercial timber harvesting thereby leading to especially severe deforestation around the city boundaries. The present fuelwood supplies cannot sustain the demand in perpetuity; and on many steep hill slopes and in catchment areas, the removal of natural woody vegetation is having adverse impact on the environment (e.g. soil erosion, effects of water regime, etc.).

Objectives

This project will assist in the development of the forest resources and energy-saving devices so as to strengthen the sustainable renewable resource base for the Blantyre City.

Work Description

The proposed project will basically involve the following main features:

(a) Establishment, development and operation of 10,000 ha of fuelwood plantations in the following areas: Chikwawa escarpment, Chingale Hills, Mpemba Hill, Mwanza, Michiru, Mulanje outer slopes, Namisu, Nkula/Tedzani, Phalula, Thyolomwani, and converting harvested pine plantation areas within the city boundaries. Based on the afforestation rate of 2500 ha/year from the second to fifth years and the mean annual increment of 15 m^3/ha, the amount of fuelwood available would be 4,800,000 m^3 (solid) during the life of the tree crops (32 years) (one 8-year seedling rotation and three 8-year coppice rotations), representing a value of MKW 80,400,000 at current real fuelwood prices.

(b) Protection, control, management and utilisation of natural woody vegetation covering 54,660 ha (546.6 km^2) of uncultivated and unreserved customary land situated in Blantyre, Chikdwawa, Machinga, Mwanza and Zomba Districts.

The estimated volume on sustained yield basis will be over 300,000 m^3 (solid) per year, but the mean annual increment ranges from 0.21 to 1.74 m^3/ha/year. The productivity may be improved through regulatory measures; forest regeneration; entrusting the management of the natural forests to rural communities (Village Forest Committees) who will receive forestry advice and training; and creation of infrastructure, etc.

(c) Establishment of modern charcoal production in distant fuelwood plantation areas and distribution channels in Blantyre City basically for household purposes.

(d) Distribution of improved stoves permitting a saving of fuel in cooking and other household operations.

(e) Increasing the yield of traditional carbonisation techniques on customary land.

(f) Rehabilitation of degraded and uncroppable lands totalling 500 ha which have no or few alternative uses, by planting trees, and establishing wood lots and plantations with a view to reduce erosion and to protect the environment.

(g) Identification and establishment of some 50-80 ha of species/provenance trials in the dry zones of Blantyre, Chikwawa, Machinga, Mwanza and Zomba Districts.

(h) Training of staff and communities in social forestry.

(i) Provision of civil works, plant, vehicles, equipment, services and other resources required for the purpose.

Implementation

This project proposal is for a 5-year period with a possible extension period thereafter. This is primarily so, because the fuelwood tree crops attain utilisable size in 8 years, are renewable resources, and can be managed on a sustained yield basis.

It is envisaged that the project would be executed, managed and supervised by the Wood Energy Division of the Forestry Department in the Malawi's Ministry of Forestry and Natural Resources.

Cost Estimate

The project is estimated to cost MWK 9,342,856, equal to USD 6,540,000 at current exchange rates. The costs are estimated as shown in the following table.

Estimated Cost for Blantyre City Fuelwood Project

(Malawi kwacha)

Category	Year 1	Year 2	Year 3	Year 4	Year 5	Total
Buildings						
Houses	755000	706000	18800	14124	22000	1515924
Office/stores	110000	-	-	-	-	110000
Roads and bridges	35000	48875	60000	75000	60250	279125
Water supplies	66680	1650	1900	2190	2520	74940
Electricity	29040	3000	3450	3970	4600	44060
Other Construction						
Wood sales sheds	30000	750	750	800	1000	33300
Nursery	-	-	-	-	-	-
Establishment	-	5000	1450	1600	1800	9850
Fire towers	-	8000	800	1100	1200	11100
Plant and Vechicles						
Four-wheel drive vehicles	129600	-	-	-	-	129600
Motorcycles	27000	36000	-	-	-	63000
Saloon car	18000	-	-	-	-	18000
7-ton lorries	120000	-	-	-	-	120000
Tractors	120000	-	-	-	-	120000
Push-bikes	-	2400	-	-	-	2400
Personal emoluments (salaries & wages)	99222	607672	729206	875047	1050056	3361203
Maintenance and running expenses	179000	233380	268387	308645	354942	1344354
Other equipment	37500	86000	90000	100000	30000	343500
Special Expenditure						
Extension and training	30000	35000	40000	50000	50000	205000
Surveys	5000	-	-	-	-	5000
Materials	-	340000	372500	400000	440000	1552500
TOTALS	1821042	2113727	1587243	1832476	2018368	9342856

Funding

The requested funding is for the entire project.

Project No. 5.7.1

Project title: ESTABLISHING A FUELWOOD PLANTATION AT RUVU - (TANZANIA)

Background

Forest resources in Tanzania are currently being exploited beyond their sustainable yield. In order to ease the pressures on the forests a fuelwood plantation has been proposed at Ruvu. The plantation would supply the coastal area and Dar es Salaam in particular. The existing facilities of the experimental station would be utilised, and trees with known survival rates for that area would be planted.

The products could be sold either as fuelwood or converted to charcoal. The usefulness of the project does not depend on which market is chosen at this point, since minimum time until the first harvest will be 6 years. In the meantime different options for marketing the wood will be investigated.

The project is capable of providing energy at the same or less cost to the consumer as the present system, at the same time as reforestation is achieved.

Given the pressures for clearing forests for agriculture the net effect of withdrawing semi-forested land such as the proposed area may be that existing forests are turned into fields. In this particular case there are sound reasons for the location, but there may still be areas within Ruvu that should be selectively planted. Existing forest, even if it is of a low productive variety, should not be cleared to make room for the fuelwood plantation.

The documentation available does not provide a clear basis for deciding that the area is suitable for large-scale plantation with the assumed yield. Before a final decision is made the results of trials begun in 1981 should be assessed so as to get a firm basis for the calculations of forest economy.

Objectives

The main objective is to reduce deforestation in Tanzania.

The plantation is expected to yield at least 12 m^3 dry wood per year per ha, with 7200 m^3 to be harvested after 6 years.

The plantation together with the marketing and final conversion chosen should aim at yielding energy at a cost which is less than the current 860 TZS/GJ to final consumers. Rough calculations indicate that direct use of fuelwood in improved, but cheap stoves may give an energy cost below 500 TZS/GJ. If the best available combustion technology was to be used, energy costs to the final consumer would sink below 200 TZS/GJ.

Even if the lower range of cost targets is not met the project should be counted as a success if it breaks even at the same time as forest cover is increased. This is equivalent to having a free reforestation programme. The break-even point is currently at 860 TZS/GJ to final consumers via the production of charcoal. In the evaluation of the programme one should ensure that no existing forested area has been lost, even if the varieties concerned have a lower yield.

The plantation is so small compared with the fuelwood and charcoal markets that no significant social benefits should be expected whichever product range is chosen. If the wood is sold as charcoal without improving stoves at the consumer side, the economy of the project does not allow any lowering of the energy prices. Income distribution effects will be long term, and must follow from the experiences gained in this project.

There will be beneficial effects on local employment, but this should not be designated as one of the prime objectives of the project. It is far more important that personnel gains experience that can be applied elsewhere. Given that the site is chosen due to its existing experimental plantation and infrastructure, it should not be expected that this project will contribute to the general infrastructure of the area.

Work Description

An area between the north and south Ruvu forest reserves is proposed as a fuelwood plantation. Given the long maturing times of such a plantation it is proposed that the investment be spread over 6 years. From the 6th year onwards the project should generate enough income to replant as well as slowly expand.

Of the total area of 67,000 ha, a future fuelwood plantation of 45,000 ha is envisaged. The economic plans envisage the use of seedlings of Cassia siamea, but the results of current trials will be taken into consideration when choosing stock. It is proposed that 100 ha be planted each year for 6 years to give a total area of 600 ha financed by development funds. This will require an investment of TZS 1.8 million per year spread over 9 years, with a total expenditure of TZS 10.8 million from first seed to last harvest. The steady state yield is estimated to be 7200 m^3/year.

The programme will be run by a specially appointed manager, who will be integrated into the Tanzanian administrative structure, locally and nationally. Management costs as well as equipment maintenance have been included in the budget as an overhead of 30% of direct establishment costs. The choice of site and scope for the project is for the express purpose of avoiding purchase of new equipment and establishment of new administrative structures in this exploratory phase.

Due to the importance of the concept and the long time lags involved, the project should be periodically assessed so that experiences can be brought to bear in other geographical eras. These expenses will not be debited the project account, but should be carried by the Donor. They are however assessed as part of the total cost to the Donor.

Implementation

Project implementation will be undertaken by the Division of Forestry. The schedule of establishment will be as follows:

Year 0	100 ha taken up and planted
Year 1	100 ha taken up, 100 ha maintained
Year 2	100 ha taken up, 200 ha maintained
Year 3	100 ha taken up, 300 ha maintained
Year 4	100 ha taken up, 400 ha maintained, marketing prepared
Year 5	100 ha taken up, 500 ha maintained, marketing ready
Year 6	100 ha harvested and replanted, 600 ha maintained
Year 7	100 ha cycled, 600 ha maintained, expansion considered.

Forestry staff and available labourers are already at work at the site. From the Donor country side one Liaison Officer will be needed for approximately 3 months a year. Analysis work should be performed within a similar framework.

Year 0 will require approximately 3 man-years for 100 ha, expanding to about 40 man-years when the entire area is being concurrently worked.

The plantation will prepare a progress report each year, in addition there will be a monitoring report from the Liaison Officer.

Cost Estimate

The investment per hectare was estimated in January 1984. Allowing for 10% inflation the afforestation should require some TZS 18,000 per ha. The investment for one new field would be required over a period of 3 years with the bulk of the expenditure occurring in the first year. A small maintenance expenditure will be incurred for 3 years after the initial establishment until harvesting at year 6. All expenses concerning the plantation have been included but they have not been discounted to give the present value.

Further expenditure will occur with harvesting, converting and marketing the wood. It is proposed that this phase of operations be studied separately and these costs are not included here.

A suitable area for this phase of the project would be 100 ha/year, leading to a steady state area of 600 ha after 6 years. The average steady state cost of this will be TZS 1.8 million. Due to the time profile of the expenditure, investment will continue for 9 years after year 0, but total expenditure for 600 ha brought up to a steady state yield of 7200 m^3, is estimated to be TZS 10.8 million.

All the expenditure excepting the expatriate personnel contribution will be in Tanzania.

In addition there will be same management costs estimated at TZS 100,000 per year.

The cost of a Liaison Officer for 3 months a year will be approximately USD 40,000 per year.

In the second or the third year of the plantation programme two separate studies are envisaged.

1. A feasibility study to determine the need and profitability of charcoal production associated with the plantation at a total cost of USD 80,000.

2. A market study and market plan for sale and distribution of woodfuel from the plantations at a cost of USD 120,000.

Hence the total cost estimated is as follows:

	TZS	USD
Establishing Ruvu fuelwood plantation	10.8 million	
Administration	0.9 million	
Liaison Officer		270,000
Feasibility study and charcoal production		80,000
Market study and market plan		120,000
Total	11.7 million	470,000

Funding

The total needs for funds will be TZS 11.7 million in local currency and an additional USD 470,000 in foreign currency. This is approximately equal to a total cost of USD 936,000.

SOUTHERN AFRICAN DEVELOPMENT COORDINATION CONFERENCE (SADCC)

TOWARDS AN ENERGY POLICY FOR SOUTHERN AFRICA (1)

1. The Southern African Development Coordination Conference, comprising the People's Republic of Angola, the Republic of Botswana, the Kingdom of Lesotho, the Republic of Malawi, the People's Republic of Mozambique, the Kingdom of Swaziland, the United Republic of Tanzania, the Republic of Zambia and the Republic of Zimbabwe, is committed to developing a coordinated approach to the problems of energy development, conservation and security. SADCC States recognise that the profligate use of the world's non-renewable energy resources, particularly by the industrialised countries, undermines the present and future development, not only of the Third World, but of humanity as a whole.

2. As a sub-region, the Southern African Development Coordination Conference countries are potentially rich in energy resources. We have reserves of gas and oil in Angola, massive deposits of coal in Zimbabwe, Botswana, Swaziland, Mozambique, Zambia and Tanzania, as well as large hydro-electric capacity, both actual and potential, in most of the countries of the region. These energy resources are used almost entirely for modern sector development and for export. Even given our energy resources, however, SADCC countries are concerned lest the seemingly insatiable demand for energy of the industrialised world blocks our future development prospects. It has been predicted that the demand for energy of our modern sector will develop rapidly within the next twenty five years. By that time it is estimated that, on present trends, the developed world will already have consumed the vast bulk of the world's identified fossil fuel reserves. Plentiful and cheap energy was a prerequisite for the development of Europe and North America. The present policies, however, of the industrialised countries seem designed to ensure that similar conditions will not prevail as the accelerated development of our own region gathers momentum.

3. In all our countries the traditional sources of energy, wood and draught power, remain crucial to the livelihood of the majority of our populations, both rural and urban. However, there are serious ecological problems related to present consumption patterns and it is our intention to cooperate regionally to promote cheap and efficient forms of energy which can be made available to the masses of our people with the minimum of ecological damage. We believe that technological advance, leading to improved use of the new sources for the production of energy, can contribute to meeting basic energy needs in our rural areas.

(1) Issued in Luanda, People's Republic of Angola, February 1982

4. The Southern African Development Coordination Conference countries are committed to using energy in a more balanced, more economical and more self sustaining way. We intend to lessen our dependence on imported fossil fuels and, within the region, progressively to diversify the sources of energy available to us. In this effort we will, within our region, give priority to indigenous sources of energy, both renewable, such as hydro power, and non-renewable, such as gas, oil and coal. SADCC countries are conscious that hydro-electric power is one of the most important sources of energy and will, in future, continue to play a crucial role. As we develop the hydro power potential of the region it is our intention to create an integrated electricity network which will make available energy throughout the region - even in the most remote areas.

5. One unique regional characteristic is that, given the inheritance of colonialism, certain of our major hydro-electric schemes have been designed not only to meet our needs but the needs of South Africa. It is our intention to correct this situation and also to establish new hydro-electric schemes which will be planned, designed and implemented directly to contribute to meeting the requirements of our region.

6. In recent years, although consumption of oil, which is used mainly for transport, agriculture and for industrial purposes, has actually dropped, price increases have ensured that the purchase of oil represents an ever increasing burden on our scant foreign exchange reserves. The rapid advance of oil prices to more economic levels, though justified, has placed massive adjustment strains on all our economies. Although, in the short term, it is hoped that further savings can be made through conservation measures and the increased use of local energy sources, the cost of imported oil will continue to represent, for the majority of our countries, both a major foreign exchange drain and a real constraint on our development. Even given effective conservation measures we believe that, in the coming years our demand for oil must inevitably increase due to:

(i) the building up of a sound industrial base;

(ii) the associated increase in demand for transport;

(iii) the rapid and large scale development of intensive methods of agricultural production;

(iv) the accelerated and integral development of our rural areas.

It is, therefore, difficult for us to be sanguine about both the cost and the availability of fossil fuels in the years to come.

7. We, the Southern African Development Coordination Conference States, recognise that former world oil consumption patterns were, in the long term, both insupportable and irrational. We accept arguments, economic as well as moral, to achieve a more realistic pricing system. The transition from cheap to more expensive oil is one, however, for which we are ill prepared. This transition has already created massive problems for us and will continue to do so for many years to come. We fully support, however, the oil producers of the developing world in their constant struggle to obtain an economic price for this essential and non-renewable raw material. Even so, it must be recalled that it is we, the non-oil producing countries of the Third World, who are hit hardest by this increase in prices. We pay twice. First to the producers for their oil. Second, to the industrialised countries which have the power to shift the burden of these new costs to us in the form of increased prices for their manufactured goods. The terms of trade of developing countries progressively deteriorate and, as has already been mentioned, our foreign exchange reserves are all but wiped out. We are concerned about the negative effect which the cutting of development assistance has on our economies. We therefore request that these cuts be restored and that the agreed UN aid targets be achieved. In global terms our demand for oil is not high. We look also to the oil-producing countries to increase the level of assistance they already make available.

8. Policies of national and regional self reliance provide the fundamental basis on which we build our response to these problems. We look first to our own resources and skills but, as is often the case, in order to mobilise these resources for our own benefit and for the needs of the rest of the world, we require adequate assistance, not only financial, but also in terms of appropriate technology transfer and technical assistance. In particular, assistance is needed to help meet the often high initial costs of developing the new and renewable sources of energy.

9. The People's Republic of Angola has been charged, by SADCC Heads of State and Government, with the responsibility for developing a regional energy development, conservation and security plan. This involves the systematic collection and analysis of energy data from each of the countries of the region. On the basis of this information, and in close consultation with Member States, an integrated regional energy policy will be developed. Regional consultations are already in hand and preliminary research has been initiated. One area of special concern relates to the problems of technology transfer. In the energy field the region is heavily dependent on the transfer of capital goods and technology from the industrialised world. SADCC will seek to acquire and develop appropriate technologies, both in the field of new and renewable sources of energy, as well as in more traditional fields, to ensure that energy can be made available in the most efficient and cost effective manner. High priority will be given to increasing local involvement in the production and distribution of energy within the region.

10. In the light of our analysis of the current world energy situation SADCC's strategy will be aimed at achieving the following objectives:

(i) Careful and calculated policy of oil conservation with the intention, ultimately, of using this resource only where there is no alternative.

(ii) Exploration and exploitation of the region's massive coal deposits, both to meet regional needs and for export.

(iii) Intensification of oil, gas and coal prospecting within the region, as well as other promising sources of energy.

(iv) Increased use of large hydro-electric schemes to meet, inter alia, the demands of agriculture, industry and transport systems, such as railways.

(v) To promote small scale hydro-electric schemes as a main contribution to rural development.

(vi) The application of biomass, solar energy, etc. to improve the living standards of the rural population and to meet energy requirements in the urban areas.

(vii) To ensure that existing research and training facilities are used to their capacity and that additional resources are made available to them to expand to meet urgent regional needs.

(viii) To promote information exchange and technology transfer by building links within the region and between the region and international agencies and institutions.

(ix) To seek ways to increase intra-regional trade in energy resources and related technologies.

(x) To promote the interconnection of the national electrical networks to guarantee the supply of energy throughout the region. Such integration will allow for the rational utilisation of the region's energy resources.

(xi) To promote afforestation programmes, to improve forest management practices and to provide basic information to populations in order to achieve rational utilisation and environmental improvement.

11. Our international cooperating partners are invited to assist in the following ways:

(i) By increasing access to concessional finance, particularly from the industrialised countries, to support viable projects for the production of energy especially those leading to a reduction in the use of imported fossil fuels - e.g. the electrification of the railways, the development of river transport in place of roads, etc.

(ii) By finding more effective and flexible mechanisms through which to increase, in consultation with the oil producing countries, the resources made available to the SADCC Member States to assist in meeting energy needs.